Intended for

The Duck River Development Agency
Shelbyville, Tennessee

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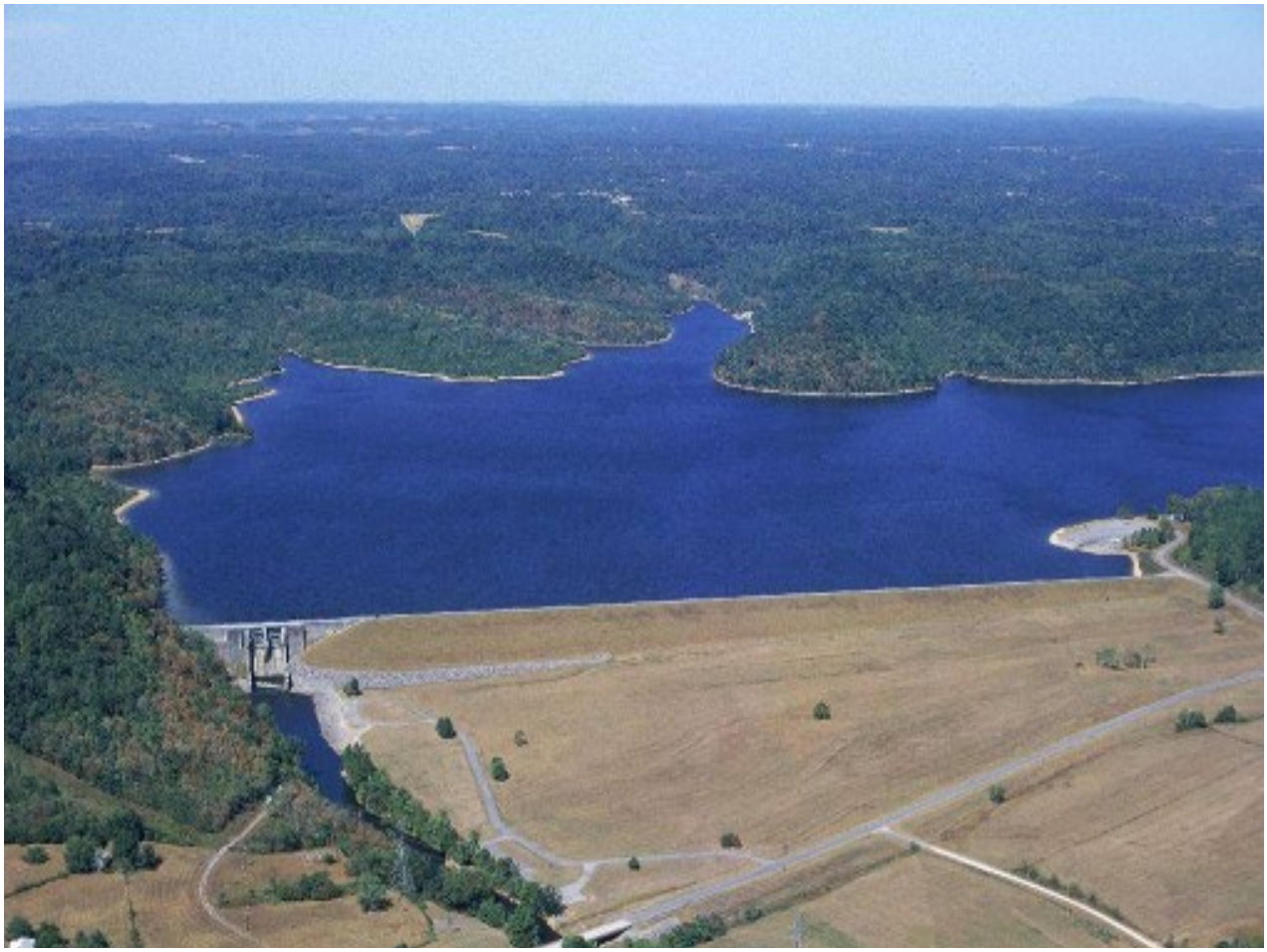
Expedited Update of Structural Elements from the 2011 Duck River Comprehensive Regional Water Supply Plan



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Expedited Update of Structural Elements from the 2011 Duck River Comprehensive Regional Water Supply Plan

Version	**Final**
Date	**November 4, 2025**
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Glossary of Terms

ARAP	Aquatic Resource Alteration Permit
BCUD	Bedford County Utility District
cfs	Cubic feet per second
CIP	Capital Improvements Program
CPWS	Columbia Power & Water Systems
CWA	Clean Water Act
DRA	Tennessee Duck River Development Agency
DRUC	Duck River Utility Commission
DRWPP	Duck River Watershed Planning Partnership
EA	Environmental Assessment
EIS	Environmental Impact Statement
EPA	US Environmental Protection Agency
FONSI	Finding of No Significant Impact
ft	Feet
fps	Feet per second
gpm	Gallons per minute
L	Liter
MCL	Maximum Contaminant Level
MCBPU	Marshall County Board of Public Utilities
MCWS	Maury County Water System
MG	Million Gallons
MGD	Million Gallons per Day
mg/L	Milligrams per Liter
NEPA	National Environmental Policy Act
OBG	O'Brien & Gere (acquired by Ramboll)
PEIS	Programmatic Environmental Impact Statement
psi	Pounds per Square Inch
SDWA	Safe Drinking Water Act
SRF	State Revolving Fund
SWTR	Surface Water Treatment Rule
TDEC	Tennessee Department of Environment and Conservation
TN	Tennessee
TNC	The Nature Conservancy
TWRA	Tennessee Wildlife Resource Agency
TVA	Tennessee Valley Authority
µq/L	Micrograms per Liter
USACE	US Army Corps of Engineers
USDA	US Department of Agriculture
USEDA	US Economic Development Administration
USFWS	US Fish & Wildlife Service
USGS	US Geological Survey
WTP	Water Treatment Plant
WWTP	Wastewater Treatment Plant

Executive Summary

In November 2024, Governor Bill Lee established the Duck River Watershed Planning Partnership (DRWPP or "the Partnership"). The Partnership was directed to identify solutions for water management, with particular emphasis on regional approaches. The Duck River Development Agency (DRA) is a key member of the Partnership and agreed to prepare an expedited update of priority aspects of its 2011 Comprehensive Regional Water Supply Plan. The expedited update includes:

- Updating the projected water demands, which were developed previously for water systems in the Duck River basin.
- Revisiting the two structural elements (raising Normandy Dam and constructing a water supply intake in the Duck River downstream of Columbia) and assessing whether/how they should be modified to meet the region's current needs.
- Assessing each structural element's feasibility, cost, and potential schedule for implementation.

DRA retained Ramboll Americas Engineering Solutions, Inc. ("Ramboll", formerly known as O'Brien & Gere or OBG) to complete the update on an expedited basis. Ramboll is the primary author of DRA's *2011 Comprehensive Regional Water Supply Plan*. DRA also retained Hazen and Sawyer ("Hazen", HydroLogics, acquired by Hazen and Sawyer) to perform hydrologic modeling using the OASIS modeling software. Hazen performed the OASIS modeling for DRA's 2011 Comprehensive Regional Water Supply lan.

Current Water Needs and Status of DRA's 2011 Recommendations

1. ***The need for water has grown since 2011***
    a. Water demands for the water systems that draw water from the Duck River and Normandy Reservoir have increased, consistent with the projection in the 2011 Comprehensive Regional Water Supply Plan.
    b. The requirement for environmental flows has also increased for a portion of the Duck River upstream of Columbia. Prior to 2011, only Columbia Power & Water System's (CPWS) Aquatic Resource Alteration Permit (ARAP) (water withdrawal permit) for withdrawing water from the Duck River at the Columbia Pool had a cease withdrawal requirement. The permit stipulates that CPWS's water withdrawals must be cut back as needed to maintain a flow of at least 100 cubic feet per second (cfs) downstream of the Columbia Pool dam. Since 2011, several ARAPs with cease withdrawal conditions were issued for water systems that withdraw water from the Duck River. While other ARAPs are within a 5-year grace period for implementing their cease withdrawal, the Marshall County Board of Public Utility (MCPBU) ARAP includes a "cease withdrawal" requirement that is currently in place (i.e., no waiver), when river flow is less than 175 cfs at the Milltown gage.
2. ***Implementation of the recommendations from the 2011 Comprehensive Regional Water Supply Plan, while substantial, has not kept pace with the increasing need for water***
    a. DRA, in collaboration with Tennessee Valley Authority (TVA) and Tennessee Department of Environment and Conservation (TDEC), has made significant progress on the recommended non-structural elements, which include measures to improve drought resilience via optimization of releases from Normandy Reservoir, a drought management plan, and the start for a water use efficiency program. The Duck River Utility Commission (DRUC) also is

completing a project with support from DRA, TVA and TDEC, to enhance resilience of its water supply by improving its intake pumps to access deeper water in Normandy Reservoir.

b. However, neither of the structural elements from the 2011 Comprehensive Regional Water Supply Plan have been completed.
   i. Raise Normandy Dam: DRA collaborated with TVA to investigate the viability of raising TVA's Normandy Dam and the Winter Pool level by approximately 5 feet (ft) to increase water storage for use during droughts and enhance flood protection while minimizing environmental impacts. To date, TVA has not prioritized this structural project, but the investigations appear to support the technical viability of this project.
   ii. Construct a new water supply intake on the Duck River downstream of Columbia: DRA collaborated with CPWS by providing $10 million to CPWS to support permitting, property purchase, and design of a new intake in the Duck River in the western portion of Maury County, along with a raw water pumping station and raw water pipeline to deliver water to CPWS's existing WTP. CPWS secured an ARAP from TDEC and completed design of the intake, raw water pumping station, pipeline, and related water facilities. The project is near "shovel ready" but requires an approved financial plan to proceed.

Key Findings

A. Normandy Dam

- The 2011 recommendation for raising Normandy Dam and the Winter Pool by 5 ft remains a viable approach for increasing drought resilience, which benefits all uses of the reservoir and the river. Note that this 2011 recommendation did not alter the downstream flow targets (i.e., current flow target at Shelbyville remained unchanged) or releases from Normandy Reservoir. This approach, which involves raising the Winter Pool in Normandy Reservoir, avoids most adverse environmental impacts in the reservoir and surrounding area and some costs associated with raising the Summer Pool.
- This Expedited Update of Structural Elements also explored raising the Normandy Reservoir Summer Pool, to allow for additional Normand Reservoir releases to address the need for increased water supply demands and increased environmental flows in the segment of the Duck River downstream of Shelbyville. This option (raising Normandy Reservoir Winter and Summer Pools) would be essentially the same project identified by TVA in their 2000 Programmatic Environmental Impact Statement (EIS) (Programmatic Environmental Impact Statement PEIS), although for a slightly different purpose. The PEIS is included in Appendix 5.
- The Normandy Dam project as described in TVA's 2000 PEIS would have released an additional 16 cfs downstream of Normandy Dam to address increasing water demands and was projected to maintain the 100 cfs flow at Columbia gage through 2035.
- The 2025 Updated Normandy Dam Project described here would be similar, except it would also be designed to maintain minimum environmental flows identified by TDEC at the Milltown gage. OASIS modeling indicates that raising the dam and pool heights by approximately 5 ft provides enough additional storage to support projected water demands plus the additional releases for environmental flows at Milltown.
  - Water released from Normandy Reservoir could continue to meet the Milltown flow target through at least 2060.
- The updated OASIS model was used to confirm the ability of the watershed to refill Normandy Reservoir during the critical record drought (i.e., 2007-2008). The model results show that the watershed is adequate to refill the larger reservoir, with its pool level raised by 5 ft.

- The 5 ft higher pools will refill with approximately the same frequency as currently, and the minimum pool level would be approximately 6-8 ft higher than status quo in the drought of record, even with 2060 demands and increased releases for environmental flows, as shown on Table 1.

Table 1: Minimum Pool Level in Normandy Reservoir based on Worst Case Drought of 2007-2008

Scenario	2025 Water Demand Conditions			2060 Water Demand Conditions		
	Current downstream flow target at Shelbyville of 155 cfs in Summer	Increase downstream flow target at Shelbyville by 25 cfs (155 cfs to 180 cfs) in Summer	Increase downstream flow target at Shelbyville by 40 cfs (155 cfs to 195 cfs) in Summer	Current downstream flow target at Shelbyville of 155 cfs in Summer	Increase downstream flow target at Shelbyville by 25 cfs (155 cfs to 180 cfs) in Summer	Increase downstream flow target at Shelbyville by 40 cfs (155 cfs to 195 cfs) in Summer
Minimum Pool Level under Current Dam and Pool Conditions (elevation ft)	852	848	845	850	845	842
Minimum Pool Level under a Raised Dam and Pool Levels by 5 ft Condition (elevation ft)	858	854	852	857	853	850
Increase in Minimum Pool Level (ft)	6	6	7	7	8	8

** All modeling results based on "Optimized Releases" (7-day average rather than instantaneous flow requirement)*

- TVA has identified several risks associated with raising Normandy Dam:
  - Increased flood risk during construction due to one of the two spillway gates being temporarily out-of-service.
  - Risk of cost escalation if there is a need to grout karst voids that could otherwise cause the reservoir to leak along is perimeter.
  - Risk of significant environmental impacts associated raising the Summer Pool or possibly the Winter Pool.
- TVA also identified the potential to reduce these risks by raising the Summer Pool 2-3 ft rather than 5 ft. OASIS modeling indicates that even a 2-3 foot increase in the Summer Pool could support projected water demands downstream of Shelbyville and upstream of the Columbia Pool through 2060 plus the environmental flows at the Milltown gage, provided TDEC modifies the 175 cfs minimum flow "cease withdrawal" constraint from instantaneous condition to a weekly average.
- Ramboll estimates an order-of-magnitude (OOM) cost at roughly $100 million to raise Normandy Dam, the Summer Pool and the Winter Pool all by approximately 5 ft. Of this $100 million amount, approximately $70 million is for raising the dam and gates and $30 million is for non-dam related costs, such as easements, relocating roads, raising bridges, and addressing other impacts associated with the higher pool levels.

- Ramboll estimates it will take approximately 6 years to plan, permit and construct the raising of Normandy Dam, assuming some concurrent activities. However, there are risks and challenges that could prolong this schedule or even block the project. These schedule challenges include:
  - More extensive geotechnical studies and flood risk assessments. (Potential to delay)
  - More extensive environmental studies (Potential to delay)
  - An adverse determination in the National Environmental Policy Act (NEPA) process (Potential to delay or block)
  - Cost escalation that exceeds available funding (Potential to delay or block)
  - A decision by TVA that there are unacceptable risks, such as flood risks during construction. (Potential to block)

B. Duck River Intake Downstream of Columbia

- Currently, except for Spring Hill's direct withdrawal from the Duck River, the Maury County area depends primarily on water withdrawals from the Columbia Pool. As predicted in the 2011 Comprehensive Regional Water Supply Plan, this source is at risk primarily due to severe droughts; the new downstream intake on the Duck River would also provide valuable redundancy. The water demand update and OASIS modeling completed for this Expedited Update of Structural Elements confirms that river flow at the Columbia gage (03599500) will drop below 100 cfs in a severe drought at current Normandy Reservoir releases and water withdrawals, thereby restricting water available to CPWS and its customers (including the City of Spring Hill and Maury County Water System).
- The proposed new intake would be downstream of the discharge for the City of Columbia and Spring Hill wastewater treatment plants, and in a location without flow constraints. It is expected that river flow at this location would be adequate to meet the needs of Maury County for well over 50 years, because most of the water withdrawn by CPWS and Spring Hill would be returned to Duck River (approximately 60%) via the Columbia and Spring Hill wastewater treatment plants, which are upstream of the proposed intake.
- The downstream intake project as designed by CPWS is consistent with the recommendation in the 2011 Comprehensive Regional Water Supply Plan. Ramboll has reviewed CPWS's estimated cost and schedule (below) and finds them both consistent with our knowledge of the construction market for this type of project. The intake would be located approximately 11 river miles further downstream than proposed in 2011. This intake site, further downstream, is at a location where there is more flow in the river, making for an even longer-term solution. CPWS's project also includes an expansion of their water treatment plant and use of advanced treatment technology. DRA's 2011 Comprehensive Regional Water Supply Plan was focused solely on raw water supply, but the planned investments in water treatment are reasonable to meet projected demands and drinking water quality regulations.
- CPWS has estimated the cost for the downstream intake, raw water pumping station and Phase 1 raw water pipeline (36-inch diameter), including unexpended engineering and miscellaneous costs, at approximately $250 million. Of this amount, approximately $92 million is for the intake and raw water pumping station, $130 million is for the first 36-inch pipeline and approximately $30 million for unexpended engineering and miscellaneous costs. The second 36-inch raw water pipeline (Phase 2) is assumed to have a similar cost to the Phase 1 pipeline in today's dollars (~ $132 million). CPWS estimates the cost for upgrades to their existing water treatment plant and construction of additional treatment capacity at approximately $200 million. Note that the costs for raising Normandy Dam include only the raw water costs (i.e., no water treatment costs). The scope

and cost for water treatment improvements are assumed at this time to be about the same, whether the source of raw water is increased releases from raised Normandy Dam or the proposed downstream intake.

- CPWS identified that the remaining permits and easements should be secured by the beginning of 2026, and a financing plan is under development. Once permits and financing are in place, CPWS estimates it will then take approximately 3½ years to construct the downstream intake project (intake, raw water pumping station and first 36-inch raw water pipeline). Ramboll has reviewed CPWS's estimated schedule and finds it consistent with our knowledge of the construction market for this type of project. Based on information provided by CPWS, the only known challenge that could significantly delay or block the project is securing financial approvals from their governing bodies.
- This project has the potential to serve as the "first leg" for future connection to a pipeline from outside Duck River basin.

C. Modifying the instantaneous flow constraint in recent TDEC ARAP permits will enhance resilience, reduce risk and/or prolong the effectiveness of the Normandy Dam project

- OASIS modeling indicates that modifying the details of the 175 cfs flow constraint at the Milltown gage would substantially reduce the need for additional storage in Normandy Reservoir, which is expected to reduce the risks associated with raising the Normandy Dam and Summer Pool.
- Changing the instantaneous flow target condition to a weekly average flow target condition could provide several benefits:
  - Reduces the required increase in Summer Pool level from approximately 4.4 ft to 1.7 ft, thereby reducing risks and cost, or
  - Allows a 5 ft increase in pool levels in Normandy Reservoir to meet the flow targets at Milltown and Columbia for significantly longer, or
  - Increases the amount of additional flood storage in Normandy Reservoir.
- A similar approach involving the recent switch from an instantaneous flow target to weekly average flow target at the Shelbyville gage (03597860), optimized releases from Normandy Reservoir to preserve water storage in Normandy Reservoir and increase drought resilience.

Suggested Strategy

A. Implement both structural elements: Raise Normandy Dam and Construct the Downstream Intake Project, as soon as possible.

- Neither structural element alone will meet the region's long-term water needs.
  - Raising Normandy Dam would supplement flows upstream of Columbia during dry weather conditions, to support growth and environmental flows in that segment of the Duck River.
  - While raising Normandy Dam and pool levels to release more water from the reservoir will also supplement river flows at Columbia, the need for more water supply in Maury County exists now, and sole reliance on Normandy Reservoir would delay but not avoid the need for the downstream intake in the future. Further, Ramboll finds that if financing is in place by early 2026, as CPWS anticipates, the downstream intake project could resolve the current water shortage in Maury County at least three years sooner than by raising Normandy Dam.

B. Revisit the instantaneous flow constraints in ARAP permits

- Both structural elements (raising Normandy Dam and constructing the intake downstream of Columbia) are driven in part by the instantaneous flow target conditions in TDEC's ARAP, water

withdrawal permits. These permits define the "cease withdrawal" requirement which are based on the Duck River flows at Milltown and Columbia, establishing the magnitude and timing of the water supply and environmental need.

i. In the case of raising Normandy Dam, confirming the need for cease withdrawal conditions in the ARAP constraints will be essential for a successful and timely outcome from the NEPA process.
ii. Switching the cease withdrawal conditions in the ARAP permits from instantaneous flow to a weekly average flow will reduce cost, enhance resilience, reduce risk and/or prolong the effectiveness of the Normandy Dam project.

1. Introduction

1.1 Purpose

In 2011, the Tennessee Duck River Development Agency (DRA) developed a Comprehensive Regional Water Supply Plan (2011 WSP) for Bedford, Coffee, Marshall, Maury, and southern Williamson Counties to meet future water needs and address concerns with possible water shortages brought on by drought conditions. The 2011 WSP addressed water needs in this central Tennessee region through a 50-year planning period with a 100-year planning horizon and provides direction to the DRA for the management of available water resources, including the implementation of specific water supply infrastructure projects.

Due to ongoing concerns about having adequate water supplies in the region, Governor Bill Lee issued Executive Order 108 on November 20, 2024, which established the Duck River Watershed Planning Partnership (DRWPP or "the Partnership"). Among several priorities, the Partnership has a goal "*to evaluate large scale engineering projects for near-term drought mitigation and long-term sustainability of the Duck River. These projects should be evaluated on a cost and feasibility basis and presented to the Governor for further consideration.*"

In collaboration with other members of the Partnership, DRA has undertaken the task to update the two structural elements recommended in the 2011 WSP:

- Increasing the volume of water storage in Normandy Reservoir by raising the water level and increasing the height of the dam.
- Constructing a water supply intake in the Duck River downstream of Columbia near Williamsport.

Ramboll was authorized to perform this (WSP Update) on August 20, 2025, with a schedule to deliver draft and final reports in approximately 60 and 90 days respectively, in support of the Partnership's highly expedited schedule.

1.2 Background

In 2011, the Duck River Development Agency (DRA) developed the 2011 Comprehensive Regional Water Supply Plan (2011 WSP) for Bedford, Coffee, Marshall, Maury, and southern Williamson Counties. The WSP addresses water needs through a 50-year planning period with a 100-year planning horizon and provides direction to the DRA for the management of available water resources, including the implementation of specific water supply infrastructure projects.

Evolving weather patterns and updated growth projections, combined with the obligation to manage water resources responsibly for future generations, present the need to update the structural elements identified in the regional water supply plan for the Duck River Watershed (Figure 1).

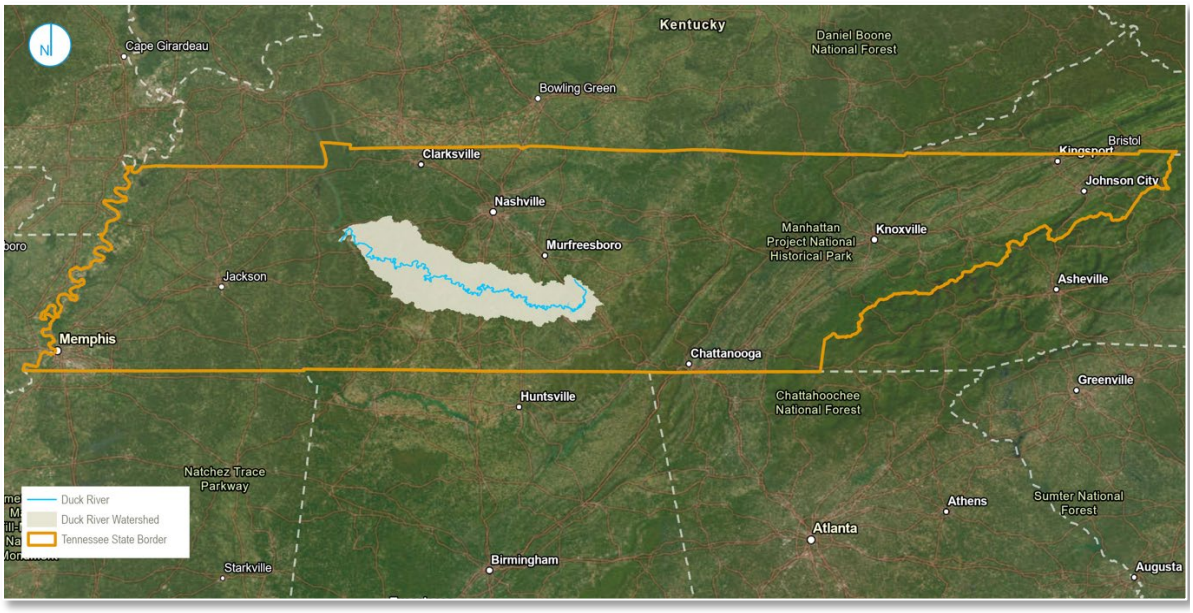


Figure 1: Duck River Watershed

1.2.1 Tennessee Duck River Development Agency (DRA)

The Tennessee General Assembly created the DRA in 1965 (§TCA-64-1-601) as a comprehensive regional development agency. Its broad powers include the "control and development of the water resources" of those portions of the Duck River Watershed lying in Bedford, Coffee, Hickman, Marshall and Maury Counties. In 1998, the DRA Board of Directors adopted the following mission statement:

"To develop, protect, and sustain a clean and dependable water resource for all citizens of the Duck River region."

In 2025, HB 0375/SB 1397 amended §TCA-64-1-601 to broaden the structure and powers of DRA, adding the authority to charge a per thousand-gallon mandatory fee to participating entities for water withdrawals from the Duck River. This change strengthened the financial position of DRA, making them "investment worthy" and thereby a viable entity to undertake capital projects. The bill also expanded DRA's Board to include members of the water utilities, allowing any entity that withdraws water from the Duck River watershed (Duck River main stem or tributaries) and holds an Aquatic Resource Alteration Permit (ARAP) from the Tennessee Division of Water Resources to be a participating entity in the DRA.

The DRA represents water utilities that serve approximately 300,000 people and industries that include car manufacturers, food processing plants, and other businesses utilizing water for production. In addition to these uses, the river provides a wide range of other values including recreation, an excellent fishery, and some of the most biologically-rich freshwater habitats in North America.

The DRA represents the following water utilities:

- Regular Members:
  - Bedford County Utility District
  - Columbia Power and Water Systems
  - Duck River Utility Commission
  - Lewisburg Water and Wastewater
  - Shelbyville Power, Water and Sewerage System
  - Spring Hill Water Department
- Associate Members:
  - Bell Buckle Utility Department
  - Chapel Hill Water System
  - Hillsville Utility District
  - Manchester Water Department
  - Marshall County Board of Public Utilities
  - Maury County Water System
  - Mount Pleasant Water System
  - Wartrace Utility Department
  - Tullahoma Utilities Authority

Regular members are the managers or designated representatives of each of the Water Systems in the Duck River Region. Associate members are managers of other water systems that either purchase and distribute water pumped from the watershed and/or return wastewater to it.

1.2.2 Droughts in the Duck River Watershed

DRA's member water systems and citizens of the Duck River region depend on the water released from Normandy Reservoir (Figure 2) to meet all designated uses, including drinking water, wastewater assimilation, recreation, and natural resource protection. During the drought of 2007-2008, the dramatic decrease in rainfall and continued releases to support multiple uses of the reservoir and river, caused record low water levels in Normandy Reservoir. TDEC and TVA responded with temporary changes in dam operation to slow the loss of storage. Several more droughts of varying degrees have occurred since the development of the 2011 WSP. In 2016, a prolonged drought prevented the Summer Pool levels of the reservoir from being reached (i.e., reservoir failed to refill from the lower Winter/Spring Pool level to the higher Summer/Fall Pool level).



Figure 2: Normandy Reservoir

In 2024, an intense but shorter localized drought again threatened the region with unusually low flows in the lower portion of the Duck

River basin. Evolving weather patterns and updated growth projections, combined with the obligation to manage water resources responsibly for future generations, present the need to update the structural elements identified in the regional water supply plan for the Duck River Region.

1.2.3 2011 Comprehensive Regional Water Supply Plan

The 2011 WSP developed a multi-pronged water supply strategy composed of the following non-structural and structural components:

- **Non-structural components** - These three non-structural components, as described in the 2011 WSP, promote the wise use of water throughout the service area and make the best use of existing water resources:
  - Develop a regional drought management plan.
  - Implement a water use efficiency program.
  - Optimize releases from Normandy Reservoir to preserve storage in the reservoir for when it is most needed.
- **Structural components** – These two structural components, as described in the 2011 WSP, are intended to increase the availability of water resources in the upper and lower parts of the Duck River watershed:
  - Raise Normandy Dam and raise the Winter/Spring Pool without raising the Summer/Fall Pool. This approach increases water storage for use during droughts and enhances flood protection while minimizing environmental impacts. Adding storage to Normandy Reservoir enhances the reliable yield available for all Duck River uses.
  - Construct a new water supply intake on the Duck River approximately 25 miles downstream of Columbia's existing intake; the downstream location has adequate flow during droughts to satisfy projected water needs during critical droughts. The new intake (near Williamsport) addresses the deficit at Maury County and Southern Williamson County with a local, highly reliable supply, rather than relying solely on releases from Normandy Reservoir during critical drought events.

1.2.4 Progress Since 2011

Since 2011, DRA has collaborated with regional stakeholders on each of the recommended non-structural and structural components with substantial success:

- Develop a regional drought management plan:
  - DRA developed a regional drought management plan in 2013 and initiated an environmental review (NEPA) in 2016, which is ongoing.
- Implement a water use efficiency program:
  - DRA completed the first phase of a regional water use efficiency study in 2016 that included collecting and analyzing key water use data to create the demand projections and develop the regional water efficiency program.
- Optimize releases from Normandy Reservoir to preserve storage in the reservoir for when it is most needed:
  - DRA collaborated with the Tennessee Valley Authority (TVA) to develop a strategy for optimizing water releases from Normandy Reservoir in 2013 and initiated an environmental review (NEPA) in 2016. The environmental studies and strategy were recently approved, which

now provides optimized releases from Normandy Reservoir to preserve storage in the reservoir for when it is most needed (i.e., prolonged droughts).

- Raise Normandy Dam:
  - DRA collaborated with TVA to investigate the viability of raising TVA's Normandy Dam approximately 5 ft to increase water storage for use during droughts and enhance flood protection while minimizing environmental impacts. To date, TVA has not prioritized this structural project, but the investigations support the technical viability of the project.
- Construct a new water supply intake on the Duck River downstream of Columbia:
  - DRA collaborated with Columbia Power & Water Systems (CPWS), providing $10,000,000 to CPWS to support permitting, property purchase, and design of a new intake in the Duck River in the western portion of Maury County. CPWS secured an ARAP (withdrawal permit) from TDEC and completed design of the intake, raw water pumping station, pipeline, and related facilities. On August 11, 2025, USEPA announced the Environmental Assessment and Preliminary Finding of No Significant Impact (FONSI) for CPWS's Long-Term Water Supply Program ("Community H2O") was released for a 30-day public review. The final status of the FONSI will be considered by TVA and United States Army Corps of Engineers (USACE) prior to issuing their permits, which are also required for construction of the project.
- The 2011 WSP also recommended that DRA adopt financial and organizational approaches that support the region's water supply enhancement strategies:
  - The amendments to §TCA-64-1-601, which are noted above, expanded DRA's Board to include members of the water utilities and strengthened the financial position of DRA, making it a viable entity to support and undertake capital projects.

In November 2024, Governor Lee established the Duck River Watershed Planning Partnership. The Partnership was directed to identify solutions for water management, with a particular emphasis on regional approaches. The DRA is a key member of the Partnership.

DRA agreed to support the Partnership by performing this expedited update to the 2011 Comprehensive Regional Water Supply Plan. The update builds on prior efforts and aims to update and focus findings on two previously identified structural elements:

- Increasing the volume of water storage in Normandy Reservoir by raising the water level and increasing the height of the dam.
- Constructing a water supply intake in the Duck River downstream of Columbia near Williamsport.

1.3 Goals and Objectives

The key objectives of DRA's expedited update of the two structural elements, which were included in the 2011 WSP are as follows:

- Update the projected water demands, which were developed previously for water systems in the Duck River basin.
- Revisit the two structural elements and assess whether/how they should be modified to meet the region's current needs, with a focus on the ability to meet the projected water needs of the water systems supplied by the Duck River.
- Assess the feasibility, cost, and potential schedule for implementation.
- Communicate findings, including a briefing with the Duck River Watershed Planning Partnership.

1.4 Approach

This Expedited Update to DRA's Comprehensive Regional Water Supply Plan benefitted from participation by TVA, CPWS, DRUC, and TDEC and two Partnership meetings. The following meetings took place to inform about this study and meet the expedited schedule:

- August 26, 2025: Virtual meeting; CPWS, DRA, and Ramboll
- September 4, 2025: Virtual meeting; TVA, DRA, and Ramboll
- October 1, 2025: Virtual meeting; TVA, DRA, and Ramboll
- October 10, 2025: Tabletop discussion on Normandy Dam Alternative; DRWPP Regionalization Committee, with attendance by TVA, TDEC, USACE and Ramboll
- October 16, 2025: Virtual meeting; DRUC, DRA, and Ramboll
- October 27, 2025: Workshop on Reservoir Alternatives; Partnership with attendance by DRA, TVA, TDEC, Tennessee Wildlife Resources Agency (TWRA), USACE several elected officials, and Ramboll

Additional correspondence took place via email and telephone.

2. Water Supply Need

2.1 Water Demand Update

Potable water demands are influenced by many factors, including population, water use by commercial and industrial customers, housing, employment, income, weather, household size, water price, culture, lot size, season, water loss to theft, leakage, flushing, accidents, and firefighting. During the 2011 WSP process, it was projected that water demands would roughly double over the next 50 years (30 mgd in 2010 to 57 mgd in 2060). For the purposes of this expedited update to the 2011 Comprehensive Regional Water Supply Plan, Ramboll reviewed the sources used in the 2011 WSP as well as new data available.

As shown in Figure 3, the following sources of information were used to project average-day water use for the water systems through 2060:

- **2011 WSP –** The 2011 WSP estimated population growth based primarily on Center for Business and Economic Research (CBER) data from 2009. The 2011 WSP is included in Appendix 2.
- **2013 OBG revised demands –** In 2013, OBG revised the demands presented in the 2011 WSP because actual demands were trending lower than estimated in 2011.
- **DRA Maddaus Water Management Water Use Efficiency Program –** DRA retained Maddaus Water Management (MWM) Inc. to develop a water use efficiency program. MWM's 2015 Report relied on annual average-day water use data that was obtained from the DRA for each water system for the period from 2010 to 2050. This data set provided a trend line similar to the 2013 OBG revised demands. MWM's report was useful in assessing the reasonableness of future projections. The full report is included in Appendix 1.

In addition to the above, the following sources were used for this expedited update:

- **Recent updates by the Center for Business and Economic Research (CBER) –** In August 2024, the University of Tennessee Boyd Center for Business and Economic Research published population projections for the State of Tennessee for the period from 2023 through 2070. The University of Tennessee CBER is widely recognized as an independent source with authority on demographics in Tennessee. CBER data was reviewed to ensure consistent growth patterns with those seen in 2011. Based on the analysis, the growth trend used in the 2011 WSP has remained

steady, with annual growth continuing at approximately 1.5%. The 2009 CBER report is included in Appendix 3.

- **CPWS Projections –** Near-term water withdrawal projections provided by CPWS. These demands include CPWS as well as their wholesale customers. Demands, which were maximum day demands, were reviewed and compared with projected average day demands as a check. Demands were also used to confirm the sizing of the proposed infrastructure for the downstream intake structural element. The CPWS projections are included in Appendix 4.

The results of the water demand projections through 2075 are summarized in Figure 3. The forecast from 2060 to 2075 is based on a linear extrapolation, which would be consistent with the projection through 2060.

Average day demands in 2024 were approximately 35.5 MGD. Based on the projection, demands will grow by approximately 85% by 2075.

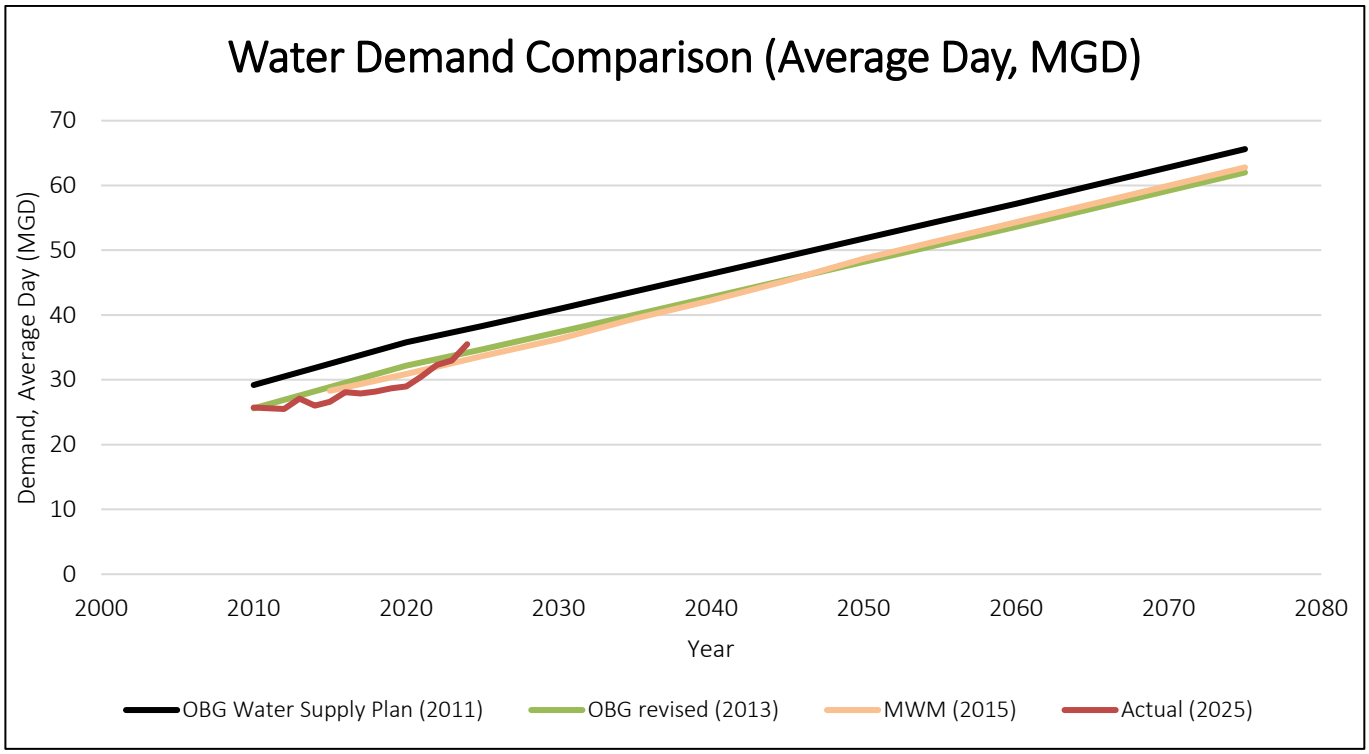


Figure 3: Water Demands 2010 – 2075

A few key parameters are used when discussing water demands:

- ***Average day demands*** represent the amount of potable water required in a year, divided by 365 days.
- ***Maximum day demands*** represent the amount of potable water required in a single 24-hour period for a day of maximum usage.

Both parameters are used to size or evaluate certain parts of a potable water system. The water storage capacity of reservoirs, such as Normandy Reservoir, are typically associated with annual average day demands. In the case of Normandy Reservoir, the annual average day demands include those withdrawn from the pool to supply Manchester and Tullahoma plus the downstream release to the Duck River to maintain the target flows at the Shelbyville gage. The projected average day demands for DRA areas are provided in Table 2 by county and municipality.

Table 2: Average Day Demands (MGD)

Water System	2030	2040	2050	2060	2075
Coffee County					
Tullahoma	3.5	3.8	4.1	4.4	4.9
Manchester	3.2	3.4	3.7	4.0	4.4
Bedford County					
Shelbyville	7.2	8.2	9.3	10.4	12.1
BCUD	3.1	3.5	4.0	4.4	5.1
Marshall County					
Lewisburg	4.1	4.5	4.9	5.3	6.0
Maury/South Williamson					
Spring Hill	3.5	4.1	4.6	5.1	5.9
Columbia	16.3	18.8	21.2	23.6	27.2
Total	**41**	**46**	**52**	**57**	**66**

Ramboll used the maximum day demands to confirm the size of the raw water intake, water pumping facilities, and transmission mains. The OASIS model used the average day demands with monthly adjustments to reflect seasonal use patterns.

2.2 Water Sources

Normandy Reservoir and the Duck River supply virtually all of the public water supply needs in the five-county planning area. Portions of the Duck River have been impounded since the mid-1800s. Currently, three low-head dams are located on the Duck River, which were constructed in the early 1900s for water supply:

- Shelbyville (drainage area = 481 square miles)
  - The City of Shelbyville withdraws water from this pool.
- Lillards Mill near Milltown (drainage area = 916 square miles)
  - The City of Lewisburg withdraws water from this pool, and the Marshall County Board of Public Utilities has a permit to withdraw from this pool
- Columbia (drainage area = 1,208 square miles)
  - Columbia Power & Water System (CPWS) withdraws water from this pool.

Normandy Reservoir was constructed in 1976 and is the primary source of water supply for the Duck River during dry weather conditions. Normandy Reservoir has the following characteristics:

- Located in the upper portion of the Duck River watershed between Shelbyville and Manchester (Duck River Mile 248.6).
- Normandy Dam is 2,248 ft in length and about 95 ft in height.
- Storage volume is roughly 38 billion gallons at a Summer/Fall Pool level of 875 ft.
- Drainage area is roughly 195 square miles.

Normandy Reservoir was designed to provide a variety of benefits upstream and/or downstream from the dam, including recreation, flood protection, water supply, and water quality benefits. Water users upstream from Normandy Dam (primarily Tullahoma and Manchester) are served from DRUC's water intake located in Normandy Reservoir. The mainstem of the Duck River is the primary water supply source for water systems downstream of Normandy Reservoir.

TVA operates Normandy Reservoir using the following priorities to decide how to release water under normal rainfall conditions:

- Minimize downstream flooding (especially in winter and early spring).
- 40 cfs minimum instantaneous flow just downstream from the dam (sustains aquatic habitat in the reach immediately downstream of the dam).
- 120 cfs minimum instantaneous flow at Shelbyville (December - May) at the USGS gage located at Duck River Mile 221.4.
- 155 cfs minimum instantaneous flow at Shelbyville (June - November) at the USGS gage located at Duck River Mile 221.4.
- Up to 10 cfs additional instantaneous flow at Shelbyville for water supply; the City of Shelbyville withdraws from Duck River upstream of the Shelbyville gage.

Note, the Duck River flow target near Shelbyville is located at Duck River Mile 221.4, which is approximately 27 river miles downstream of Normandy Reservoir (~18 hours travel time).

In 1996, the TDEC Division of Water Pollution Control evaluated the minimum instream flow required to maintain recreation and aquatic life uses in the Duck River at Columbia in response to questions about the ability of the Duck River to meet additional water supply needs. The analysis resulted in a requirement that the streamflow should not fall below 100 cfs at Duck River Mile 132.8, immediately downstream from the Columbia water supply intake.

This minimum flow requirement is included in CPWS's water permit (ARAP NRS24.228) and establishes a state-identified limit below which no additional water can be withdrawn from the Duck River by Columbia (Appendix 6-A). This is commonly referred to as a "cease withdrawal". This 100 cfs "cease withdrawal" requirement at Duck River Mile 132.8 is recognized as a key constraint in the Comprehensive Regional Water Supply Plan.

Additionally, a 175 cfs cease withdrawal requirement is included in Bedford County Utility District's recent water permit (ARAP NRS22.320), Lewisburg's draft water permit (ARAP NRS19.148), and MCPBU's water permit (ARAP NRS20.177). These permits are attached as Appendices 6-B, 6-C, and 6-D, respectively. This cease withdrawal is measured at the Milltown USGS Gage (03599240), depicted in Figure 4, and establishes a state-identified limit below which no additional water can be withdrawn from the Duck River by these permittees. The 175 cfs "cease withdrawal" requirements have all been included in the named permits since the 2011 Comprehensive Regional Water Supply Plan.

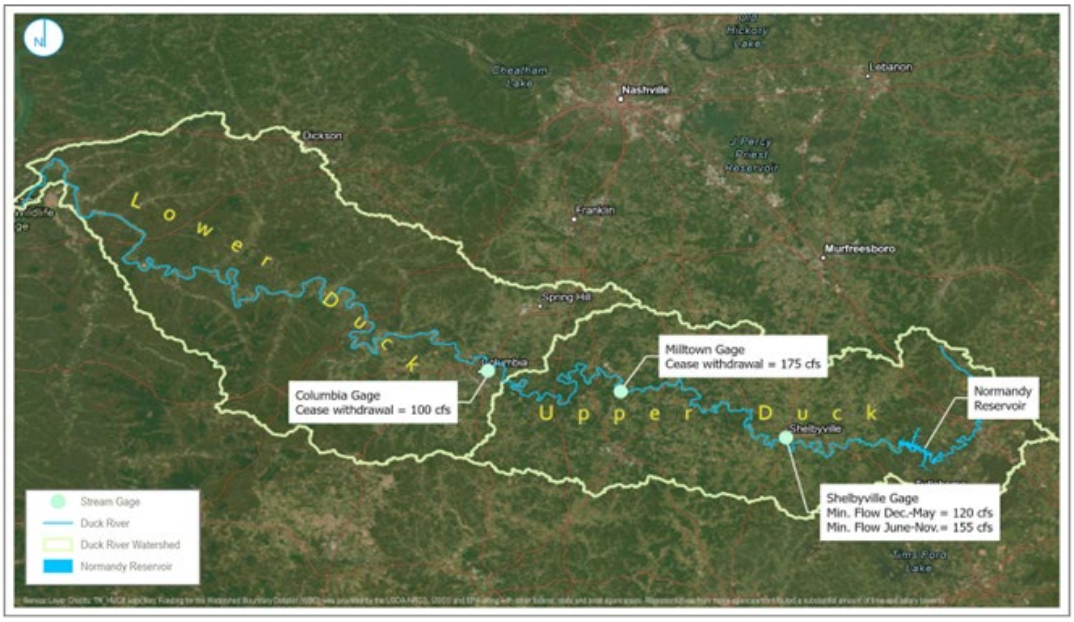


Figure 4: Relevant USGS Gage Location and Target Flows

2.3 Available Water Supply

The OASIS computer model developed by HydroLogics, Inc. (now part of Hazen) was used to evaluate the adequacy of Normandy Reservoir and the Duck River to meet current and future water demands and environmental flows using a period of hydrologic record extending from 1921 through 2024 (103 years). The OASIS model performs a daily water budget using reservoir inflow data, reservoir releases, streamflow data, water demands, minimum flows in Duck River, flood releases, and water withdrawal return flows. In 2011, the model was originally used to separately evaluate the adequacy of the following:

1. Normandy Reservoir for its users (i.e., Manchester and Tullahoma)
2. Duck River for Shelbyville and the downstream users to Columbia

2.3.1 Modeling Objectives

For this expedited update, the OASIS model was used to understand the following:

- The volume of additional storage that would be required at Normandy Reservoir to allow for increased releases to maintain 175 cfs at the Milltown gage.
    - The model estimated the additional storage compared to a baseline in which Normandy Reservoir releases are as needed to maintain the current flow targets at the Shelbyville USGS gage. The volume of additional storage informs the required increase in the water pool level in Normandy Reservoir, to define scope of work and cost for dam raising. The higher pool level also establishes the area of permanent inundation around the perimeter of Normandy Reservoir, costs for easement purchase and impact to environment, roadways, etc.
- The relationship between the flows at the Shelbyville USGS gage and the Milltown USGS gage if releases from Normandy are modified to maintain 175 cfs at the Milltown USGS gage.
- The relationship between the flows at the Columbia USGS gage and Milltown USGS gage if releases from Normandy are modified to maintain 175 cfs at the Milltown USGS gage.

- The model estimated that flow at the Columbia gage, downstream of the CPWS intake, would be maintained above 100 cfs when flows at Milltown are above 175 cfs. So, as an example, with 2060 water demands and a + 40 cfs release from Normandy, the model indicates that flow at Columbia would be maintained above 100 cfs.

The goal of the OASIS runs was to identify how much additional volume of storage, million or billion gallons (MG or BG), is needed in Normandy Reservoir (i.e., increase in pool elevation) in a given year for release downstream to maintain a 175 cfs flow target at the Milltown USGS gage (assumes that TVA will meet a higher flow target at the current Shelbyville USGS gage). The additional volume of storage in Normandy Reservoir was used to establish the required increase in the water pool level in Normandy Reservoir to identify how many feet Normandy Dam will need to be raised (to define scope of work and cost for dam raising) and determine the area of permanent inundation around the perimeter of Normandy Reservoir (costs for easement purchase and impact to environment, roadways, etc.).

The OASIS modeling applied the following conditions and data:

- Optimization of Normandy Reservoir Releases (i.e., the recently enacted 7-day average is in effect at the Shelbyville USGS gage).
- Model used the historical period of record (1921 through 2024) for analysis of stream flows.
- Model ignores regional drought management plan operations, which could otherwise reduce releases during a drought.
- Current and projected water demands as described in Section 2.1.
- Model applied several alternate releases, that were selected based on iterative runs, attempting to consistently meet the 175 cfs target at the Milltown gage, by establishing a flow target at Shelbyville.
  - Status quo or "no Raise (maintain current flow targets)" means release to meet the current target flow at the Shelbyville gage.
  - "+25 cfs" means release to meet the target flow at Shelbyville plus 25 cfs, so for summertime, 155 cfs + 25 cfs = 180 cfs.
    - This alternate was selected based on iterative runs and data analysis showing that "+25 cfs" meets the 175 cfs at Milltown about 97% of the time.
  - "+40 cfs" means release to meet the target flow at Shelbyville plus 40 cfs, so for summertime, 155 cfs + 40 cfs = 195 cfs.
    - This alternate was selected based on iterative runs and data analysis showing that "+40 cfs" meets the 175 cfs at Milltown nearly 100% of the time.
- Model applied the same wastewater return flow percentages for existing and future conditions which is consistent with the prior (2011) OASIS model runs.

2.3.2 Modeling Results

Estimated Increase in Dam Height – The OASIS model was used to estimate the increase (feet) that would be required to increase reservoir storage to satisfy projected water demands and environmental flows. Results are shown in Table 3 below. The additional releases modeled are:

- Release exact amount of water needed to theoretically meet the 175 cfs flow constraint at the Milltown gage

- +25 cfs release as defined above, as a more practical way to maintain 175 cfs at Milltown gage. The model results indicate that +25 cfs would achieve 175 cfs at Milltown gage approximately 97% of the days.
- +40 cfs release as defined above as a more conservative way to achieve 175 cfs at Milltown gage; this approach meets the 175 cfs target nearly 100% of the days. The "theoretical" match would require less storage, but is rather impractical, given the difficulty in hitting a flow target that far away. However, if the flow constraint could be switched from instantaneous to weekly average, similar the Shelbyville flow target, the estimated 1.7' raising should meet the needs.

In the most conservative scenario, the dam would require that the pool be raised a minimum of 4.4 ft. For the purposes of this WSP Update, Ramboll assumed a 5 ft increase in dam height for estimating costs, schedule and a variety of impacts.

Table 3: Estimated Increase (feet) in Dam Height

Basis for Release	Increase	Comments
Increase release to meet env. flow (175 cfs) at Milltown	1.7 feet	Requires flexibility similar to optimized Shelbyville target
Increase Shelbyville target by 25 cfs	2.8 feet	Meets env. flow at Milltown ~97% of days, near 100% with flexibility in Shelbyville target
Increase Shelbyville target by 40 cfs	4.4 feet	Meets env. flow at Milltown nearly all days

Notes:
1. Above results based on OASIS model runs.
2. Results assume that withdrawals from Pool (DRUC) and from Duck River prior to Shelbyville gage will be supplied by current pool.

Normandy Reservoir refill - The OASIS model was also used to answer questions regarding refill of Normandy Reservoir. In this case, the model used 2060 projected demands and 5 ft higher Winter and Summer Pool elevations, with additional releases to satisfy the 175 cfs environmental flow constraint at Milltown gage.

Figures 5 and 6 illustrate the OASIS model results, showing the estimated water surface elevation in Normandy Reservoir during the critical drought of record (2007-2008). Figure 5 shows water surface elevations using 2025 demands and Figure 6 uses 2060 demands. The figures illustrate the impact of a 5 ft raise compared to no raise and show the impact of the release scenarios noted above on resulting water surface elevations in Normandy Reservoir. For context, note that during the actual 2007-2008 drought, Normandy Reservoir did not completely refill to the Summer Pool (elevation 875 ft) in the Summer of 2008 and the lowest water surface elevation was approximately 852 ft. These graphs allow for assessing the relative impact of raising the dam and increasing release of water from Normandy Reservoir.

See also Table 4, which summarizes the lowest water surface elevations for ease of comparison with the historical low water level in 2008. Figure 7 provides graphs of the probability that the reservoir

would refill to its Summer Pool by June 1st each year. The lower curves illustrate the probability of refilling to elevation 875 ft, the current Summer Pool. The upper curves illustrate the probability of refilling to elevation 880 ft, if the Summer Pool is raised to elevation 880 ft. This pair of curves shows that the current dam and pool levels and raising the dam and pool levels will result in approximately the same probability for refilling to the Summer Pool level. Some other observations:

- With the current dam and pool elevations, the increased water demands from 2025 to 2060 for the reservoir users (DRUC and Shelbyville) will lower the minimum water level by 2 ft (852 ft to 850 ft) under the current (normal) releases. Recent improvements by Duck River Utility Commission (DRUC) now allow it to withdraw water from Normandy Reservoir pool elevations down to 840 ft, meaning the projected 850 ft water surface is well within the capability of DRUC's water intake.
- If the dam and pools are raised approximately 5 ft and the release target is raised by 40 cfs (to maintain 175 cfs flow at Milltown), the lowest pool level would also be approximately 850 ft with 2060 demands. In other words, the higher dam allows for essentially the same level of refill in the drought of record, as would the existing dam.
- The bottom row in Table 4 shows that raising the dam and pools by 5 ft results in minimum water surface elevations that are approximately 6 ft to 8 ft higher, meaning the reservoir will be more drought resilient.

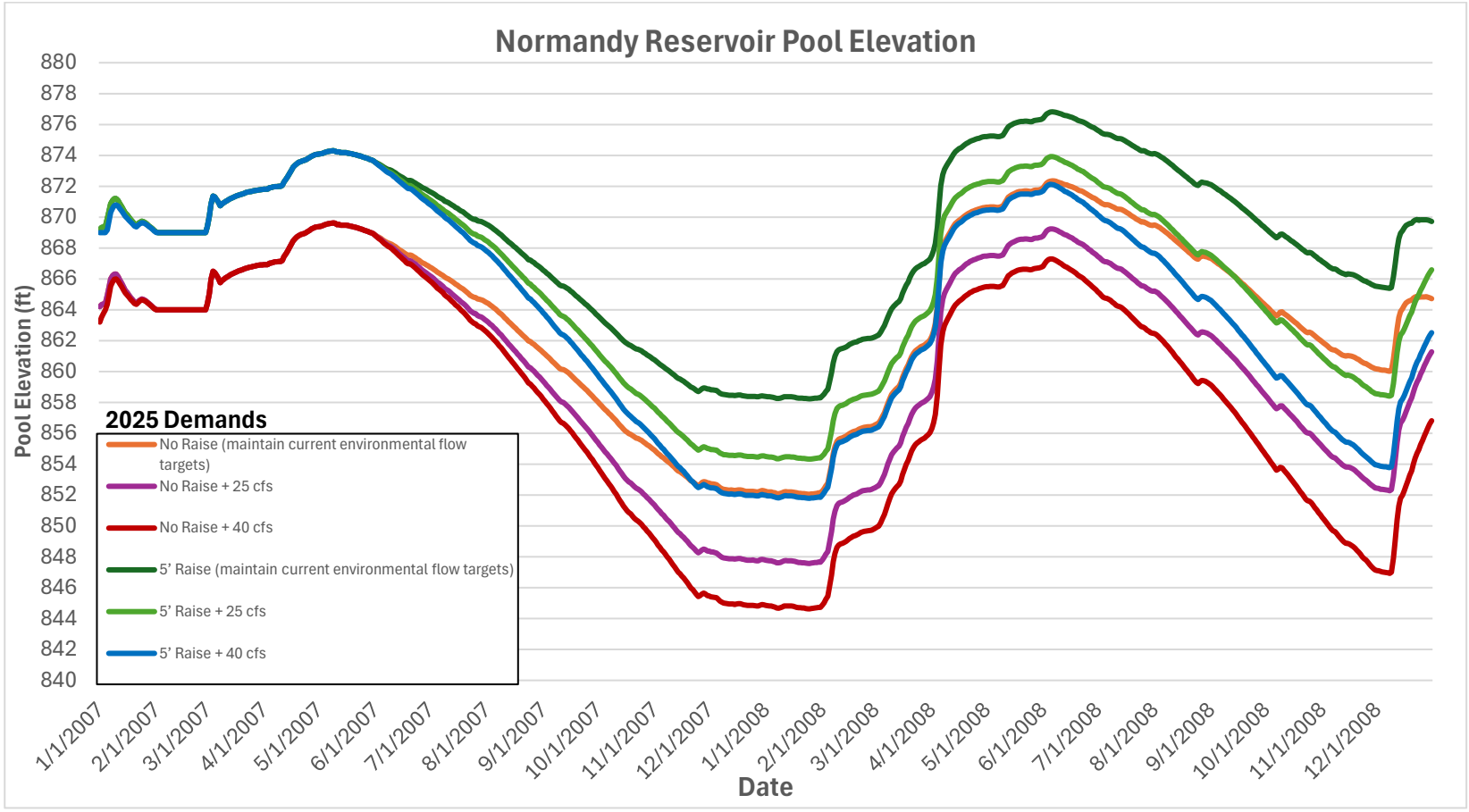


Figure 5: Elevation of Normandy Reservoir Pool Under Various Scenarios (2025 Demands)

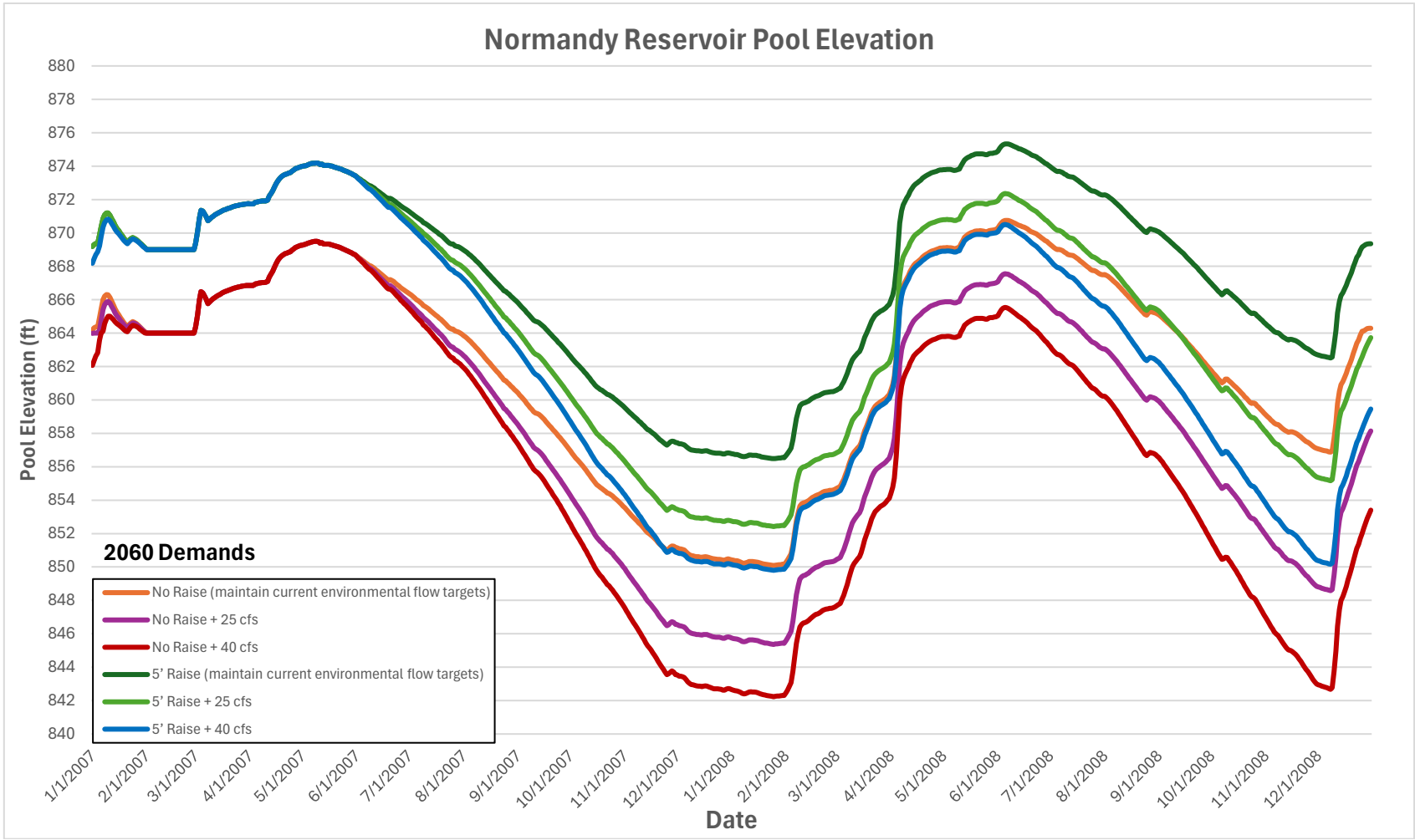


Figure 6: Elevation of Normandy Reservoir Pool Under Various Scenarios (2060 Demands)

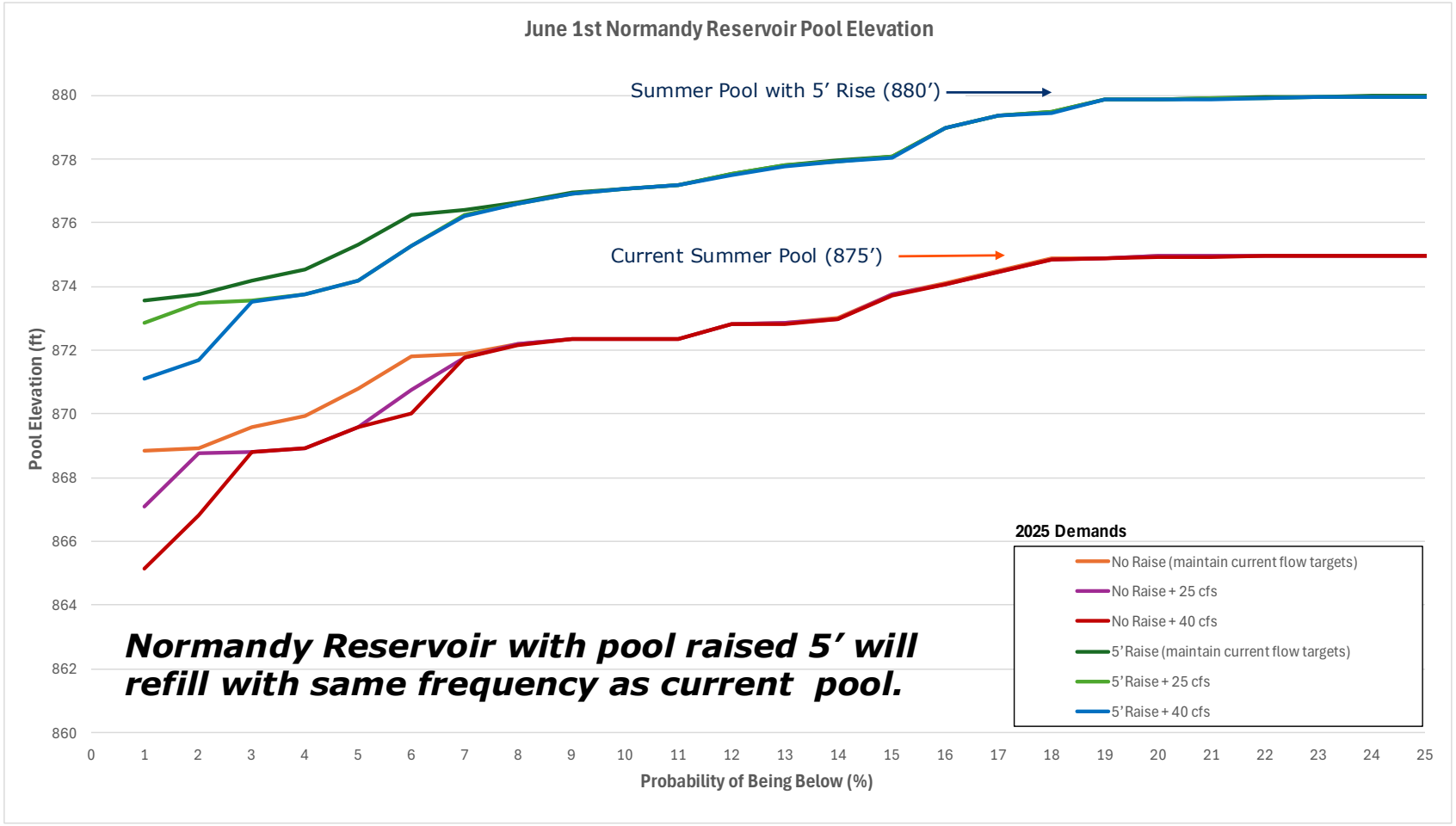


Figure 7: Probability of Being Below Pool Elevations, June 1st

Table 4: Minimum Pool Level in Normandy Reservoir based on Worst Case Drought of 2007-2008

Scenario	2025 Water Demand Conditions			2060 Water Demand Conditions		
	Current downstream flow target of 155 cfs at Shelbyville in Summer	Increase downstream flow target at Shelbyville by 25 cfs (155 cfs to 180 cfs) in Summer	Increase downstream flow target at Shelbyville by 40 cfs (155 cfs to 195 cfs) in Summer	Current downstream flow target of 155 cfs at Shelbyville in Summer	Increase downstream flow target at Shelbyville by 25 cfs (155 cfs to 180 cfs) in Summer	Increase downstream flow target at Shelbyville by 40 cfs (155 cfs to 195 cfs) in Summer
Minimum Pool Level under Current Dam and Pool Conditions (elevation ft)	852	848	845	850	845	842
Minimum Pool Level under a Raised Dam and Pool Levels by 5 ft Condition (elevation ft)	858	854	852	857	853	850
Increase in Minimum Pool Level (ft)	6	6	7	7	8	8

** All modeling results based on "Optimized Releases" (7-day average rather than instantaneous flow requirement)*

3. Structural Elements

In general, the structural elements presented herein are similar to those shown in the 2011 WSP. There are, however, differences due to new water supply and demand considerations, risk-based guidance from TVA, cost considerations, and schedule considerations. The structural elements are not being compared to each other but analyzed as two projects to be completed as part of a larger program to enhance the water supply for the region. This section outlines the criteria used for evaluation, components of each structural element, anticipated impacts, potential costs, and potential schedules.

3.1 Description of Structural Elements

3.1.1 Raise Normandy Dam

Although the 2011 recommendation for raising the dam and Winter Pool by 5 ft remains a viable option for increasing drought resilience, this update also evaluated raising the Summer Pool, to allow for additional releases to address increased water supply demands and increased environmental flows. This option (raising Winter and Summer Pools) would be essentially the same project as identified by TVA in their 2000 PEIS, although for a slightly different purpose.

The project would include the following components:

- Raise the Winter Pool level from 864 ft to 869 ft and raise the Summer Pool from 875 ft to 880 ft.
- Raise the Normandy Dam crest 5 ft from 895 ft to 900 ft (concrete gravity and earth embankment sections) and top of spillway gates from 880 ft to 885 ft.
- Spillway Alternatives
  - Raise spillway crest 5 ft from 840 ft to 845 ft and raise radial gates 5 ft. Raising includes modification to spillway training walls for new radial gate trunnion anchors and new spillway bridge, or

  - Maintain the existing spillway crest at 840 ft and modify the existing gates to include an extension at the tops of the gates
- Stabilization measures for monolith Blocks 3 and 5 (right non-overflow section) may be necessary upon further analysis
- Improvements to the stilling basin and discharge channel
- Karst mitigation measures along reservoir rim, if necessary

Table 5: Current and Proposed Normandy Dam Elevations

Normandy Dam Element	Current Elevation (ft)	Proposed Elevation (ft)
Spillway Crest	840	845
Winter Pool	864	869
Summer Pool	875	880
Top of Spillway Gates	880	885
Typical TVA flood easement 5 ft above top of gates *	885*	890
Top of Dam (Crest)	895	900

**TVA advised it currently owns the property in lieu of flood easements.*

Raising the permanent Summer Pool would have environmental impacts as areas that were previously dry (except during flooding) would be inundated during the Summer Pool period. Assuming the Summer Pool is raised 5 ft, approximately 150 acres would be inundated.

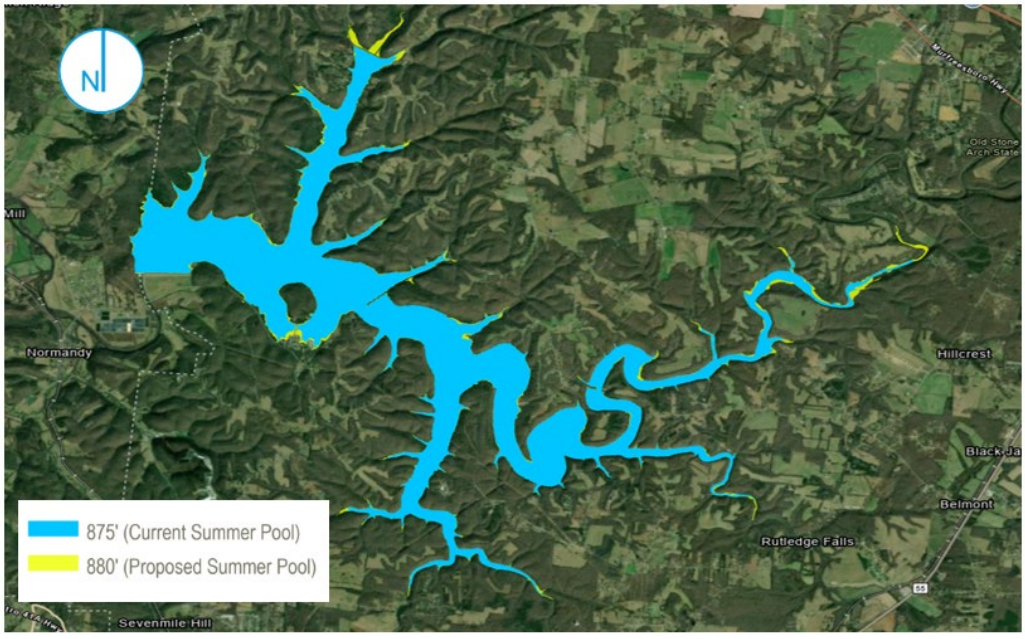


Figure 8: Inundated Area based on 5' Normandy Reservoir Pool Raise

Areas that may be partially inundated by raising the Summer Pool to 880 ft, include:

- Roberts Ridge Fishing Access & Boat Launch
- Normandy Wildlife Management Area
- Firelake Public Use Area
- Hiking trails at Short Springs
- Barton Springs Public Use Area
- Barton Spring Campground
- TVA Normandy Dam Public Use Area
- Several residential properties
- Wetlands

Based on conversations with TVA and as shown in Table 5, flood easements would be required up to 5 ft above the top of the gates. The proposed top of gate elevation is 885 ft; therefore, flood easements would be required up to 890 ft. Based on Geographic Information System (GIS) data and Tennessee property data, TVA would need to obtain flood easements on approximately 120 properties. The breakdown of properties, as identified in Tennessee Property Assessment data, are as follows:

- Residential – 50 parcels
- State – 1 parcel (Short Springs)
- Agricultural – 59 parcels
- Forest – 10 parcels

The total area of flood easements required is approximately 58 acres.

3.1.2 Construct Water Intake near Williamsport and Pipeline to Columbia / Maury County

CPWS has undertaken this structural element as their Long-Term Water Supply Program (LTWSP), also branded as Community H2O. The proposed new intake would be downstream of the City of Columbia's WWTP discharge, in a location of the Duck River without flow constraints. It is expected that river flow at this location would be adequate to meet Maury County's needs for well over 50 years, because most of the water withdrawn by CPWS and Spring Hill would be returned to Duck River (approximately 60%) via the Columbia and Spring Hill wastewater treatment plants, which are upstream of the proposed intake.

The downstream intake project, as designed by CPWS, is generally consistent with the recommendation in the 2011 Comprehensive Regional Water Supply Plan. However, as designed, the intake would be located approximately 11 river miles further downstream than proposed in 2011, to a location where the river has more flow, making for an even longer-term solution. The project components are:

- A 32 MGD raw water intake and pumping station on Duck River near Williamsport.
- A 36-inch raw water pipeline (approximately 17 miles) to convey water to the CPWS's water treatment plant in Columbia.
- An additional 36-inch raw water pipeline (approximately 17 miles) to convey water to CPWS's water treatment plant would be constructed in a later phase, when needed to address drought resilience and demand growth.
- CPWS's LTWSP also includes upgrades to their existing water treatment plant and construction of additional treatment capacity to bring total treatment capacity to 32 MGD. Note that the Normandy Dam structural element addresses raw water supply only. The scope and cost for CPWS's treatment improvements is assumed at this time be about the same, whether the source of raw water is via

increased releases from Normandy Dam or the proposed downstream intake. This report therefore does not assess details associated with water treatment improvements.

- This project has the potential to serve as the "first leg" for future connection to a pipeline from outside Duck River basin. While the location of a future pipeline from outside the basin is currently unknown, the basic infrastructure of the downstream intake project (intake, pumps, pipes and treatment) may be compatible with access to a future additional source of supply.

The project is permitted under the following ARAPs:

- NRS23.228 (Appendix 6-A), which permits CPWS to withdraw water from the Duck River at an instantaneous rate of up to 13,900 gpm to obtain up to 20 MGD for public water supply from an existing intake structure located along the Duck River near River Mile 134 and to construct a new intake downstream along the Duck River near River Mile 100, and to withdraw water from the Duck River at an instantaneous rate of up to 22,222 gpm (32 MGD). The permit allows for a maximum combined withdrawal of 32 MGD, which could be all from the downstream intake near River Mile 100, or split between the two intakes, provided the withdrawal from the existing intake does not exceed 20 MGD.
- NRS23.226 (Appendix 6-E), which permits CPWS to construct its 36-inch pipeline, including twenty-seven stream and wetlands crossings.

Additionally, on August 11, 2025, the Environmental Protection Agency (EPA) announced that the Environmental Assessment and Preliminary Finding of No Significant Impact (FONSI) for the Columbia Power & Water Systems' Long-Term Water Supply Program has been released for a 30-day public review.

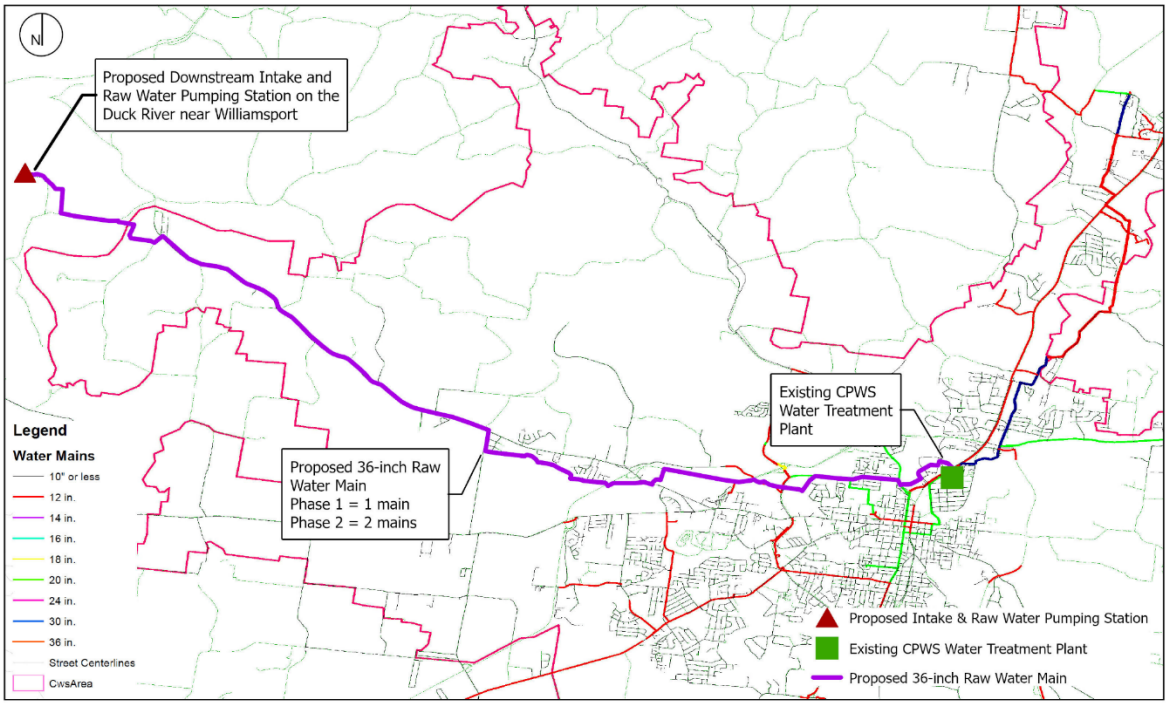


Figure 9: Downstream Intake and Raw Water Main

3.2 Potential Costs

3.2.1 Raise Normandy Dam

Ramboll estimates an order of magnitude (OOM) cost of roughly $100 million to raise Normandy Dam and the radial gates, the Summer Pool and the Winter Pool all by approximately 5 ft. Of this $100 million amount, approximately $70 million is for raising the dam and gates and $30 million is for non-dam related costs, such as relocating roads, raising bridges, and addressing other impacts associated with the higher pool levels as shown in Table 6 below.

Table 6: OOM Cost to Raise Normandy Dam approximately 5 ft

Project Component	Cost
Mobilization/Demobilization	$2M
Temporary Control of Water	$12M
Earthwork & Site Improvements	$9M
Concrete Construction & Demolition	$8M
Post-Tensioned Anchors / Shear Blocks	$6M
Raise Radial Gates, Trunnion Base & Install Anchor Tendons	$5M
New Spillway Bridge	$3M
Construction Subtotal	$45M
Investigations & Engineering	$5M
Design & Construction Contingency (40%)	$20M
Dam Costs	**$70M**
Placeholder for Non-Dam Costs	**$30M**
Total Estimated Project Cost	**$100M**

3.2.2 Construct Water Intake near Williamsport and Pipeline to Columbia / Maury County

CPWS has estimated the cost for the downstream intake, raw water pumping station and Phase 1 raw water pipeline (36-inch diameter), including unexpended engineering and miscellaneous costs, at approximately $250 million. Of this amount, approximately $92 million is for the intake and raw water pumping station, $130 million is for the first 36-inch pipeline and approximately $30 million for unexpended engineering and miscellaneous costs. Ramboll has reviewed CPWS's cost estimate and finds it consistent with our knowledge of the construction market for the type and scope of this project. The second 36-inch raw water pipeline (Phase 2) is assumed to have a similar cost as the Phase 1 pipeline in today's dollars (approximately $132 million). CPWS estimates the cost for upgrades to their existing water treatment plant and construction of additional treatment capacity at approximately $200 million. Note that the costs for raising Normandy Dam include only the raw water costs. The scope and cost for CPWS's treatment improvements is assumed at this time to be about the same, whether the

source of raw water is increased releases from raised Normandy Dam or the proposed downstream intake.

Table 7: OOM to Construct Water Intake near Williamsport and Pump Back to Columbia / Maury County

Project Component	Cost
Phase 1	
Planning, Design, Pre-Construction	$6.0M
Downstream Intake and Raw Water Pump Station	$91.8M
36-inch Raw Water Transmission Main	$129.4M
Engineering Services During Construction	$19.5M
Easements	$3.1M
Permits Fees	$1.0M
Phase 1 Subtotal	**$250M**
Phase 2	
36-inch Raw Water Transmission Main	$130M
Easements	$1.1M
Permits Fees	$1.0M
Phase 2 Subtotal	**$132M**

CPWS has commissioned Raftelis Financial Consulting to develop a financial plan including recommended water billing rates to pay for the debt service and operating costs for these water system improvements. The financial plan and rate recommendations are expected to be available by the end of 2025 and will be shared with CPWS's governing bodies to secure their approvals. CPWS continues to seek available grants and loans to assist with financing.

3.3 Potential Schedules and Schedule Challenges

3.3.1 Raise Normandy Dam

Ramboll estimates it will take approximately 6 years to plan, permit and construct the raising of Normandy Dam, assuming some concurrent activities and property acquisition, as illustrated by Figure 10 below. However, some risks and challenges could prolong this schedule or even block the project. Based in part on discussions between Ramboll and TVA, several potential schedule challenges are described further below.

I. More extensive geotechnical studies and flood risk assessments. (Potential to delay)
   - Normandy Dam is located in a region with karst geology, which can exhibit voids, sinkholes, and caves. While the current Normandy Dam and Reservoir are not known to be impacted by

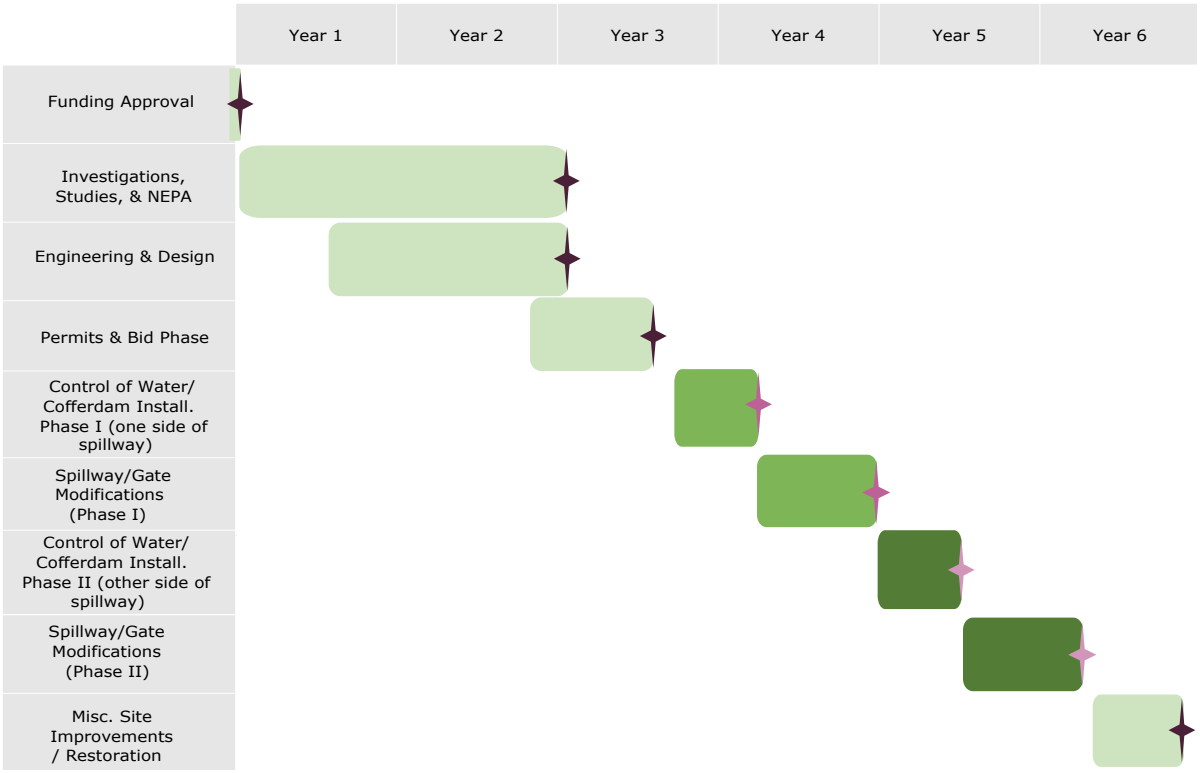
significant leakage, additional geotechnical studies may be needed around the rim/perimeter of the impoundment and possibly more investigations near the dam.
    - TVA will require an assessment of flood risks associated with the project, including temporary risks during construction for flooding downstream of the dam.

II. More extensive environmental studies (Potential to delay)
    - While there are currently no known environmental "blockers," it is possible that initial environmental, cultural, and archaeological studies may indicate the need for more extensive investigations into environmental, cultural, and archaeological resources due to impacts resulting from the larger impoundment area, etc.

III. An adverse determination in the NEPA process (Potential to delay or block)
    - The NEPA process requires a determination that the project represents the least environmentally damaging, practicable alternative to address the needs. It is possible that initial NEPA activities would identify the need for more extensive studies. If the NEPA process ultimately concludes that there is a better alternative than raising Normandy Dam, this project would not receive the required permits from USACE.

IV. Financing and cost escalation that exceeds available funding (Potential to delay or block)
    - The Normandy project will require a financing plan. Ramboll understands that the project is being considered for significant grant funding from the State of Tennessee.
    - It is possible that the project cost could escalate due to the need for sealing karst-related voids, more extensive dam construction, or other unforeseen needs. This could cause delays while additional funding is secured or possibly block the project if adequate funding is not available.

V. A decision by TVA noting unacceptable risks, such as flood risks during construction. (Potential to block)
    - As noted above, TVA will assess risks such as downstream flood risks and evaluate measures to mitigate these risks. One such risk relates to the need to rely on one spillway gate while the other is under construction (i.e., raised or extended). If TVA determines that it cannot adequately mitigate risks, it is possible that TVA would not agree to implement the project.



Schedule assumes embankment and non-overflow gravity section raising constructed concurrently with other tasks and NEA process concurrent with engineering studies and design.

Figure 10: Schedule to Raise Normandy Dam approximately 5 ft

3.3.2 Construct Water Intake near Williamsport and Pipeline to Columbia / Maury County

CPWS advises that engineering for Phase 1 of the Long-Term Water Supply Project is complete, the remaining permits and easements should be secured by the beginning of 2026, and a financing plan is under development. Once permits and financing are in place, CPWS estimates it will then take approximately 3½ years to construct the downstream intake project (intake, raw water pumping station and first 36-inch raw water pipeline), as illustrated on Figure 11. Ramboll has reviewed CPWS's estimated schedule and finds it consistent with our knowledge of the construction market for this type of project. Based on information provided by CPWS, the only known challenge that could significantly delay or block the project is securing financial approvals from CPWS's governing bodies.

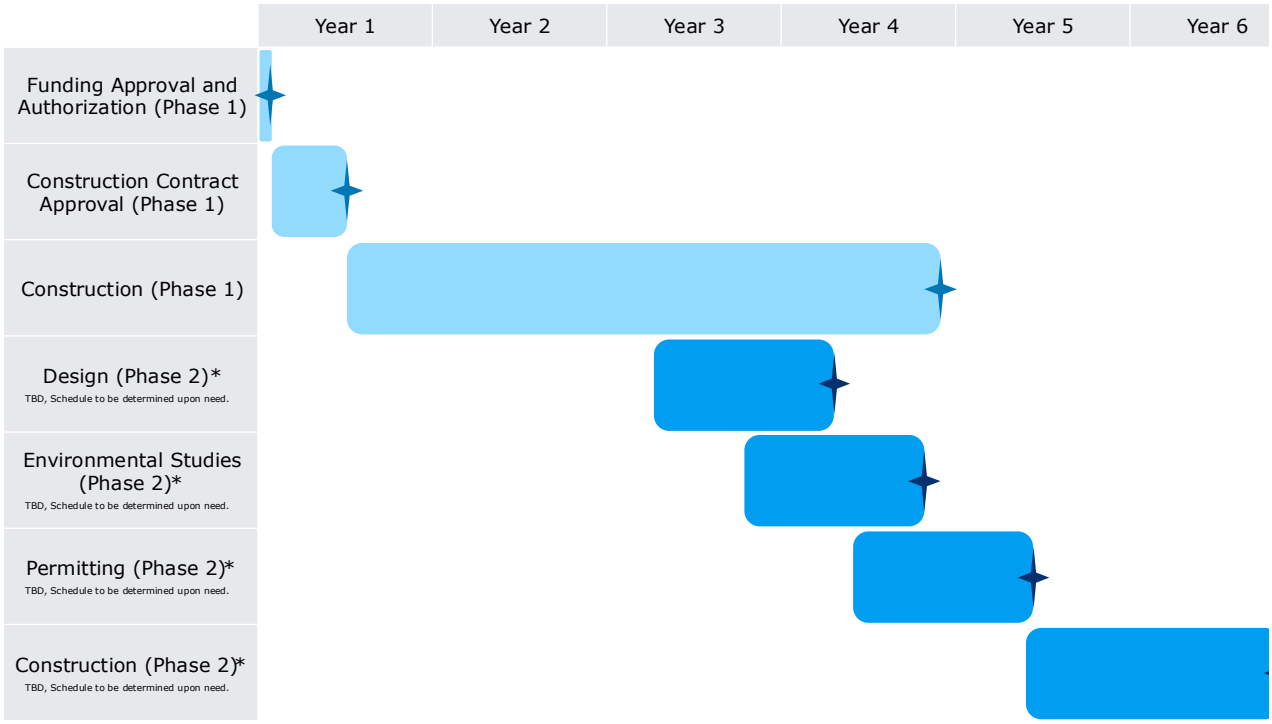


Figure 11: Schedule to Construct Downstream Intake

4. Key Findings and Suggested Strategy

4.1 Summary of Key Findings

The "Update at a Glance' below provides a concise summary of key findings. Please see the Executive Summary for a more detailed summary.

Table 8: Duck River Comprehensive Regional Water Supply Plan Structural Elements "Update at a Glance"

Structural Element	Raise Normandy Dam (increase pool levels and increase flow releases)	Construct water intake near western side of Maury County and pipeline to Columbia area
Description	• Raise Summer/Fall and Winter/Spring Pool levels by ~3-5 ft (TBD). • Increase downstream releases from Normandy Reservoir to meet water supply and environmental needs at Shelbyville, Milltown, and Columbia.	• Construct a 32 mgd raw water intake and pumping station on Duck River near the western side of Maury County and a 36-inch raw water pipeline (approximately 17 miles) to convey water to the existing

Table 8: Duck River Comprehensive Regional Water Supply Plan Structural Elements "Update at a Glance"

Structural Element	Raise Normandy Dam (increase pool levels and increase flow releases)	Construct water intake near western side of Maury County and pipeline to Columbia area
		CPWS water treatment plant (WTP). • Construct an additional, parallel 36-inch raw water pipeline when needed to meet water supply needs through 2060.
Reliable Capacity	• Increased drought resilience (entire region) and flood protection. • Increased releases from Normandy Reservoir to meet the region's growing water supply needs (duration depends on extent of dam raising and environmental flow targets). • Mitigates the impact of cease withdrawal requirements in recent/new ARAP permits.	• Increased drought resilience for Maury County. • Meets long-term water supply needs for Maury County. • Does not address water supply capacity constraints in the Duck River upstream of Columbia. • Redundant intake mitigates impact of low-head dam failure. • Second (future) 36-inch raw water pipeline improves reliability and capacity.
Cost*	• ~$100 million	• ~$250 million for raw water improvements (includes design, engineering services during construction, downstream intake, raw water pump station, 36-inch pipeline, and easements). • ~$130 million (TBD) for the second 36" pipeline.
Schedule	• ~6 years (see challenges)	• ~3.5 years (see challenges)
Challenges and Risks to Schedule or Project	• Higher Summer/Fall Pool level and flow alteration requires additional environmental studies; review of flood easements; potential relocation of campgrounds, boat ramps, and trails; and potential raising of roads and bridges. • Increased flood risk during construction due to one of the two spillway gates being temporarily out-of-service. • Need for geotechnical investigations to assess the need and cost to grout karst	• Design completed, ARAP permit and ~half of needed easements in hand; TVA and USACE permits are expected soon, as well as remaining easements. (Low risk for delays) • Risks to Schedule or Project: • Financial plan under development, requires approval from governing bodies for debt

Table 8: Duck River Comprehensive Regional Water Supply Plan Structural Elements "Update at a Glance"

Structural Element	Raise Normandy Dam (increase pool levels and increase flow releases)	Construct water intake near western side of Maury County and pipeline to Columbia area
	voids that could otherwise cause the reservoir to leak. pipeline <u>Risks to Schedule or Project:</u> i. More extensive geotechnical studies and flood risk assessments by TVA. (Potential to Prolong) ii. A decision by TVA noting unacceptable risks, such as flood risks during construction. (Potential to Block) iii. More extensive environmental studies by TVA. (Potential to Prolong) iv. An adverse determination in the NEPA process. (Potential to Block) v. Cost escalation that exceeds available funding. (Potential to Block)	obligations and rate increases (Potential to Block).
Environmental Benefits and Recreation	• Increased flood protection. • Increased river flows during dry weather; minimum river flows up to 175 cfs at Milltown. • Increased Summer Pool levels.	• Reduces or eliminates withdrawal needed from Columbia Pool but does not address low flows upstream of Columbia. • No significant recreational benefits or impacts identified.

4.1.1

Suggested Strategy

Based on Ramboll's expedited update of the structural elements from the 2011 Comprehensive Regional Water Supply Plan, we suggest the Duck River Development Agency and the Duck River Watershed Planning Partnership consider an overall strategy based on the following foundation:

A. Implement both structural elements: Raise Normandy Dam and construct the Downstream Intake Project, as soon as possible.

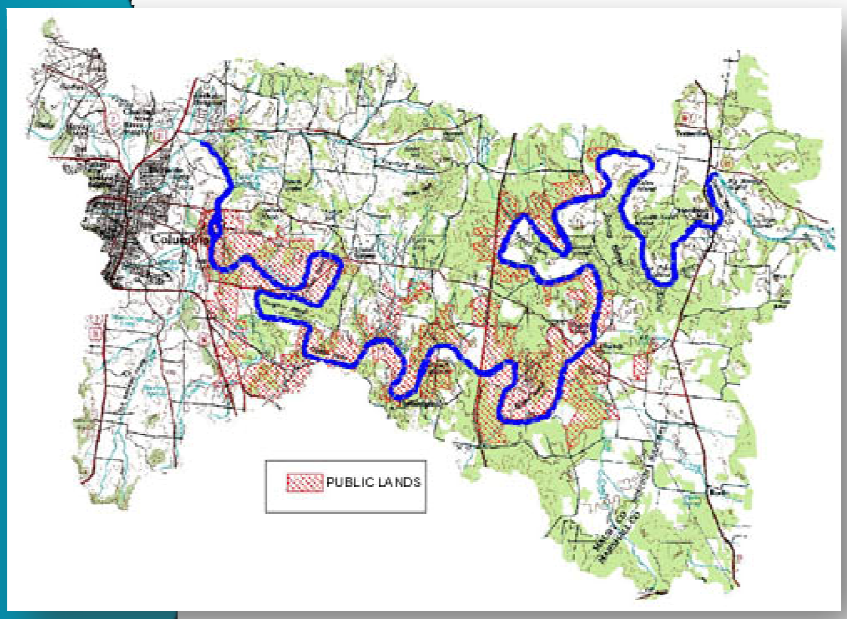
- Neither structural element <u>alone</u> will meet the region's long-term water needs.
  - Raising Normandy Dam would supplement flows upstream of Columbia during dry weather conditions, to support growth and environmental flows in that segment of Duck River.
  - While raising Normandy Dam and pool levels to release more water from the reservoir will also supplement river flows at Columbia, the need for more water supply in Maury County exists now, and sole reliance on Normandy Reservoir would at best delay but not avoid the need for the downstream intake in the future. Further, Ramboll finds that if financing is in place by early 2026, the downstream intake project could resolve the current water shortage in Maury County at least three years sooner than by raising Normandy Dam.

B. Revisit the instantaneous flow constraints in ARAP permits

- Both structural elements are driven by the instantaneous flow target conditions in the TDEC ARAP water withdrawal permits. These permits define the "cease withdrawal" requirement which are based on the Duck River flows at Milltown and Columbia, establishing the magnitude and timing of the water supply and environmental need.
  - In the case of raising Normandy Dam, confirming the need for cease withdrawal conditions in the ARAP constraints will be essential for a successful and timely outcome from the NEPA process.
  - Switching the cease withdrawal conditions in the ARAP permits from instantaneous flow to a weekly average flow will reduce cost, enhance resilience, reduce risk and/or prolong the effectiveness of the Normandy Dam project.

END OF REPORT

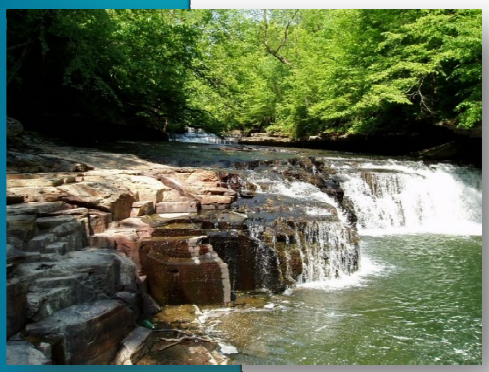
Appendix 1
Duck River Regional Water Data Collection and Demand Projection Analysis

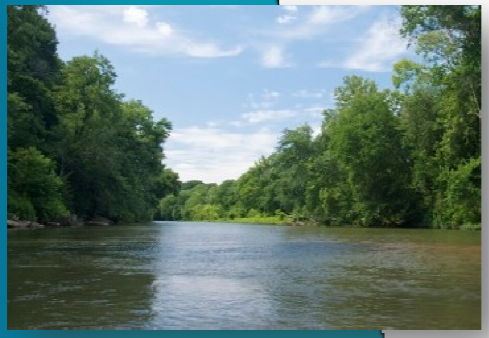


Tennessee Duck River Development Agency

FINAL Regional Water Data Collection and Demand Projection Analysis

September 29, 2016





MADDAUS WATER MANAGEMENT INC.

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LIST OF ACRONYMS

AB	Assembly Bill
ACS	American Community Survey
AF	acre-foot/acre-feet
AFY	acre-foot/acre-feet per year
AMI	Automated Meter Infrastructure
AWWA	American Water Works Association
AWWARF	American Water Works Association Research Foundation
BCUD	Bedford County Utility District
BLS	Bureau of Labor Statistics
BMP	Best Management Practice
CBER-UT	University of Tennessee's Center of Business and Economics Research
CEC	California Energy Commission
CII	Commercial, Industrial, and Institutional
CPI	Consumer Price Index
CPWS	Columbia Power and Water Systems
CUWCC	California Urban Water Conservation Council
DMP	Drought Management Plan
DRA	Duck River Development Agency
DRATAC	Tennessee Duck River Development Agency Technical Advisory Committee
DSS	Decision Support System
EPA	Environmental Protection Agency
FY	Fiscal Year
gpd	gallons per day
gpf	gallons per flush
gpm	gallons per minute
HE	High Efficiency
HEU	High Efficiency Urinal
ILI	Infrastructure Leakage Index
IRR	Irrigation
LWW	Lewisburg Water and Wastewater
MF	multifamily
MG	million gallons
MGD	million gallons per day
MMDD	Master Measure Design Database
MWM	Maddaus Water Management, Inc.
MWSD	Manchester Water and Sewer Department
ND	new development
NRW	non-revenue water
O&M	operations and maintenance
OBG	O'Brien and Gere
PV	present value
PWSS	Public Water System Statistics
SF	single family
SHWS	Spring Hill Water System
SMSWP	Sonoma-Marin Saving Water Partnership
SPWSS	Shelbyville Power, Water, and Sewerage System
TAC	Tennessee Advisory Commission
TUB	Tullahoma Utilities Board
UHET	Ultra-High Efficiency Toilet
ULFT	Ultra-Low Flow Toilet
WF	Water Factor
WSP	Water Supply Plan

EXECUTIVE SUMMARY

The purpose of the Executive Summary is to briefly describe the findings from the Tennessee Duck River Development Agency's (Duck River or DRA) Regional Water Data Collection and Demand Projection Analysis Report (Report). A more detailed discussion of the evaluation process and assumptions used to develop this Report and ideas for future implementation are included in the main body of the report.

Overview

Growing concerns regarding the reliability of increasing demand for quality water due to regional growth, uncertain climate change impacts, and new regulatory requirements are all driving the need for increased water-use efficiency in all water-use sectors. These long-term trends will continue to challenge the efforts of Tennessee water agencies to supply increasing water demands. The purpose of the Demand Projection Analysis Report is to update the projected demands for the seven Water Systems represented by the DRA, including Bedford County Utility District (BCUD), Columbia Power and Water Systems (CPWS), Lewisburg Water and Wastewater (LWW), Manchester Water and Sewer Department (MWSD), Shelbyville Power, Water, and Sewerage System (SPWSS), Spring Hill Water System (SHWS), and Tullahoma Utilities Board (TUB).

For the water demand projections (2015 through 2050) in this study, Maddaus Water Management Inc.'s Demand Side Management Least Cost Planning Decision Support System (DSS) Model was used to forecast water demand for each Water System. The initial phase of this effort included a data collection process using a Data Collection File (Data Workbook) that each Water System completed and/or verified.

Demographic Data and Historical Water Demand

Each Water System's future population and employment projection rates were incorporated into each DSS Model to project future water demand through the year 2050. Population projections were obtained from the June 2009 joint publication of the *Population Projections for the State of Tennessee, 2010-2030* by the Tennessee Advisory Commission (TAC) on Intergovernmental Relations and the University of Tennessee's Center of Business and Economics Research (CBER-UT). Employment projection rates were based on historical County employment rates from 2010-2015 and applied as relevant to each Water System. The actual number of jobs was neither provided nor determined for the Water Systems; rather 2010-2015 average employment growth was applied to each Water System's commercial and industrial account growth through year 2050.

The historical water use patterns were analyzed based on water production and consumption data provided by each Duck River Water System. When available, 15 years of monthly water consumption and production were analyzed (years 2000 to 2015) and for most Water Systems a baseline range of 2010-2015 was used to derive an average per type of account per day water use.

A different approach for developing water demands was used by DRA's engineering consultants O'Brien and Gere (OBG) in their 2011 regional water supply planning study and more specifically in their 2013 Regional Drought Management Plan. The OBG water demand projections were developed in year 2009 and used year 2000 data as a baseline to establish a gross per capita demand which was held constant through the planning period. In summary, the projected 2050 water demand for the seven water systems based on MWM and OBG analyses was approximately 41 MGD and 48

MGD, respectively. A comparison of the water demands published in the Maddaus Water Management's report (2016) to the water demands published in the OBG 2013 analysis is presented in Appendix D.

Demand Projections

Each Water System's water demand is forecasted through 2050 using the DSS Model. The demand analysis process includes forecasting future water demand (2015-2050) by customer category based upon forecasted increases in population and employment. Average water use per customer category account is based on an analysis of historical data between 2000 and 2015 historical range (or a shorter period if a Water System's historical data was incomplete). To forecast water demands, the DSS Model relies on demographic and employment projections, combined with the effects of natural fixture replacement due to the implementation of plumbing codes. Natural fixture replacement due to the implementation of plumbing codes is part of passive conservation savings. Passive conservation refers to water savings resulting from actions and activities that do not depend on direct financial assistance or educational programs from Water Systems. Information and assumptions about plumbing codes and appliance standards can be found in Appendix A. Projected water demands for each Water System can be found in Appendix B.

The following tables and figure present each Water System's average day water demands with and without plumbing code savings. By 2050, water demands are projected to increase 73% without the plumbing code and 52% with the code. The plumbing codes are projected to save an overall 5 MGD or over 12% without the codes by 2050. Savings of this magnitude could produce large benefits in terms of deferred capital and operation expenditures.

Table ES-1. Average Day Water Demands WITHOUT Plumbing Code Savings (MGD)

Water System	2015	2020	2025	2030	2035	2040	2045	2050
Coffee County								
Tullahoma Utilities Board	3.08	3.39	3.73	4.12	4.55	5.03	5.57	6.18
Manchester Water and Sewer Department	2.46	2.68	2.90	3.15	3.43	3.73	4.07	4.45
Bedford County								
Shelbyville Power, Water, and Sewerage System	3.85	4.18	4.52	4.89	5.19	5.51	5.85	6.22
Bedford County Utility District	1.80	1.94	2.07	2.21	2.31	2.40	2.50	2.60
Marshall County								
Lewisburg Water and Wastewater	2.47	2.64	2.90	3.17	3.40	3.64	3.90	4.20
Maury/Southern Williamson County								
Spring Hill Water System	2.66	3.03	3.41	3.84	4.08	4.31	4.55	4.79
Columbia Power and Water Systems	7.54	8.22	8.91	9.63	10.35	11.10	11.88	12.74
Total DRA Demand WITHOUT Plumbing Code Savings	**23.86**	**26.08**	**28.44**	**31.01**	**33.31**	**35.72**	**38.32**	**41.18**

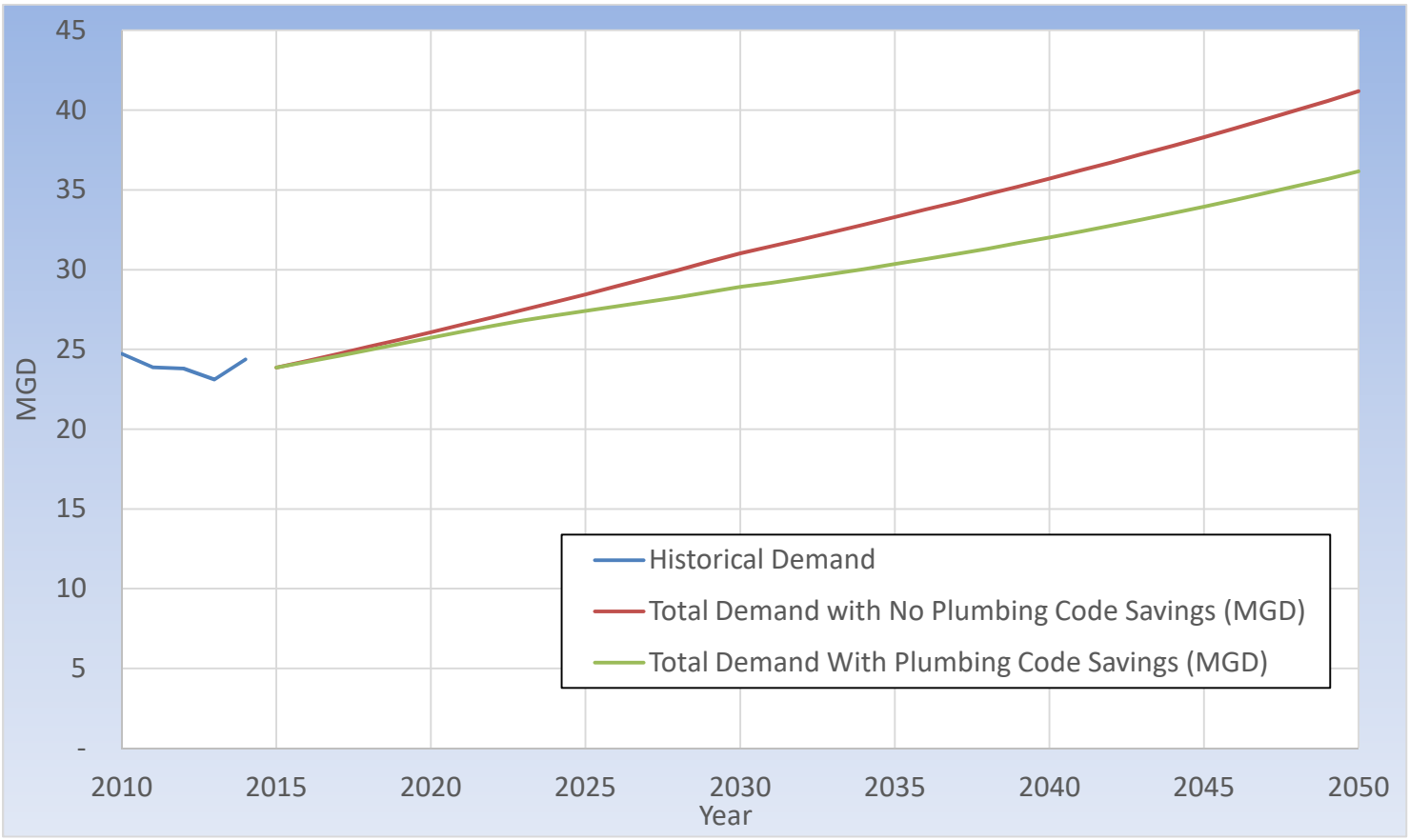
Note: Demands based on surface water supply deliveries from public water systems. Demands do not include historical, current, or future private well use by customers. Demands do not include conversion of existing private well-users to the public water system.

Table ES-2. Average Day Water Demands WITH Plumbing Code Savings (MGD)

Water System	2015	2020	2025	2030	2035	2040	2045	2050
Coffee County								
TUB	3.08	3.33	3.57	3.82	4.12	4.49	4.92	5.43
Manchester Water and Sewer Department	2.46	2.64	2.81	2.98	3.18	3.41	3.68	3.99
Bedford County								
Shelbyville Power, Water, and Sewerage System	3.85	4.13	4.39	4.60	4.80	5.02	5.28	5.57
Bedford County Utility District	1.80	1.91	1.98	1.99	1.99	2.01	2.03	2.07
Marshall County								
Lewisburg Water and Wastewater	2.47	2.59	2.76	2.93	3.06	3.21	3.39	3.61
Maury/Southern Williamson County								
Spring Hill Water System	2.66	3.01	3.30	3.56	3.68	3.82	3.97	4.14
Columbia Power and Water Systems	7.54	8.12	8.60	9.04	9.52	10.07	10.67	11.35
Total DRA Demand WITH Plumbing Code Savings	**23.86**	**25.73**	**27.41**	**28.92**	**30.35**	**32.03**	**33.94**	**36.16**

Note: Demands based on surface water supply deliveries from public water systems. Demands do not include historical, current, or future private well use by customers. Demands do not include conversion of existing private well-users to the public water system.

Figure ES-1. Regional Average Day Water Demands (MGD)



Note: Total Demand accounts for the total projected water demand in a service area Water System regardless of source. Source can be from surface water or groundwater.

Conclusions

The service areas for the Tennessee Duck River Development Agency's seven Water Systems have a relatively high portion of residential water use and moderate total forecasted growth. Consequently, residential indoor plumbing codes are projected to produce significant water savings. Since the service areas do not use a significant amount of water outdoors and are not as heavy in manufacturing, the water-reduction potential for outdoor water-use efficiency measures and the commercial sector is lower than that of indoor water use. The amount of new growth forecasted for some of the service areas is high, indicating that measures directed at new development have the potential to produce large savings. It is recommended that a water-use efficiency analysis be conducted for the region, particularly to address the high non-revenue water use in many of the Water Systems. Water loss management is critical, as is identifying and tracking any deliberate and necessary non-revenue water uses. See Section 6 Conclusions/Next Steps for additional detail on actions that the Water Systems can take.

1. INTRODUCTION

This section describes the purpose and scope of the Regional Water Data Collection and Demand Projection Analysis Report (Report), provides an overview of the Tennessee Duck River Development Agency Water Systems, presents background information on the demand modeling approach, and provides a project history of the steps used to complete the Report.

1.1 Project Background and Purpose

The DRA recognizes that water-use efficiency is a necessary part of any overall water supply strategy. Significant water savings is potentially achievable by providing customers with the tools and education they need to use water efficiently.

This report is part of a two-phased project (Project) with the ultimate goal being to develop a regional water-use efficiency program. This first phase includes the collection and analysis of key water use data to create the demand projections needed to prepare a regional water-use efficiency program in a subsequent project phase. DRA's objective in this first phase is to collect and analyze historical water use and other data from the Tennessee Duck River Development Agency Technical Advisory Committee (DRATAC) using a consistent approach. The purpose of the DRATAC, which is made up of the seven Water Systems, is to provide advice and guidance to the DRA concerning water projects and other activities it may pursue to fulfill its mission.

Key components of the DRA two-phased Project include:

- Coordination and buy-in from DRA and DRATAC;
- Working with DRA, who is leading the Project and directing specific activities;
- Conducting two workshops with DRA staff to first explain the type of data needed and the program analysis and verification and second to present the results in the form of a water use profile for each Water System;
- Data compilation in Excel workbooks, one per Water System and one for the region;
- Analysis of data in Decision Support System (DSS) Models for demand forecasts to the year 2050;
- Conducting workshops with DRA staff to discuss preliminary and final demand projections; and
- Documentation of the work in a report.

1.2 Overview of Duck River Agency's Water Systems

The Tennessee General Assembly created the DRA in 1965 as a comprehensive regional development agency. Its broad powers include the "control and development of the water resources" of those portions of the Duck River Watershed in Bedford, Coffee, Hickman, Marshall, and Maury Counties. Any county or municipality in the Duck River Basin, any governmental entity from which flows any tributary stream of the river, or any county adjoining the river basin may become a sponsoring and participating entity. In 1998, the DRA Board of Directors adopted the following mission statement:

> "To develop, protect, and sustain a clean and dependable water resource for all citizens of the Duck River region."

The DRA represents seven water utilities that serve approximately 250,000 people as well as industries that include car manufacturers, food processing plants, and other businesses utilizing water for production. In addition to these uses, the

river provides a wide range of other values, including recreation, an excellent fishery, and one of the most biologically-rich freshwater habitats in North America.

The DRA represents the following seven water utilities:

- Bedford County Utility District (BCUD)
- Columbia Power and Water Systems (CPWS)
- Lewisburg Water and Wastewater (LWW)
- Manchester Water and Sewer Department (MWSD)
- Shelbyville Power, Water, and Sewerage System (SPWSS)
- Spring Hill Water System (SHWS)
- Tullahoma Utilities Board (TUB)

Figure 1-1 shows the location of the Duck River watershed as well as the areas studied for the 2011 Comprehensive Regional Water Supply Plan developed by OBG for the DRA.

The drought of 2007 highlighted the issue that in extended dry weather conditions the citizens of the Duck River Region primarily depend on the water stored in Normandy Reservoir to meet multiple uses, including drinking water, wastewater dilution, recreation, and natural resource protection. The dramatic decrease in rainfall, combined with the multiple uses of the reservoir and the river, caused record low-water levels in Normandy Reservoir that resulted in temporary operational changes in downstream water releases to protect all water uses. Weather patterns and growth projections were drivers in development of a comprehensive regional water supply plan for the Duck River Region.

This region typically experiences 50 inches of rain per year allowing for an abundance of water in the river from this amount of precipitation. If the watershed only receives 30-40 inches of rain per year, then the Water Systems experience issues similar to those exhibited during the 2007-2008 drought. In year 2015, the total average daily water use from the Duck River for the seven DRA Water Systems was approximately 24 MGD.

1.3 Modeling Demands using the DSS Model

Maddaus Water Management Inc.'s Demand Side Management Least Cost Planning Decision Support System Model (DSS Model) can be used to prepare long-range, water demand and water-use efficiency water savings projections. First developed in 1999 and continuously updated, the DSS Model is an end-use model that breaks down total water production (i.e., water demand in the service area) into specific water end uses (e.g., toilets, faucets, irrigation, etc.). This "bottom-up" approach allows for detailed criteria to be considered when estimating future demands, such as the effects of natural fixture replacement, plumbing codes, and water-use efficiency efforts. The purpose of using end-use data is to enable a more accurate assessment of the impact of plumbing codes and water efficiency programs on demand and to provide a rigorous and defensible modeling approach necessary for projects subject to regulatory or environmental review.

Figure 1-1. Duck River Watershed and Water Supply Plan Study Areas



Source: O'Brien & Gere Engineers, Inc. *Duck River Comprehensive Regional Water Supply Plan*, Prepared for Tennessee Duck River Development Agency (March 25, 2011).

The DSS Model can be used to prepare short- and long-range, detailed water demand projections and water-use efficiency savings projections to enable a more accurate assessment of the impact of water-use efficiency programs on water demand. The DSS Model can use one of the following:

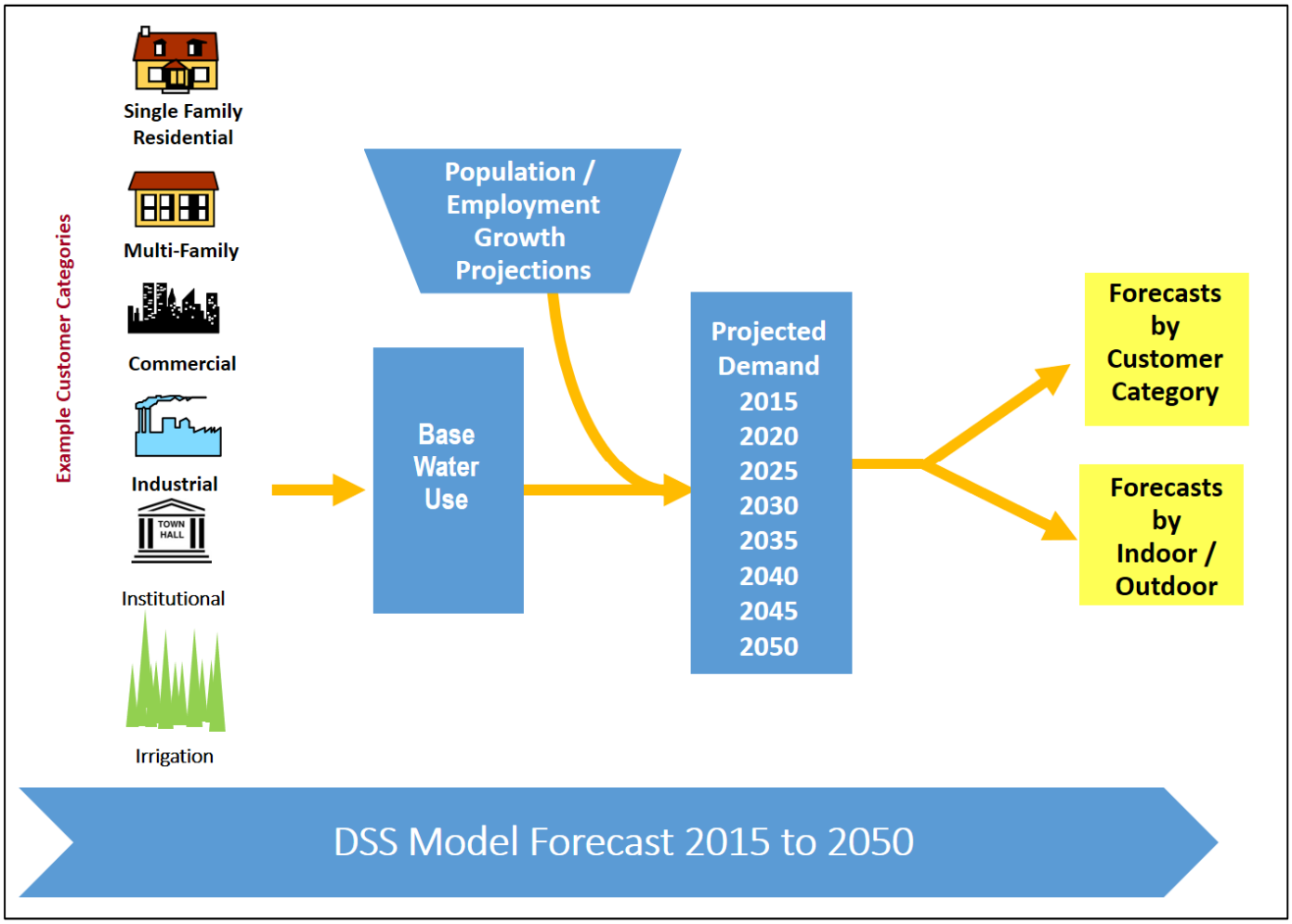
- A statistical approach to forecast demands (e.g., an econometric model)
- A forecasted increase in population and employment
- Predicted future demands
- A demand projection which is input into the model from an outside source

For Duck River Agency's Water Systems, the water demand projection was based on a forecasted increase in population and employment. Forecasted population was developed by the University of Tennessee Center of Business and Economics Research (CBER-UT) through year 2030 and was used in this project. More background information about the DSS Model can be found in Appendix A.

For the water demand projections (2015 through 2050), the DSS Model was used to forecast water demand for each Water System. The DSS Model also includes a water-use efficiency component that quantifies savings from passive water-use efficiency (e.g., plumbing codes) and active water-use efficiency programs. Quantification of savings potential from active water-use efficiency programs was not conducted in this phase of the Project.

This Report presents the DSS Model's demand estimates taking into account savings only from passive water-use efficiency. Passive water-use efficiency or "passive conservation" refers to water savings resulting from customer actions and activities that do not depend on direct assistance from Water System water-use efficiency programs. This includes water savings resulting from 1) the natural replacement of existing plumbing fixtures with water-efficient models required under current plumbing code standards, and 2) the installation of water-efficient fixtures in new buildings and retrofits as required under federal building code standards.

Figure 1-2. DSS Model Flow Diagram



As shown in the Figure 1-2, the first step in forecasting water demands using the DSS Model is to gather customer category billing data from each Water System. The next step is to check the model by comparing water use data with available demographic data to characterize water usage for each customer category (single family, multifamily, commercial, industrial, and institutional) in terms of number of users per account and per capita water use. During the DSS Model calibration process, data was further analyzed to approximate the indoor/outdoor split by customer category. The indoor/outdoor water usage was also further divided into typical end uses for each customer category. Published data on average per capita indoor water use and average per capita end use was combined with the number of water users to verify that the volume of water allocated to specific end uses in each customer category is consistent with social norms from end-use studies on water use behavior (e.g., flushes per person per day).

1.4 Report Development

Working with the DRA staff, the Report was prepared by Maddaus Water Management, Inc. (MWM). The Report development included review of past documentation and previously performed data analyses. The Duck River Water Systems provided data per a list of MWM-requested parameters. The information requested and received includes the following:

- Prior year production data on a monthly or quarterly basis for the different sources of water
- Prior year water use data on a monthly or quarterly basis for the different classes of water users
- Historical and projected Water System service area population and employment through the year 2050, or other suitable end year along with maps of the Water System, political jurisdiction boundaries, and study area(s)

1.4.1 Water System Input and Review

As part of the Project's collaborative approach, the draft report was provided to the Water Systems on July 18, 2016. An instructional webinar conference call was held with the Water Systems on July 26, 2016 to facilitate DRA Water Systems' understanding of and involvement in the development of the water demand projections. During the webinar, MWM reviewed the methodology using a real example with preliminary results from one of the DRA Water Systems. The goals of the webinar were: 1) to review the demand modeling approach and results, and 2) to answer Water System questions. The DRA staff and the Water Systems had the opportunity to review the draft water demand modeling results and to provide questions and comments to the MWM Project Team. MWM had multiple calls and emails with DRA staff to discuss the data submitted from the Water Systems and preliminary water demand results.

1.4.2 Report Content

The following information is included in this report and is discussed in individual sections below:

- Section 2 – Data Collection and Verification Process
- Section 3 – Demographic Data
- Section 4 – Analysis of Historical Water Demand
- Section 5 – Water Demand Projections
- Section 6 – Conclusions/Next Steps
- Section 7 – References
- Section 8 – List of Contacts
- Appendix A – DSS Model Overview and Key Assumptions
- Appendix B – Water System Specific Information
- Appendix C – Department of Water Resources Public Water System Statistics Report Sample
- Appendix D – Published Demands Methodology Comparison

2. DATA COLLECTION AND VERIFICATION PROCESS

This section presents an overview of the long-term water demand evaluation process, including the initial data collection steps.

2.1 Data Collection Process

The initial phase of this effort included a data collection process using a Data Collection and Verification File (Data Workbook). The quantitative Data Workbook was developed by MWM in Microsoft Excel to collect, organize, and verify the necessary input data for the DSS Model. The data required for the water demand projections was organized into the Data Workbooks (one per Water System). Each Water System was asked to input the requested information in the Data Workbook.

The Data Workbook was completed and verified by the Water Systems through the following steps:

1. **Distribution of Data Workbooks to Individual Water Systems**: The files were distributed to the individual Water Systems in July 2015 via e-mail.
2. **Data Workbook Completion by Water Systems**: Each Water System reviewed and completed their individual Data Workbook, which required data entry of missing production and consumption information as well as other data elements.
3. **Data Workbook Submission by Water Systems**: After completing Step 2, Water Systems submitted the files via e-mail from September 2015 through June 2016.
4. **Data Workbook Review and Refinement**: The Project Team reviewed the individual data workbooks in the order submitted. If further data and refinement were required, DRA staff contacted the individual Water System to obtain the necessary information.

2.2 Types of Data Collected

The data needs of the DSS Model drove the data collection effort. The individual data elements within each category are documented in the following table. Data such as water rates and total employment (jobs) were collected to evaluate the historical growth and future growth in the service area. The service area data was used for the demand forecasting tools in the DSS Model.

Service area demographic data, such as the number of dwelling units, was collected from the 2010 U.S. Census data and 2011-2013 American Community Survey (ACS) 3-Year Estimates or 2010-2014 ACS 5-Year Estimates, as available. Population sources include the June 2009 joint publication of the *Population Projections for the State of Tennessee, 2010-2030* by the Tennessee Advisory Commission on Intergovernmental Relations and the University of Tennessee's Center of Business and Economics Research (CBER-UT) projections and other Water System provided projections. County employment sources include the Bureau of Labor Statistics (BLS) of the U.S. Department of Labor (US Dept. of Labor, 2016). The service area demographics were used for future water demand forecasting.

Table 2-1. Data Collected for Water Systems

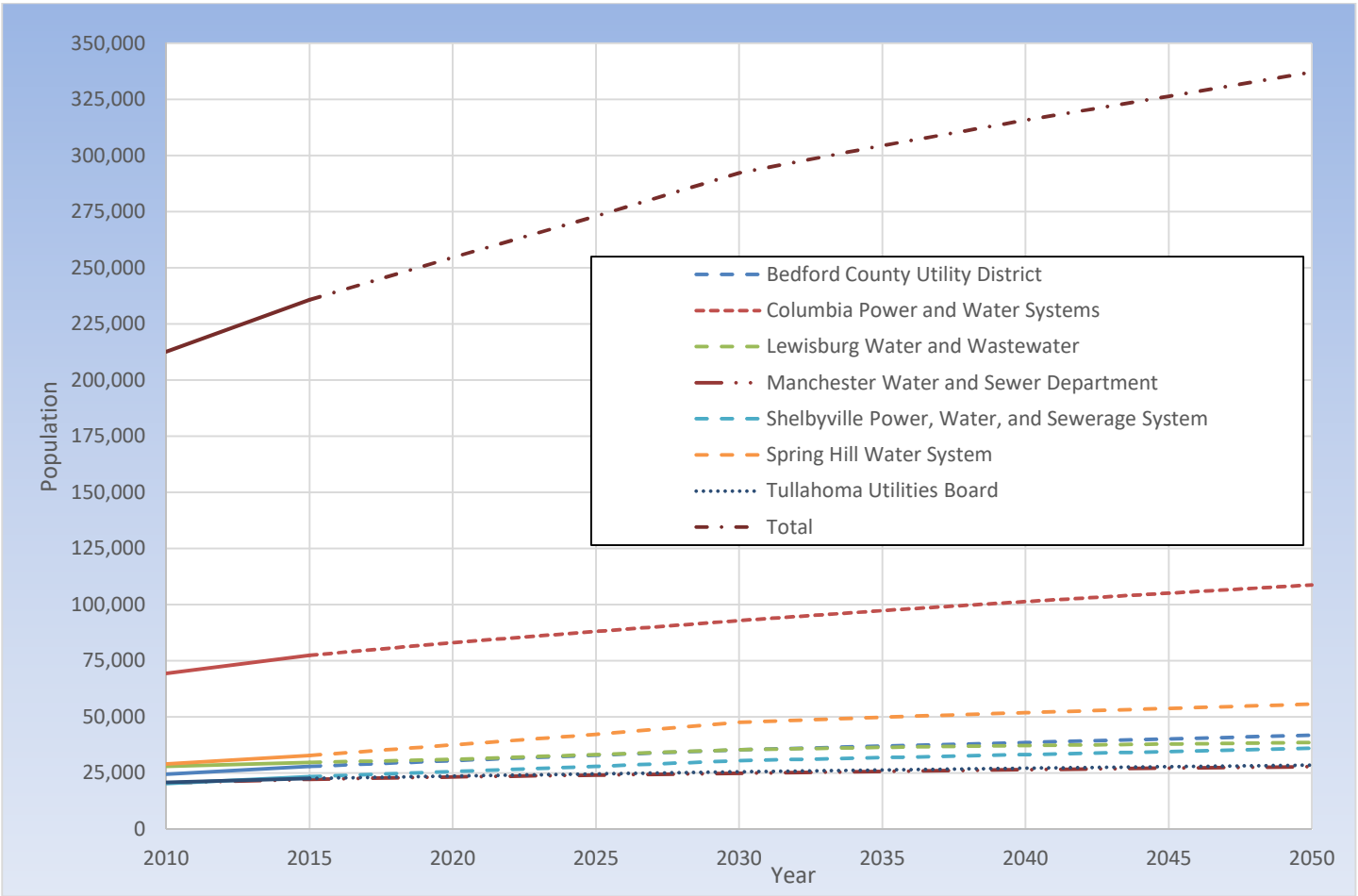
Model Input Parameter	Time Period	Units	Source(s)
Service Area Data			
Water System Info	Current	NA	Water System Provided
Contact Info	Current	Name, number, email	Water System Provided
Planning Documents	Varies	NA	Water System Provided
Abnormal Years	Varies	Years	Water System Provided
Customer Classes	Varies	NA	Water System Provided
System Input Volume (Water Production)	2000-2015 as available	Volume	Water System Provided
Consumption and Accounts	2000-2015 as available	Volume	Water System Provided
Maximum Day Demand	Varies	Date & Volume	Water System provided
Water System Audits	2010 to 2014 if available	NA	Water System Provided American Water Works Association (AWWA) Methodology
Service Area Demographics			
Historical Service Area Population	2000-2015	People	CBER-UT Water System Provided
Projected Population	2016-2050	People	CBER-UT Water System Provided
DP-1 General Profile and Housing Characteristics	2010	Various units	2010 US Census
DP04 Selected Housing Characteristics	2010 or average 2010-2014	Various units	2010 US Census 2013/2014 ACS 3-yr or 5-yr
B25033 Population in Housing Units	2010 or average 2010-2014	Dwelling units	2010 US Census 2013/2014 ACS 3-yr or 5-yr
Economy			
Historical Service Area Employment	2001-2015	County Jobs	Bureau of Labor Statistics
Projected Jobs	2016-2050	County Job Growth Rate (based on 2010-2015 County Jobs)	Bureau of Labor Statistics

3. DEMOGRAPHIC DATA

Each Water System's future population and employment (job) projections were incorporated into each DSS Model to project future water demand. Population and employment projections were provided or confirmed by each Water System through the data collection process described in the previous section. These growth projections were used to develop a projected water demand through the year 2050. Population projections were obtained through year 2030 from the June 2009 joint publication of the *Population Projections for the State of Tennessee, 2010-2030* by the Tennessee Advisory Commission (TAC) on Intergovernmental Relations and the University of Tennessee's Center of Business and Economics Research (CBER-UT). Population projections through 2050 were derived using CBER-UT's projections by county and applied as relevant to the individual Water Systems. Employment projections were based on historical County employment rates from 2010-2015 and applied as relevant to each Water System. The actual number of jobs was neither provided nor determined for the Water Systems; rather 2010-2015 average employment growth was applied to each Water System's commercial and industrial account growth through year 2050. Historical county employment was provided by the Bureau of Labor Statistics (BLS) of the U.S. Department of Labor (US Dept. of Labor, 2016).

Population and employment rate estimates used in this effort were aligned as closely as possible with Water System projections to be consistent with the Water System's planning projections. Historical and projected population for all seven Duck River Water Systems is shown in the following figure. Individual figures and tables presenting each Water System's historical and projected population and employment rate values can be found in Appendix B.

Figure 3-1. Total Historical and Projected Regional Population – DRA



Notes:

1. 2010-2030 population is taken from the June 2009 *Population Projections for the State of Tennessee, 2010-2030* by the TAC on Intergovernmental Relations and the CBER-UT. Population projections from 2035 through 2050 were derived using CBER-UT's projections by county and applied as relevant to the individual Water Systems. Population represents those served by the public water system; no population that is solely self-served by wells is included.
2. Some Water Systems serve a portion of their population by wholesale water sales or accounts and not directly by residential accounts, often through an intermediary water purveyor. This applies to the following Water Systems who have a wholesale or bulk water sale customer account category: CPWS, LWW, and MWSD.

Table 3-1. Regional Historical and Projected Population – DRA[1]

Year	Bedford County Utility District	Columbia Power and Water Systems	Lewisburg Water and Wastewater	Manchester Water & Sewer Department	Shelbyville Power, Water, and Sewerage System	Spring Hill Water System	Tullahoma Utilities Board	Total
Communities Served[2]	Bedford County outside Shelbyville incl. Unionville and Wheel	Columbia City Wholesale to unincorporated Maury County, Mt. Pleasant, and Spring Hill (partial)	Lewisburg, Cornersville, Chapel Hill, Belfast, and Petersburg	Manchester City Wholesale to Hillsville Utility District	City of Shelbyville only	Spring Hill (partial)	Tullahoma City Wholesale to Bell Buckle	N/A
% Population Served by Wholesale[3]	N/A	48%	61%	38%	N/A	N/A	N/A	N/A
2010	24,384	69,388	27,999	20,536	20,322	29,036	20,888	212,553
2015[3]	27,897	77,364	29,735	22,139	23,330	32,807	22,518	235,790
2020	30,451	83,015	31,009	23,217	25,661	37,479	23,655	254,487
2025	32,857	87,987	33,196	24,069	28,009	42,247	24,576	272,941
2030	35,387	92,918	35,376	24,901	30,481	47,565	25,581	292,209
2035	36,996	97,332	36,368	25,695	31,867	49,824	26,385	304,467
2040	38,559	101,341	37,181	26,406	33,213	51,876	27,103	315,679
2045	40,125	105,056	37,872	27,079	34,563	53,778	27,781	326,254
2050	41,786	108,759	38,563	27,779	35,993	55,674	28,486	337,040

[1] 2010-2030 population is taken from the June 2009 *Population Projections for the State of Tennessee, 2010-2030* by the TAC on Intergovernmental Relations and the CBER-UT. Population projections from 2035 through 2050 were derived using CBER-UT's projections by county and applied as relevant to the individual Water Systems. Population represents those served by the public water system; no population that is solely self-served by wells is included.

[2] Communities Served represents the communities that the listed population serves directly with residential accounts and indirectly with wholesale accounts.

[3] The year 2015 population served by wholesale sales or accounts represents the percent of the Water System's population NOT served directly by residential accounts, but rather through an intermediary water purveyor. This only applies to the following Water Systems who have a wholesale or bulk sale customer account category: CPWS, LWW, and MWSD.

Table 3-2. Regional Employment - DRA

	Bedford County Utility District	Columbia Power and Water Systems	Lewisburg Water and Wastewater	Manchester Water and Sewer Department	Shelbyville Power, Water, and Sewerage System	Spring Hill Water System	Tullahoma Utilities Board
County Used for Projection	Bedford	Maury	Marshall	Coffee	Bedford	Maury	Coffee
2015-2050 County and Water System Average Annual Employment Growth Rate*	1.48%	2.43%	3.15%	2.83%	1.48%	2.43%	2.83%

* Employment projections were based on historical County employment rates from 2010-2015 and applied as relevant to each Water System. Historical county employment from BLS.

4. ANALYSIS OF HISTORICAL WATER DEMAND

The historical water use patterns were analyzed based on water production and consumption data provided by each Duck River Water System. When available, fifteen years of monthly water consumption and production were analyzed (years 2000 to 2015) and for most Water Systems a baseline range of 2010-2015 was used to derive an average per account per day water use. Specific baseline ranges for each Water System can be found in Appendix B. Data from each major customer category were analyzed separately. Historical data was segregated into indoor and outdoor water use by customer type using the billing data.

4.1 Production and Consumption

Total water production and consumption (billed water) data was compared for each Water System over the period 2000-2015 when data was available. Water production data was measured at its respective sources. Water consumption data was measured at the customer meters. A figure of each Water System's total production versus total consumption for the Water System's service area is presented in Appendix B. Regional production versus consumption is NOT presented due to the significant data gaps in historical consumption data for many of the Water Systems; this is clearly presented in Appendix B.

Each Duck River Water System has a variety of customer categories utilized in their billing system. This Report organizes each individual Water System's customer categories according to what was provided by that particular Water System. Each Water System's customer categories are presented in Appendix B.

4.2 Water Use Data Analysis and Key Inputs to the DSS Model

The demand analysis process includes using baseline average water use per customer to forecast water demands by customer category based upon forecasted increases in population and employment to predict customer category account growth. Average water use per customer category account was based on an analysis of historical and current water use data and demographic data. This analysis includes the following elements:

- *Model Start Year* – This is the starting year for the analysis. For this project, the start year for the model is 2015. The DSS Model includes 35 years of data projecting information until the year 2050.
- *Base Year for Future Water Factors* – Based on an analysis of historical water billing data, a specific year or an average of multiple years was selected for each Water System that is representative of current water use and this current water use served as a base year demand factor for developing future water use projections. Specific Water System base water use factors are presented in Appendix B. The year(s) were chosen by DRA for the following reasons:
    - The selected year(s) shows less of an effect from the recession.
    - The year(s) selected had relatively "normal" climate conditions (i.e., not a drought or excessively wet year), so no significant weather adjustments were necessary. The water billing or production data shown in the previous section was not weather normalized for this analysis.
    - Many Water Systems elected to average a few years of data for the analysis. Some Water Systems selected an individual year as they felt it was representative in terms of weather, vacancy, and customer water use for demand projection purposes.
- *Start Year Accounts* – The start year accounts represent the average number of accounts for each customer category in 2015.

- *Average Gal/Day/Acct* – This is the average amount of water in gallons that is used per day, per account.
- *Indoor/Outdoor Water Use* – This is the amount of water per account split into the percent that is used indoors and outdoors.
- *Non-Revenue Water (NRW)* – This is the sum of all water input to the system that is not billed (metered and unmetered) water consumption, including apparent (metering accuracy) and real losses. The values were calculated by taking the difference between the amount of water produced and the amount of water that was sold. Data provided by the Water System was used, if provided, unless another more accurate value from the AWWA M36 Water Loss reports was provided.
- *Census Data* – The 2010 Census data or 2013 or 2014 American Community Survey 3-year or 5-year data was used as a general reference when determining population, housing units, and household sizes for each individual city (and/or unincorporated area) serviced by the Water Systems. Housing units and household sizes were used to estimate water use per person in the service area as well as individual residential customer categories.
- *Current Service Area Population* – The 2015 total population for each Water System is based on CBER-UT provided data or data provided directly by the Water System and presented in Appendix B.
- *Procedure for Service Areas Not Contiguous with City Boundaries* – When a Water System serves an area outside a city boundary, estimates were generated by the local Water System if known.
- *Employment Data* – No employment figures were available for the Water Systems. The employment projection basis was obtained from the selected employment source as discussed earlier in this report in Section 3.

Table 4-1 shows the key inputs and assumptions used in each Water System's DSS Model. The assumptions having the most dramatic effect on future demands are the natural replacement rate of fixtures, how residential or commercial future water use is projected, and finally the percent of estimated non-revenue water. More details on these assumptions, including screenshots of where they are incorporated into the DSS Model, can be found in Appendix A and Appendix B.

Table 4-1. Water Use Data Analysis and DSS Model Key Assumptions

Parameter	Model Input Value, Assumptions, and Key References
Model Start Year	2015
Water Demand Factor Year(s) (Base Year[s])	Varies by Water System. Water System specific value can be found in Appendix B.
Non-Revenue Water in Start Year	Varies by Water System. Water System specific value can be found in Appendix B. This value can be found in the green NRW section of each Water System's DSS Model.
Population Projection Source	CBER-UT or may vary by Water System. Water System specific value can be found in Table 3-1 and Appendix B.
Employment Projection Source	BLS and varies by Water System. Water System specific value can be found in Table 3-2 and Appendix B.
Base Year Water Use Profile	Varies by Water System. Water System specific values can be found in Appendix B.
Residential End Uses	Key Reference: CA DWR Report "California Single Family Water Use Efficiency Study," (DeOreo, 2011 – Page 28, Figure 3: Comparison of household end-uses) and Water Research Foundation (WRF) Report "Residential End Uses of Water, Version 2 - 4309" (DeOreo, 2016). Table 2-A. Water Consumption by Water-Using Plumbing Products and Appliances – 1980-2012. PERC Phase 1 Report. Plumbing Efficiency Research Coalition. 2013. http://www.map-testing.com/content/info/menu/perc.html Model Input Values are found in the "End Uses" section of the DSS Model on the "Breakdown" worksheet.
Non-Residential End Uses, %	Key Reference: AWWARF Report "Commercial and Institutional End Uses of Water" (Dziegielewski, 2000 – Appendix D: Details of Commercial and Industrial Assumptions, by End Use). Santa Clara Valley Water District Water Use Efficiency Unit. "SCVWD CII Water Use and Baseline Study." February 2008. Model Input Values are found in the "End Uses" section of the DSS Model on the "Breakdown" worksheet.
Residential Fixture Efficiency Current Installation Rates	U.S. Census, Housing age by type of dwelling plus natural replacement plus rebate program (if any). Key Reference: California Urban Water Conservation Council Potential Best Management Practice Report "High Efficiency Plumbing Fixtures – Toilets and Urinals" (Koeller, 2005 – Page 42, Table 8 and Table 9: Residential toilet installation rates in California). Key Reference: Consortium for Efficient Energy (www.cee1.org). Model Input Values are found in the "Codes and Standards" green section of the DSS Model by customer category fixtures.
Water Savings for Fixtures, gal/capita/day	Key Reference: AWWARF Report "Residential End Uses of Water, Version 2 - 4309" (DeOreo, 2016).

Parameter	Model Input Value, Assumptions, and Key References
	Key Reference: CA DWR Report "California Single Family Water Use Efficiency Study" (DeOreo, 2011 – Page 28, Figure 3: Comparison of household end-uses). Water System supplied data on costs and savings; professional judgment was made where no published data was available. Key Reference: California Energy Commission (CEC), Staff Analysis of Toilets, Urinals and Faucets, Report # CEC-400-2014-007-SD, 2014. Model Input Values are found in the "Codes and Standards" green section on the "Fixtures" worksheet of the DSS Model.
Non-Residential Fixture Efficiency Current Installation Rates	Key Reference: 2010 U.S. Census, Housing age by type of dwelling plus natural replacement plus rebate program (if any). Assume commercial establishments built at same rate as housing plus natural replacement. California Energy Commission, Staff Analysis of Toilets, Urinals and Faucets, Report # CEC-400-2014-007-SD, 2014. Santa Clara Valley Water District Water Use Efficiency Unit. "SCVWD CII Water Use and Baseline Study." February 2008. Model Input Values are found in the "Codes and Standards" green section of the DSS Model by customer category fixtures.
Residential Frequency of Use Data, Toilets, Showers, Faucets, Washers, uses/user/day	Key Reference: AWWARF Report "Residential End Uses of Water, Version 2 - 4309" (DeOreo, 2016). Summary values of the report can be found in the following presentation: http://watersmartinnovations.com/documents/pdf/2014/sessions/2014-T-1458.pdf Key Reference: California Energy Commission, Staff Analysis of Toilets, Urinals and Faucets, Report # CEC-400-2014-007-SD, 2014. Key Reference: Alliance for Water Efficiency, The Status of Legislation, Regulation, Codes & Standards on Indoor Plumbing Water Efficiency, January 2016. Model Input Values are found in the "Codes and Standards" green section on the "Fixtures" worksheet of the DSS Model and confirmed in each "Service Area Calibration End Use" worksheet by customer category.
Non-Residential Frequency of Use Data, Toilets, Urinals, and Faucets, uses/user/day	Key References: Estimated based on AWWARF Report "Commercial and Institutional End Uses of Water," Appendix D: Details of Commercial and Industrial Assumptions, by End Use (Dziegielewski, 2000). Key Reference: California Energy Commission, Staff Analysis of Toilets, Urinals and Faucets, Report # CEC-400-2014-007-SD, 2014. Based on three studies of office buildings in which the numbers varied from 2.0 to 3.45 toilet flushes per employee per day (Darell Rogers cited in Schultz Communications, 1999; Konen Plumbing Engineer, July/August 1986; and Eva Opitz cited in PMCL, 1996). Fixture uses over a 5-day work week are prorated to 7 days. Non-residential 0.5 gpm (gallons per minute) faucet standards per Table 2-A. Water Consumption by Water-Using Plumbing Products and Appliances - 1980-2012. PERC

Parameter	Model Input Value, Assumptions, and Key References
	Phase 1 Report. Plumbing Efficiency Research Coalition. 2013. http://www.map-testing.com/content/info/menu/perc.html Model Input Values are found in the "Codes and Standards" green section of the "Fixtures" worksheet of the DSS Model and confirmed in each "Service Area Calibration End Use" worksheet by customer category.
Natural Replacement Rate of Fixtures (% per year)	Residential Toilets 2% (1.28 gpf and lower), 3% (1.6 gpf toilets), 4% (3.5 gpf and higher)
	Non-Residential Toilets 2% (1.6 gpf and lower), 3% (3.5 gpf and higher toilets)
	Residential Showers 4% (corresponds to 25-year life of a new fixture)
	Residential Clothes Washers 10% (based on 10-year washer life). Key References: "Residential End Uses of Water" (DeOreo, 2016) and "Energy Efficiency Program for Consumer Products and Commercial and Industrial Equipment: Residential Clothes Washers" (Department of Energy, 2012).
	Residential Faucets 10% and Non-Residential Faucets 6.7% (every 15 years). CEC uses an average life of 10 years for faucet accessories (aerators). A similar assumption can be made for public lavatories, though no hard data exists and since CII fixtures are typically replaced less frequently than residential, 15 years is assumed. CEC, Analysis of Standards Proposal for Residential Faucets and Faucet Accessories, a report prepared under CEC's Codes and Standards Enhancement Initiative, Docket #12-AAER-2C, August 6, 2013.
	Model Input Value is found in the "Codes and Standards" green section on the "Fixtures" worksheet of the DSS Model.
Residential Future Water Use	Increases based on Population Growth and Demographic Forecast
Non-Residential Future Water Use	Increases based on Employment Growth Rate and Demographic Forecast

5. WATER DEMAND PROJECTIONS

The purpose of this section is to document the water demand projections developed for the Project. This section presents an overview of the water demand methodology and the total water demand projections with and without the plumbing code savings through year 2050.

5.1 Demand Methodology Overview

Each Water System's water demand (i.e., average year demand before additional active water-use efficiency measure savings were incorporated) is forecasted through 2050 using the DSS Model. The demand analysis process includes forecasting future water demand (2015-2050) by customer category based upon forecasted increases in population and employment. Average water use per customer category account is based on an analysis of historical data between 2000 and 2015 (or a shorter period if a Water System's historical data was incomplete). To forecast water demands, the DSS Model relies on demographic and employment projections combined with the effects of natural fixture replacement due to the implementation of plumbing codes to forecast future demands. Natural fixture replacement due to the implementation of plumbing codes is part of passive conservation savings. Passive conservation refers to water savings resulting from actions and activities that do not depend on direct financial assistance or educational programs from Water Systems.

5.2 Demand Projections With and Without Passive (Plumbing Code) Savings

Since it is beneficial to model the impact of the natural changes in the different types of appliances, the DSS Model forecasts service area water fixture use. In the codes and standards part of the DSS Model, specific fixture end-use type (point of use fixture or appliance), average water use, and lifetime are compiled. Additionally, state and national plumbing codes and appliance standards for toilets, urinals, showers, and clothes washers are modeled by customer category. These fixtures and plumbing codes can be added to, edited, or deleted by the user. This yields two demand forecasts: 1) with plumbing codes, and 2) without plumbing codes.

The following tables present each Water System's projected water use. Figure 5-1 presents Duck River's regional demand with and without plumbing code savings. Information and assumptions about plumbing code and appliance standards can be found in Appendix A. Water System individual projected demands can be found in Appendix B.

The demand projections reflect average water use under average weather conditions and do **NOT** reflect drier and hotter drought conditions. Likewise, climate change (which might alter weather patterns), increased or decreased rainfall, and possible increased irrigation demand in the spring and fall (due to a warmer climate) have **NOT** been addressed in this analysis.

Plumbing code measures are based on customers following applicable current local, state, and federal laws, building codes, and ordinances.

The DSS Model shows an annual total plumbing code savings of 5 MGD by 2050 meaning the plumbing codes and appliance standards will reduce 2050 demands by 5 MGD or 12% of demands without the plumbing code. Further reductions in demand due to voluntary and regulatory conservation measures are calculated from an end-use version of the demands with the plumbing code.

Table 5-1. Average Day Water Demands WITHOUT Plumbing Code Savings (MGD)

Water System	2015	2020	2025	2030	2035	2040	2045	2050
Coffee County								
Tullahoma Utilities Board	3.08	3.39	3.73	4.12	4.55	5.03	5.57	6.18
Manchester Water and Sewer Department	2.46	2.68	2.90	3.15	3.43	3.73	4.07	4.45
Bedford County								
Shelbyville Power, Water, and Sewerage System	3.85	4.18	4.52	4.89	5.19	5.51	5.85	6.22
Bedford County Utility District	1.80	1.94	2.07	2.21	2.31	2.40	2.50	2.60
Marshall County								
Lewisburg Water and Wastewater	2.47	2.64	2.90	3.17	3.40	3.64	3.90	4.20
Maury/Southern Williamson County								
Spring Hill Water System	2.66	3.03	3.41	3.84	4.08	4.31	4.55	4.79
Columbia Power and Water Systems	7.54	8.22	8.91	9.63	10.35	11.10	11.88	12.74
Total DRA Demand Without Plumbing Code Savings	**23.86**	**26.08**	**28.44**	**31.01**	**33.31**	**35.72**	**38.32**	**41.18**

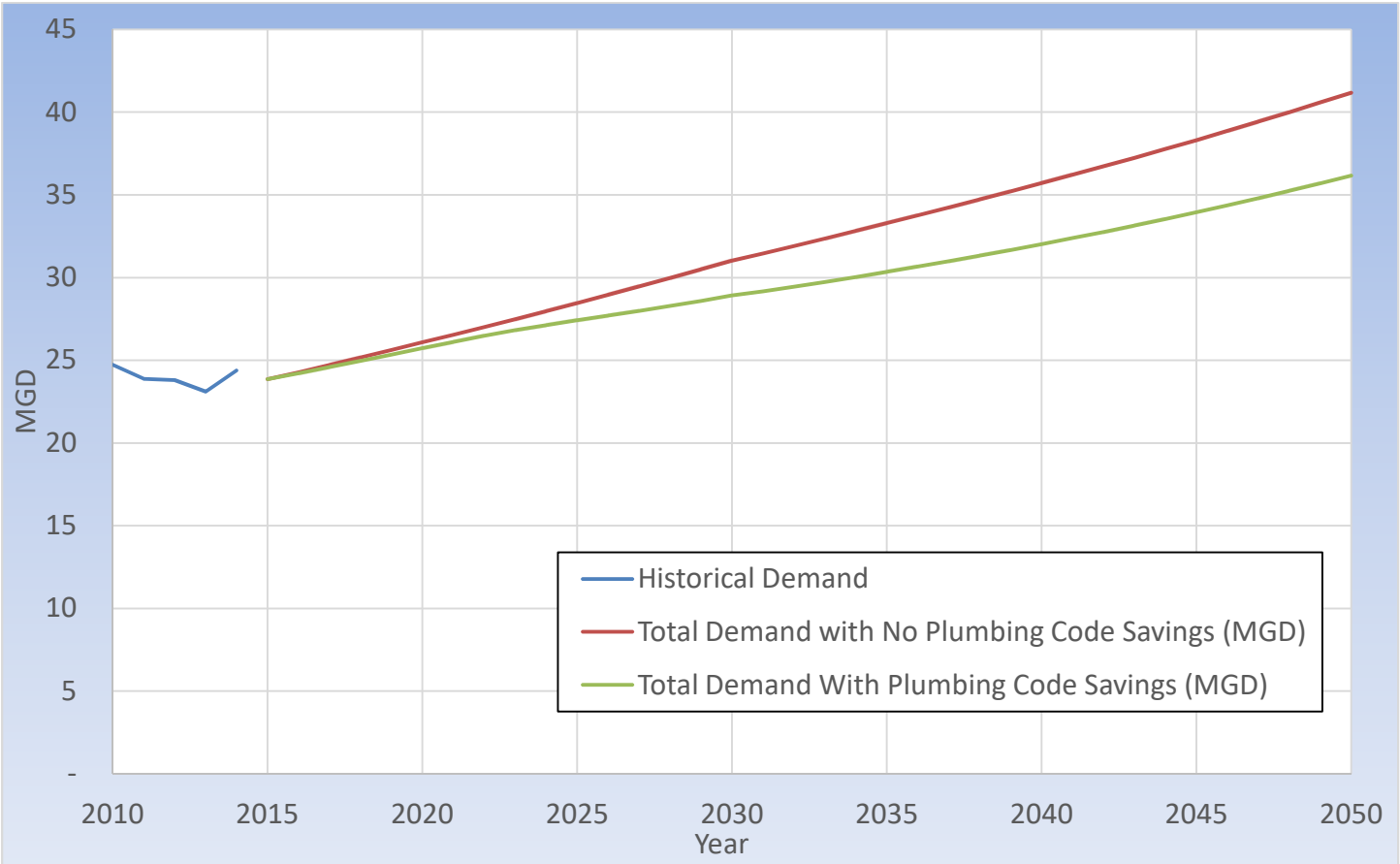
Note: Demands based on surface water supply deliveries from public water systems. Demands do not include historical, current, or future private well use by customers. Demands do not include conversion of existing private well-users to the public water system.

Table 5-2. Average Day Water Demands WITH Plumbing Code Savings (MGD)

Water System	2015	2020	2025	2030	2035	2040	2045	2050
Coffee County								
Tullahoma Utilities Board	3.08	3.33	3.57	3.82	4.12	4.49	4.92	5.43
Manchester Water and Sewer Department	2.46	2.64	2.81	2.98	3.18	3.41	3.68	3.99
Bedford County								
Shelbyville Power, Water, and Sewerage System	3.85	4.13	4.39	4.60	4.80	5.02	5.28	5.57
Bedford County Utility District	1.80	1.91	1.98	1.99	1.99	2.01	2.03	2.07
Marshall County								
Lewisburg Water and Wastewater	2.47	2.59	2.76	2.93	3.06	3.21	3.39	3.61
Maury/Southern Williamson County								
Spring Hill Water System	2.66	3.01	3.30	3.56	3.68	3.82	3.97	4.14
Columbia Power and Water Systems	7.54	8.12	8.60	9.04	9.52	10.07	10.67	11.35
Total DRA Demand WITH Plumbing Code Savings	**23.86**	**25.73**	**27.41**	**28.92**	**30.35**	**32.03**	**33.94**	**36.16**

Note: Demands based on surface water supply deliveries from public water systems. Demands do not include historical, current, or future private well use by customers. Demands do not include conversion of existing private well-users to the public water system.

Figure 5-1. Regional Average Day Water Demands (MGD)



Note: Total Demand accounts for the total projected water demand in a service area Water System regardless of source. Source can be from surface water or groundwater.

6. CONCLUSIONS/NEXT STEPS

The service areas for the Tennessee Duck River Development Agency's seven Water Systems have a relatively high portion of residential water use. Consequently, incorporating residential indoor plumbing codes into the DSS Model produces water savings on the order of 12% in year 2050. Since the service areas do not use a significant amount of water outdoors and are not as heavy in manufacturing, the water-reduction potential for outdoor water-use efficiency measures and the commercial sector is lower than that of indoor residential water use.

The amount of new growth forecasted for some of the service areas is high, indicating that measures directed at new development could produce significant water and cost savings by deferring or downsizing new capital infrastructure. It is recommended that a water-use efficiency analysis be conducted for the region, particularly in addressing the high real water losses (non-revenue water) in many of the Water Systems. Non-revenue water consists of three components: unbilled authorized consumption, apparent losses, and real losses. Unbilled authorized consumption includes fire department usage and operational flushing. Apparent losses include non-physical losses like slow meters, billing issues, and theft. Real losses are physical losses like leakage. Water loss management is critical, as is identifying and tracking any authorized non-revenue water uses (i.e., system flushing).

It is recommended that in order to improve Water System demand management each Water System should do the following as far as data management:

- Track daily water withdrawal
- Track water use and accounts by customer category on a regular time-scale – minimum monthly or bimonthly, depending upon the frequency of meter reading
- Track single family and multifamily customers separately
- Use standardized definitions of customer classes to ease regional information sharing and analysis
- Survey a random sample of the individual water accounts by customer type to better understand the population served (people per account, employees per account, etc.)
- Estimate or track the number of people served by the different residential account types on an annual basis
- Estimate or track the number of employees served by the different non-residential account types by each Water System or county on an annual basis
- Transition rate structure to be more volumetric based where applicable
- Track annual unemployment within each Water System or by county
- Track large water users' (top 100) monthly water use
- Track non-active accounts/vacancies
- Survey customers regarding fixture types – even a small sampling of the service area can provide a valuable picture of the water use profile of an account type
- Use AWWA M36 water loss management tools to track non-revenue water and real water loss
- Submit standard form/annual report to DRA with monthly or bimonthly production by source and consumption and accounts by category. Service area population and number of employees would also be tracked on this document. A sample document used by California Department of Water Resources can be found in Appendix C.
- Track the avoided cost of water; if water is saved, how much money is saved (cost of water supply, water treatment, distribution, energy, delaying new supply source, wastewater, etc.)
- Track water-use efficiency initiatives, whether they be public education, school education, water fixture rebates (toilets), water/energy fixture rebates (clothes washers), giveaways (faucet aerators), pricing re-structuring, etc.

- Develop water use targets to measure improvements of new water use efficiency practices. Water use targets might be developed on a per capita basis or for the water systems or region as a whole.
- Track residential account lot sizes to better understand their water use.

It is MWM's estimation that following some or all of the above recommendations would allow each Water System to more efficiently manage its water use and move DRA closer toward its goal of being the most efficient water management organization in the country. In the future, the Water Systems, with the support of DRA and expert consultants, would evaluate the cost-benefit relationship of these recommendations and prioritize next steps and actions. Other water sectors, such as agriculture, golf courses, and chicken farms, are included in these recommendations as far as data and demand management. This report's recommendations should be reviewed annually and updated every 3-5 years and/or when any significant changes in the water system occur.

A second phase of this analysis could involve conducting a water-use efficiency measures analysis to understand the value of investing in water demand reduction combined with and/or in lieu of other infrastructure investments. This allows for balancing revenue needs to assist with rehabilitation and replacement of aging infrastructure in addition to striving to maintain and expand services to existing and future customers.

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8. LIST OF CONTACTS

The following presents each Water System's contact information.

Water System	Name	Phone Number	E-mail	Role
Bedford County Utility District	Martin Davis	931-684-1667	mdavisgm@bcud.net	General Manager
	Willie West	931-294-5117	williewest@united.com	Water Treatment Plant Manager
Columbia Power and Water Systems	Jonathan Hardin	931-375-7646	jonathan.hardin@cpws.com	Water System Manager
Lewisburg Water and Wastewater	Cathey Nash	931-359-3345	cathey@lewisburgwater.org	Water Plant Manager
	Trigg Cathey	931-359-6831	trigg@lewisburgwater.org	General Manger
Manchester Water and Sewer Department	Dana Douglas	931-728-4652 ext. 2002	ddouglas@cityofmanchestertn.com	Assistant Manager
	Bryan Pennington	931-728-4652 ext. 2001	water@cityofmanchestertn.com	Water System Manager
Shelbyville Power, Water, and Sewerage System	John Freeman	931-684-7171	jfreeman@shelbyvillepower.com	City Engineer
	Dennis Rankin	931-684-5817	drankin@shelbyvillepower.com	Water Plant Manager
Spring Hill Water System	Caryl A. Giles	931-489-5791	cgiles@springhilltn.org	Water Plant Manager
Tullahoma Utilities Board	Scott Young	931-571-7106	syoung@tub.net	Water/Wastewater Department Manager
	Dale Willis	931-571-7126	dwillis@tub.net	Engineering Supervisor
Maddaus Water Management	Michelle Maddaus	925-831-0194	michelle@maddauswater.com	MWM Project Manager
Tennessee Duck River Development Agency	Doug Murphy	931-684-7820	doug@duckriveragency.org	Executive Director

APPENDIX A – DSS MODEL OVERVIEW AND KEY ASSUMPTIONS

Plumbing codes and appliance standards for toilets, urinals, faucets, clothes washers, and showerheads will continue to reduce indoor residential and non-residential water demands in the future. This reduction in demand is accounted for in Maddaus Water Management's Decision Support System (DSS) Model. Background on the DSS Model as well as details on the method of determining plumbing code savings is presented in the following sections.



A.1 DSS Model Overview

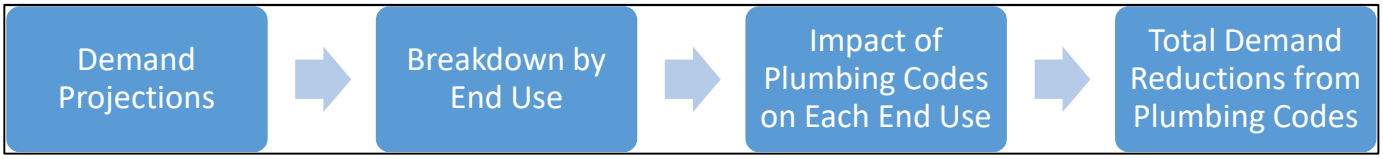
The DSS Model is used to prepare long-range, detailed demand projections. The purpose of the extra detail is to enable a more accurate assessment of the impact of water efficiency programs on demand. A rigorous modeling approach is especially important if the project will be subject to regulatory or environmental review.

The DSS Model is an end-use model that breaks down total water production (water demand in the service area) to specific water end uses. The model uses a bottom-up approach that allows for multiple criteria to be considered when estimating future demands, such as the effects of natural fixture replacement, plumbing codes, and water-use efficiency efforts. The DSS Model may also use a top-down approach with a utility-prepared water demand forecast.

To forecast urban water demands using the DSS Model, customer demand data is obtained from the water agency being modeled. The demand data is reconciled with available demographic data to characterize the water usage for each customer category in terms of number of users per account and per capita water use. The data is further analyzed to approximate the split of indoor and outdoor water usage in each customer category. The indoor/outdoor water usage is further divided into typical end uses for each customer category. Published data on average per capita indoor water use and average per capita end use is combined with the number of water users to calibrate the volume of water allocated to specific end uses in each customer category. In other words, the DSS Model checks that social norms from end-use studies on water use behavior (e.g., flushes per person per day) are not exceeded.

The DSS Model evaluates water-use efficiency measures using benefit-cost analysis with the present value of the cost of water saved ($/Acre-Foot). Benefits are based on savings in water and wastewater facility operations and maintenance (O&M). The figure below illustrates the process for forecasting water-use efficiency water savings, including the impacts of fixture replacement due to plumbing codes and standards already in place.

The DSS Model has been used for practical applications of water-use efficiency planning in over 250 service areas representing 20 million people, including extensive efforts nationally in California, Colorado, Hawaii, Idaho, Utah, Georgia, Florida, North Carolina, Tennessee, Oregon, Texas, and Ohio, and internationally in Australia, New Zealand, and Canada. The California Urban Water Conservation Council (CUWCC) did a peer review and has endorsed the model since 2006. The model is offered to all of the CUWCC members for use to estimate water demand, plumbing code, and conservaiton program savings. For more information please see the CUWCC website: https://www.cuwcc.org/Resources/Planning-Tools-and-Models?folderId=776&view=gridview&pageSize=10



The DSS Model is used to forecast service area water fixture use. In the codes and standards part of the DSS Model, specific fixture end-use type (point of use fixture or appliance), average water use, and lifetime are compiled. Additionally, state and national plumbing codes and appliance standards for toilets, urinals, showers, and clothes washers are modeled by customer category. These fixtures and plumbing codes can be added to, edited, or deleted by the user. This yields two demand forecasts: 1) with plumbing codes and 2) without plumbing codes. Plumbing code measures are independent of any water-use efficiency program; they are based on customers following applicable current local, state, and federal laws, building codes, and ordinances.

A.2 Plumbing Codes and Legislation

The DSS Model incorporates the following national plumbing code items as a "code," meaning that the savings are assumed to occur and are therefore "passive" savings.

The Federal Energy Policy Act of 1992, as amended in 2005, mandates that only fixtures meeting the following standards can be installed in new buildings:

- Toilets – 1.6 gal/flush maximum
- Urinals – 1.0 gal/flush maximum
- Showerheads – 2.5 gal/min at 80 psi
- Residential faucets – 2.2 gal/min at 60 psi
- Public restroom faucets – 0.5 gal/min at 60 psi
- Dishwashing pre-rinse spray valves – 1.6 gal/min at 60 psi

Replacement of fixtures in existing buildings is also governed by the Federal Energy Policy Act, which mandates that only devices with the specified level of efficiency (as shown above) can be sold as of 2006. The net result of the plumbing code is that new buildings will have more efficient fixtures and old, inefficient fixtures will slowly be replaced with new, more efficient models. The national plumbing code is an important piece of legislation and must be carefully taken into consideration when analyzing the overall water efficiency of a service area.

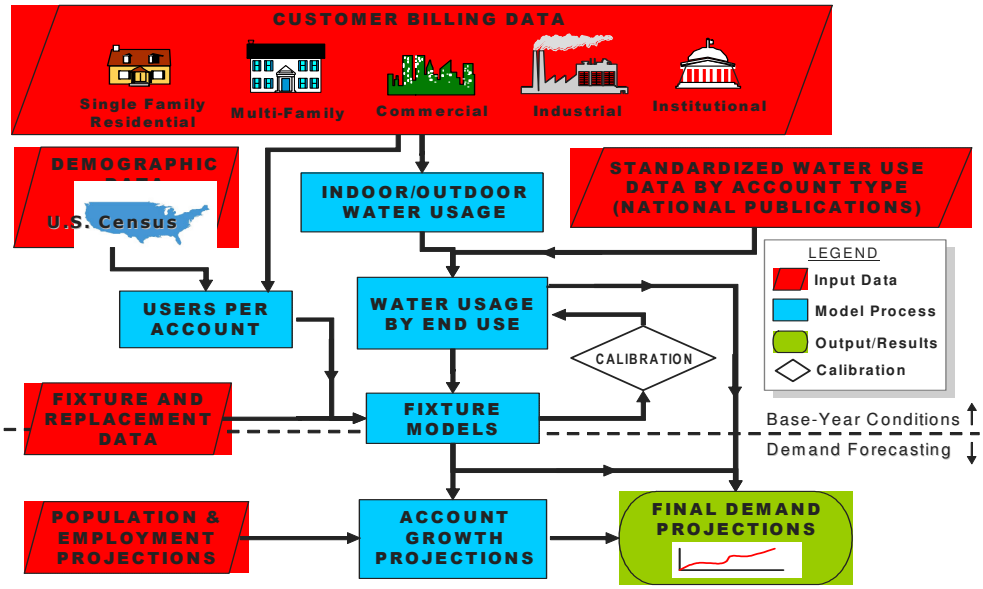
In addition to the plumbing code, the U.S. Department of Energy regulates appliances, such as residential clothes washers, further reducing indoor water demands. Regulations to make these appliances more energy efficient have driven manufactures to dramatically reduce the amount of water these machines use. Generally, front loading washing machines use 30-50% less water than conventional models (which are still available). In a typical analysis, the DSS Model forecasts a gradual transition to high efficiency clothes washers (using 12 gallons or less) so that, by the year 2025, they will be the only type of machines available for purchase.

In addition to the industry becoming more efficient, rebate programs for washers have been successful in encouraging customers to buy more water efficient models. Given that machines last about 10 years, eventually all machines on the market will be the more water efficient models. Energy Star® washing machines have a water factor (WF) of 6.0 or less – the equivalent of using 3.1 cubic feet (or 23.2 gallons) of water per load. The maximum water factor for residential clothes washers under current federal standards is 9.5. The water factor equals the number of gallons used per cycle per cubic foot of capacity. Prior to year 2000, the water factor for a typical new residential clothes washer was about 12. In March 2015, the federal standard reduced the maximum water factor for top- and front-loading machines to 8.4 and 4.7, respectively. In 2018, the maximum water factor for top-loading machines will be further reduced to 6.5.

For commercial washers, the maximum water factors were reduced in 2010 to 8.5 and 5.5 for top- and front-loading machines, respectively. Beginning in 2015, the maximum water factor for Energy Star® certified washers was changed to 4.3 for top-loading machines and 3.7 for front-loading. In 2011, the Environmental Protection Agency (EPA) estimated that Energy Star® washers comprised more that 60% of the residential market and 30% of the commercial market (Energy Star®, 2011). A new Energy Star® compliant washer uses about two-thirds less water per cycle than washers manufactured in the 1990s.

The following figure conceptually describes how plumbing codes are incorporated into the flow of information in the DSS Model.

Figure A-1. DSS Model Overview Used to Make Potable Water Demand Projections



DSS Model Fixture Replacement

The DSS Model is capable of modeling multiple types of fixtures, including fixtures with slightly different design standards. For example, currently toilets can be purchased that flush at a rate of 0.8 gallons per flush (gpf), 1.0 gpf, 1.28 gpf or 1.6 gpf. Higher than 1.6 gpf toilets still exist but can no longer be purchased in the United States. Therefore, they cannot be used for replacement or new installation of a toilet. So, the DSS Model utilizes a fixture replacement table to decide what type of fixture should be installed during replacement or new installation of a fixture. The replacement of the fixtures is listed as a percentage, as shown in the following figure. A value of 100% would indicate that all the toilets sold would be of one particular flush volume. A value of 75% means that three out of every four toilets installed would be of that particular flush volume type. The DSS Model contains a pair of replacement tables for each fixture type and customer category combination (i.e., Residential Single Family Toilets, Residential Multifamily Toilets, Commercial Toilets, Residential Clothes Washing Machines, Commercial Washing Machines, etc.).

In the following example, the DSS Model includes the effects of the Federal Policy Act on each toilet fixture type. This DSS Model feature determines the “saturation” of 1.6 gpf toilets while the Federal Policy Act was in effect from 1992-2014 for 1.6 gpf toilet replacements.

Figure A-2. Toilet Replacement Percentages by Type of Toilet

Replacement Appliance Market Shares					
Year	High Use Toilet Residential	1.6 gpf ULFT Residential	1.28 gpf HET Residential	<1.0 gpf Toilet Residential	Total
2015	0%	100%	0%	0%	100%
2020	0%	75%	25%	0%	100%
2025	0%	50%	40%	10%	100%
2035	0%	25%	50%	25%	100%
2050	0%	0%	70%	30%	100%
New Appliance Market Shares					
Year	High Use Toilet Residential	1.6 gpf ULFT Residential	1.28 gpf HET Residential	<1.0 gpf Toilet Residential	Total
2015	0%	100%	0%	0%	100%
2020	0%	65%	35%	0%	100%
2025	0%	0%	80%	20%	100%
2035	0%	0%	70%	30%	100%
2050	0%	0%	65%	35%	100%

APPENDIX B –WATER SYSTEM SPECIFIC INFORMATION

This appendix presents each Water System's specific information.

B.1 Bedford County Utility District

This section presents Bedford County Utility District's historical and projected population and employment, historical production and consumption, DSS Model input values, sources and assumptions as well as projected demands with and without plumbing codes.

B.1.1 Demographic Data

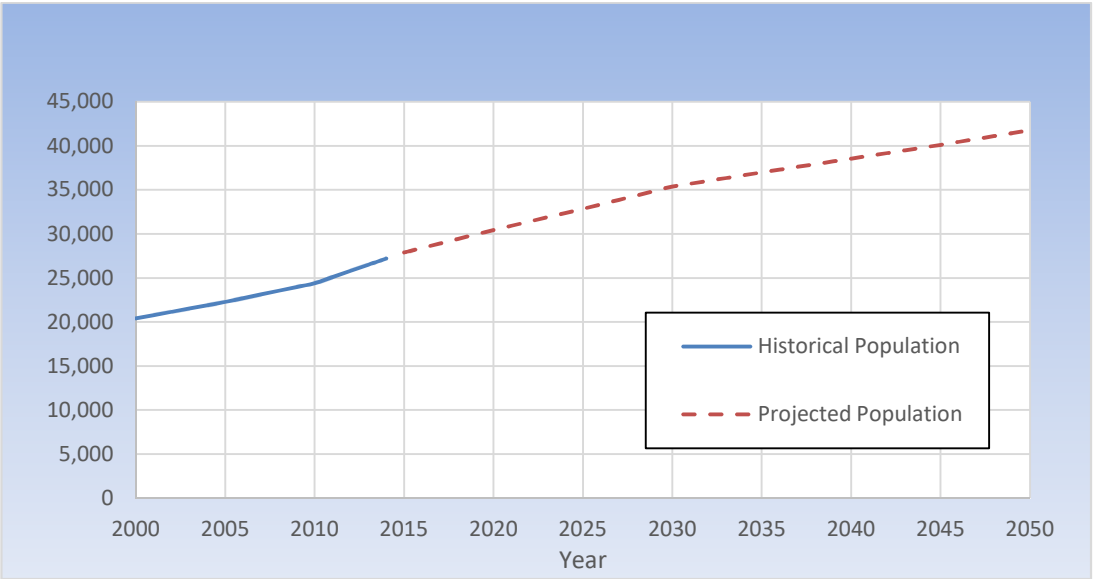
Population projections were obtained through year 2030 from the June 2009 joint publication of the *Population Projections for the State of Tennessee, 2010-2030* by the Tennessee Advisory Commission (TAC) on Intergovernmental Relations and the University of Tennessee's Center of Business and Economics Research (CBER-UT). Population projections from 2035 through 2050 were derived using CBER-UT's projections for Bedford County. Employment projections were based on Bedford County's employment rate from 2010-2015 of 1.48%. The actual number of jobs was not provided or determined for the Water System, rather the 2010-2015 average employment growth was applied to non-residential account growth through year 2050. The historical county employment was provided by the BLS of the U.S. Department of Labor (US Dept. of Labor, 2016).

The following table and figure present the historical and projected population for the water supplier.

Table B-1. Historical and Projected Population– Bedford County Utility District

	2010	2015	2020	2025	2030	2035	2040	2045	2050
Population	24,384	27,897	30,451	32,857	35,387	36,996	38,559	40,125	41,786

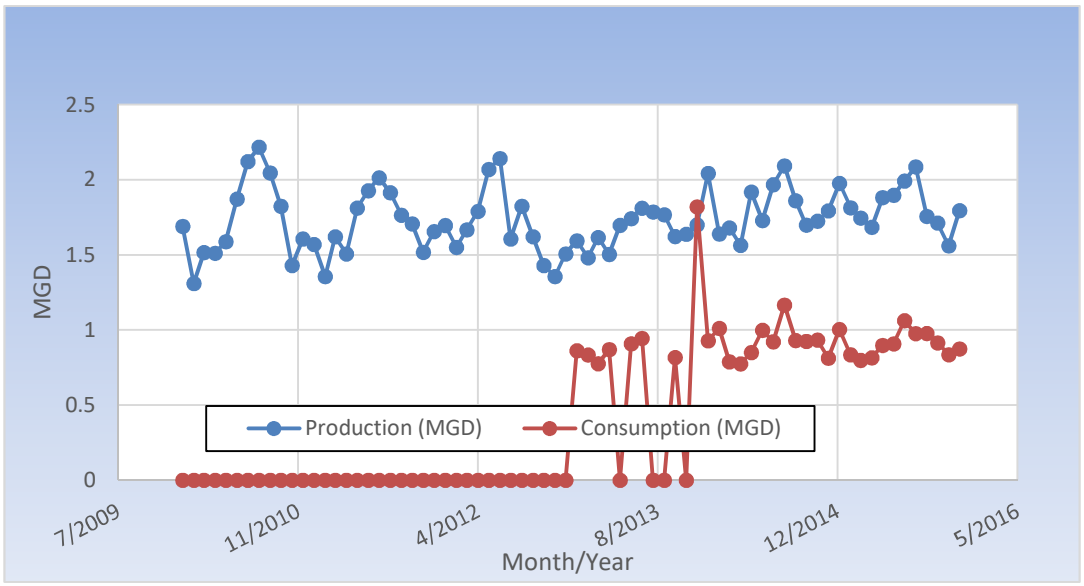
Figure B-1. Historical and Projected Population – Bedford County Utility District



B.1.2 Production and Consumption

Total water production and consumption (billed water) data was compared over the period 2010-2015. Water production data was measured at its respective sources. Water consumption data was measured at the customer meters. The Water System's total production versus total consumption for the service area is presented in the following figure. Only years 2014 and 2015 consumption data is consistently reliable.

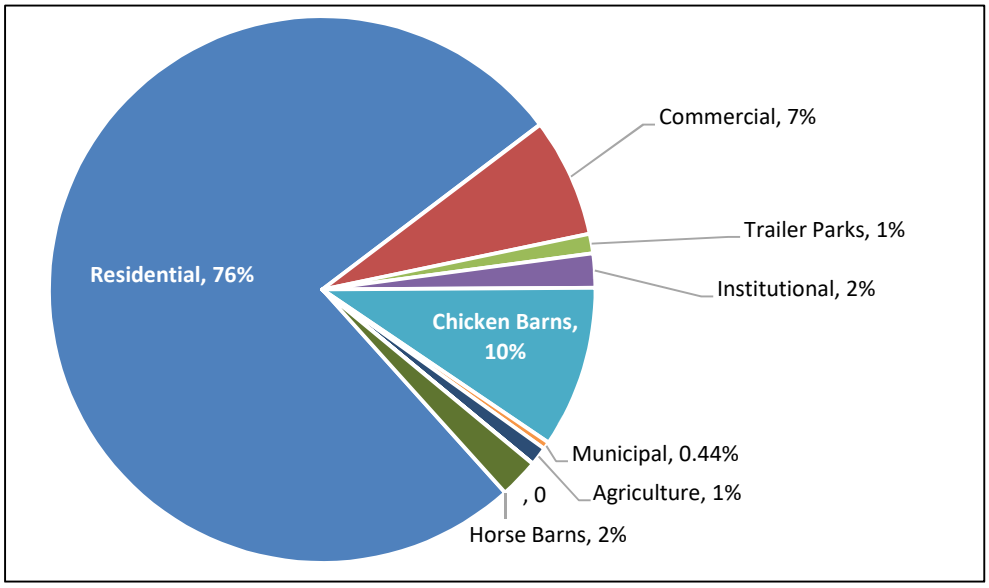
Figure B-2. Total Production vs. Total Consumption – Bedford County Utility District



Each Duck River Water System has a variety of customer categories utilized in their billing system. This Water System has organized users into Residential, Commercial, Trailer Parks, Institutional, Chicken Barns, Municipal, Agriculture, and Horse Barns categories. Residential is the largest category of water users, using more than 75% of the water consumed.

The following figure illustrates the water usage breakdowns within the Water System's service area based on historical water use in years 2014-2015.

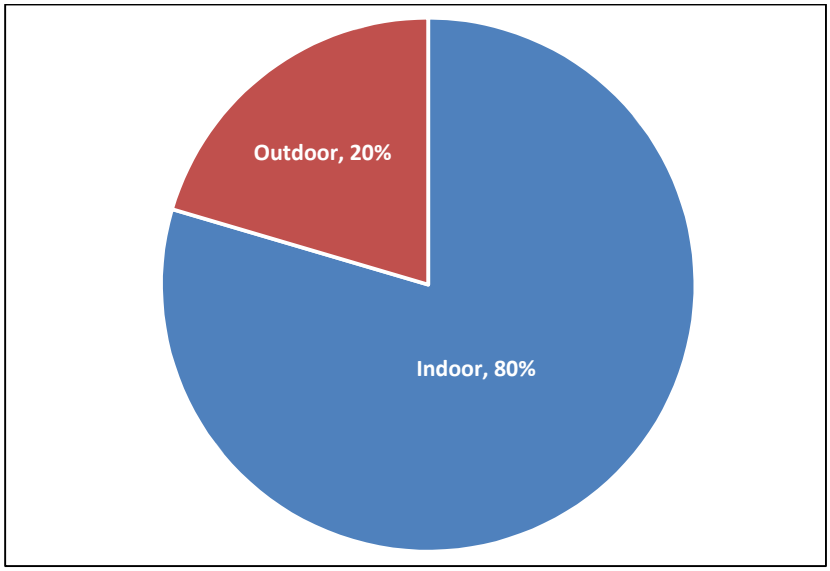
Figure B-3. Consumption by Customer Category – Bedford County Utility District



Note: Figure is based on water use in years 2014-2015.

The following figure shows the breakdown of water use into indoor and outdoor components based on the assumption that indoor use is approximately equal to the minimum use in the winter. While there may be minimal landscape watering in the winter, or leakage from irrigation systems, it is assumed that this is minor at less than 5-10% of the average winter water use. Residential indoor water use is assumed to be 95% of total water use due to a high number of private wells which are used for outdoor purposes and an overall low percentage of irrigation.

Figure B-4. Overall Use: Indoor vs. Outdoor – Bedford County Utility District



Note: Figure is based on average water use in years 2014-2015.

B.1.3 Water Use Data Analysis and Key Inputs to the DSS Model

The following table shows the key inputs and assumptions used in the Water System's DSS Model.

Table B-2. Water Use Data Analysis and DSS Model Key Inputs and Assumptions – Bedford County Utility District

Parameter	Model Input Values, Sources and Assumptions				
Model Start Year	2015				
Water Demand Factor Year(s) [Base Year(s)]	2014-2015				
Non-Revenue Water in Start Year	33.9%				
	This value is based on year 2014 and 2015 production and consumption data and can be found in the green NRW section of each Water System's DSS Model.				
Population Projection Source	CBER-UT				
Employment Projection Source	BLS 2010-2015 average annual historical employment for Bedford County				
Base Year Water Use Profile					
Customer Categories	**Start Year Accounts**	**Total Water Use Distribution**	**Demand Factors (gpd/acct)**	**Indoor Use %**	**Residential Indoor Water Use**
Residential	6,421	76%	141	95%	43
Commercial	70	7%	1,191	59%	N/A
Trailer Parks	15	1%	913	90%	N/A
Institutional	5	2%	4,785	70%	N/A
Chicken Barns	47	10%	2,426	0%	N/A
Municipal	2	0%	2,608	88%	N/A
Agriculture	6	1%	2,287	0%	N/A
Horse Barns	58	2%	479	0%	N/A
Total	**6,623**	**100%**	**N/A**	**80%**	N/A

B.1.4 Water System Demand Projections

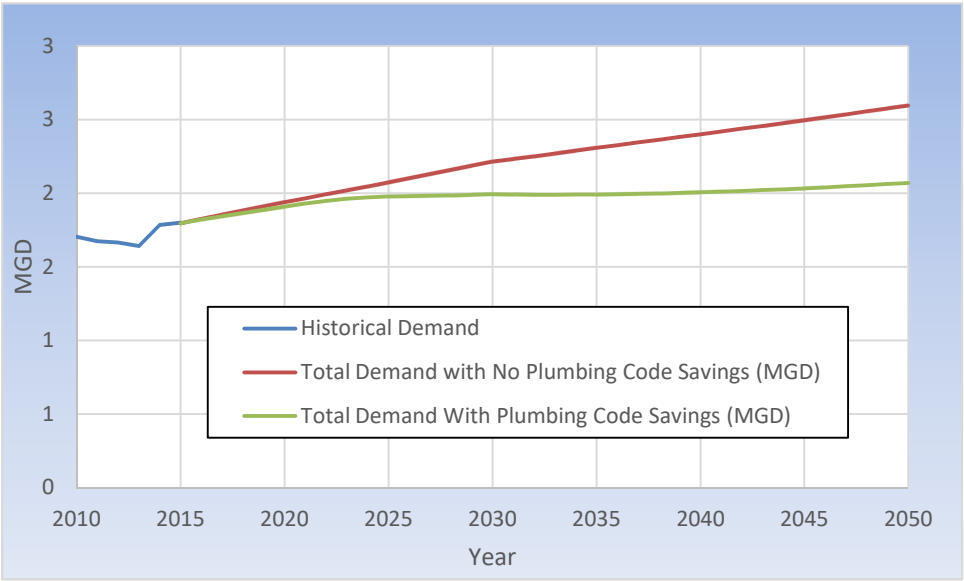
The following table and figure present the average day water demand projections for the Water System.

Table B-3. Demand Projections – Bedford County Utility District

Demand Forecast	2015	2020	2025	2030	2035	2040	2045	2050
Total Demand Without Plumbing Code Savings (MGD)	1.80	1.94	2.07	2.21	2.31	2.40	2.50	2.60
Total Demand With Plumbing Code Savings (MGD)	1.80	1.91	1.98	1.99	1.99	2.01	2.03	2.07

Note: Total Demand accounts for the total projected water demand in a service area Water System regardless of source. Source can be from surface water or groundwater.

Figure B-5. Demand Projection – Bedford County Utility District



B.2 Columbia Power and Water Systems

This section presents Columbia Power and Water Systems' historical and projected population and employment, historical production and consumption, DSS Model input values, sources and assumptions as well as projected demands with and without plumbing codes.

B.2.1 Demographic Data

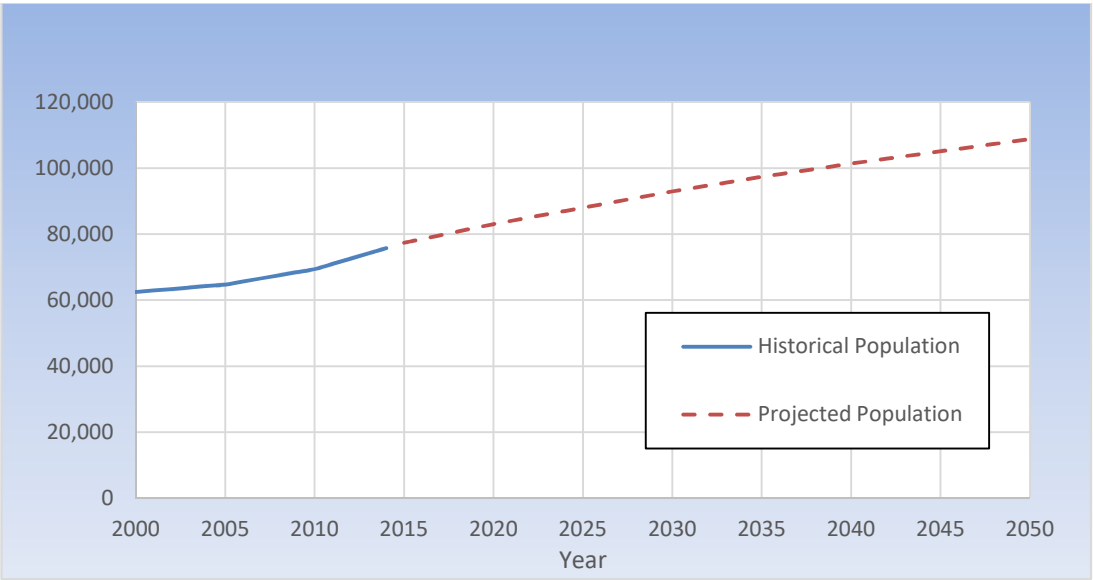
Population projections were obtained through year 2030 from the June 2009 joint publication of the *Population Projections for the State of Tennessee, 2010-2030* by the TAC on Intergovernmental Relations and the CBER-UT. Population projections from 2035 through 2050 were derived using CBER-UT's projections for Maury County. Employment projections were based on Maury County's employment rate from 2010-2015 of 2.43%. The actual number of jobs was not provided or determined for the Water System, rather the 2010-2015 average employment growth was applied to non-residential account growth through year 2050. The historical county employment was provided by the BLS of the U.S. Department of Labor (US Dept. of Labor, 2016).

The following table and figure present the historical and projected population for the water supplier.

Table B-4. Historical and Projected Population – Columbia Power and Water Systems

	2010	2015	2020	2025	2030	2035	2040	2045	2050
Population	69,388	77,364	83,015	87,987	92,918	97,332	101,341	105,056	108,759

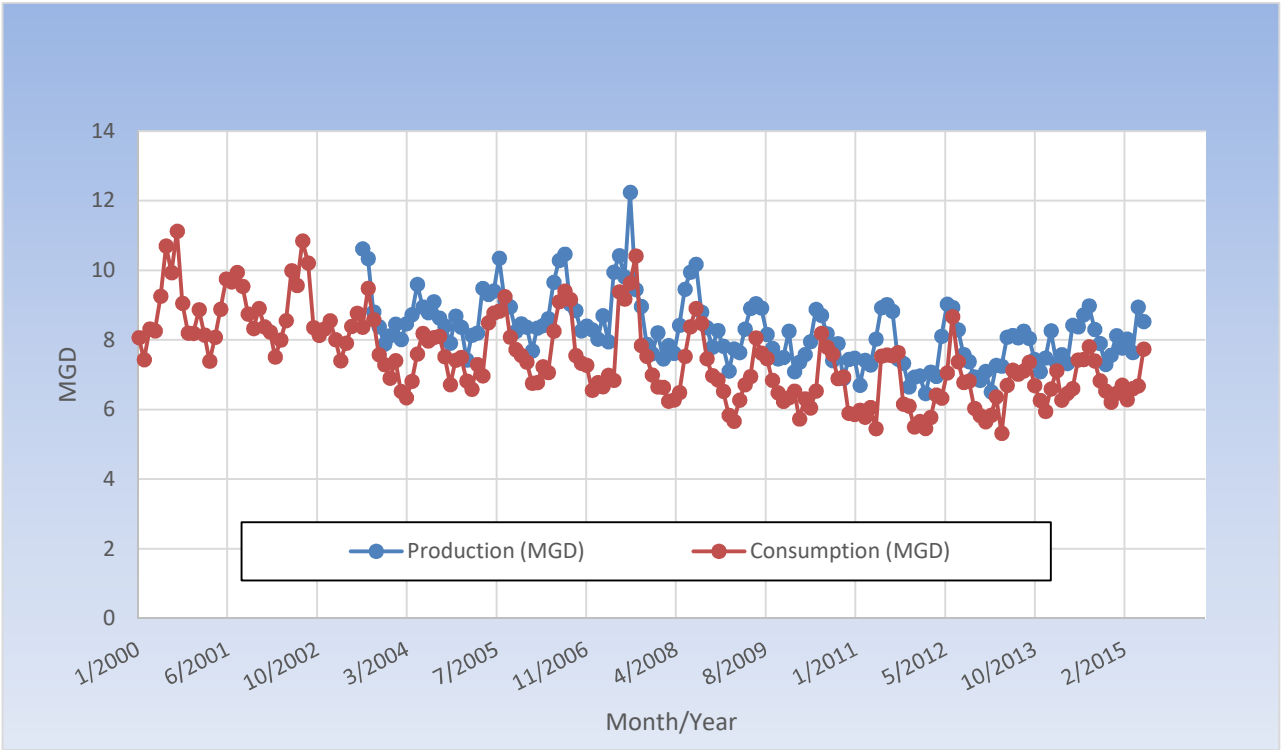
Figure B-6. Historical and Projected Population – Columbia Power and Water Systems



B.2.2 Production and Consumption

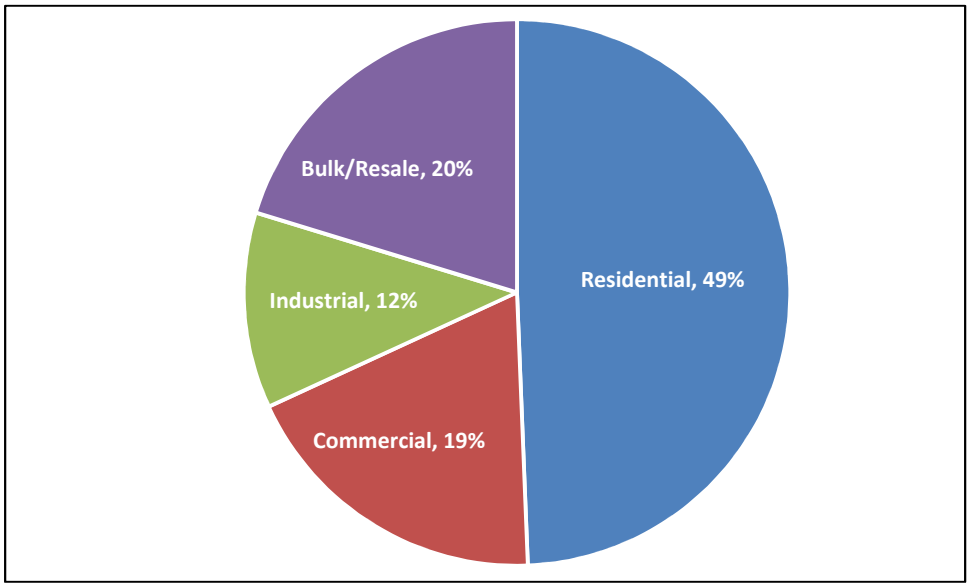
Total water production and consumption (billed water) data was compared over the period 2000-2015. Water production data was measured at its respective sources. Water consumption data was measured at the customer meters. The Water System's total production versus total consumption for the service area is presented in the following figure. By year 2008, CPWS account Saturn car manufacturer closed yielding a reduction in demand. More specifically, the assembly line for Saturn closed in 2007, with the final day of production March 30, 2007 (Daily Herald, 2015). The plant continued to make parts through 2007 and was officially closed in 2008.

Figure B-7. Total Production vs. Total Consumption – Columbia Power and Water Systems



Each Duck River Water System has a variety of customer categories utilized in their billing system. This Water System has organized users into Residential, Commercial, Industrial, and Bulk/Resale categories. Residential is the largest category of water users, using 49% of the water consumed. The following figure illustrates the water usage breakdowns within the Water System's service area based on historical water use in years 2010-2015.

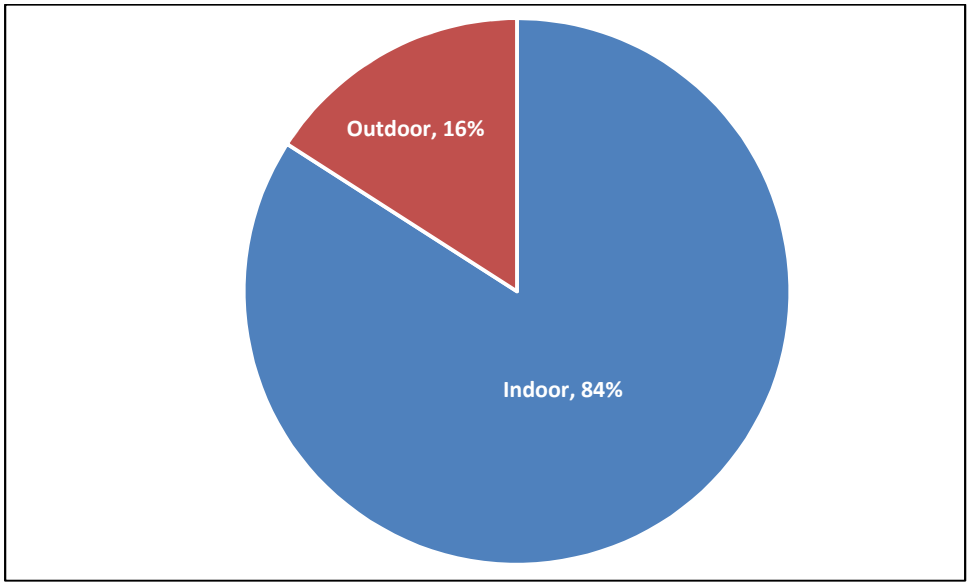
Figure B-8. Consumption by Customer Category – Columbia Power and Water Systems



Note: Figure is based on water use in years 2010-2015.

The following figure shows the breakdown of water use into indoor and outdoor components based on the assumption that indoor use is approximately equal to the minimum use in the winter. While there may be minimal landscape watering in the winter, or leakage from irrigation systems, it is assumed that this is minor at less than 5-10% of the average winter water use.

Figure B-9. Overall Use: Indoor vs. Outdoor – Columbia Power and Water Systems



Note: Figure is based on average water use in years 2010-2014.

B.2.3 Water Use Data Analysis and Key Inputs to the DSS Model

The following table shows the key inputs and assumptions used in the Water System's DSS Model.

Table B-5. Water Use Data Analysis and DSS Model Key Inputs and Assumptions – Columbia Power and Water Systems

Parameter	Model Input Values, Sources and Assumptions
Model Start Year	2015
Water Demand Factor Year(s) [Base Year(s)]	2010-2015
Non-Revenue Water in Start Year	14.4%
	This value is based on 2010-2014 and can be found in the green NRW section of each Water System's DSS Model.
Population Projection Source	CBER-UT
Employment Projection Source	BLS 2010-2015 average annual historical employment for Maury County
Base Year Water Use Profile	

Parameter	Model Input Values, Sources and Assumptions				
Customer Categories	**Start Year Accounts**	**Total Water Use Distribution**	**Demand Factors (gpd/acct)**	**Indoor Use %**	**Residential Indoor Water Use**
Residential	18,236	49%	175	87%	69
Commercial	2,175	19%	557	79%	N/A
Industrial	25	12%	29,894	64%	N/A
Bulk/Resale	45	20%	28,956	93%	N/A
Total	20,481	100%	N/A	84%	N/A

B.2.4 Water System Demand Projections

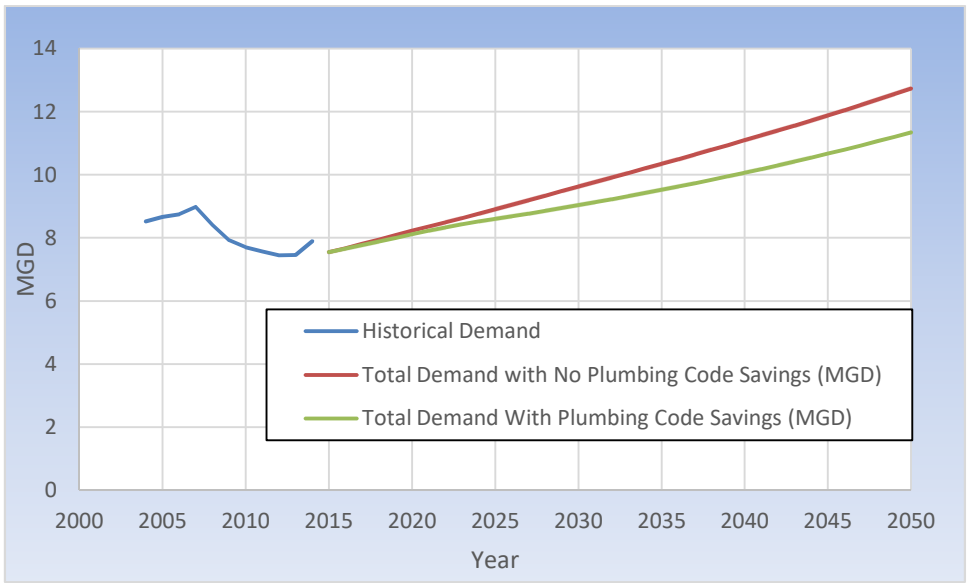
The following table and figure present the average day water demand projections for the Water System.

Table B-6. Demand Projections – Columbia Power and Water Systems

Demand Forecast	2015	2020	2025	2030	2035	2040	2045	2050
Total Demand Without Plumbing Code Savings (MGD)	7.54	8.22	8.91	9.63	10.35	11.10	11.88	12.74
Total Demand With Plumbing Code Savings (MGD)	7.54	8.12	8.60	9.04	9.52	10.07	10.67	11.35

Note: Total Demand accounts for the total projected water demand in a service area Water System regardless of source. Source can be from surface water or groundwater.

Figure B-10. Demand Projection – Columbia Power and Water Systems



B.3 Lewisburg Water and Wastewater

This section presents Lewisburg Water and Wastewater's historical and projected population and employment, historical production and consumption, DSS Model input values, sources and assumptions as well as projected demands with and without plumbing codes.

B.3.1 Demographic Data

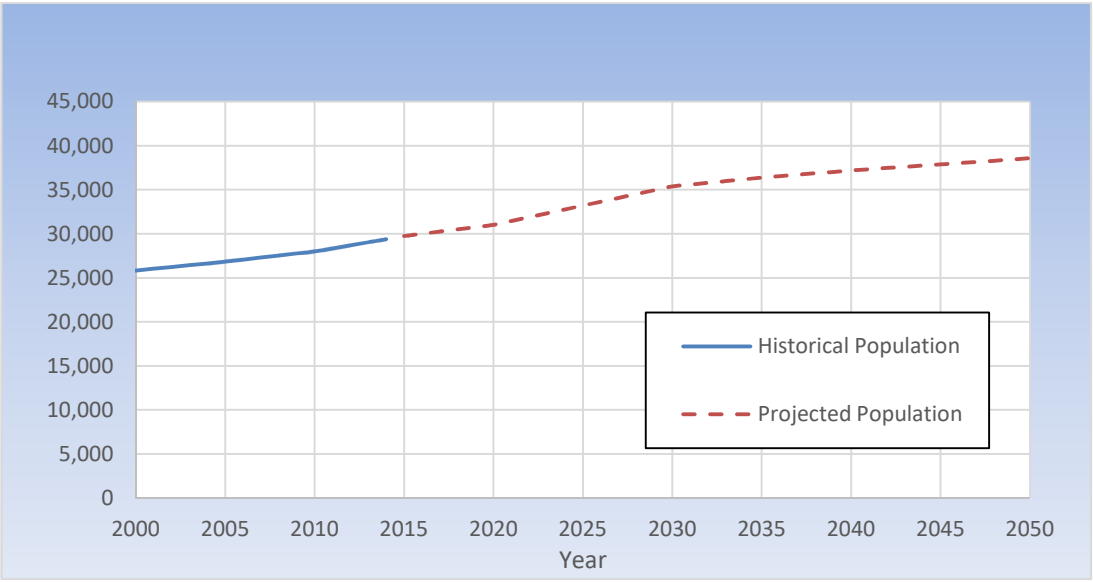
Population projections were obtained through year 2030 from the June 2009 joint publication of the *Population Projections for the State of Tennessee, 2010-2030* by the TAC on Intergovernmental Relations and the CBER-UT. Population projections from 2035 through 2050 were derived using CBER-UT's projections for Marshall County. Employment projections were based on Marshall County's employment rate from 2010-2015 of 3.15%. The actual number of jobs was not provided or determined for the Water System, rather the 2010-2015 average employment growth was applied to non-residential account growth through year 2050. The historical county employment was provided by the BLS of the U.S. Department of Labor (US Dept. of Labor, 2016).

The following table and figure present the historical and projected population for the water supplier.

Table B-7. Historical and Projected Population – Lewisburg Water and Wastewater

	2010	2015	2020	2025	2030	2035	2040	2045	2050
Population	27,999	29,735	31,009	33,196	35,376	36,368	37,181	37,872	38,563

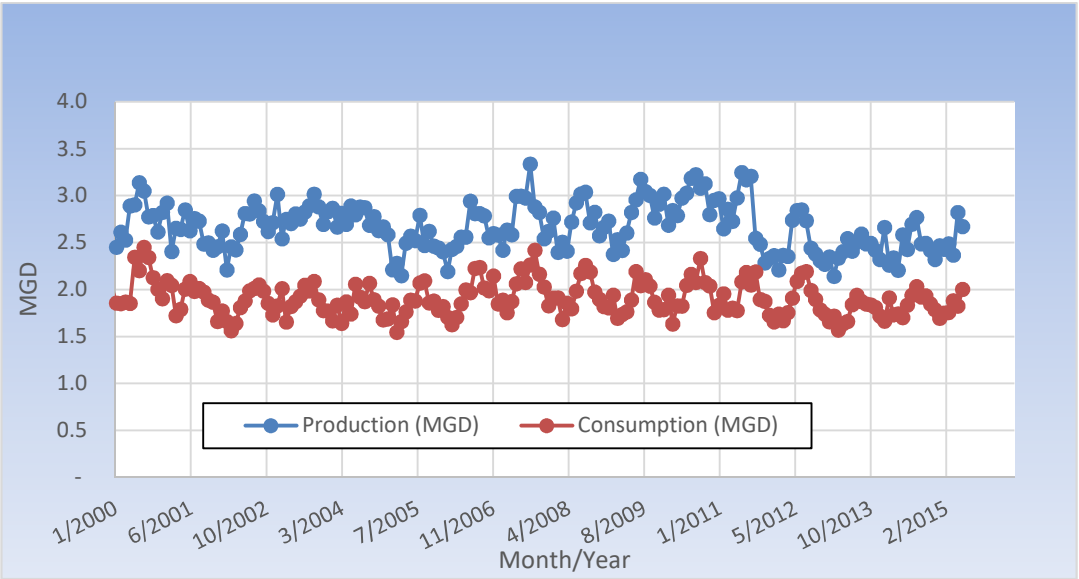
Figure B-11. Historical and Projected Population – Lewisburg Water and Wastewater



B.3.2 Production and Consumption

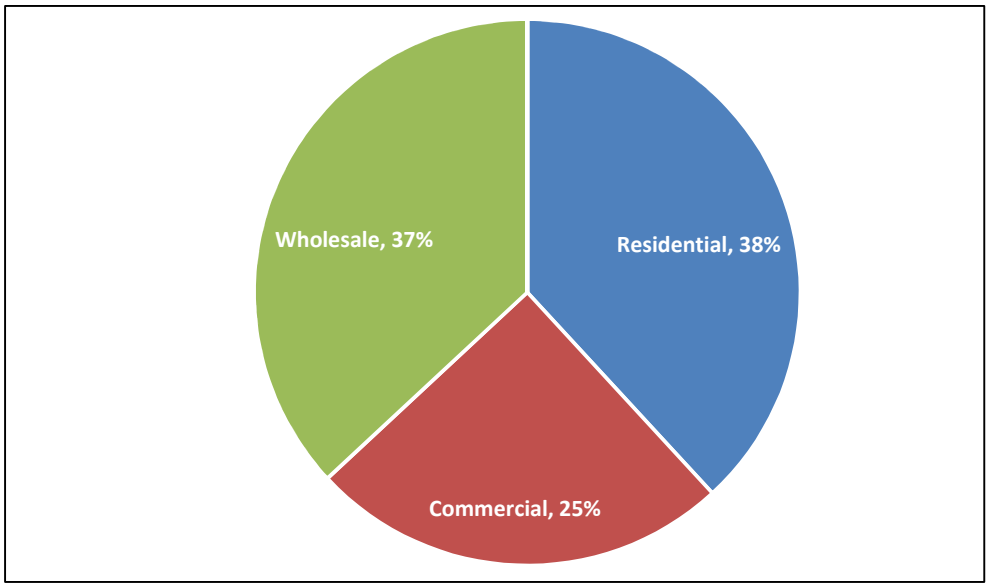
Total water production and consumption (billed water) data was compared over the period 2000-2015. Water production data was measured at its respective sources. Water consumption data was measured at the customer meters. The Water System's total production versus total consumption for the service area is presented in the following figure.

Figure B-12. Total Production vs. Total Consumption – Lewisburg Water and Wastewater



Each Duck River Water System has a variety of customer categories utilized in their billing system. This Water System has organized users into Residential, Commercial, and Wholesale categories. Residential is the largest category of water users, using 38% of the water consumed. The following figure illustrates the water usage breakdowns within the Water System's service area based on historical water use in years 2010-2015.

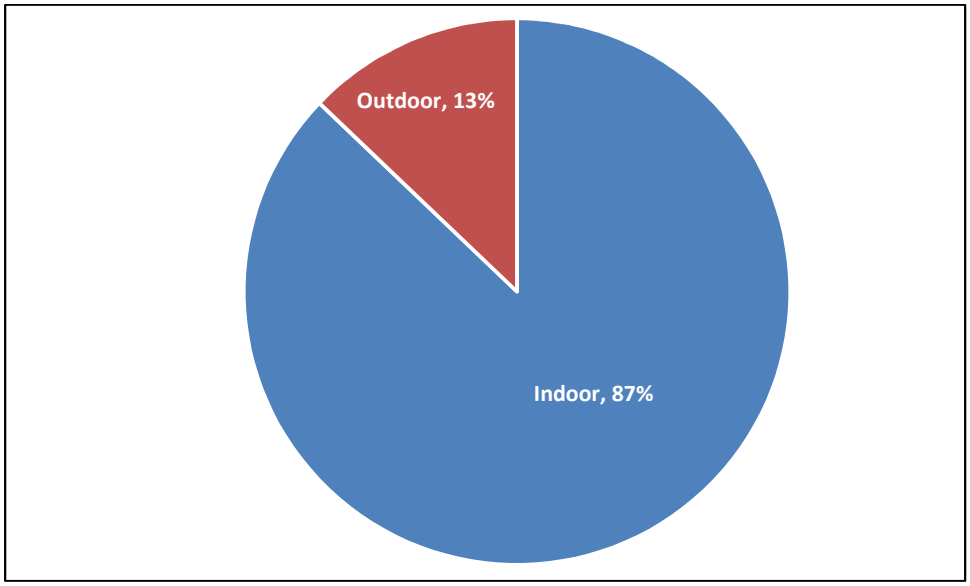
Figure B-13. Consumption by Customer Category – Lewisburg Water and Wastewater



Note: Figure is based on water use in years 2010-2015.

The following figure shows the breakdown of water use into indoor and outdoor components based on the assumption that indoor use is approximately equal to the minimum use in the winter. While there may be minimal landscape watering in the winter, or leakage from irrigation systems, it is assumed that this is minor at less than 5-10% of the average winter water use.

Figure B-14. Overall Use: Indoor vs. Outdoor – Lewisburg Water and Wastewater



Note: Figure is based on average water use in years 2010-2014.

B.3.3 Water Use Data Analysis and Key Inputs to the DSS Model

The following table shows the key inputs and assumptions used in the Water System's DSS Model.

Table B-8. Water Use Data Analysis and DSS Model Key Inputs and Assumptions – Lewisburg Water and Wastewater

Parameter	Model Input Values, Sources and Assumptions				
Model Start Year	2015				
Water Demand Factor Year(s) [Base Year(s)]	2010-2015				
Non-Revenue Water in Start Year	28.7%				
	This value is based on 2010-2014 and can be found in the green NRW section of each Water System's DSS Model.				
Population Projection Source	CBER-UT				
Employment Projection Source	BLS 2010-2015 average annual historical employment for Marshall County				
Base Year Water Use Profile					
Customer Categories	**Start Year Accounts**	**Total Water Use Distribution**	**Demand Factors (gpd/acct)**	**Indoor Use %**	**Residential Indoor Water Use**
Residential	5,616	38%	119	89%	51
Commercial	672	25%	652	86%	N/A

Parameter	Model Input Values, Sources and Assumptions				
Wholesale	11	37%	58,974	86%	N/A
Total	6,299	100%	N/A	87%	N/A

B.3.4 Water System Demand Projections

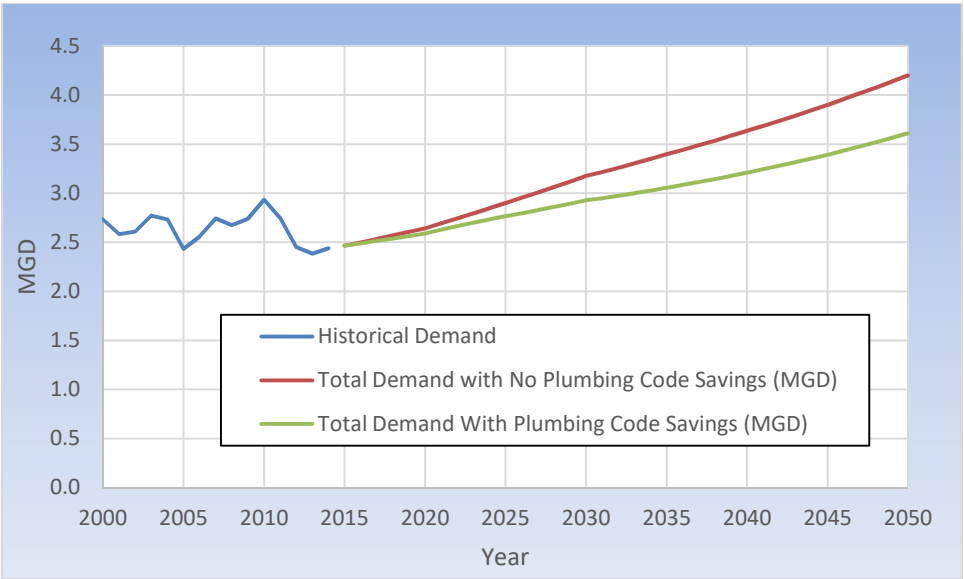
The following table and figure present the average day water demand projections for the Water System.

Table B-9. Demand Projections – Lewisburg Water and Wastewater

Demand Forecast	2015	2020	2025	2030	2035	2040	2045	2050
Total Demand Without Plumbing Code Savings (MGD)	2.47	2.64	2.90	3.17	3.40	3.64	3.90	4.20
Total Demand With Plumbing Code Savings (MGD)	2.47	2.59	2.76	2.93	3.06	3.21	3.39	3.61

Note: Total Demand accounts for the total projected water demand in a service area Water System regardless of source. Source can be from surface water or groundwater.

Figure B-15. Demand Projection – Lewisburg Water and Wastewater



B.4 Manchester Water and Sewer Department

This section presents Manchester Water and Sewer Department's historical and projected population and employment, historical production and consumption, DSS Model input values, sources and assumptions as well as projected demands with and without plumbing codes.

B.4.1 Demographic Data

Population projections were obtained through year 2030 from the June 2009 joint publication of the *Population Projections for the State of Tennessee, 2010-2030* by the TAC on Intergovernmental Relations and the CBER-UT.

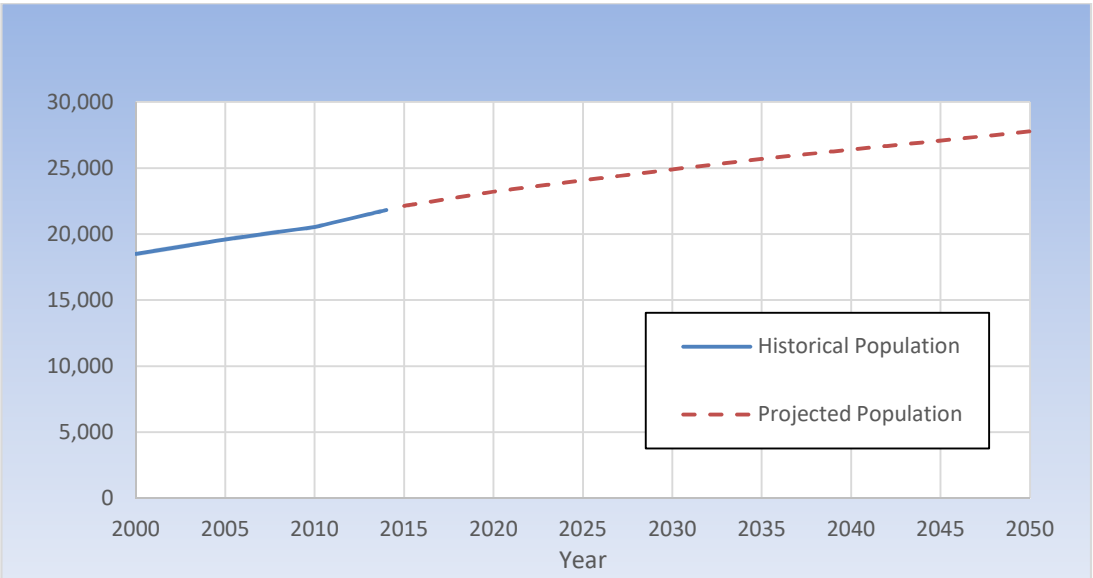
Population projections from 2035 through 2050 were derived using CBER-UT's projections for Coffee County. Employment projections were based on Coffee County's employment rate from 2010-2015 of 2.83%. The actual number of jobs was not provided or determined for the Water System, rather the 2010-2015 average employment growth was applied to non-residential account growth through year 2050. The historical county employment was provided by the BLS of the U.S. Department of Labor (US Dept. of Labor, 2016).

The following table and figure present the historical and projected population for the water supplier.

Table B-10. Historical and Projected Population – Manchester Water and Sewer Department

	2010	2015	2020	2025	2030	2035	2040	2045	2050
Population	20,536	22,139	23,217	24,069	24,901	25,695	26,406	27,079	27,779

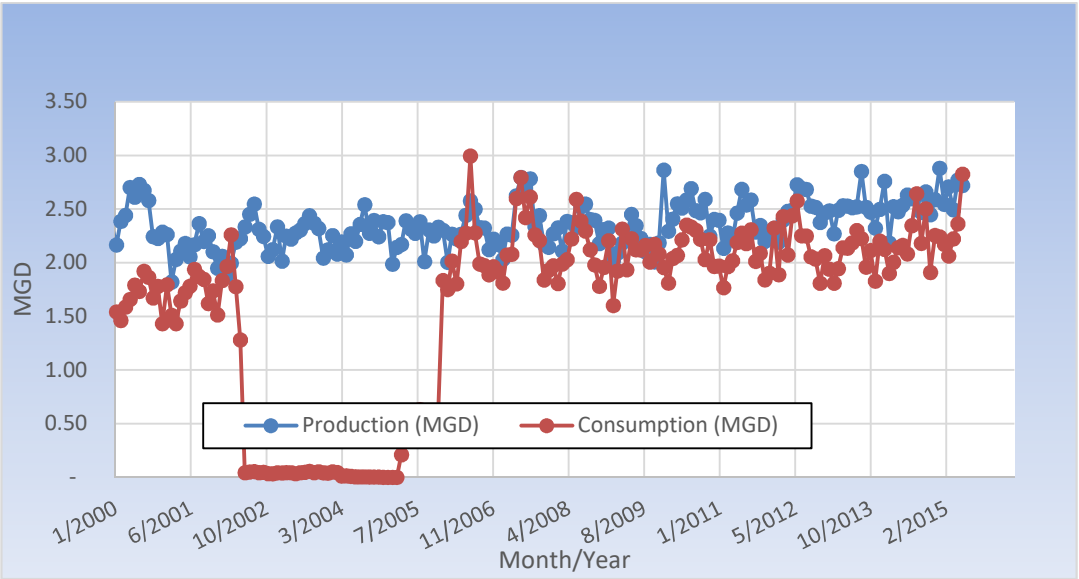
Figure B-16. Historical and Projected Population – Manchester Water and Sewer Department



B.4.2 Production and Consumption

Total water production and consumption (billed water) data was compared over the period 2000-2015. Please note 2002-2005 consumption data is NOT accurately presented. Water production data was measured at its respective sources. Water consumption data was measured at the customer meters. The Water System's total production versus total consumption for the service area is presented in the following figure.

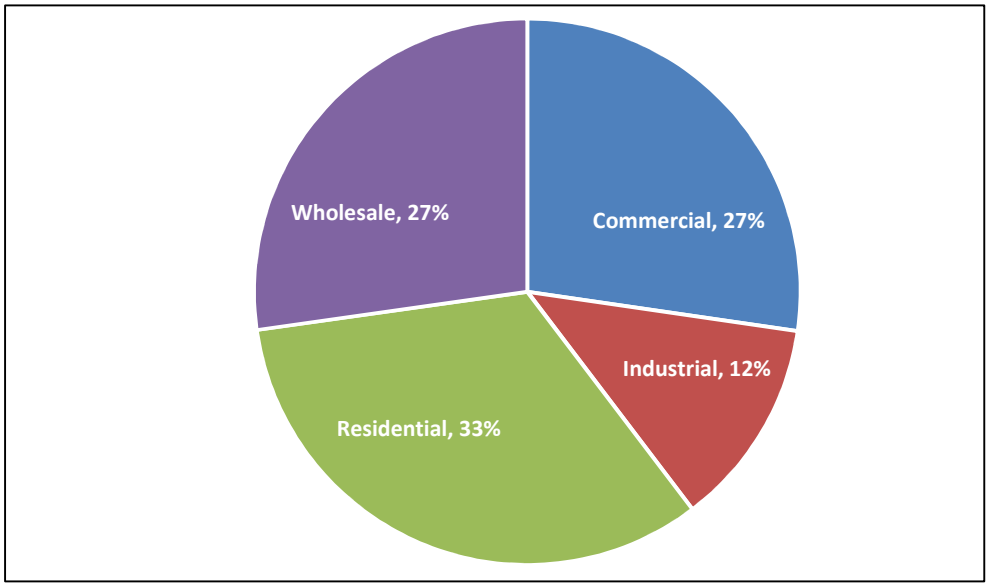
Figure B-17. Total Production vs. Total Consumption – Manchester Water and Sewer Department



Note: 2002-2005 consumption data is NOT accurately presented.

Each Duck River Water System has a variety of customer categories utilized in their billing system. This Water System has organized users into Residential, Commercial, Industrial, and Wholesale categories. Residential is the largest category of water users, using 33% of the water consumed. The following figure illustrates the water usage breakdowns within the Water System's service area based on historical water use in years 2010-2015.

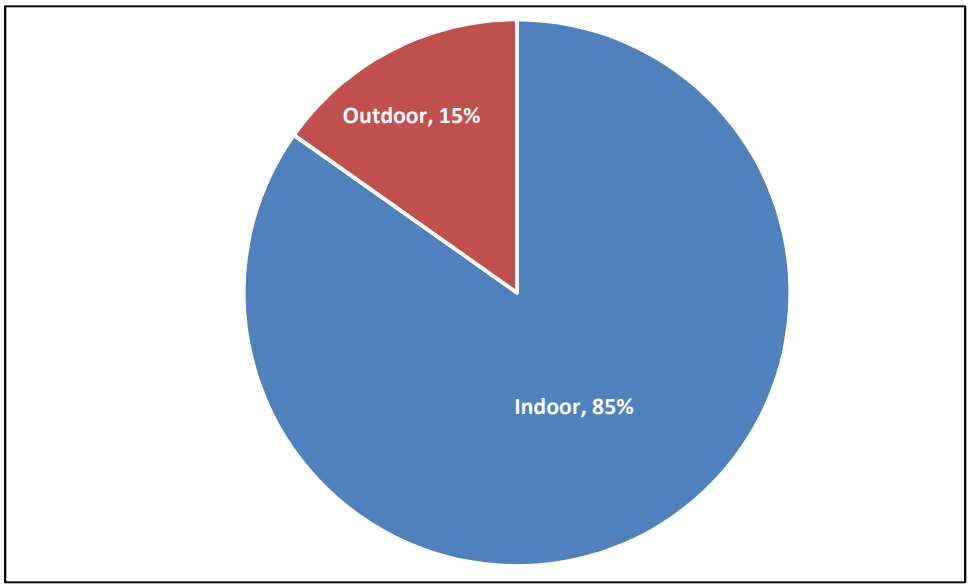
Figure B-18. Consumption by Customer Category – Manchester Water and Sewer Department



Note: Figure is based on water use in years 2010-2015.

The following figure shows the breakdown of water use into indoor and outdoor components based on the assumption that indoor use is approximately equal to the minimum use in the winter. While there may be minimal landscape watering in the winter, or leakage from irrigation systems, it is assumed that this is minor at less than 5-10% of the average winter water use.

Figure B-19. Overall Use: Indoor vs. Outdoor – Manchester Water and Sewer Department



Note: Figure is based on average water use in years 2010-2014.

B.4.3 Water Use Data Analysis and Key Inputs to the DSS Model

The following table shows the key inputs and assumptions used in the Water System's DSS Model.

Table B-11. Water Use Data Analysis and DSS Model Key Inputs and Assumptions – Manchester Water and Sewer Department

Parameter	Model Input Values, Sources and Assumptions				
Model Start Year	2015				
Water Demand Factor Year(s) [Base Year(s)]	2010-2015				
Non-Revenue Water in Start Year	14.5%				
	This value is based on 2010-2014 and can be found in the green NRW section of each Water System's DSS Model.				
Population Projection Source	CBER-UT				
Employment Projection Source	BLS 2010-2015 average annual historical employment for Coffee County				
Base Year Water Use Profile					
Customer Categories	**Start Year Accounts**	**Total Water Use Distribution**	**Demand Factors (gpd/acct)**	**Indoor Use %**	**Residential Indoor Water Use**
Commercial	751	27%	766	81%	N/A
Industrial	47	12%	5,554	79%	N/A
Residential	5,704	33%	122	86%	44
Wholesale	8	27%	71,653	90%	N/A

Parameter	Model Input Values, Sources and Assumptions				
Total	6,509	100%	N/A	85%	N/A

B.4.4 Water System Demand Projections

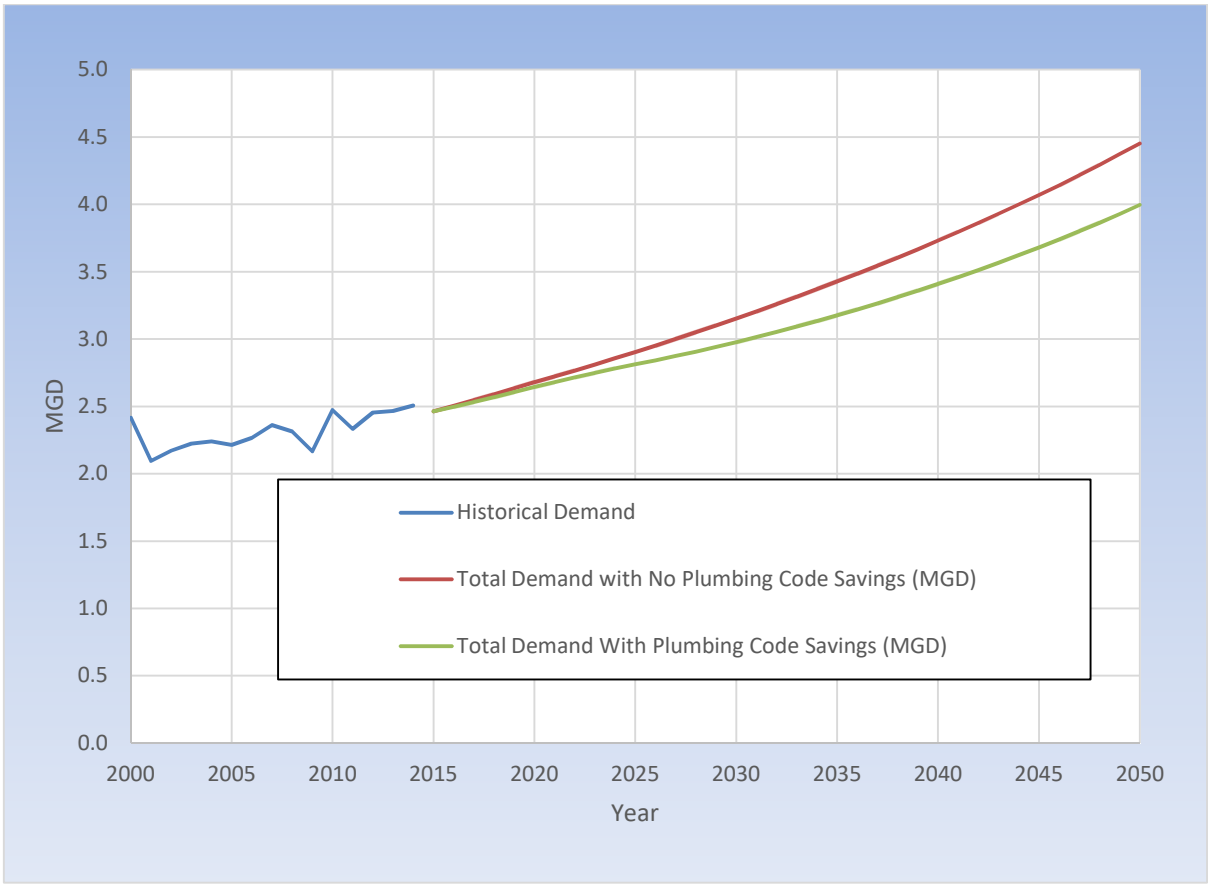
The following table and figure present the average day water demand projections for the Water System.

Table B-12. Demand Projections – Manchester Water and Sewer Department

Demand Forecast	2015	2020	2025	2030	2035	2040	2045	2050
Total Demand Without Plumbing Code Savings (MGD)	2.46	2.68	2.90	3.15	3.43	3.73	4.07	4.45
Total Demand With Plumbing Code Savings (MGD)	2.46	2.64	2.81	2.98	3.18	3.41	3.68	3.99

Note: Total Demand accounts for the total projected water demand in a service area Water System regardless of source. Source can be from surface water or groundwater.

Figure B-20. Demand Projection – Manchester Water and Sewer Department



B.5 Shelbyville Power, Water, and Sewerage System

This section presents Shelbyville Power, Water, and Sewerage System's historical and projected population and employment, historical production and consumption, DSS Model input values, sources and assumptions as well as projected demands with and without plumbing codes.

B.5.1 Demographic Data

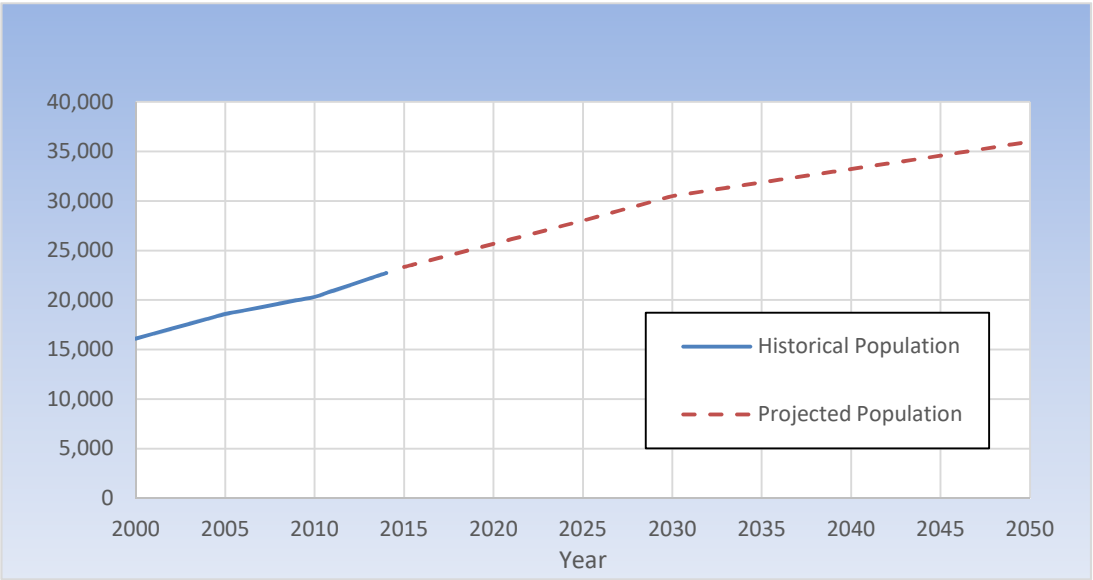
Population projections were obtained through year 2030 from the June 2009 joint publication of the *Population Projections for the State of Tennessee, 2010-2030* by the TAC on Intergovernmental Relations and the CBER-UT. Population projections from 2035 through 2050 were derived using CBER-UT's projections for Bedford County. Employment projections were based on Bedford County's employment rate from 2010-2015 of 1.48%. The actual number of jobs was not provided or determined for the Water System, rather the 2010-2015 average employment growth was applied to non-residential account growth through year 2050. The historical county employment was provided by the BLS of the U.S. Department of Labor (US Dept. of Labor, 2016).

The following table and figure present the historical and projected population for the water supplier.

Table B-13. Historical and Projected Population – Shelbyville Power, Water, and Sewerage System

	2010	2015	2020	2025	2030	2035	2040	2045	2050
Population	20,322	23,330	25,661	28,009	30,481	31,867	33,213	34,563	35,993

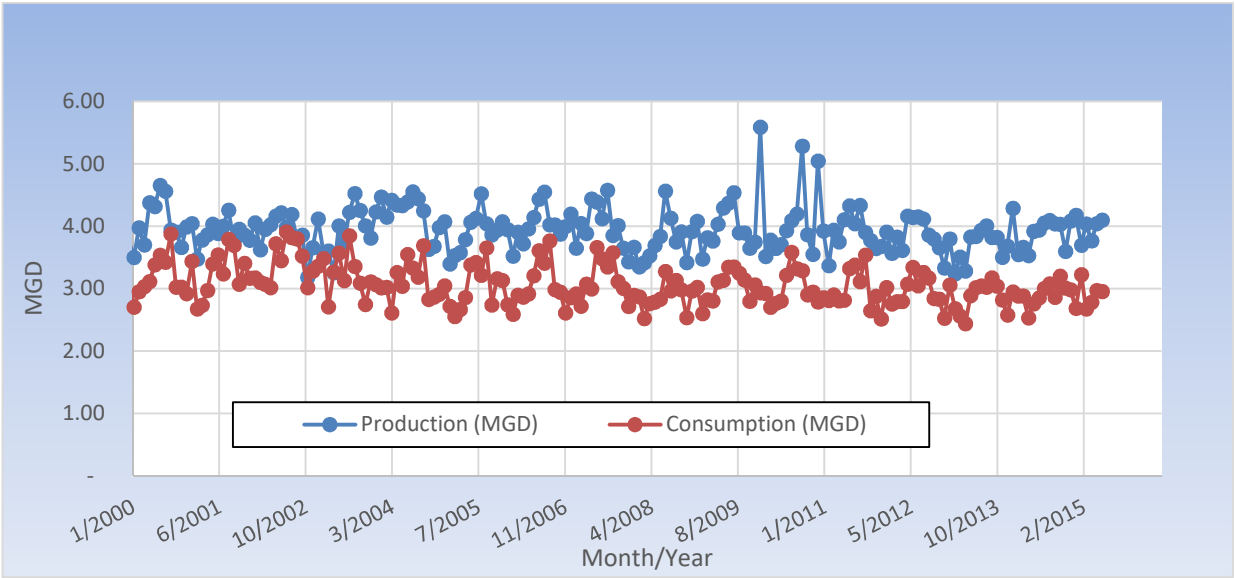
Figure B-21. Historical and Projected Population – Shelbyville Power, Water, and Sewerage System



B.5.2 Production and Consumption

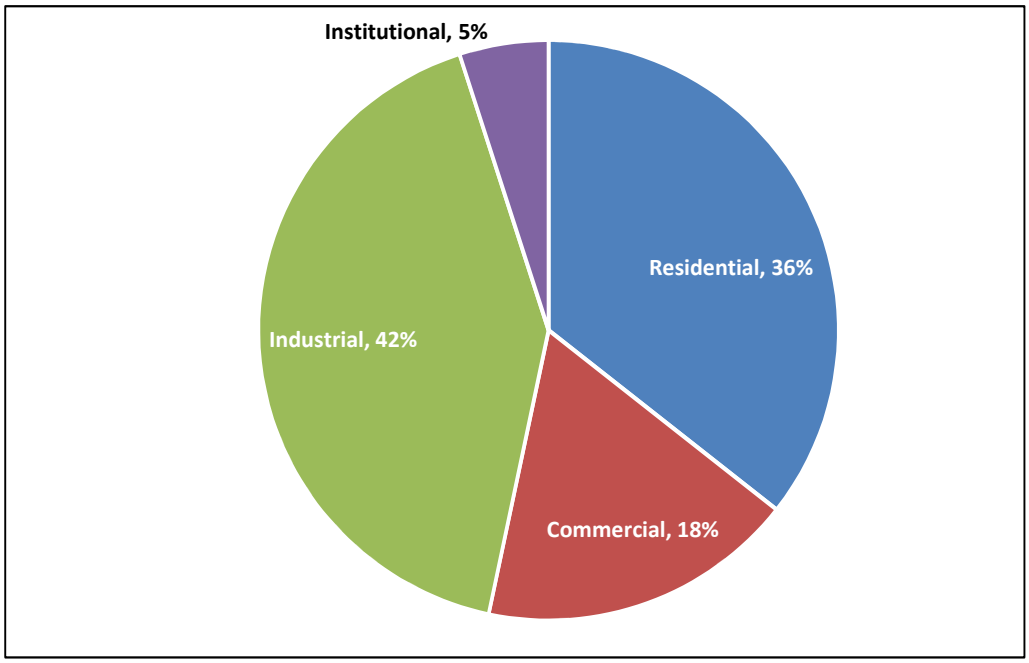
Total water production and consumption (billed water) data was compared over the period 2000-2015. Water production data was measured at its respective sources. Water consumption data was measured at the customer meters. The Water System's total production versus total consumption for the service area is presented in the following figure.

Figure B-22. Total Production vs. Total Consumption – Shelbyville Power, Water, and Sewerage System



Each Duck River Water System has a variety of customer categories utilized in their billing system. This Water System has organized users into Residential, Commercial, Industrial, and Institutional categories. Industrial is the largest category of water users, using 42% of the water consumed. The following figure illustrates the water usage breakdowns within the Water System's service area based on historical water use in years 2010-2015.

Figure B-23. Consumption by Customer Category – Shelbyville Power, Water, and Sewerage System

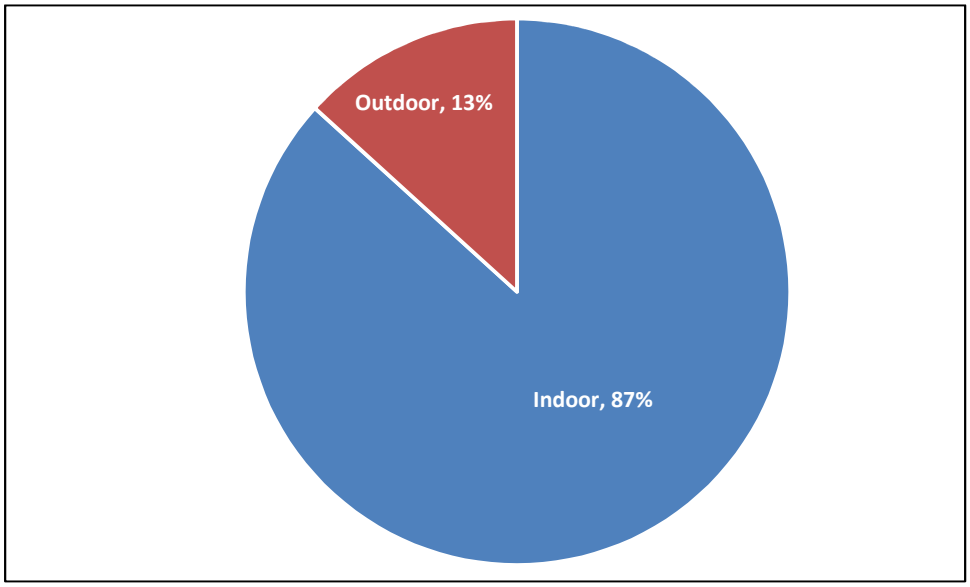


Note: Figure is based on water use in years 2010-2015.

The following figure shows the breakdown of water use into indoor and outdoor components based on the assumption that indoor use is approximately equal to the minimum use in the winter. While there may be minimal landscape watering in the winter, or leakage from irrigation systems, it is assumed that this is minor at less than 5-10% of the

average winter water use. Residential indoor water use is assumed to be 95% of total water use due to minimal irrigation.

Figure B-24. Overall Use: Indoor vs. Outdoor – Shelbyville Power, Water, and Sewerage System



Note: Figure is based on average water use in years 2010-2014.

B.5.3 Water Use Data Analysis and Key Inputs to the DSS Model

The following table shows the key inputs and assumptions used in the Water System's DSS Model. NRW is high due to the large number of dead-end lines and the size of distribution lines required for fire protection in the Water System which requires frequent flushing. Flushing is needed to meet state limits for halocitic and trihalomethane levels in the distribution system.

Table B-14. Water Use Data Analysis and DSS Model Key Inputs and Assumptions – Shelbyville Power, Water, and Sewerage System

Parameter	Model Input Values, Sources and Assumptions
Model Start Year	2015
Water Demand Factor Year(s) [Base Year(s)]	2010-2015
Non-Revenue Water in Start Year	24.6%
	This value is based on 2010-2014 and can be found in the green NRW section of each Water System's DSS Model.
Population Projection Source	CBER-UT
Employment Projection Source	BLS 2010-2015 average annual historical employment for Bedford County

Parameter	Model Input Values, Sources and Assumptions				
Base Year Water Use Profile					
Customer Categories	**Start Year Accounts**	**Total Water Use Distribution**	**Demand Factors (gpd/acct)**	**Indoor Use %**	**Residential Indoor Water Use**
Residential	7,786	36%	133	95%	42
Commercial	1,077	18%	476	78%	N/A
Industrial	38	42%	31,824	83%	N/A
Institutional	1	5%	143,819	87%	N/A
Total	8,902	100%	N/A	87%	N/A

B.5.4 Water System Demand Projections

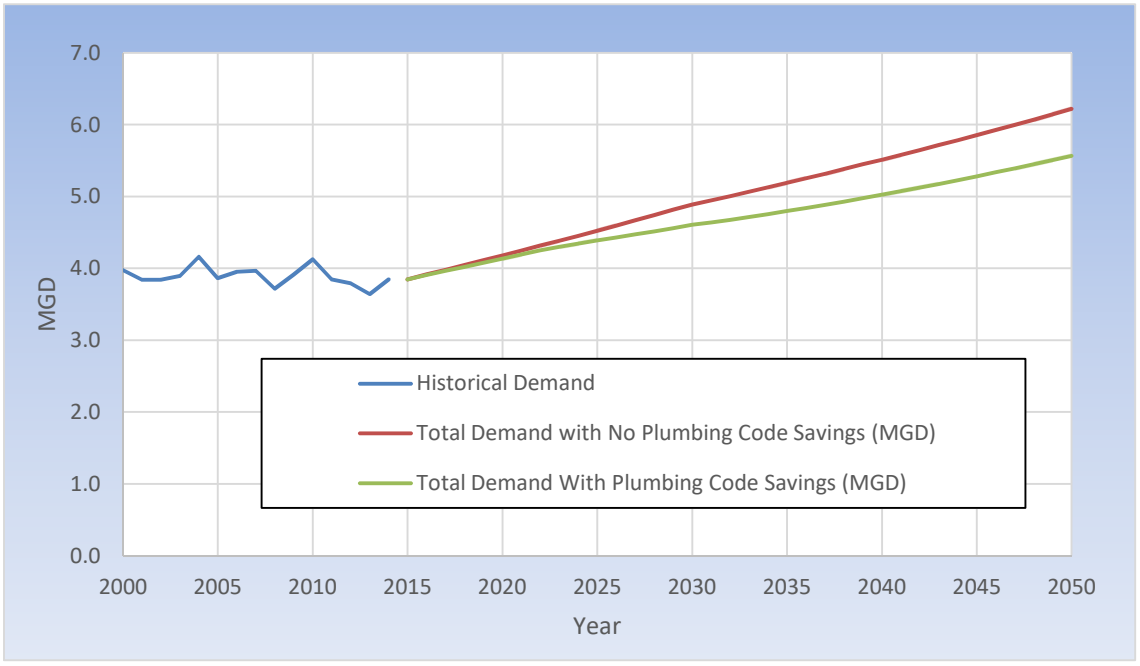
The following table and figure present the average day water demand projections for the Water System.

Table B-15. Demand Projections – Shelbyville Power, Water, and Sewerage System

Demand Forecast	2015	2020	2025	2030	2035	2040	2045	2050
Total Demand Without Plumbing Code Savings (MGD)	3.85	4.18	4.52	4.89	5.19	5.51	5.85	6.22
Total Demand With Plumbing Code Savings (MGD)	3.85	4.13	4.39	4.60	4.80	5.02	5.28	5.57

Note: Total Demand accounts for the total projected water demand in a service area Water System regardless of source. Source can be from surface water or groundwater.

Figure B-25. Demand Projection – Shelbyville Power, Water, and Sewerage System



B.6 Spring Hill Water System

This section presents Spring Hill Water System's historical and projected population and employment, historical production and consumption, DSS Model input values, sources and assumptions as well as projected demands with and without plumbing codes.

B.6.1 Demographic Data

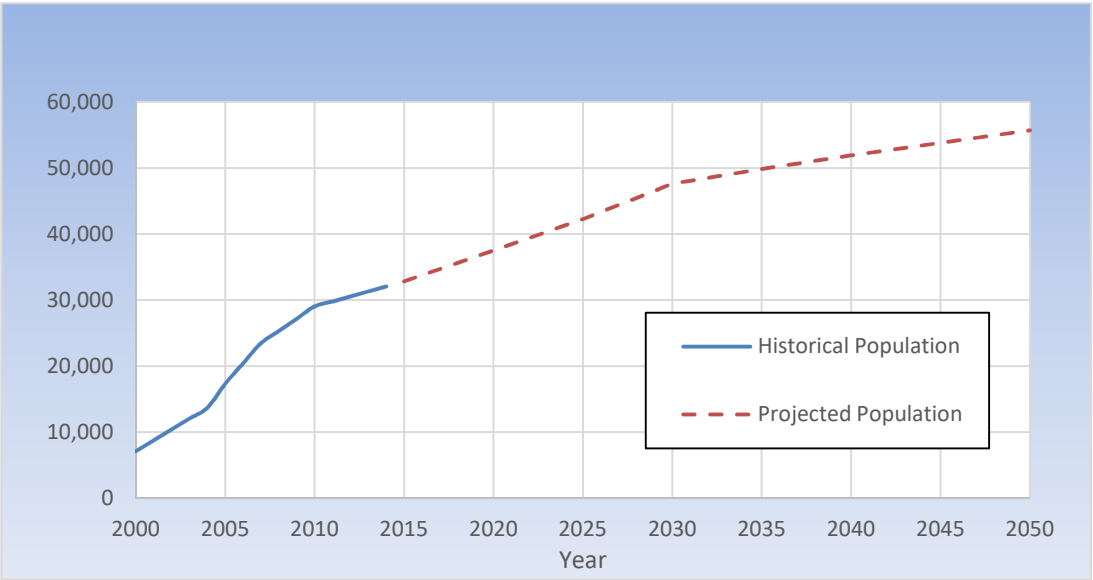
Population projections were obtained through year 2030 from the June 2009 joint publication of the *Population Projections for the State of Tennessee, 2010-2030* by the TAC on Intergovernmental Relations and the CBER-UT. Population projections from 2035 through 2050 were derived using CBER-UT's projections for Maury County. Employment projections were based on Maury County's employment rate from 2010-2015 of 2.43%. The actual number of jobs was not provided or determined for the Water System, rather the 2010-2015 average employment growth was applied to non-residential account growth through year 2050. The historical county employment was provided by the BLS of the U.S. Department of Labor (US Dept. of Labor, 2016).

The following table and figure present the historical and projected population for the water supplier.

Table B-16. Historical and Projected Population – Spring Hill Water System

	2010	2015	2020	2025	2030	2035	2040	2045	2050
Population	29,036	32,807	37,479	42,247	47,565	49,824	51,876	53,778	55,674

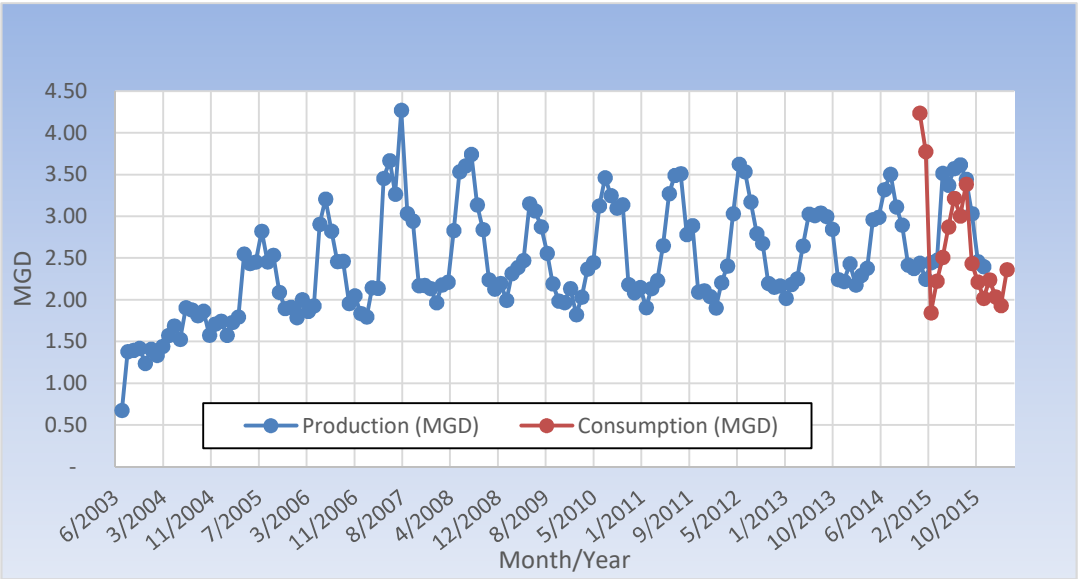
Figure B-26. Historical and Projected Population – Spring Hill Water System



B.6.2 Production and Consumption

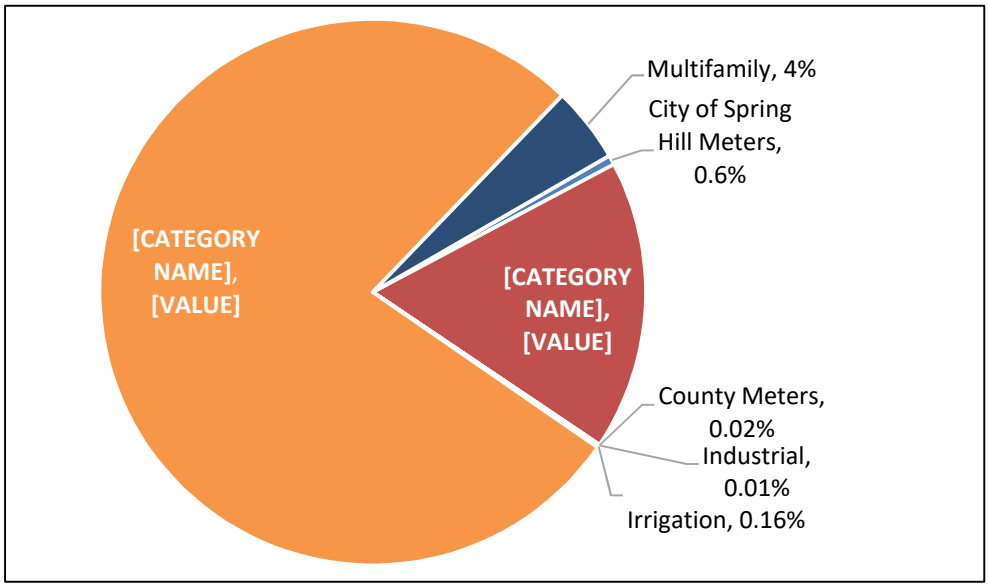
Total water production and consumption (billed water) data was compared over the period 2003-2015. Water production data was measured at its respective sources. Water consumption data was measured at the customer meters. The Water System's total production versus total consumption for the service area is presented in the following figure. Only year 2015 consumption data was available and provided by Spring Hill for the analysis.

Figure B-27. Total Production vs. Total Consumption – Spring Hill Water System



Each Duck River Water System has a variety of customer categories utilized in their billing system. This Water System has organized users into City of Spring Hill Meters, Commercial, County Meters, Industrial, Irrigation, Residential, and Multifamily categories. Residential is the largest category of water users, using 78% of the water consumed. The following figure illustrates the water usage breakdowns within the Water System's service area based on historical water use in year 2015.

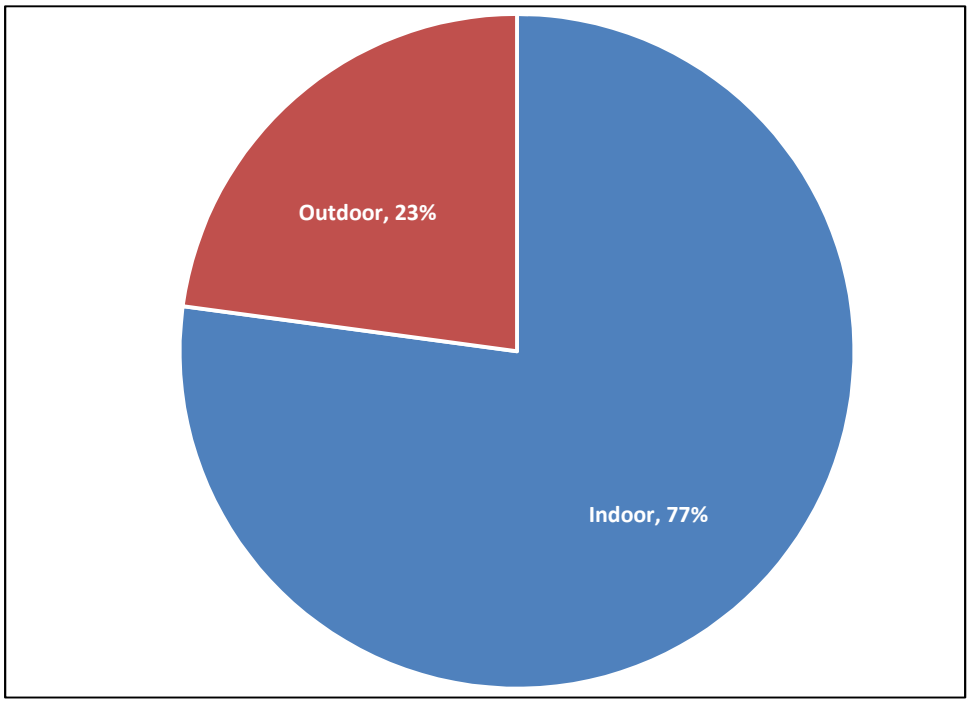
Figure B-28. Consumption by Customer Category – Spring Hill Water System



Note: Figure is based on water use in year 2015.

The following figure shows the breakdown of water use into indoor and outdoor components based on the assumption that indoor use is approximately equal to the minimum use in the winter. While there may be minimal landscape watering in the winter, or leakage from irrigation systems, it is assumed that this is minor at less than 5-10% of the average winter water use.

Figure B-29. Overall Use: Indoor vs. Outdoor – Spring Hill Water System



Note: Figure is based on average water use in year 2015.

B.6.3 Water Use Data Analysis and Key Inputs to the DSS Model

The following table shows the key inputs and assumptions used in the Water System's DSS Model.

Table B-17. Water Use Data Analysis and DSS Model Key Inputs and Assumptions – Spring Hill Water System

Parameter	Model Input Values, Sources and Assumptions				
Model Start Year	2015				
Water Demand Factor Year(s) [Base Year(s)]	2015				
Non-Revenue Water in Start Year	7.0%				
	Since minimal consumption data was available to compare to production data, a conservative value of 7% NRW (which is typical of a new water system) was used. This value can be found in the green NRW section of each Water System's DSS Model.				
Population Projection Source	CBER-UT				
Employment Projection Source	BLS 2010-2015 average annual historical employment for Maury County				
Base Year Water Use Profile					
Customer Categories	**Start Year Accounts**	**Total Water Use Distribution**	**Demand Factors (gpd/acct)**	**Indoor Use %**	**Residential Indoor Water Use**

Parameter	Model Input Values, Sources and Assumptions				
City of Spring Hill Meters	39	1%	370	46%	N/A
Commercial	663	17%	640	65%	N/A
County Meters	3	0%	189	55%	N/A
Industrial	1	0%	198	90%	N/A
Irrigation	2	0%	2,402	0%	N/A
Residential	12,370	78%	155	80%	50
Multifamily	5	4%	21,998	80%	38
Total	**13,082**	**100%**	**N/A**	**77%**	**N/A**

B.6.4 Water System Demand Projections

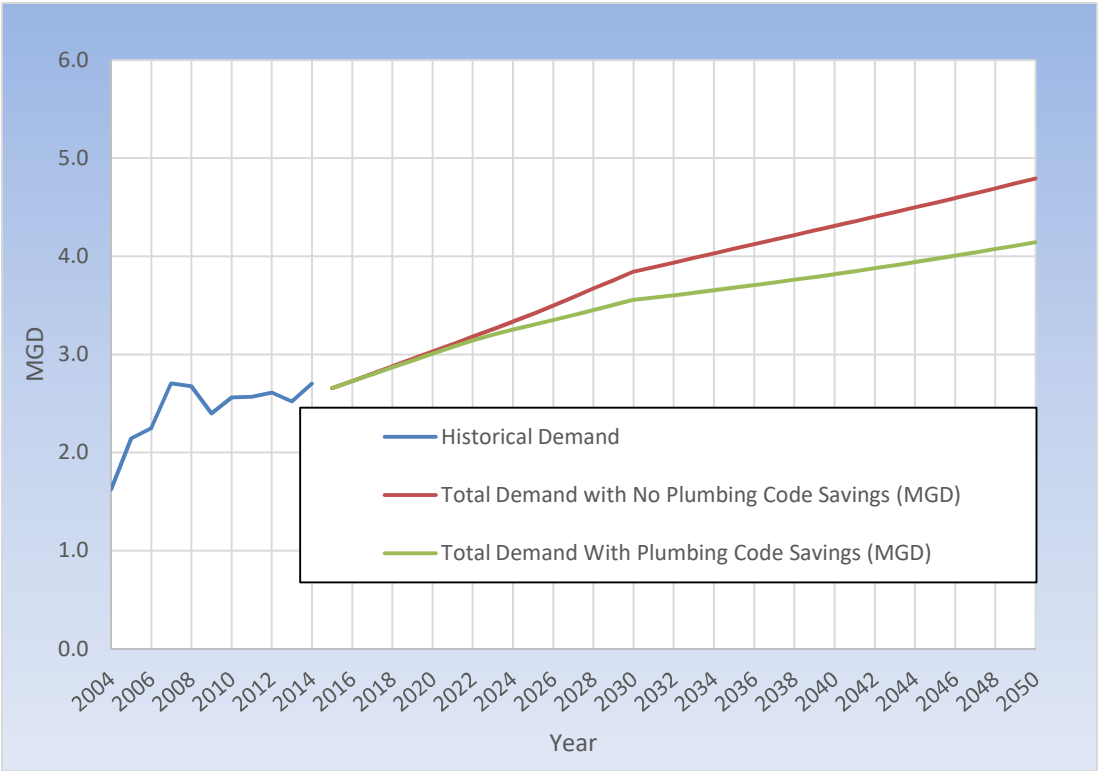
The following table and figure present the average day water demand projections for the Water System.

Table B-18. Demand Projections – Spring Hill Water System

Demand Forecast	2015	2020	2025	2030	2035	2040	2045	2050
Total Demand Without Plumbing Code Savings (MGD)	2.66	3.03	3.41	3.84	4.08	4.31	4.55	4.79
Total Demand With Plumbing Code Savings (MGD)	2.66	3.01	3.30	3.56	3.68	3.82	3.97	4.14

Note: Total Demand accounts for the total projected water demand in a service area Water System regardless of source. Source can be from surface water or groundwater.

Figure B-30. Demand Projection – Spring Hill Water System



B.7 Tullahoma Utilities Board

This section presents Tullahoma Utilities Board's historical and projected population and employment, historical production and consumption, DSS Model input values, sources and assumptions as well as projected demands with and without plumbing codes.

B.7.1 Demographic Data

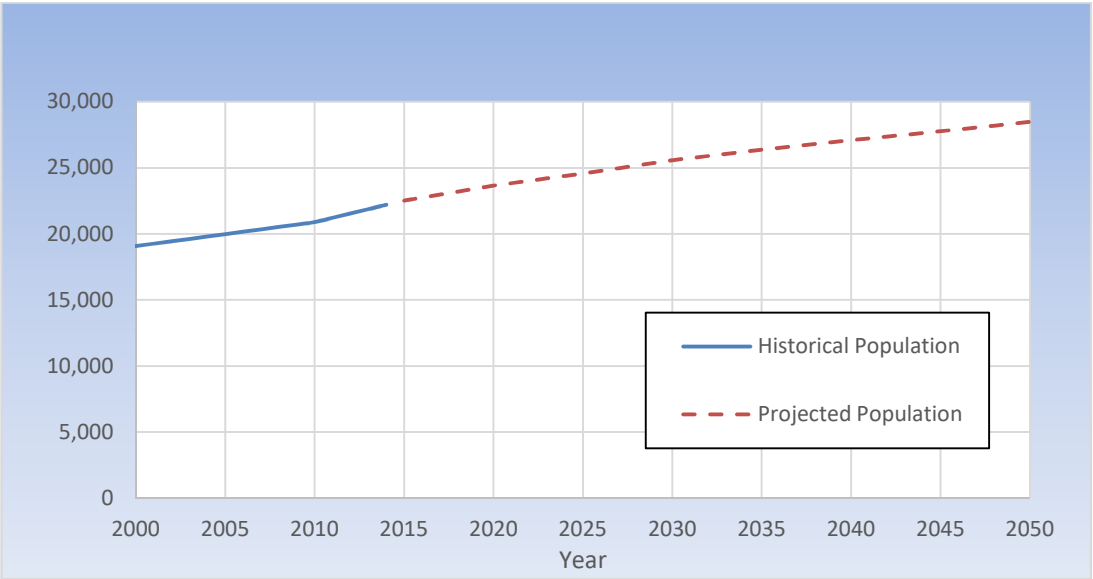
Population projections were obtained through year 2030 from the June 2009 joint publication of the *Population Projections for the State of Tennessee, 2010-2030* by the TAC on Intergovernmental Relations and the CBER-UT. Population projections from 2035 through 2050 were derived using CBER-UT's projections for Coffee County. Employment projections were based on Coffee County's employment rate from 2010-2015 of 2.83%. The actual number of jobs was not provided or determined for the Water System, rather the 2010-2015 average employment growth was applied to non-residential account growth through year 2050. The historical county employment was provided by the BLS of the U.S. Department of Labor (US Dept. of Labor, 2016).

The following table and figure present the historical and projected population for the water supplier.

Table B-19. Historical and Projected Population – Tullahoma Utilities Board

	2010	2015	2020	2025	2030	2035	2040	2045	2050
Population	20,888	22,518	23,655	24,576	25,581	26,385	27,103	27,781	28,486

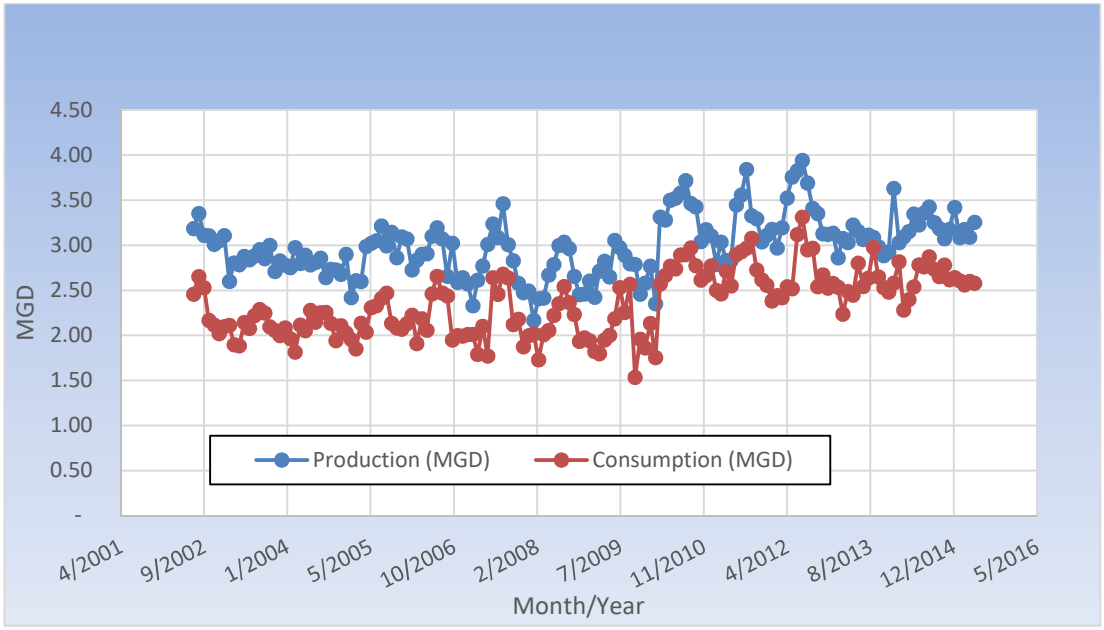
Figure B-31. Historical and Projected Population – Tullahoma Utilities Board



B.7.2 Production and Consumption

Total water production and consumption (billed water) data was compared over the period 2002-2015. Water production data was measured at its respective sources. Water consumption data was measured at the customer meters. The Water System's total production versus total consumption for the service area is presented in the following figure.

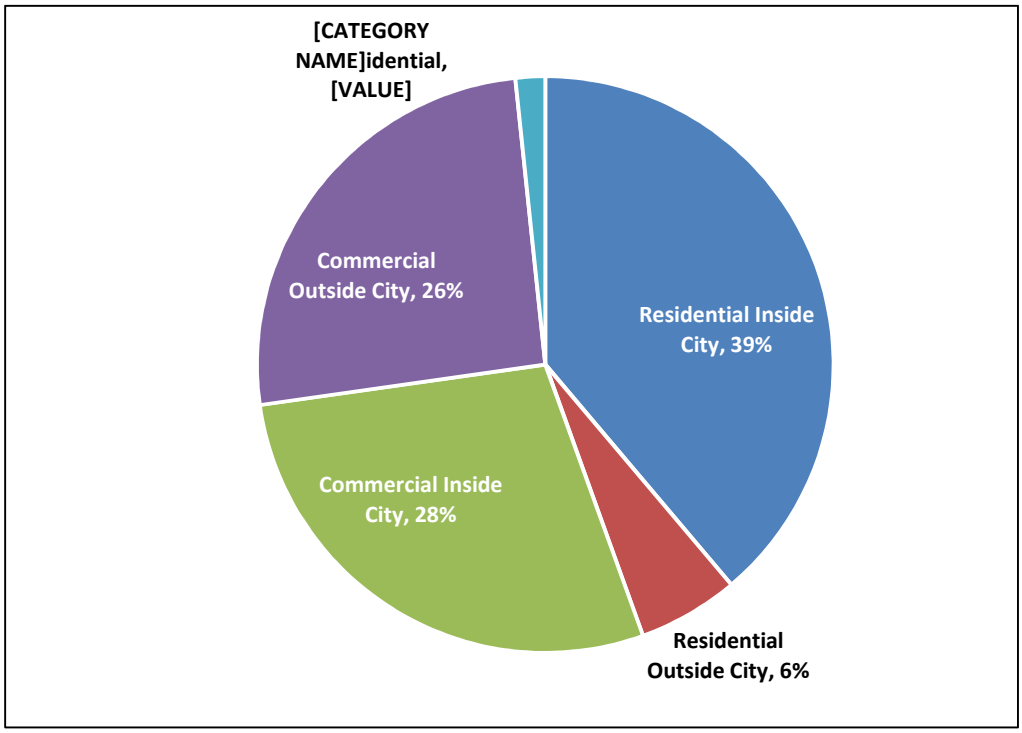
Figure B-32. Total Production vs. Total Consumption – Tullahoma Utilities Board



Each Duck River Water System has a variety of customer categories utilized in their billing system. This Water System has organized users into Residential Inside City, Residential Outside City, Commercial Inside City, Commercial Outside City, and County Line Co-Op Residential categories. Residential Inside City customer category water use is the largest

category of water users, using 39% of the water consumed. The following figure illustrates the water usage breakdowns within the Water System's service area based on historical water use in years 2010-2015.

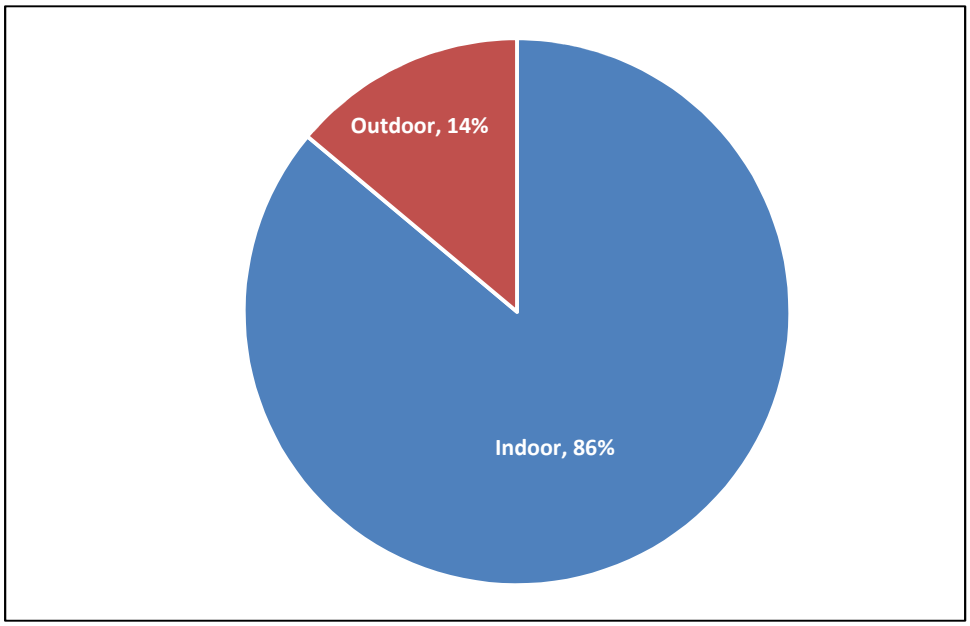
Figure B-33. Consumption by Customer Category – Tullahoma Utilities Board



Note: Figure is based on water use in years 2010-2015.

The following figure shows the breakdown of water use into indoor and outdoor components based on the assumption that indoor use is approximately equal to the minimum use in the winter. While there may be minimal landscape watering in the winter, or leakage from irrigation systems, it is assumed that this is minor at less than 5-10% of the average winter water use. Residential indoor water use is assumed to be 95% of total water use due to minimal irrigation.

Figure B-34. Overall Use: Indoor vs. Outdoor – Tullahoma Utilities Board



Note: Figure is based on average water use in years 2010-2014.

B.7.3 Water Use Data Analysis and Key Inputs to the DSS Model

The following table shows the key inputs and assumptions used in the Water System's DSS Model.

Table B-20. Water Use Data Analysis and DSS Model Key Inputs and Assumptions – Tullahoma Utilities Board

Parameter	Model Input Values, Sources and Assumptions				
Model Start Year	2015				
Water Demand Factor Year(s) [Base Year(s)]	2010-2015				
Non-Revenue Water in Start Year	17.8%				
	This value is based on 2010-2014 and can be found in the green NRW section of each Water System's DSS Model.				
Population Projection Source	CBER-UT				
Employment Projection Source	BLS 2010-2015 average annual historical employment for Coffee County				
Base Year Water Use Profile					
Customer Categories	**Start Year Accounts**	**Total Water Use Distribution**	**Demand Factors (gpd/acct)**	**Indoor Use %**	**Residential Indoor Water Use**

Parameter	Model Input Values, Sources and Assumptions				
Residential Inside City	7,409	39%	132	95%	44
Residential Outside City	988	6%	145	95%	N/A
Commercial Inside City	1,043	28%	685	88%	N/A
Commercial Outside City	46	26%	14,177	69%	N/A
County Line Co-Op Res	278	2%	151	76%	N/A
Total	9,764	100%	N/A	86%	N/A

B.7.4 Water System Demand Projections

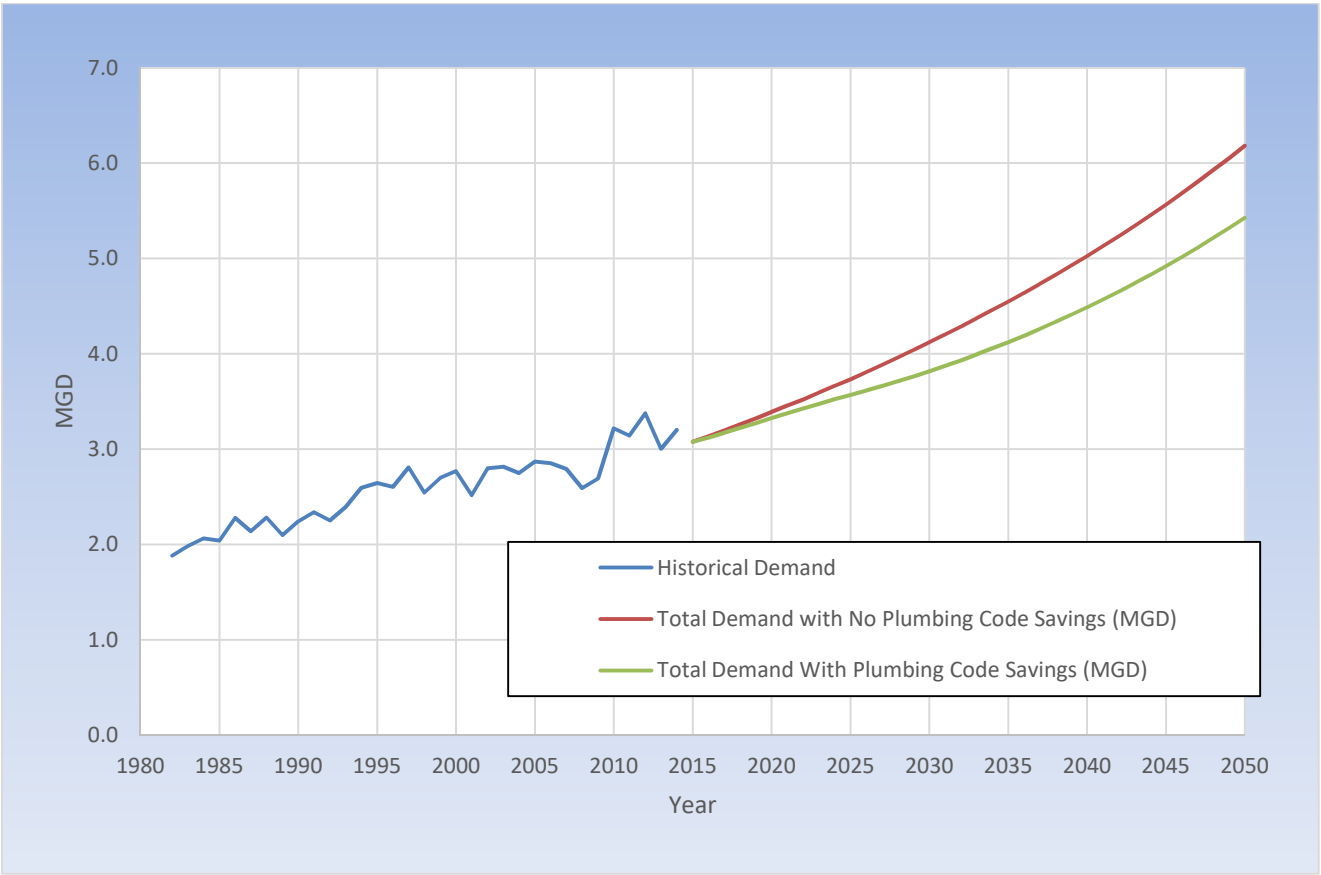
The following table and figure present the average day water demand projections for the Water System.

Table B-21. Demand Projections – Tullahoma Utilities Board

Demand Forecast	2015	2020	2025	2030	2035	2040	2045	2050
Total Demand Without Plumbing Code Savings (MGD)	3.08	3.39	3.73	4.12	4.55	5.03	5.57	6.18
Total Demand With Plumbing Code Savings (MGD)	3.08	3.33	3.57	3.82	4.12	4.49	4.92	5.43

Note: Total Demand accounts for the total projected water demand in a service area Water System regardless of source. Source can be from surface water or groundwater.

Figure B-35. Demand Projection – Tullahoma Utilities Board



APPENDIX C – DEPARTMENT OF WATER RESOURCES PUBLIC WATER SYSTEM STATISTICS REPORT SAMPLE

It is recommended that Water Systems submit standard form/annual report to DRA with monthly or bimonthly production by source and consumption and accounts by category. Service area population and number of employees would also be tracked on this document. A sample document used by California Department of Water Resources is provided below.

State of California — DEPARTMENT OF WATER RESOURCES — California Natural Resources Agency

PUBLIC WATER SYSTEM STATISTICS — Calendar Year **2013**

Mailing Label

1. General Information

Please follow the provided instructions.

Contact : Misty Smith
Title: Senior Water Operator/CPO
Phone: (555) 927-6227
Fax: (555) 927-6224
E-mail: Msmith@watercsd.org
Website: watercsd.org
County: **San Piper**
Population served: **6200**
Names of communities served: Waterville

2. Active Service Connections

Customer Class	Potable Water		Recycled Water	
	Metered	Unmetered	Metered	Unmetered
Single Family Residential	3642			
Multi-family Residential	136			
Commercial/Institutional	229			
Industrial	0			
Landscape Irrigation	0			
Other	24			
Agricultural Irrigation	1			
TOTAL	4032			

3. Total Water Into the System - Units of production: **AF** (Select: **AF**=acre-feet; **MG**=million gallons; **CCF**=hundred cubic feet)

		Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
Potable	*Wells*	50.55	46.55	54.72	55.27	63.18	46.01	60.82	72.32	65.41	52.4	52.1	54.22	673.55
	Surface	0	0	0	4.27	5.28	27.57	18.12	3.5	0	0	0	0	58.74
	Purchased 1/	0	0	0	0	0	0	0	0	0	0	0	0	0
	Total Potable	50.55	46.55	54.72	59.54	68.46	73.58	78.94	75.82	65.41	52.4	52.1	54.22	732.29
Untreated Water														
Recycled 2/														

1/ Potable wholesale supplier(s):

2/ Recycled wholesale supplier(s):

Level of treatment: Chlorination

4. Metered Water Deliveries - Units of delivery: **CCF** (Select: **AF**=acre-feet; **MG**=million gallons; **CCF**=hundred cubic feet)

If recycled is included, X box ↓		Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
A.SingleFamilyResidential		14601	14601	15534.5	15534.5	19449	19449	22161	22161	16186	16186	13858.5	13858.5	203580
B.Multi-family Residential		844	844	835	835	920	920	940.5	940.5	770	770	665	665	9949
C.Commercial/Institutional		4770	4770	5440.5	5440.5	6231.5	6231.5	7810.5	7810.5	6257	6257	4474	4474	69967
D.Industrial		0	0	0	0	0	0	0	0	0	0	0	0	0
E.Landscape Irrigation		0	0	0	0	0	0	0	0	0	0	0	0	0
F.Other		0.52	0.52	0.4	0.41	0.84	0.84	1.3	1.31	1.15	1.15	0.82	0.82	10.08
Total Urban Retail *(A thru F)*		20215.52	20215.52	21810.4	21810.41	26601.34	26601.34	30913.3	30913.31	23214.15	23214.15	18998.32	18998.32	283506.1
Agricultural Irrigation														
Wholesale*(to other agencies)*														

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APPENDIX D – PUBLISHED DEMANDS METHODOLOGY COMPARISON

A different approach to modeling demands was used by DRA's engineering consultants O'Brien and Gere (OBG) in their ongoing water supply planning analysis and more specifically in their most recently published 2013 Regional Drought Management Plan (DMP). The OBG water supply planning approach used gross per capita demand and held the per capita use constant through the planning period. This appendix compares the demands published in this report to the demands published in the OBG 2013 analysis.

In Spring 2013, OBG and DRA collaborated to revise previously developed 2011 water demands from the 2011 Water Supply Plan (WSP) based on the recent availability of 2010 historic raw water withdrawal data for each Water System. It was agreed by DMP participants that the DMP would be a 10-year plan, so revised water demands for 2010 and 2020 were published. Revised water demands for each water system for the year 2020 were based on a straight-line difference in the 2010 WSP values vs. the 2010 raw water withdrawals. The April 2013 revised water demands for each Water System were developed through year 2060 using the straight-line difference between the 2010 WSP values and the 2010 raw water withdrawals.

In making a comparison between OBG's 2013 projection methodology and the 2016 analysis presented in this report, it is important to note that OBG did not break down water use into sub-sectors or customer category accounts, nor did the analysis account for employment conditions. As explained in more detail throughout the 2016 report, this analysis uses more recent, post-2007 drought data: average year 2010-2015 baseline consumption and production data, when available.

The following graphs present a comparison of Water System demands between this 2016 demand projection analysis and the OBG water supply planning analysis conducted in 2013.

Despite the differing modeling approaches briefly summarized above and introduced previously in Section 1.3, for most of the Water Systems, the water use projections are comparable, except for the demands projected for CPWS between the two analysis techniques. This difference has been investigated and is considered to be a result not only of the differing demand development methodology and varying base year water use, but also due to the fact that the large account Saturn car manufacturer ceased operations by 2008. More specifically, the assembly line for Saturn closed in 2007, with the final day of production being March 30, 2007. The plant continued to make parts through 2007 and was officially closed in 2008. The difference in CPWS projected water use, therefore, can be attributed to the following: 1) the closure of the Saturn assembly line; 2) a difference in base year per capita and per account water use as a result of a different base time period being used; and 3) a slightly different population growth in addition to the use of Maury County's 2010-2015 employment growth to grow non-residential accounts.

Figure D-1. 2016 MWM vs. 2013 OBG Water Demand Projection Analysis – Bedford County Utility District

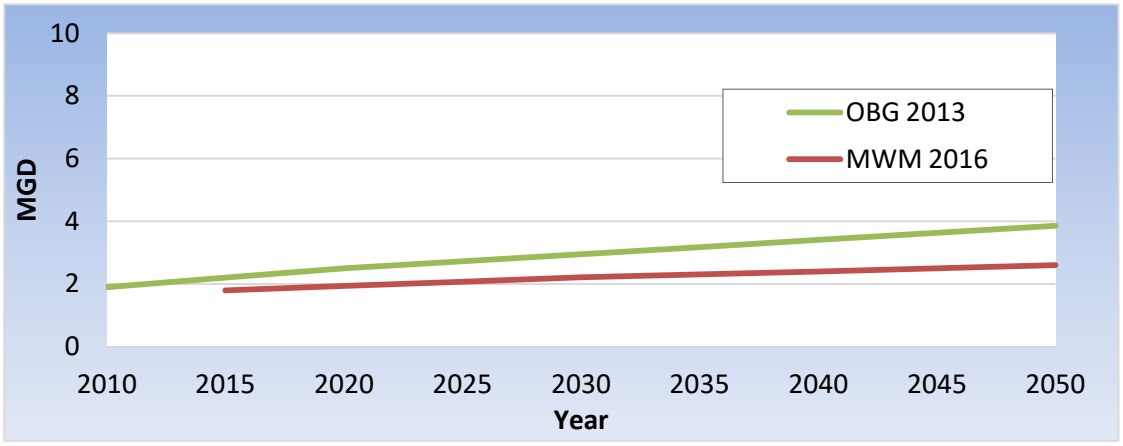
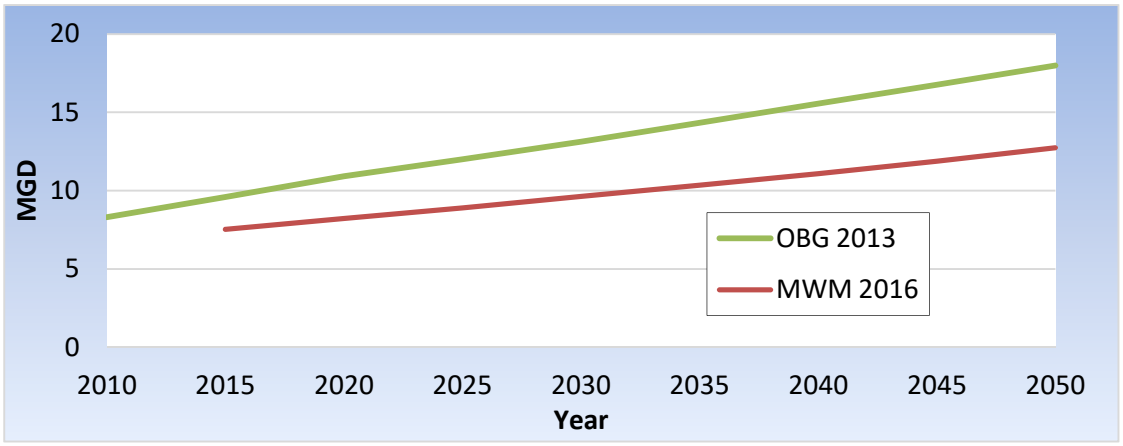


Figure D-2. 2016 MWM vs. 2013 OBG Water Demand Projection Analysis – Columbia Power and Water Systems*



* Note y-axis extends to 20 MGD versus 10 MGD like the other Water System figures.

Figure D-3. 2016 MWM vs. 2013 OBG Water Demand Projection Analysis – Lewisburg Water and Wastewater

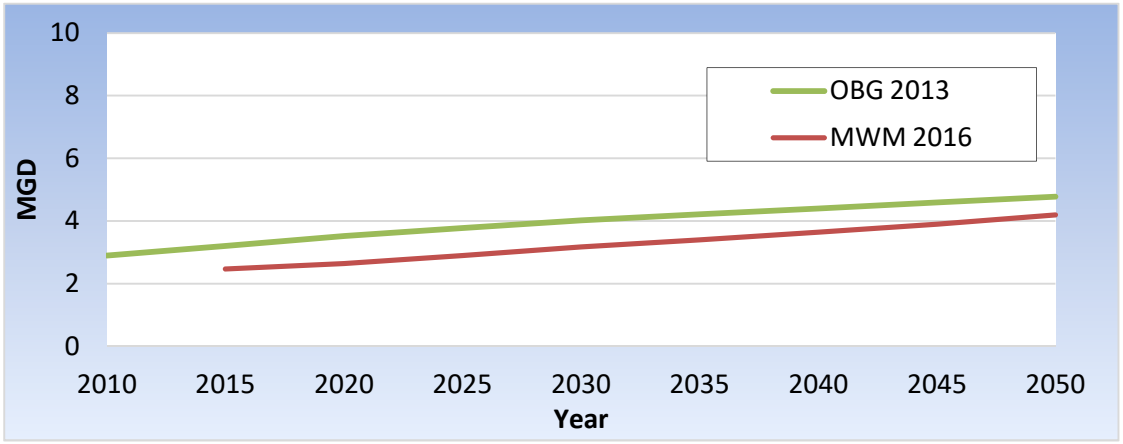


Figure D-4. 2016 MWM vs. 2013 OBG Water Demand Projection Analysis – Manchester Water and Sewer Department

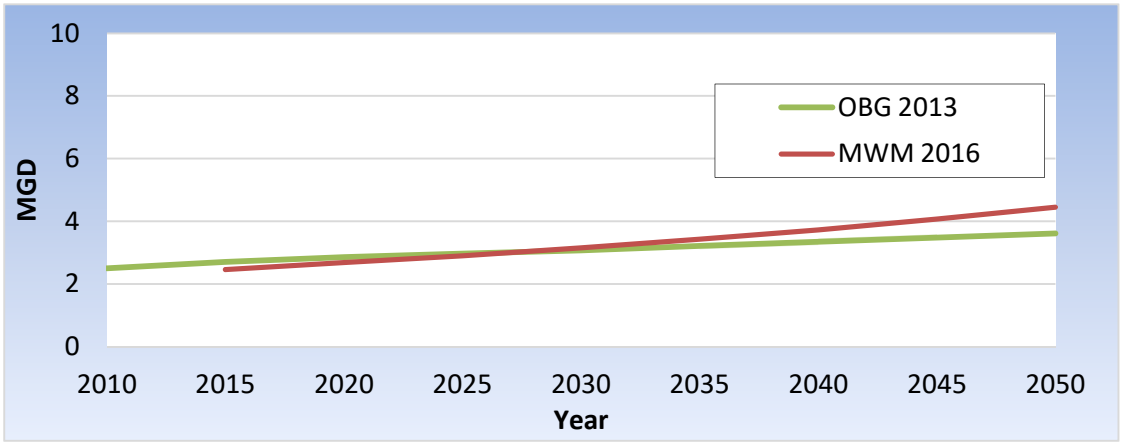


Figure D-5. 2016 MWM vs. 2013 OBG Water Demand Projection Analysis – Shelbyville Power, Water, and Sewerage System

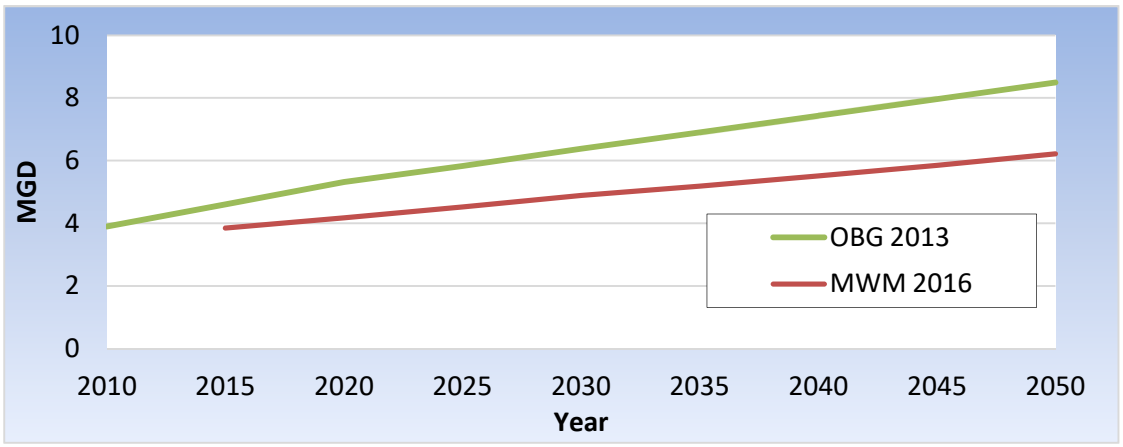


Figure D-6. 2016 MWM vs. 2013 OBG Water Demand Projection Analysis – Spring Hill Water System

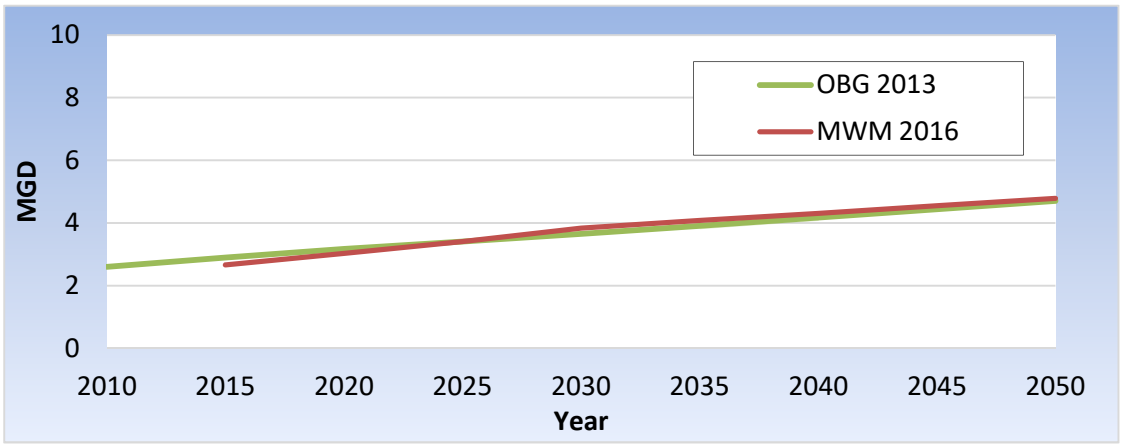
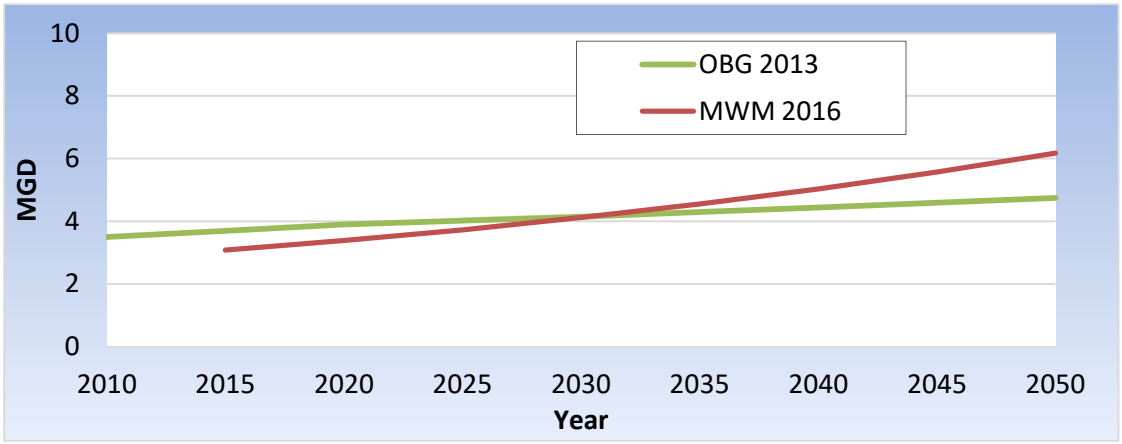


Figure D-7. 2016 MWM vs. 2013 OBG Water Demand Projection Analysis – Tullahoma Utilities Board

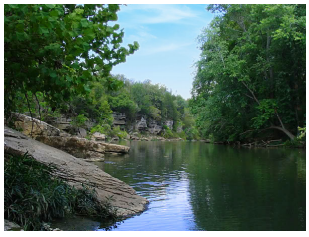


Appendix 2
Duck River Comprehensive Water Supply Plan, 2011

REPORT

Duck River Comprehensive Regional Water Supply Plan







Tennessee Duck River Development Agency

March 25, 2011

O'BRIEN & GERE

Duck River Comprehensive Regional Water Supply Plan

Shelbyville, Tennessee

Prepared for:
Tennessee Duck River Development Agency

Prepared by:
George Rest, PE and Thomas Dumm, PE
O'Brien & Gere Engineers, Inc.

Strategic Team:
Joseph Bishop, PE, CTI Engineers, Inc.
Brian McCrodden, PE, HydroLogics, Inc.
Richard Young, BDY Environmental, LLC
Justin Adams, Trauger & Tuke

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The appendices can be found under the Project Reports section of the Water Supply Plan at: www.duckriveragency.org

GLOSSARY OF TERMS

ARAP	Aquatic Resource Alteration Permit
BCUD	Bedford County Utility District
CIP	Capital Improvements Program
CWA	Clean Water Act
D/DBP	Disinfectants/Disinfection Byproducts
DRA	Tennessee Duck River Development Agency
DRUC	Duck River Utility Commission
EA	Environmental Assessment
EIS	Environmental Impact Statement
EPA	US Environmental Protection Agency
fps	Feet per Second
FY	Fiscal Year
gpm	Gallons per Minute
HAAs	Haloacetic Acids
IESWTR	Interim Enhanced Surface Water Treatment Rule
L	Liter
MCL	Maximum Contaminant Level
MG	Million Gallons
mgd	Million Gallons per Day
mg/l	Milligrams per Liter
NEPA	National Environmental Policy Act
psi	Pounds per Square Inch
SDWA	Safe Drinking Water Act
SRF	State Revolving Fund
SWTR	Surface Water Treatment Rule
TDEC	Tennessee Department of Environment and Conservation
THMs	Trihalomethanes
TNC	The Nature Conservancy
TWRA	Tennessee Wildlife Resource Agency
TVA	Tennessee Valley Authority
ug/L	Micrograms per Liter
USACE	US Army Corps of Engineers
USDA	US Department of Agriculture
USEDA	US Economic Development Administration
USEPA	US Environmental Protection Agency
USFWS	US Fish & Wildlife Service
USGS	US Geological Survey

WTP	Water Treatment Plant
WWTP	Wastewater Treatment Plant
7Q10	Seven-day ten-year low flow

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Water Systems
Bedford County Utility District

Columbia Power and Water Systems

Duck River Utility Commission

HB&TS Utility District

Lewisburg Water and Wastewater

Manchester Water Department

Maury County Water System

Shelbyville Power, Water and Sewerage System

Spring Hill Water Department

Tullahoma Utility Board

Federal Agencies
Natural Resource Conservation Service

Tennessee Valley Authority

U S Department Agricultural

U S Fish and Wildlife Service

U S Geological Survey

State Agencies/Committees
Tennessee Advisory Commission on Intergovernmental Relations

Tennessee Department of Environment and Conservation

Tennessee Water Resource Technical Advisory Committee

Tennessee Wildlife Resource Agency

Legislators
Senator Bill Ketron

Senator Jim Tracy

Non – Government Organizations
Duck River Watershed Association

Friends of Short Springs

Tennessee Environmental Council

Tennessee Duck River Agency Board

Tennessee Farm Bureau Federation

The Nature Conservancy

World Wildlife Fund

Municipals
Columbia

Lewisburg

Manchester

Shelbyville

Spring Hill

Tullahoma

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EXECUTIVE SUMMARY

INTRODUCTION

The Tennessee Duck River Development Agency (DRA) developed a Comprehensive Regional Water Supply Plan (Plan) for Bedford, Coffee, Marshall, Maury, and southern Williamson Counties to meet future water needs and address concerns with possible water shortages brought on by drought conditions. The Plan addresses water needs in this central Tennessee region through a 50-year planning period with a 100-year planning horizon and provides direction to the DRA for the management of available water resources, including the implementation of specific water supply infrastructure projects.

The Tennessee General Assembly created the DRA in 1965 as a comprehensive regional development agency. Its broad powers include the "control and development of the water resources" of those portions of the Duck River Watershed lying in Bedford, Coffee, Hickman, Marshall and Maury Counties. Any county or municipality in the Duck River Basin or any governmental entity from which flows any tributary stream of the river, or any county adjoining the river basin may become a sponsoring and participating entity. In 1998, the DRA Board of Directors adopted the following mission statement:

"To develop, protect, and sustain a clean and dependable water resource for all citizens of the Duck River region."

The DRA represents seven water utilities that serve approximately 250,000 people and industries that include car manufacturers, food processing plants, and other businesses utilizing water for production. In addition to these uses, the river provides a wide range of other values including recreation, an excellent fishery, and some of the most biologically-rich freshwater habitat in North America.

The drought of 2007 highlighted the issue that in extended dry weather conditions, the citizens of the Duck River region primarily depend on the water stored in Normandy Reservoir (Figure 1) to meet all designated uses, including drinking water, wastewater assimilation, recreation, and natural resource protection. The dramatic decrease in rainfall, combined with the multiple uses of the reservoir and the river, caused record low water levels in Normandy Reservoir that resulted in temporary changes in dam operation to protect water uses. Weather patterns and growth projections, combined with the obligation to manage water resources responsibly for future generations, have created the need for a comprehensive regional water supply plan for the Duck River Region.



Figure 1 Normandy Reservoir

PLANNING PERIOD

This Comprehensive Regional Water Supply Plan project addresses a planning period that begins after 2010 and extends through 2060 – a 50-year plan with a 100-year vision. The level of detailed study for this planning period is adequate to make decisions regarding preferred alternatives. Near-term planning and additional studies will be required in order to develop a detailed implementation plan for the recommended alternatives (i.e., secure permits, refine cost estimates, purchase property, etc.).

SELECTING WATER SUPPLIES

As shown in Figure 2, the selection process for identifying the recommended water supply alternatives included the following steps:

- Determining the need for water supply
- Establishing evaluation criteria to be used for selection of alternatives
- Identifying comprehensive list of alternatives
- Identifying baseline alternatives
- Eliminating fatally-flawed alternatives
- Screening the remaining alternatives

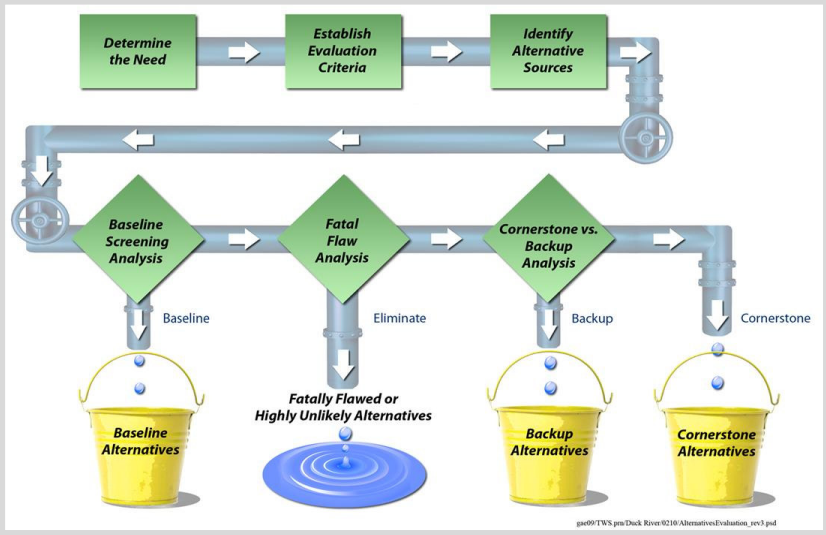

Figure 2 Alternatives selection process

WATER SUPPLY NEEDS

The first step in the Comprehensive Regional Water Supply Plan was the assessment of the need for additional water supply through the year 2060. This assessment included an evaluation of the available supply from Normandy Reservoir and the Duck River and a projection of water demands for domestic, commercial, and industrial purposes. The OASIS computer model was used to examine the operation of Normandy Reservoir and the hydrology of the Duck River to help gain a better understanding of how to satisfy the future need for not only public water supply but for all designated uses. Water users upstream from Normandy Dam (primarily Tullahoma and Manchester) are served from a water intake located in Normandy Reservoir while downstream uses are met by withdrawals from the Duck River. In periods of extended dry weather, the flow in the Duck River is primarily consists of water released from Normandy Reservoir. To estimate future water needs, the OASIS model used current and projected water demands as well as the following reservoir and river constraints defined by the Tennessee Department of Environment and Conservation (TDEC):

- Normandy Reservoir
  - » Release from Normandy Reservoir to maintain 25.8 mgd (40 cfs) minimum instantaneous flow just downstream of the dam.
- Shelbyville
  - » 77.5 mgd (120 cfs) minimum instantaneous flow at Shelbyville (December through May).
  - » 100.2 mgd (155 cfs) minimum instantaneous flow at Shelbyville (June through November).
  - » 6.5 mgd (10 cfs) allocation for Shelbyville's water supply intake.

- Columbia
  Columbia Power and Water System's Aquatic Resource Alteration Permit (ARAP) identifies the following permit conditions:
  - » Columbia Power and Water System's maximum instantaneous withdrawal rate shall be limited to 19.4 mgd (30 cfs).
  - » Columbia Power and Water System's withdrawal shall not result in a reduction of flow in the Duck River of less than 64.6 mgd (100 cfs) as measured downstream of the intake (Figure 3).



Figure 3 Columbia Dam

Demands for municipal, industrial, and other needs were calculated based on the amount of water that would be needed during a drought of record to assure that ample supplies would be available during a repeat of such a drought. Several sources of information were reviewed (i.e., US Geological Survey, Tennessee Valley Authority, and University of Tennessee) and ultimately water demands were projected using population projections from the University of Tennessee's Center for Business and Economic Research (CBER). Unrestricted water demands were projected to approximately double over the next 50 years (30 mgd in 2010 to 57 mgd in 2060). The OASIS modeling was performed over a period of hydrologic record extending from 1921 through 2008. The modeling results indicated that there is adequate supply for the users of Normandy Reservoir through 2060, but a potential deficit of up to 32 mgd for users of the Duck River between Shelbyville and Columbia. Currently, drought conditions such as those experienced in 2007 could result in a 4 mgd deficit, straining the river's ability to maintain water supply for all uses. The drought and population growth challenges faced by the region indicate that water supply plans must be reliable, flexible, and collaborative to meet both current and future demands.

WATER SUPPLY ALTERANTIVES ANALYSIS

The water supply alternatives were evaluated using the following criteria which were developed and adopted by DRA early in the study process:

- **Reliable Capacity** – Reliable quantity of raw water to meet projected demands through the planning period. This criteria addresses interruptibility of sources of supply.
- **Raw Water Quality** – Raw water quality that meets existing water quality requirements, and can readily achieve future anticipated regulations. This criterion may also address water quality preferences such as superior raw water quality and finished water taste.
- **Cost** – The present worth cost for proposed raw and finished water improvements, including capital, operating and maintenance costs. This cost could include an allowance for wholesale water purchases.
- **Implementability** – The relative ease of implementing the proposed improvements in time to meet projected demands. This criterion considers the potential that regulatory permitting, public acceptance, property acquisition, or constructability issues could delay implementation.
- **Flexibility** – The ability to phase implementation and spread the cost over time, while still meeting projected demands.

- **Environmental** –This criterion includes environmental benefits associated with hydrologic regime, physical habitat, water quality and biota.
- **Recreation** – This criterion includes recreational benefits, either reservoir or riverine (e.g., boating, fishing, canoeing, sightseeing) and related economic benefit of the recreational features (e.g., tourism/eco tourism, enhanced property values).

A list of 40 potential water supply alternatives identified in previous studies was reduced to 26 unique alternatives which were considered worthy of further consideration. Alternatives included a wide array of non-structural and structural measures such as:

- Implementing a regional drought management plan
- Implementing a water use efficiency program
- Changing operation of Normandy Reservoir
- Modifying river constraints
- Raising Normandy Dam
- Constructing tributary reservoirs (i.e., Fountain Creek Reservoir)
- Building offstream storage reservoirs (pumped storage)
- Utilizing quarries
- Constructing pipelines from reservoirs, rivers or other water systems

A summary matrix was developed which described each of the alternatives and documented key aspects of the alternative related to seven criteria: reliable capacity, raw water quality, cost, implementability (permitting), flexibility (phasing), environmental benefits, and recreation. Using the evaluation criteria and working closely with the stakeholders, the Strategic Planning Team identified and recommended a reliable, diverse, and flexible portfolio of water supply alternatives which included the following non-structural and structural components:

- **Baseline** – an alternative that was selected at the outset of the alternatives evaluation to be a component of the recommended water supply plan such as a drought management plan or water use efficiency program.
- **Fatally Flawed or Highly Unlikely** – an alternative that was eliminated from further consideration due to lack of reliability, permitting obstacles, etc.
- **Backup** – an alternative that is less desirable when compared to the remaining alternatives, but will be considered as a potential component of the 50-year water supply plan.
- **Cornerstone** – an alternative in the "shortlist" that could satisfy the entire deficit through 2060, and is receiving further consideration as a key element of the 50-year water supply plan.

Using the evaluation criteria and working closely with the stakeholders, the Strategic Planning Team identified and recommended a reliable, diverse, and flexible portfolio of water supply alternatives which included the following non-structural and structural components shown in Figure 4:

- **Non-Structural Components:**
  - **Drought Management Plan** – Develop and implement a regional drought management plan.
  - **Water Use Efficiency Program** – Develop and implement a water use efficiency program.
  - **Optimize Normandy Reservoir Releases** – Optimize releases from Normandy Reservoir to preserve storage in the reservoir for periods when it is most needed.

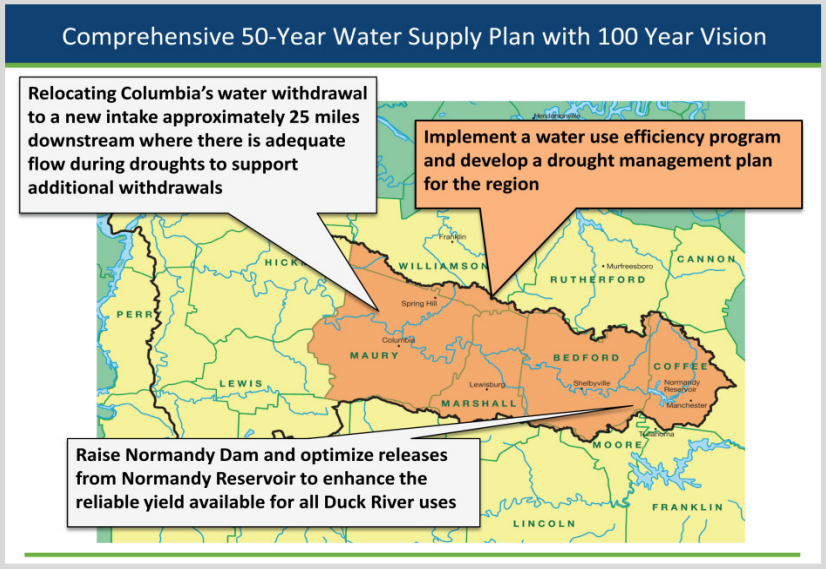

Figure 4 Recommended alternatives

- **Structural Components**
  - **Normandy Dam Improvements** – Increase the elevation of Normandy Dam by five feet and increase the Winter/Spring pool elevation by approximately five feet without increasing the Summer/Fall pool elevation. This component increases water storage during droughts, enhances flood protection while minimizing environmental impacts, and enhances the reliable yield available for all Duck River uses.
  - **Williamsport Intake** – Relocate Columbia's water withdrawals to a new intake approximately 25 miles downstream, near Williamsport, where there is adequate flow in the river during droughts to satisfy Maury County's projected needs. This component addresses the potential deficit in Maury County and southern Williamson County with a local, highly reliable supply and eliminates their sole reliance on Normandy Reservoir.

This Comprehensive Regional Water Supply Plan increases reliability by utilizing multiple sources of supply. It is also a regional solution with benefits beyond water supply. It benefits the entire Duck River region by enhancing instream flows/reliability in the entire stretch of the Duck River, garnering regional financial support to lower the cost per customer, and providing flexibility to address uncertainties associated with potential changes in future water demands, regulations and hydrologic conditions.

COST

The estimated cost for the raw water facilities recommended in the Comprehensive Regional Water Supply Plan is roughly $62 million:

- Baseline alternatives – $4 million
- Raise Normandy Dam – $20 million
- Williamsport Intake and Raw Water Pipeline to Columbia (one 30-inch pipe for 20 mgd) – $38 million

Additional technical and environmental investigations are planned in the early stages of the implementation phase to refine the project cost.

EXTENSIVE PUBLIC INVOLVEMENT

The Comprehensive Regional Water Supply Plan was conducted using a uniquely open process, with extensive opportunities for input from the public, elected officials, and governmental and non-governmental agencies through the use of public workshops and informational meetings, routine updates via DRA's website, agency briefings and press coverage.

- **Public workshops and meetings** – A series of public workshops and "open house" style public meetings facilitated extensive public participation. Since June 2009, six public workshops were held at Henry Horton State Park. Several public meetings were held in September 2009 (Henry Horton State Park, Manchester City Hall, Maury County Courthouse), March 2010 (Henry Horton State Park), and September2010 (Henry Horton State Park). These public workshops and evening "open house" meetings provided a forum for citizen input and stakeholder input as well as an opportunity to ask questions of DRA's participating utilities and the consultant.
- **E-mail** – DRA used email to provide updates on the status of the study to the public and other stakeholders that attended the meetings.
- **Website** – DRA developed and maintained a website which included an overview of the project, project participants, project contacts, briefing materials, technical data and meeting information.
- **Agency briefings and technical meetings** – DRA held several technical meetings and provided updates on the status of the study to state and federal agencies including TDEC, TWRA, TVA, USFWS, and USGS.
- **Extensive press coverage** – Numerous articles were written in area newspapers documenting the work completed and the upcoming meetings.
- **Elected official, Council, and Board Updates** – DRA and DRATAC members have provided updates as appropriate to their elected officials and their Councils/Commissions/Boards throughout the study.

The DRA conducted six public workshops and several public meetings to obtain input from the public. Among the many stakeholders were the public water systems, represented by the Duck River Agency Technical Advisory Committee (DRATAC), and the DRA's Water Resources Council, which includes over 25 governmental and non-governmental organizations. The roles of the key decision-makers are shown on Figure 5.

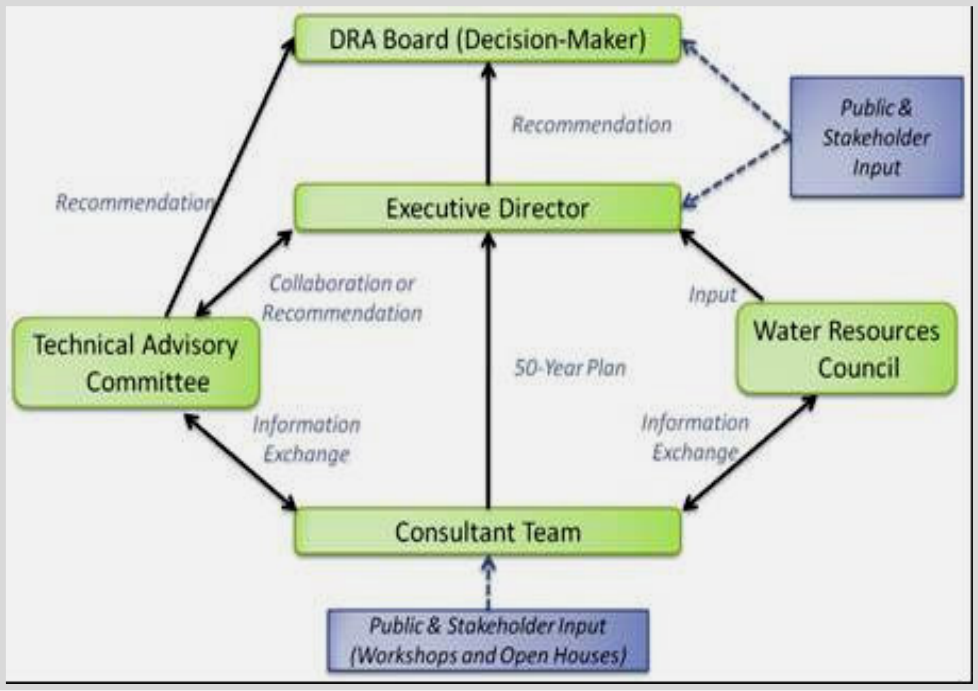

Figure 5 Roles in the decision-making process

HAVE THE OBJECTIVES OF THE STUDY BEEN MET?

The objectives of DRA's Comprehensive Regional Water Supply Plan have been met:

- DRA has identified a recommended solution that increases reliability, flexibility, and sustainability by utilizing multiple sources of supply ✓
- The recommended solution is also a regional solution with benefits beyond water supply such as reducing flood risk to communities downstream of Normandy Dam and extending recreation (reservoir and river) during droughts ✓
- A financial approach is being developed that is affordable and fairly apportions costs to the entire region ✓
- DRA has used a credible process with good science and worked effectively with stakeholders and the public by clearly communicating the study process and findings ✓

WHAT ARE THE NEXT STEPS?

DRA has identified that the following items need to be addressed in the near term:

- Initiate work on a regional drought management plan.
- Initiate work on a water use efficiency program.
- Conduct planning and design of the proposed facilities as needed for permits and approvals.
- Develop appropriate financial and organizational structures to support implementation of the alternatives recommended in the Comprehensive Regional Water Supply Plan.

The DRA intends to move forward aggressively with these and other action items. By endorsing the recommendations of this study, DRA is "driving a stake in the ground", completing the first step in the long process to bring ample water supplies to the residents of central Tennessee.

INTRODUCTION

BACKGROUND

The Tennessee Duck River Development Agency (DRA) developed a Comprehensive Regional Water Supply Plan (Plan) for Bedford, Coffee, Marshall, Maury, and southern Williamson Counties (Figure 6) to meet future water needs and address concerns with possible water shortages brought on by drought conditions. The Plan addresses water needs in this central Tennessee region through a 50-year planning period with a 100-year planning horizon and provides direction to the DRA for the management of available water resources, including the implementation of specific water supply infrastructure projects.

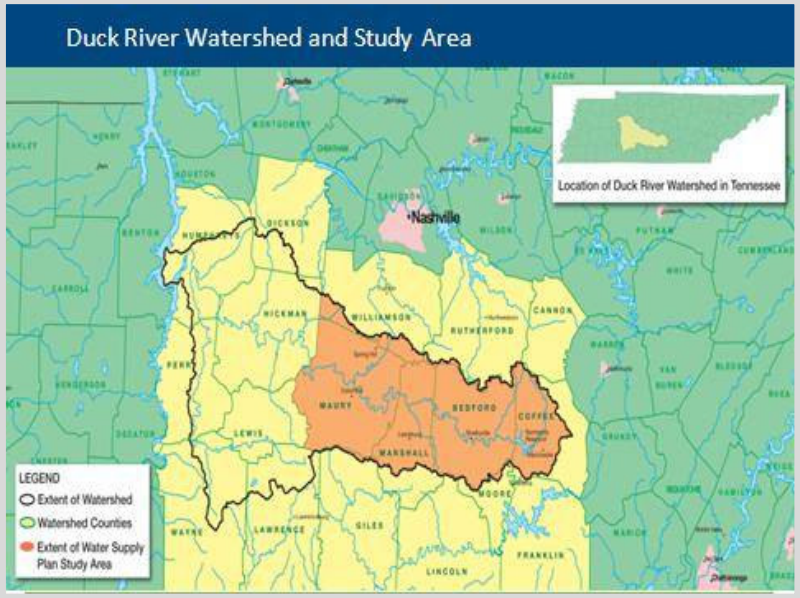

Figure 6 Duck River watershed and study area

The Tennessee General Assembly created the DRA in 1965 as a comprehensive regional development agency. Its broad powers include the "control and development of the water resources" of those portions of the Duck River Watershed lying in Bedford, Coffee, Hickman, Marshall and Maury Counties. Any county or municipality in the Duck River Basin or any governmental entity from which flows any tributary stream of the river, or any county adjoining the river basin may become a sponsoring and participating entity. In 1998, the DRA Board of Directors adopted the following mission statement:

"To develop, protect, and sustain a clean and dependable water resource for all citizens of the Duck River region."

The DRA represents seven water utilities:

- Bedford County Utility District
- Columbia Power and Water Systems
- Lewisburg Water and Wastewater
- Manchester Water Department
- Shelbyville Power, Water and Sewerage System
- Spring Hill Water Department
- Tullahoma Utility Board

These utilities serve approximately 250,000 people and industries that include car manufacturers, food processing plants, and other businesses utilizing water for production. In addition to these uses, the river provides a wide range of other values including recreation, an excellent fishery, and some of the most biologically-rich freshwater habitat in North America.



Figure 7 Normandy Reservoir during 2007 drought

The drought of 2007 highlighted the issue that in extended dry weather conditions, the citizens of the Duck River region primarily depend on the water stored in Normandy Reservoir to meet all designated uses, including drinking water, wastewater assimilation, recreation, agriculture, and natural resource protection. The dramatic decrease in rainfall, combined with the multiple uses of the reservoir and the river, caused record low water levels in Normandy Reservoir that resulted in temporary changes in dam operation to protect water uses (Figure 7). Weather patterns and growth projections, combined with the obligation to manage water resources responsibly for future generations, have created the need for a comprehensive regional water supply plan for the Duck River Region.

This study was financed by DRA from contributions from the water utilities. DRA served as manager for the study. A Strategic Team with expertise in engineering, environmental permitting, management and law, led by O'Brien & Gere Engineers, Inc. of Landover, Maryland was retained by DRA, in association with DRATAC, to complete this study:

- George Rest and Thomas Dumm, O'Brien & Gere - program management and primary authors of the Comprehensive Regional Water Supply Plan
- Joe Bishop, CTI Engineers – local engineering support
- Brian McCrodden, HydroLogics – hydrologic modeling
- Richard Young, BDY Environmental – environmental permitting
- Justin Adams, Trauger & Tuke – legal and organizational

This study represents an independent and comprehensive assessment that builds upon previous and ongoing efforts to meet the region's potable water supply needs.

STUDY GOAL AND OBJECTIVES

The source of future water supplies for the region has been the focus of numerous studies over the past 40 years. However, meaningful progress in dealing with this problem has been elusive. The DRA identified that the time had come to seek a regional solution and, through cooperative action, to implement that solution. The DRA's goal for the Comprehensive Regional Water Supply Plan is as follows:

"To develop a (comprehensive) Plan that will provide direction to the DRA regarding the management of available water resources, including the implementation of specific water supply infrastructure projects."

The key objectives for the DRA's study include:

- Identify sources of additional supply that provide reliability, flexibility and sustainability.
- Recommend solutions that provide benefits beyond water supply and address all designated uses.
- Develop a framework for financing the recommended solutions that is affordable and fairly apportions costs.
- Utilize a credible process with good science and work with stakeholders to effectively communicate the study process and findings.

The Strategic Team used a combination of independent reviews of prior studies, preparation of technical information, and extensive use of interactive workshops to facilitate decision-making to achieve each of the above objectives.

PROJECT APPROACH

The Comprehensive Regional Water Supply Plan was conducted using a uniquely open process, with extensive opportunities for input from stakeholders. At the foundation of this approach were six public workshops held at Henry Horton State Park at roughly 10 week intervals which focused simultaneously on four subject areas:

- Water Quality and Capacity
- Reliability and Permitting
- Financial
- Community Impacts and Public Policy

A graphic showing the Project Approach and Decision Making Process used in this study is included in Appendix A.

NEED FOR ADDITIONAL WATER SUPPLIES

WATER DEMANDS

Water demands for municipal, industrial, and other needs are typically calculated based on the amount of water that would be needed during a drought of record to assure that ample supplies would be available during a repeat of such a drought. Forecasts of future demands help managers and municipalities to plan for the future and to assess the adequacy of the present resources to meet future demands. Demand forecasting and resource assessments are critical to water resources planners and managers, because the time required to study, plan, and build new resources or implement demand management strategies is lengthy. Water demands are influenced by a number of factors: population, water use by commercial and industrial customers, housing, employment, income, weather, household size, water price, culture, lot size, season, water loss to theft, leakage, flushing, accidents and fire fighting. Other factors that introduce significant uncertainty into water demand projections include: vacation homes, schools, prisons, hospitals, and golf courses. It is important that the approach and sources of information used to project water demands are technically sound.

The first step in the water demand projection is to identify how water demands will be used to assess the capabilities of existing supplies and size waterworks facilities. Average day demands represent the amount of potable water required in a year, divided by 365 days. Maximum day demands represent the amount of potable water required in a single 24-hour period for a day of maximum usage. Both of these parameters are used to size or evaluate certain parts of a potable water system. Normandy Reservoir was evaluated based on meeting the annual average day demands for Manchester and Tullahoma as well as the downstream release to the Duck River. For the utilities with intakes on the Duck River, withdrawal rates must approximate customer demands which fluctuate throughout the day and from one day to the next. Consequently, the analysis for the utilities downstream of Normandy Dam were based on maximum (peak) day withdrawal rates. In addition, maximum day demands were used to size raw water intakes on river supplies, water treatment plants, and some of the major water transmission mains.

As shown in Figure 8, several sources of information were used to project average day water use for the water systems through 2060:

- **Historic water use** – Annual average day water use data was obtained from the DRA for each water system for the period from 1973 to 2008. This dataset provided a trend line which was useful in assessing the reasonableness of future projections.
- **Tennessee Valley Authority** – TVA Planning Report No. 65-100-01 projected the future potable water demands for Coffee, Bedford, Marshall, and Maury Counties for 2025 and 2075 (as presented in the *Report to OMB on Columbia Dam Alternatives* prepared by TVA in April 1979). This information was developed in 1965, but was used for comparison purposes because it projected water demands for the region through 2075.
- **US Geological Survey** – In 2008, the US Geological Survey published a report that estimated the use of water in the Upper Duck River watershed and included water demand projections from 2000 through 2030. Note that the USGS study included full or nearly full buildout of the industrial parks in the study area. This data provided a high "book end" for the projection because it assumed full or nearly full buildout of the industrial parks by 2030. Historic population data from the USGS was used in combination with the DRA's historic water use data to define the gross per capita water use for Coffee, Bedford, Marshall and Maury Counties.

- **Center for Business and Economic Research (CBER)** – In June 2009, the University of Tennessee Center for Business and Economic Research and the Tennessee Advisory Commission on Intergovernmental Relations published population projections for the State of Tennessee for the period from 2010 through 2030. The University of Tennessee CBER is widely recognized as an independent source with authority on demographics in Tennessee. As a demographic prediction, CBER attempts to capture prevailing demographic trends, such as the economy, that influence population.

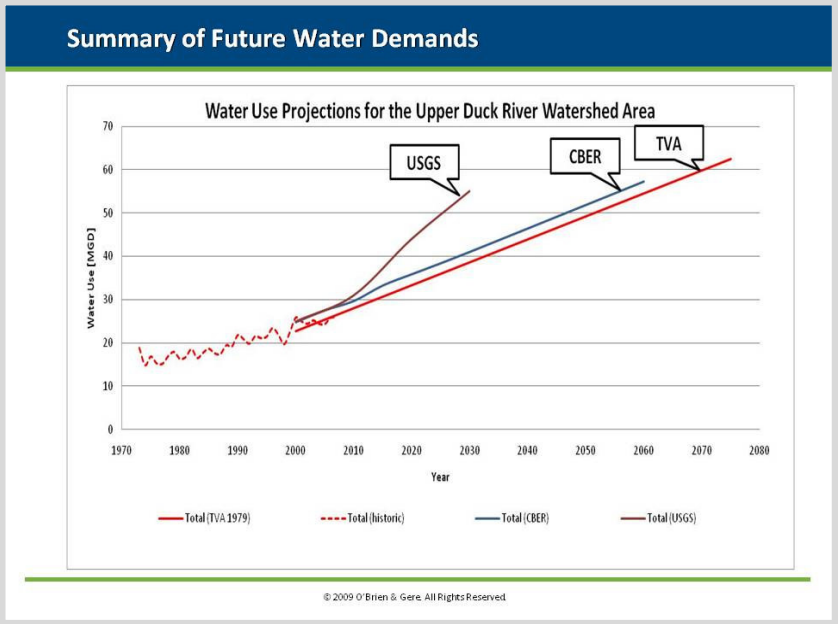

Figure 8 Summary of future water demands

Based on the availability of data, it was determined that a "gross" per capita approach should be used in the Comprehensive Regional Water Supply Plan to project water demands. Utilizing historic population data from the US Geological Survey and water use data from the DRA, a "gross" per capita water use factor was developed which represents the overall water use per unit of population for the current mix of residential, non-residential and public use/loss (i.e., total water use divided by population). The O'Brien & Gere projections are based on the assumption that the current mix of uses/customer behaviors, etc. will result in the same per capita usage in the future as is current. This assumption is founded on an analysis which shows that the gross per capita usage in the study area has been relatively constant for the period 1981-2000. A sensitivity analysis was performed on the water needs to assess the impact of potential reductions in per capita usage. Water demands were projected by multiplying the CBER-based population projections for 2010 through 2030 by the "gross" per capita usage calculated for each of the four service areas (Coffee, Bedford, Marshall and Maury). Water demands for 2030 through 2060 were derived based on a straight-line projection of the "gross" per capita usage derived from the CBER-based population for 2010 through 2030. Each of the four sources of data shown in Figure 8 was used in the projection of water demands, but the primary source was the University of Tennessee CBER because it is widely recognized as an independent source with authority on demographics in Tennessee.

The results of the water demand projections through 2060 are summarized in Table 1.

Table 1. Average day water demands

Water System	2010	2020	2030	2040	2050	2060
Coffee County						
Tullahoma	2.9	3.3	3.5	3.8	4.1	4.4
Manchester	2.6	3.0	3.2	3.4	3.7	4.0
Bedford County						
Shelbyville	4.7	6.1	7.2	8.2	9.3	10.4
BCUD	2.0	2.6	3.1	3.5	4.0	4.4
Marshall County						
Lewisburg	3.0	3.6	4.1	4.5	4.9	5.3
Maury/Southern Williamson						
Spring Hill	2.5	3.1	3.5	4.1	4.6	5.1
Columbia	11.5	14.1	16.3	18.8	21.2	23.6
Total	**29.2**	**35.8**	**41.0**	**46.4**	**51.8**	**57.2**

Population projections from CBER and current water usage patterns were used to project future water usage, which will roughly double by 2060.

EXISTING WATER SUPPLY SOURCES

Normandy Reservoir and the Duck River supply virtually all of the public water supply needs in the five county planning area. The Duck River has been impounded since the mid-1800s. Currently, there are three low head dams located on the Duck River which were constructed in the early 1900s for water supply:

- Shelbyville (drainage area = 481 square miles)
- Lillards Mill near Milltown (drainage area = 916 square miles)
- Columbia (drainage area = 1,208 square miles)

Normandy Reservoir was constructed in 1976 and is the primary source of water supply for the Duck River during dry weather conditions. Normandy Reservoir has the following characteristics:

- Located in the upper portion of the Duck River watershed between Shelbyville and Manchester (Duck River Mile 248.6).
- Normandy Dam is 2,248 feet in length and is about 95 feet in height.
- Storage volume is roughly 38 billion gallons at a Summer/Fall pool level of 875 feet.
- Drainage area is roughly 208 square miles.

Normandy Reservoir was designed to provide a variety of benefits upstream and/or downstream from the dam, including recreation, flood protection, water supply, and water quality benefits. Water users upstream from Normandy Dam (primarily Tullahoma and Manchester) are served from DRUC's water

intake located in Normandy Reservoir. The mainstem of the Duck River is the primary water supply source for water systems downstream of Normandy Reservoir. TVA operates Normandy Reservoir using the following priorities to decide how to release water under normal rainfall conditions:

- Minimize downstream flooding (especially in winter and early spring).
- 40 cfs minimum instantaneous flow just downstream from the dam (sustains aquatic habitat in the reach immediately downstream of the dam).
- 120 cfs minimum instantaneous flow at Shelbyville (December - May) at the USGS gage located at Duck River Mile 221.4.
- 155 cfs minimum instantaneous flow at Shelbyville (June - November) at the USGS gage located at Duck River Mile 221.4.
- Up to 10 cfs additional instantaneous flow at Shelbyville for water supply.

Note, the Duck River flow target near Shelbyville is located at Duck River Mile 221.4 which is approximately 27 river miles downstream of Normandy Reservoir (18 hours travel time).

In 1996, the TDEC Division of Water Pollution Control evaluated the minimum instream flow required to maintain recreation and fish and aquatic life uses in the Duck River at Columbia in response to questions about the ability of the Duck River to meet additional water supply needs. The analysis resulted in a requirement that the streamflow should not fall below 100 cfs at Duck River Mile 132.8, immediately downstream from the Columbia water supply intake. This minimum flow requirement is included in Columbia's water permit (ARAP) and establishes a state-identified limit below which no additional water can be withdrawn from the Duck River by Columbia (Appendix B). This 100 cfs requirement at Duck River Mile 132.8 (Figure 9) is recognized as a key constraint in the Comprehensive Regional Water Supply Plan.



Figure 9 Columbia Dam

PROJECTED SHORTFALL IN WATER SUPPLY

The OASIS computer model developed by HydroLogics, Inc. was used to evaluate the adequacy of Normandy Reservoir and the Duck River to meet current and future demands using a period of hydrologic record extending from 1921 through 2008 (87 years). Due to the inherent differences in the characteristics of the Normandy Reservoir and the Duck River water supplies, the model was used to separately evaluate the adequacy of the following:

1. Normandy Reservoir for its users (i.e., Manchester and Tullahoma)
2. Duck River for Shelbyville and the downstream users to Columbia

The OASIS model performs a daily water budget using numerous components such as reservoir inflow data, reservoir releases, streamflow data, water demands, minimum flows in Duck River, flood releases, and water withdrawal return flows. Note that because of streamflow data limitations (i.e., changes in the operation / flow through the Shelbyville, Lillards Mill and Columbia dams on the Duck River during the 87-

year period of record in the model), the OASIS model cannot accurately calculate daily gains and losses in the river which are needed to compute an average daily river flow and deficit at Columbia. Consequently, a weekly average flow of 125 cfs was used in the model as a surrogate flow constraint at Columbia (Duck River Mile 132.8) to represent a 100 cfs instantaneous flow constraint.

The hydrologic modeling over the 87 year period of record indicated that based on a low water level of 850 feet in Normandy Reservoir, the supply available from Normandy Reservoir is adequate to meet the needs (i.e., water withdrawals plus downstream releases to Shelbyville) of the reservoir users through 2060.
For the Duck River users downstream of Normandy Reservoir, the OASIS model was used to identify a volume and rate of deficit under current and future water demand conditions. For the 100 cfs Duck River constraint at Columbia, the hydrologic modeling indicates that during extreme or prolonged drought conditions there is a potential maximum deficit of 32 mgd in the year 2060. In drought conditions like those in 2007, there is presently (2010) a potential maximum deficit of 4 mgd, which would strain the Duck River's ability to supply water for all designated uses. The results of the OASIS modeling are shown in Table 2. The annual and daily volumes of the potential deficits are illustrated in Figures 10 and 11, respectively, and a summary of each figure follows:

- Figure 10 illustrates the annual volume of the potential deficit for maintenance of the 125 cfs average weekly flow target in the Duck River at Columbia for years 2010, 2020, 2040 and 2060 demand conditions based on the hydrology that occurred in each year of the 87-year period of record. The volumes of potential deficit shown in Table 2 are taken from the maximum values on Figure 10 which occur in year 1999.
- Figure 11 shows the daily volume of the potential deficit for maintenance of the 100 cfs target for flow in the Duck River at Columbia for 2010 through 2060 based on the 1-year in 87-year period of record (worst drought for the 87-year period of record) and for a 1-in-10-year drought event. The potential average daily deficits shown in Table 2 are based on the critical drought event for the period of record which shows the potential deficit increasing from 4 mgd in 2010 to approximately 32 mgd in 2060.

Table 2. Current and projected deficits at Columbia for Duck River users

Deficit	2010	2020	2030	2040	2050	2060
Potential deficit at Columbia based on critical drought year of record and maintenance of 100 cfs at Duck River Mile 132.8 (MG)	300	500	700	900	1150	1400
Potential deficit at Columbia based on critical drought year of record and maintenance of 100 cfs at Duck River Mile 132.8 (mgd)	4	10	15	21	27	32

A more detailed discussion of the needs assessment is included in Appendix C.

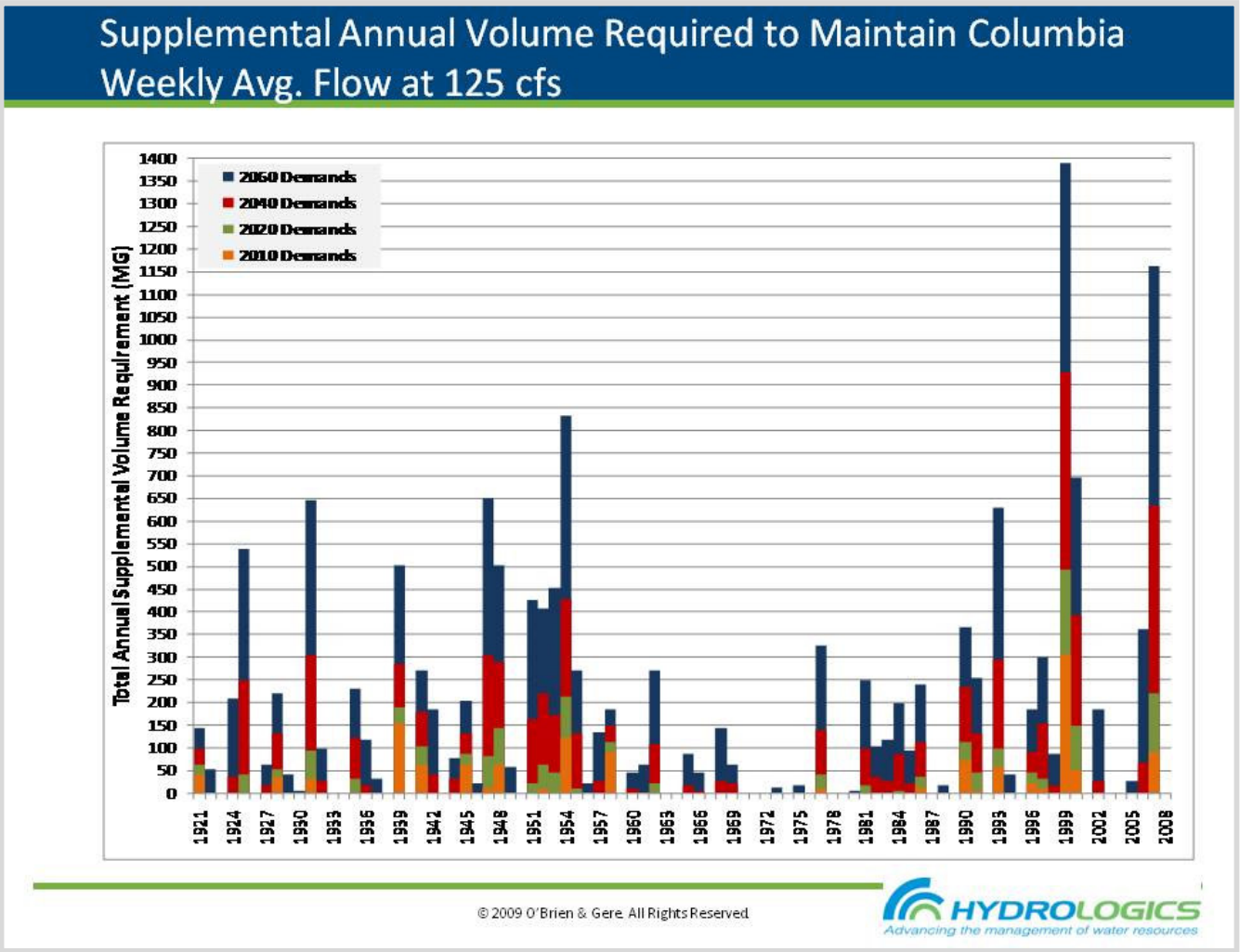

Figure 10 Supplemental annual volume required to maintain Columbia flow at 125 cfs

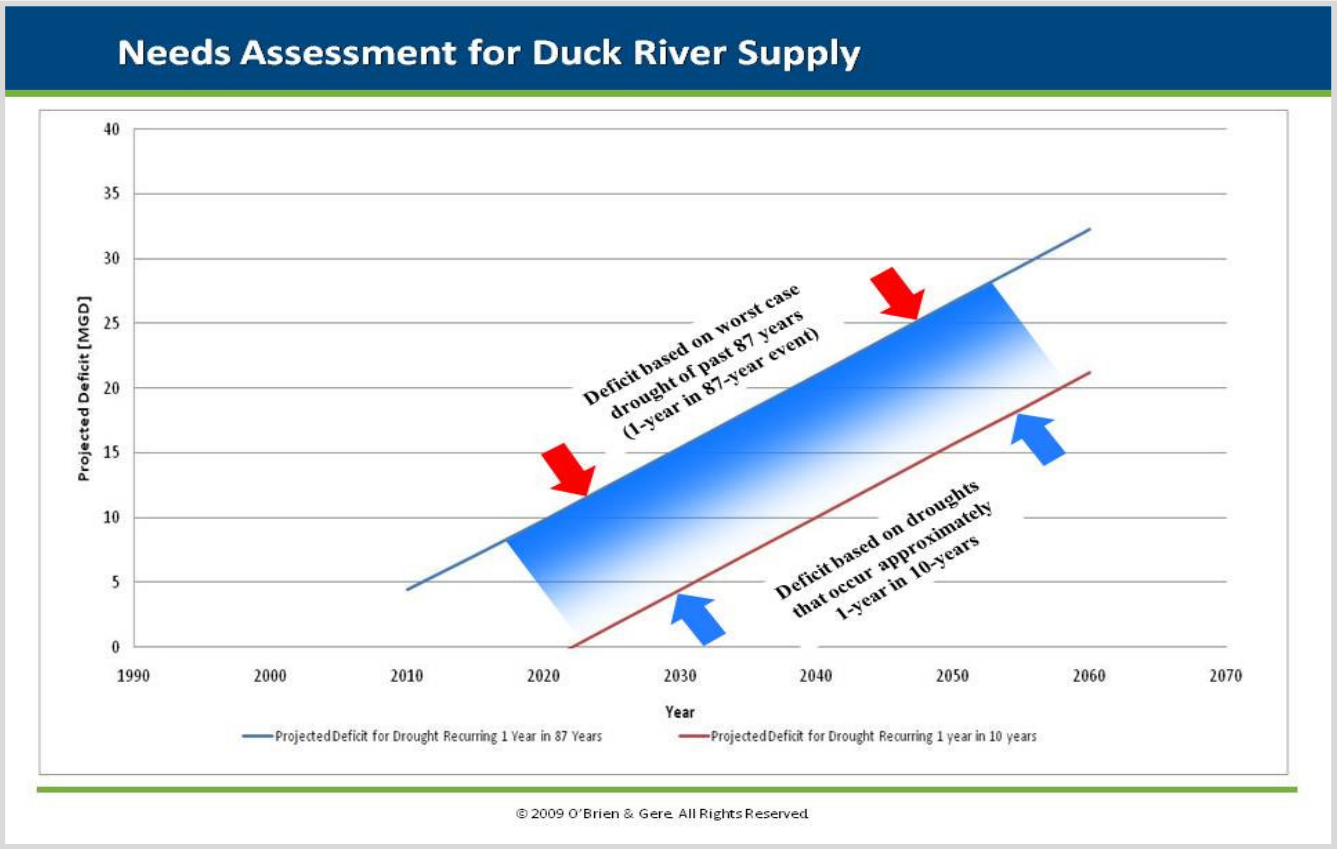

Figure 11 Needs assessment for Duck River supply

SOURCES OF UNCERTAINTY IN PROJECTED DEFICITS

Throughout the Comprehensive Regional Water Supply Plan, stakeholders discussed the sources of uncertainty that influence the ability of the water supply sources to adequately meet future needs which may include the following:

- **Alteration of instream flows (USFWS flow and habitat study).** The US Fish & Wildlife Service is initiating a study of the Duck River to identify instream flow needs for critical habitat and the outcome of this study will likely not be known for several years. Changes in the instream flow requirements could impact Normandy Reservoir storage and operations as well as river constraints used for assessing water supply needs.
- **Changes in demand projections**. Water demands will change through the 50-year planning period and the recommended structural and non-structural components can be phased to reflect changes in demand over time. The timing for construction of the water facilities associated with the withdrawals from a new river intake near Williamsport will be driven by water demands in Maury County, permitting, and water facility replacement needs.
- **Variability of drought events** – A drought more severe than the critical drought that occurred in the previous 87 years of record will occur in the future.
- **Climate change** – Shifts within the hydrologic cycle due to climate change are expected in the future, but the site specific impacts in the Duck River region are not well defined at this time.

- **Manual operation of Normandy Reservoir and travel times** – TVA operates Normandy Reservoir manually along with many other reservoirs under their supervision. Recognizing that these systems are constantly changing and require significant supervision, TVA strives to meet the instantaneous downstream constraints in the Duck River given limitations to data quality and staffing. The OASIS hydrologic model used in the Comprehensive Regional Water Supply Plan assumes that TVA can achieve nearly "perfect" releases (includes additional 5 cfs in release for buffer) from Normandy Reservoir to meet the Shelbyville constraint which is 27 river miles downstream of the dam (roughly 18 hours of travel time). The Columbia constraint is 116 river miles downstream (roughly 80 hours of travel time). In addition, the travel times between Normandy Reservoir and Columbia can vary depending on the volume of flow in the river. Consequently, TVA releases water in "excess" of the "perfect" release from Normandy Reservoir in order to meet the instantaneous flow constraints downstream at Shelbyville and the "excess" release would be much greater if TVA needed to meet the constraint significantly further downstream at Columbia.
- **Irrigation withdrawals** – By using historic streamflow data, the OASIS model accounts for historic irrigation withdrawals. For modeling purposes, it is assumed that the irrigation withdrawals will remain unchanged in the future, but the amount and timing of irrigation withdrawals is highly variable.
- **Losses underground from Duck River system downstream of Shelbyville** – Prior studies by USGS have indicated that there may be a significant "loss" of flow from the river to underground (up to 30% reduction) in the segment of the Duck River downstream of Shelbyville. The magnitude of this loss under changing river flow conditions as well as the location of its return to the Duck River is not well understood.
- **Inflows from tributary streams** – Localized thunderstorms on the ungaged tributary streams to the Duck River below Normandy Reservoir can create the impression of "excess" releases from Normandy Reservoir because they can produce flows above the target levels at Shelbyville. Flow from these ungaged streams is another factor which makes it difficult for TVA to accurately match release requirements from Normandy Reservoir to the streamflow target at Shelbyville.
- **Changes in return flows** – The difference between the amount of water withdrawn and water returned to a source (i.e., discharged back to the river by the wastewater treatment plant) is usually taken to represent "consumptive use". The model assumes that the current percentage of return flows from the wastewater plants will remain unchanged in the future. Wastewater technology and the quality of wastewater effluent will continue to improve and the demand for wastewater effluent for irrigation, industrial processes, and other consumptive uses may also increase thereby reducing the amount of water returned to the Duck River.
- **Accuracy of USGS stream gage data** – The USGS calibrates the streamflow gages on the Duck River on a monthly basis while the flows in the river at Shelbyville and Columbia must be met on an instantaneous basis.

In summary, the possible sources of uncertainty that affect the assessment of the adequacy of supply in the Duck River are many-fold and include not only demographics and water use, but uncertainty regarding weather, hydrology, accuracy of stream gaging, and many other factors. While the uncertainty of some of these factors can be mitigated, many cannot and therefore must be addressed in some other fashion. If water was stored upstream of Columbia and conveyed down the Duck River to meet the deficits at Columbia, it was concluded that a target of approximately 3 BG of additional storage should be used (rather than the 1.4 BG) to meet the projected 2060 deficit and offset potential losses in the Duck River. An approach used in this study and being employed by many water utilities in recent years to address

uncertainty is the implementation of a portfolio of non-structural and structural measures that are reliable, diverse and flexible. To assess the sensitivity of the uncertainty in water use projections and many other factors on the overall water needs, the OASIS hydrologic model was used to estimate the projected deficit in supply by considering varying levels of reduction in unrestricted water use by the utilities (i.e., 5%, 10%, 20%, and 30%) which could result from a combination of factors (i.e., water efficiency measures, climate change, economic conditions, etc.). A 30% reduction in future unrestricted water demands was used as a "book end" to test an extreme level of reduction. The unrestricted water demand of 57 mgd in 2060 would be reduced to approximately 40 mgd under the "30% reduction" scenario. Modeling results indicated that the volume of water needed to meet the permit constraint at Columbia in 2060 would be reduced by approximately one-half (1.4 billion gallons to 0.7 billion gallons) if a 30% reduction in water demands occurred. The study's initial findings are that reductions due to water efficiency measures are likely to be in the range of 5% to 10%. A summary of the modeling results is presented in Table 3.

Table 3. Water use reduction versus water needs for 2060

Water Use Reduction	Water Demand (mgd)	Volume of Water Needed to Meet Permit Constraint at Columbia (MG)
0%	57	1,400
5%	54	1,250
10%	52	1,150
20%	46	900
30%	40	700

WATER SUPPLY ALTERNATIVES

SELECTION PROCESS FOR WATER SUPPLY ALTERNATIVES

The selection process for identifying the recommended water supply solution included the following steps:

- Determining the need for water supply
- Establishing evaluation criteria
- Identifying alternative sources of water supply
- Identifying baseline alternatives
- Eliminating fatally-flawed alternatives
- Screening and evaluating backup and cornerstone alternatives
- Selecting alternatives

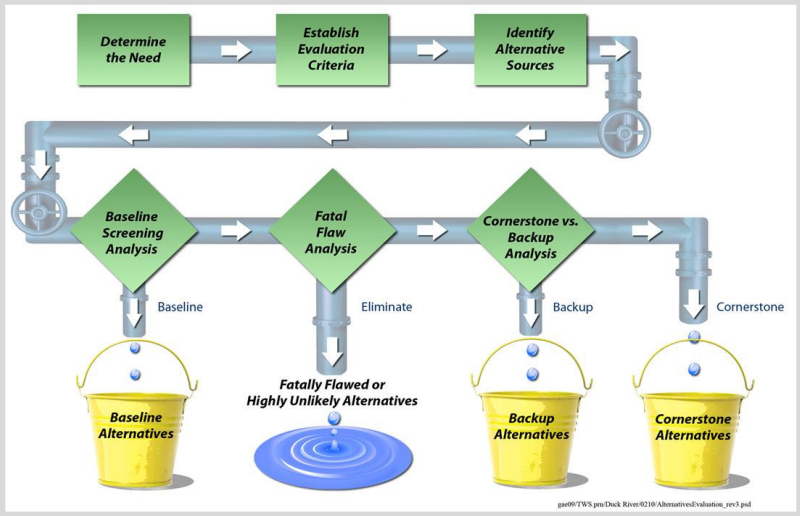

Figure 12 Alternatives selection process

EVALUATION CRITERIA

The evaluation criteria were developed and refined with the stakeholders in several meetings and workshops prior to Workshop No. 3 as follows:

- **Reliable Capacity** – Reliable quantity of raw water to meet projected demands through the planning period. This criteria addresses interruptibility of sources of supply.
- **Raw Water Quality** – Raw water quality that meets existing water quality requirements, and can readily achieve future anticipated regulations. This criterion may also address water quality preferences such as superior raw water quality and finished water taste.
- **Cost** – The present worth cost for proposed raw and finished water improvements, including capital, operating and maintenance costs. This cost could include allowance for wholesale water purchases.
- **Implementability** – The relative ease of implementing the proposed improvements in time to meet projected demands. This criterion considers the potential that regulatory permitting, public acceptance, property acquisition, or constructability issues could delay implementation.
- **Flexibility** – The ability to phase implementation and spread the cost over time, while still meeting projected demands.
- **Environmental** – This criterion includes environmental benefits associated with hydrologic regime, physical habitat, water quality and biota.
- **Recreation** – This criterion includes recreational benefits, either reservoir or riverine (e.g., boating, fishing, canoeing, sightseeing), and related economic benefit of the recreational features (e.g., tourism/eco tourism, enhanced property values).

The stakeholders requested that the evaluation criteria be used solely to document key aspects of the various alternatives, and not weighted and used for assigning scores to the alternatives.

WATER SUPPLY ALTERNATIVES EVALUATED IN THIS STUDY

A list of 40 potential water supply alternatives identified in previous studies was reduced to 26 unique alternatives which were considered worthy of further consideration. Alternatives included a wide array of non-structural and structural measures such as:

- Implementing a regional drought management plan
- Implementing a water use efficiency program
- Changing operation of Normandy Reservoir
- Modifying Duck River constraints
- Raising Normandy Dam
- Constructing tributary reservoirs (i.e., Fountain Creek Reservoir)
- Building offstream storage reservoirs (pumped storage)
- Utilizing quarries
- Constructing pipelines from reservoirs, rivers or other water systems

A detailed step-by-step process was utilized for screening and evaluating the alternatives in the Comprehensive Regional Water Supply Plan. A summary matrix was developed which described each of the alternatives and documented key aspects of the alternative related to each of the evaluation criteria (Appendix D). Using the evaluation criteria and working closely with the stakeholders through a series of workshop and meetings, the Strategic Team evaluated and assigned the alternatives to the following groups:

- **Baseline** – an alternative that was selected to be a component of the recommended water supply plan:
  - **Alt. #1** – Develop Water Use Efficiency Program – Baseline
  - **Alt. #3** – Develop Regional Drought Management Plan – Baseline
  - **Alt. #4** – Optimize Releases from Normandy Reservoir – Baseline
- **Fatally Flawed or Highly Unlikely** - an alternative that was eliminated from further consideration:
  - **Alt. #7** – Reduce Irrigation Withdrawals – Fatally Flawed (no added reliable capacity)
  - **Alt. #12** – Construct Fountain Creek Reservoir and Pipe Raw Water to Columbia WTP – Highly Unlikely (i.e., major issues include water quality and quantity, aquatic ecology, endangered and threatened species and their critical habitats, wetlands, archeological and historic resources)
  - **Alt. #13** – Construct Fountain Creek Reservoir with Downstream Release – Highly Unlikely (i.e., major issues include water quality and quantity, aquatic ecology, endangered and threatened species and their critical habitats, wetlands, archeological and historic resources)
  - **Alt. #14** – Upgrade Existing Columbia City Dam to Allow Releases – Fatally Flawed (no added reliable capacity)
  - **Alt. #17** – Construct Pipeline from Tennessee River to Columbia WTP – Highly Unlikely (high cost and energy requirements associated with long pipeline)
  - **Alt. #18** – Construct Pipeline from Tims Ford Reservoir – Highly Unlikely (i.e., major issues include interbasin transfers and potential impact on environmental flows in the Elk River downstream of Tims Ford Reservoir)

- **Alt. #20** – Purchase Water from Nearby Systems – Highly Unlikely (potential high cost due to infrequent use and lack of control)
- **Alt. #21** – Utilize Groundwater Sources – Fatally Flawed (no added reliable capacity)
- **Alt. #22** – Pump Treated Wastewater from Columbia WWTP to Below Columbia Dam – Highly Unlikely (i.e., major issues include potential transfer of species during pumping from downstream location to upstream location, change in permit conditions and flows for WWTP)
- **Alt. #23** – Construct New Intake for Maury County at River Mile 163 – Fatally Flawed (no added reliable capacity)
- **Alt. #25** – Construct New Intake for Maury County at River Mile 108 and Pump Back to Columbia Dam Pool – Highly Unlikely (Alt. #24 is similar and is a better option)
- **Alt. #26** – Construct Infrastructure to Return Treated Wastewater from Tullahoma WWTP to Normandy Reservoir – Highly Unlikely (i.e., major issue includes significant reduction or elimination of flow in existing stream if Tullahoma WWTP flow is diverted to Normandy Reservoir during dry weather conditions)

- **Backup** – an alternative that is less desirable compared to the remaining alternatives, but will be considered as a potential component of the 50-year water supply plan:
  - **Alt. #2** – Increase Normandy Reservoir Release to Meet Columbia Constraint Without Raising Dam or Pool Levels – Backup (does not provide "new" water). Combine with Alt. #10 (Improve DRUC Intake) or Alt. #11 (Construct Second DRUC Intake) to address lower Normandy Reservoir levels during drought
  - **Alt. #8** – Modify River Constraints to Preserve Storage in Normandy Reservoir – Backup (no indication that agencies will change river flow constraints)
  - **Alt. #16** – Utilize Quarries – Backup (relatively small storage volume)
  - **Alt. #19** – Convey Arnold Cooling Water to Normandy Reservoir – Backup (potential lack of control makes this poor fit for cornerstone)
- **Cornerstone** - an alternative in the "shortlist" that could satisfy the entire deficit, and is receiving further consideration as a key element of the 50-year water supply plan:
  - **Alt. #5** – Raise Normandy Reservoir Winter/Spring Pool Level Without Raising Dam – Cornerstone (difficult to obtain property or acquire easements in timely manner and may be similar in cost to Alt. #9). Combine with Alt. #6: Modify Normandy Flood Rule Curve (Early Refill).
  - **Alt. #9** – Raise Normandy Dam – Cornerstone (Recommended)
  - **Alt. #15** – Pond #15 (Existing Offstream Storage Reservoir) – Cornerstone (less reliable and more expensive compared to Alt. #24)
  - **Alt. #24** – Construct Water Intake near Williamsport and Pump Back to Columbia WTP – Cornerstone (Recommended)

RECOMMENDED ALTERNATIVES

Using the evaluation criteria and working closely with the stakeholders, the Strategic Planning Team identified and recommended a reliable, diverse, and flexible portfolio of water supply alternatives which included the following non-structural and structural components:

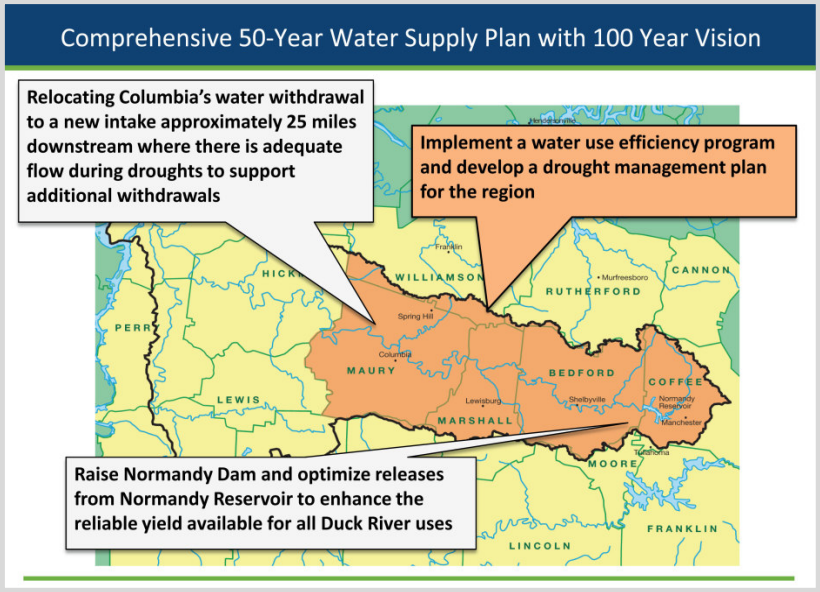

Figure 13 Recommended alternatives

- **Non-Structural Components**
  (Baseline Alternatives):
  - **Drought Management Plan (Alt. #3)** – Develop and implement a regional drought management plan.
  - **Water Use Efficiency Program (Alt. #2)** – Develop and implement a water use efficiency program.
  - **Optimize Normandy Reservoir Releases (Alt. #4)** – Optimize releases from Normandy Reservoir to preserve storage in the reservoir for periods when it is most needed.
- **Structural Components**
  (Recommended Cornerstone Alternatives):
  - **Normandy Dam Improvements (Alt. #9)** – Increase the elevation of Normandy Dam by five feet and increase the Winter/Spring pool elevation by approximately five feet without increasing the summer pool elevation. This component provides the following benefits:
    - **Water Supply Reliability** – increases water storage which enhances the reliable yield for all Duck River uses
    - **In-lake Recreation** – improves in-lake recreation by providing a higher pool level for longer use during drought
    - **Instream Flow** – provides environmental protection by allowing a longer duration of releases from Normandy Reservoir to Duck River during drought periods
    - **Flooding** – reduces flood risk to communities/property downstream of Normandy Dam due to increase in flood storage
    - **Shoreline** – reduces exposed shoreline and erosion along Normandy Reservoir because of higher Winter/Spring water levels
    - **Environment** – avoids impacts to upstream wetlands and streams compared to other alternatives
  - **Williamsport Intake (Alt. #24)** – Relocate Maury County water withdrawals to a new intake approximately 25 miles downstream, near Williamsport, where there is adequate flow in the river during droughts to satisfy Maury County projected needs. This component provides the following benefits:

- **Water Supply Reliability** – provides a highly reliable source of supply , which eliminates reliance on Normandy Reservoir as the sole source of water supply during drought
- **River Constraint** – increases instream flow at Columbia gage to maintain minimum flow of 100 cfs for all designated uses
- **Columbia Intake** – Avoids Columbia withdrawal from Columbia Pool, at least during low flows (existing Columbia intake could be used as a backup)

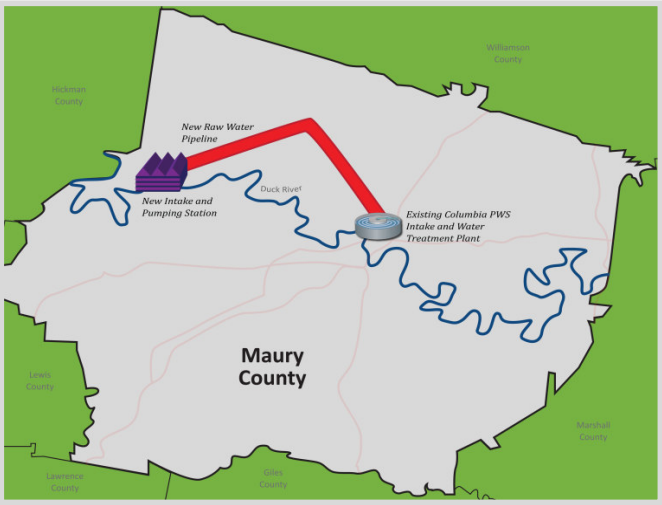

Figure 14 Williamsport intake

- **Regional Water System** – provides the potential to create a regional water system in Maury County and would also allow Spring Hill to reduce or avoid withdrawal from Duck River upstream of the Columbia Pool, thereby increasing instream flow in designated critical habitat (existing Spring Hill intake could be used as a backup)

The estimated project cost for implementation of the Comprehensive Regional Water Supply Plan is $62 million:

- Baseline alternatives – $4 million
- Raise Normandy Dam – $20 million
- Williamsport Intake and Raw Water Pipeline to Columbia (one 30-inch pipe for 20 mgd) – $38 million

The project cost represents the cost for planning, design, and construction of the reservoirs, river and reservoir intakes, pumping stations, and transmission mains needed to deliver raw water to the water systems (Appendix E). Planning-level construction costs were estimated using available information from previous reports, construction cost curves from similar projects, and manufacturers' cost data. The estimates are based on July 2010 prices and include an allowance for construction contingencies (20%); regulatory permitting (project specific); and engineering, legal, administrative (20%). In addition, an allowance in the form of an "upfront" cost was added, as necessary, for land acquisition. Additional technical and environmental investigations are planned in future phases to refine the project costs.

POTENTIAL FINANCING APPROACH AND IMPLMENTATION PLAN

At the stakeholder's request, a potential philosophy and approach for financing the recommendations was developed. A "cost-sharing" philosophy was derived based on two fundamental tenants:

1. "Growth Pays for Growth" which is based on a system development charge (SDC) for new water services and larger water services for customers served by utilities drawing water from the Duck River.
2. Common charge for all water withdrawals from Normandy Reservoir or the Duck River.

Three examples of the initial estimated increase in cost per household were developed based on a typical household usage of 5,000 gallons per month:

1. Using solely water withdrawal fees – the estimated increase in cost per household would be approximately $3.00 per month.

2. Using water withdrawal fees (all customers) and system development charges (SDC) for new services and larger services – the estimated increase in cost per household would be approximately $1.50 per month.
3. Using water withdrawal fees (all customers), system development charges (SDC) for new services and larger services, plus phasing the construction and using DRA's current reserve funds – the estimated increase in cost per household would be approximately $0.60 per month.

A more detailed financing plan for implementation of the recommendations is slated for the next phase of the study.

A potential schedule for implementation of the recommended alternatives was developed and is shown in Figure 15. Several key aspects of the proposed schedule include:

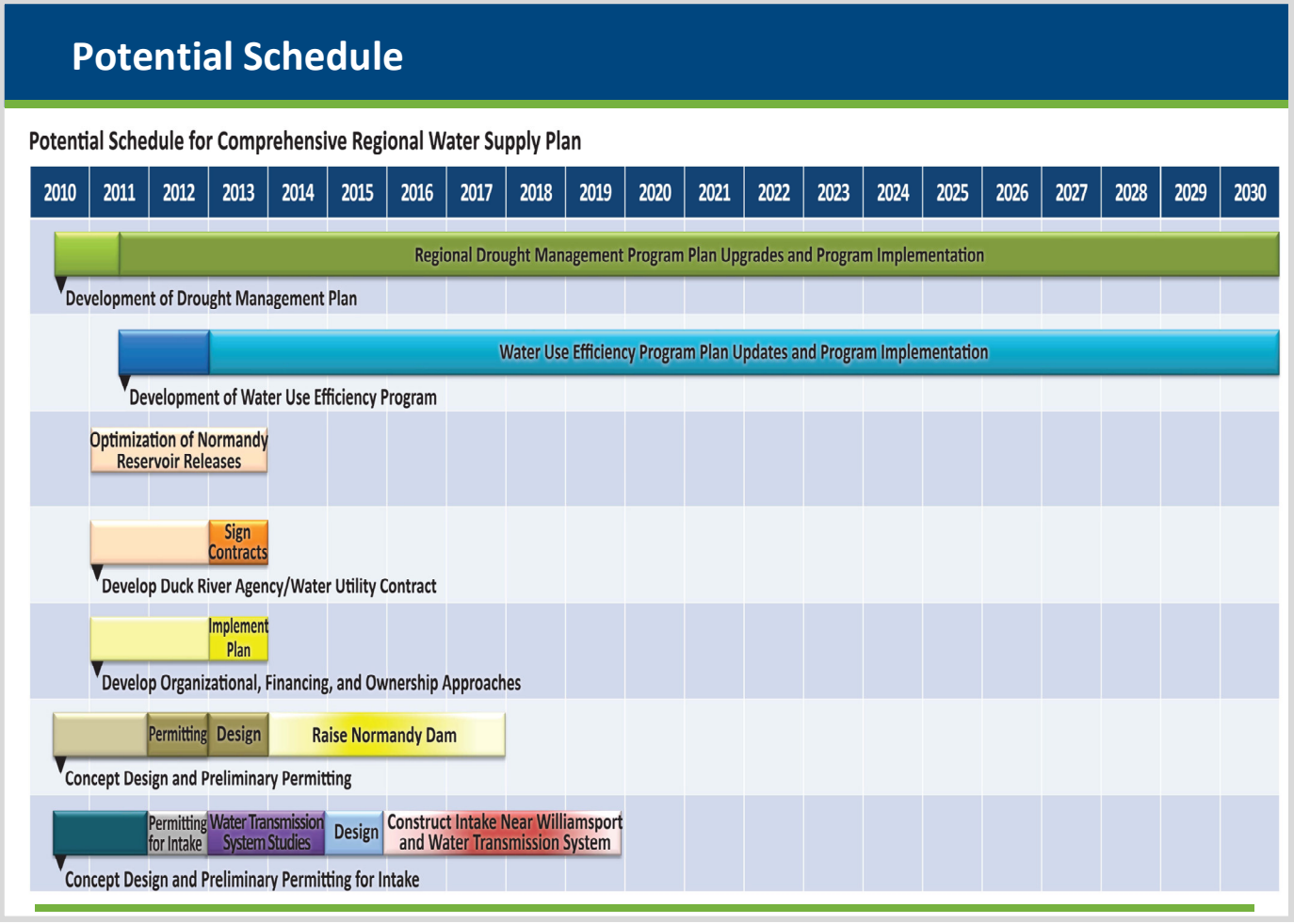

Figure 15 Potential implementation schedule

- The Drought Management Plan and Water Use Efficiency Plan will be developed over the next two years and will be implemented and updated throughout the planning period.
- A program for optimization of releases from Normandy Reservoir will be developed in concert with TVA and others over the next three years.
- The DRA/DRATAC contracts as well as the organizational, financial and ownership issues should be initiated in 2011 and need to be resolved prior to initiating bidding and construction on any of the structural recommendations.
- Permitting for the Normandy Reservoir and Williamsport intake recommendations should proceed concurrently and both should be implemented as soon as possible based on the outcome of the financial studies.

PUBLIC PARTICIPATION

OVERVIEW

The Comprehensive Regional Water Supply Plan was conducted using a uniquely open process, with extensive opportunities for input from the public, elected officials, and governmental and non-governmental agencies through the use of public workshops and informational meetings, routine updates via the DRA website, agency briefings and press coverage (Figure 16).



Figure 16 Communication with stakeholders

PUBLIC WORKSHOPS AND MEETINGS

The DRA conducted six public workshops and several public meetings to obtain input from the public. Among the many stakeholders were the public water systems, represented by the Duck River Agency Technical Advisory Committee (DRATAC), and the DRA's Water Resources Council, which includes over 25 governmental and non-governmental organizations. The roles of the key decision-makers are shown on Figure 17.

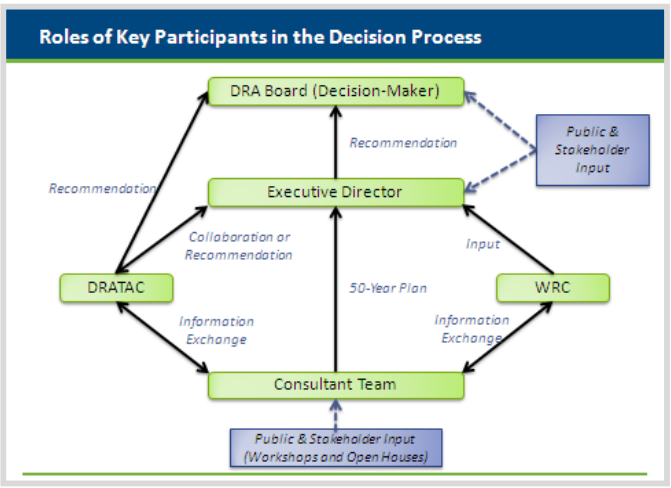

Figure 17 Roles in the decision-making process

The public workshops and "open house" style public meetings facilitated extensive public participation. Since June 2009, six public workshops were held at Henry Horton State Park (Table 4). Five public meetings were held throughout the study (Table 5). These public workshops and "open house" style public meetings provided a forum for citizen and stakeholder input as well as an opportunity to ask questions of DRA's participating utilities and the consultant. Materials from the six workshops and the "open house' meetings are included in Appendix F and Appendix G, respectively.

Table 4. Public workshops

Workshop No.	Workshop Title	Location	Date
1	Kickoff	Henry Horton State Park	June 24, 2009
2	Preliminary Feasibility	Henry Horton State Park	August 26, 2009
3	Developing Alternatives	Henry Horton State Park	December 9, 2009
4	Evaluating Alternatives	Henry Horton State Park	February 24, 2010
5	Implementation Planning	Henry Horton State Park	May 5, 2010
6	Conclusions	Henry Horton State Park	August 11, 2010

Table 5. "Open House" public meetings

Meeting No.	Meeting Title	Location	Date
1	Preliminary Feasibility	Henry Horton State Park	September 22, 2009
2	Preliminary Feasibility	Manchester City Hall	September 23, 2009
3	Preliminary Feasibility	Maury County Courthouse	September 24, 2009
4	Evaluating Alternatives	Henry Horton State Park	March 24, 2010
5	Implementation Planning	Henry Horton State Park	September 9, 2010

E-MAIL

DRA used to emails to provided updates on the status of the study to the public and other stakeholders that attended the meetings.

WEBSITE

DRA developed and maintained a website (www.duckriveragency.org) which included an overview of the project, project participants, project contacts, briefing materials, technical data, and meeting information.

AGENCY BRIEFINGS AND TECHNICAL MEETINGS

DRA held several technical meetings and provided updates on the status of the study to stakeholder agencies and organizations. A number of the meetings are shown in Table 6.

Table 6. Agency briefings and technical meetings

Meeting Participant	Meeting Date
DRATAC	July 8, 2009 September 22, 2009 October 22, 2009 January 13, 2010 April 7, 2010 July 7, 2010
Steering Committee Meetings	June 23, 2009
Water Resources Council	July 9, 2009 October 8, 2010 January 14, 2010 April 8, 2010 July 8, 2010 October 14, 2010
USGS	July 13, 2009
TDEC	August 25, 2009 September 23, 2009 January 29, 2010 July 22, 2010
TVA	September 23, 2009 October 21, 2010 April 8, 2010 July 27, 2010
TNC/USFWS/TWRA	September 24, 2009
DRA Board	January 28, 2010 April 22, 2010 July 22, 2010 October 28, 2010

EXTENSIVE PRESS COVERAGE

Numerous articles were written in area newspapers documenting the work completed and the upcoming meetings. A number of newspaper articles are included in Appendix H.

ELECTED OFFICIAL, COUNCIL, AND BOARD UPDATES

DRA and DRATAC members have provided updates as appropriate to their elected officials and their Councils/Commissions/Boards throughout the study. In addition, DRA has provided briefings to elected officials and the Boards of the Water Systems. A copy of the presentation to the DRA Board on October 28, 2010 is included in Appendix I.

RECOMMENDATIONS

The Tennessee Duck River Development Agency developed a Comprehensive Regional Water Supply Plan for Bedford, Coffee, Marshall, Maury, and southern Williamson Counties to meet future water needs and address possible water shortages brought on by drought conditions. The Comprehensive Regional Water Supply Plan addresses water needs through a 50-year planning period with a 100-year planning horizon, and provides direction to the DRA for the management of available water resources, including the implementation of specific water supply infrastructure projects.

The first step in the planning process was the assessment of demands on the Duck River for additional water supply through the year 2060, which included a projection of water demands for domestic, commercial, industrial, and other purposes. The OASIS computer model was used to examine the operation of Normandy Reservoir and the hydrology of the Duck River to better understand future needs not only for public water supply but for all designated uses. O'Brien & Gere developed water demands using population projections from the University of Tennessee's Center for Business and Economic Research ("CBER"). O'Brien & Gere's needs analysis indicates that during extreme or prolonged drought conditions there is a potential maximum deficit of 32 mgd in the year 2060. In drought conditions like those in 2007, there is presently (2010) a potential maximum deficit of 4 mgd, which would strain the Duck River's ability to supply water for all designated uses. The drought and population growth challenges faced by the region indicate that water supply plans must be reliable, flexible, and collaborative to meet both current and future demands.

O'Brien & Gere then considered 40 potential water supply alternatives and ultimately reduced that number to 26 unique alternatives for further evaluation. These alternatives included a wide array of non-structural (e.g., water efficiency) and structural measures (e.g., reservoirs). O'Brien & Gere evaluated each alternative on the basis of seven criteria: reliable capacity, raw water quality, cost, implementability (permitting), flexibility (phasing), environmental benefits, and recreation. Using the evaluation criteria and working closely with regional stakeholders, O'Brien & Gere identified a combination of non-structural and structural components that increase reliability by using multiple sources of supply.

O'Brien & Gere developed the Comprehensive Regional Water Supply Plan using an open process that incorporated extensive input from the public, elected officials, and governmental and non-governmental agencies. The resulting Comprehensive Regional Water Supply Plan provides a regional solution with benefits beyond water supply.

Based on the findings of the Duck River Comprehensive Regional Water Supply Study, O'Brien & Gere recommends that the DRA adopt and implement the Comprehensive Regional Water Supply Plan, which includes the following non-structural and structural components:

- Non-Structural Components:
  - **Drought Management Plan** – Develop and implement a regional drought management plan.
  - **Water Use Efficiency Program** – Develop and implement a water use efficiency program.
  - **Optimize Normandy Reservoir Releases** – Optimize releases from Normandy Reservoir to preserve storage in the reservoir for periods when it is most needed.

- Structural Components:
  - **Normandy Dam Improvements** – Increase the elevation of Normandy Dam by five feet and increase the Winter/Spring pool elevation by approximately five feet without increasing the Summer/Fall pool elevation. This component increases water storage during droughts, enhances flood protection while minimizing environmental impacts, and enhances the reliable yield available for all Duck River uses.
  - **Williamsport Intake** – Relocate Columbia's water withdrawal to a new intake approximately 25 miles downstream, near Williamsport, where there is adequate flow in the Duck River during droughts to satisfy Maury County's projected needs. This component addresses the potential deficit in Maury County and southern Williamson County with a local, highly reliable supply and eliminates their sole reliance on Normandy Reservoir.

The estimated project cost for implementation of the Comprehensive Regional Water Supply Plan is $62 million:

- Baseline alternatives – $4 million
- Raise Normandy Dam – $20 million
- Williamsport Intake and Raw Water Pipeline to Columbia (one 30-inch pipe for 20 mgd) – $38 million

Additional technical and environmental investigations are planned in future phases to refine the project cost.

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Appendix 3
CBER Data

POPULATION PROJECTIONS FOR THE STATE OF TENNESSEE, 2010-2030

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Overview

OVERVIEW

This report contains population projections for Tennessee cities and counties in five-year intervals from 2010 to 2030. The purpose of the projections is to aid in local planning efforts, such as those outlined in Public Chapter 1101 (PC1101).

The Center for Business and Economic Research (CBER) previously released population projections for cities, counties and unincorporated areas in 1998 and 2003. Both the 2003 and 2009 projections use the *cohort component* method to determine future population trends. This approach models the components of population change, including births, deaths, and migration, and results in population counts by sex and 5-year age group. Because of space limitations, only population totals for the state, county or place are included in this report. Further details on this model may be found in the Technical Appendix.

Like the previous study, this study uses county-level population projections to control both the state and city-level population counts. In other words, first county population projections are created. The county results are summed together to create the state population projections. In both studies, the city-level projections were weighted so that they were equal to the county totals.

There are some notable differences between the current approach and previous efforts. In the 2003 study, city-level Census data for 2000, 2001 and 2002, were used to assign a share of the county estimates to each city. The current approach uses the cohort component method on the city-level data rather than disaggregating these estimates from county totals. The population projections are generated in four steps. First, a range of fertility and mortality rates are used to predict the number of births and deaths in each county between 2000 and 2004. The fertility/mortality rate that is selected is the one that results in the smallest difference between predicted births/deaths and actual births/deaths over the 2000 to 2004 time period. Second, county-level projections are created using the cohort component method. Third, we apply the cohort component method to the place population as reported in the 2000 Census. Finally, the city-level projections are re-weighted so they are consistent with the county-level population projections.

Population projections rely on using fertility, mortality and migration rates from the past that will likely persist in the future. Unlike fertility and mortality rates, which exhibit largely consistent trends, migration patterns are extremely difficult to predict. While migration is always volatile, the recent changes that both the national and state economy have experienced will no doubt impact migration patterns in the near-term, and perhaps in the long-term as well. In many counties, the fertility rate is not high enough to sustain population growth in the absence of migration, making the number of new migrants especially important in determining future changes in the community. The population projections presented in this report rely on the migration patterns in Tennessee from 1990 to 2005. The more future migration, fertility or mortality diverges from the recent past, the less accurate population projections will be.

Because future migration is so difficult to determine over the long term, migration rates in this study are dampened from 2015 onwards. The Census uses the same process when creating their long-term population projections. The purpose is to lessen the effects of particularly high and low migration rates, both of which are unlikely to persist over a long time period. One of the consequences of reducing migration rates can be population decreases after a period of population growth. Decreasing migration rates are not the sole cause of population decline. In many counties, fertility rates have declined, and deaths exceed or will exceed births. Both changes in migration and changes in a county's age structure – which impacts the number of women of child-bearing age – can impact whether there is population growth or decline.

OVERVIEW

The projections included in this report rely exclusively on population measures – an initial population from the 2000 Census, and historic fertility, mortality and migration rates. Because of this, important factors such as space constraints for new housing, zoning rules, water availability, and road capacity in no way limit population numbers. Just as these factors do not limit growth, neither do they generate growth. The population projections will be most in error in those counties and cities where new industries or housing developments alter the prevailing migration rates of the last 15 years.

In addition to providing projections at the level of cities, CBER also explored creating population projections for individual PC1101 regions, such as municipalities, urban growth boundaries, planned growth areas and rural areas. There were two major obstacles that precluded the creation of population projections in this format. First, there is no straightforward way to ensure that the original PC1101 maps, which were submitted to the Local Government Planning Advisory Committee as paper maps, are drawn so that the Census population captured by the municipalities, urban growth boundaries, planned growth areas and rural areas are the way map-makers intended. Second, it was impossible to make certain that the paper PC1101 maps have been faithfully translated into digital maps. There are good reasons to believe that one or both of these assumptions will not hold true for every county or PC1101 area. More importantly, it is impossible to systematically evaluate areas where these assumptions hold true, and areas where they do not. For this reason, only population projections by municipalities are being released.

Data are available online at:

Center for Business and Economic Research
http://cber.bus.utk.edu/

and

Tennessee Advisory Commission on Intergovernmental Relations
http://www.tennessee.gov/tacir/population.html

Aggregate Projections for Tennessee

AGGREGATE PROJECTIONS FOR TENNESSEE

	Census		Projections				
	2000	2005	2010	2015	2020	2025	2030
Tennessee	5,689,283	5,989,309	6,229,564	6,600,486	6,860,231	7,130,776	7,397,302

Notes: 2005 data are Vintage 2007 Census Bureau intercensal estimates.
The updated projections supplant the state totals reported in the *2009 Economic Report to the Governor*.

Aggregate Projections for Counties

AGGREGATE PROJECTIONS FOR COUNTIES

	Census		Projections				
County	2000	2005	2010	2015	2020	2025	2030
Anderson	71,330	71,801	72,220	73,085	73,382	72,657	71,627
Bedford	37,586	41,963	45,891	52,552	57,529	62,364	67,456
Benton	16,537	16,274	16,098	15,981	15,784	15,938	15,994
Bledsoe	12,367	12,728	13,076	13,664	14,019	14,819	15,624
Blount	105,823	115,261	123,830	140,045	151,018	157,827	164,211
Bradley	87,965	92,288	95,755	100,980	104,536	108,917	113,241
Campbell	39,854	40,436	41,212	42,584	43,379	43,878	44,160
Cannon	12,826	13,156	13,446	13,991	14,317	14,958	15,535
Carroll	29,475	28,731	28,620	28,529	28,398	28,387	28,281
Carter	56,742	58,684	60,732	64,940	67,605	67,878	67,816
Cheatham	35,912	38,053	39,987	42,694	44,609	47,580	50,494
Chester	15,540	15,877	16,093	16,450	16,661	17,694	18,649
Claiborne	29,862	30,845	31,607	33,071	33,924	34,115	34,109
Clay	7,976	7,946	7,969	8,076	8,097	8,162	8,182
Cocke	33,565	34,741	35,858	38,002	39,289	39,699	39,897
Coffee	48,014	50,690	53,078	57,201	60,017	62,288	64,520
Crockett	14,532	14,304	14,160	13,815	13,573	13,945	14,292
Cumberland	46,802	50,912	54,251	61,112	65,343	68,231	71,249
Davidson	569,891	607,413	641,948	697,660	736,606	750,208	764,142
Decatur	11,731	11,415	11,283	11,133	10,975	11,096	11,175
DeKalb	17,423	18,214	19,038	20,551	21,579	22,707	23,770
Dickson	43,156	45,710	48,096	51,681	54,281	57,096	59,765
Dyer	37,279	37,605	37,831	37,777	37,735	38,216	38,555
Fayette	28,806	34,023	38,848	47,925	54,051	54,901	55,301
Fentress	16,625	17,037	17,371	18,003	18,342	18,455	18,477
Franklin	39,270	40,557	41,779	44,103	45,531	46,833	48,035
Gibson	48,152	47,889	48,054	48,455	48,684	48,995	49,210
Giles	29,447	29,097	28,741	28,083	27,515	27,917	28,162
Grainger	20,659	22,109	23,274	25,366	26,761	27,669	28,443
Greene	62,909	64,864	66,414	69,402	71,155	72,185	73,024
Grundy	14,332	14,348	14,382	14,311	14,272	14,363	14,403
Hamblen	58,128	60,017	61,368	62,980	64,053	65,974	67,887
Hamilton	307,896	323,426	326,104	327,665	328,290	329,514	329,365
Hancock	6,786	6,704	6,660	6,605	6,540	6,420	6,276
Hardeman	28,105	27,832	27,719	27,092	26,695	27,778	28,726
Hardin	25,578	25,810	25,953	26,440	26,590	26,578	26,391
Hawkins	53,563	56,014	58,261	62,139	64,667	67,135	69,390
Haywood	19,797	19,399	19,540	19,390	19,350	19,420	19,409
Henderson	25,522	26,173	26,691	27,472	27,999	29,144	30,202
Henry	31,115	31,324	31,516	32,146	32,475	33,113	33,638
Hickman	22,295	23,392	24,673	26,894	28,470	30,999	33,618
Houston	8,088	7,936	7,853	7,654	7,506	7,793	8,055
Humphreys	17,929	17,941	17,952	17,876	17,764	18,186	18,565
Jackson	10,984	10,984	11,100	11,446	11,606	11,954	12,226
Jefferson	44,294	47,913	51,161	57,278	61,411	67,550	74,328

AGGREGATE PROJECTIONS FOR COUNTIES

County	Census 2000	2005	Projections 2010	2015	2020	2025	2030
Johnson	17,499	18,058	18,651	19,964	20,747	20,951	21,082
Knox	382,032	409,116	425,233	453,164	471,912	482,461	491,100
Lake	7,954	7,521	7,473	7,390	7,344	7,389	7,421
Lauderdale	27,101	26,576	26,250	24,917	24,078	25,141	26,161
Lawrence	39,926	40,695	41,485	42,215	42,825	44,387	45,916
Lewis	11,367	11,341	11,425	11,463	11,471	12,062	12,620
Lincoln	31,340	32,146	32,753	33,815	34,466	35,024	35,463
Loudon	39,086	43,242	46,760	53,496	57,763	59,643	61,283
McMinn	49,015	51,069	52,729	55,680	57,607	59,300	60,827
McNairy	24,653	25,087	25,434	25,944	26,262	26,850	27,412
Macon	20,386	21,239	22,170	23,750	24,848	26,666	28,460
Madison	91,837	94,927	97,740	101,133	103,784	108,160	112,259
Marion	27,776	27,742	27,827	27,702	27,504	27,591	27,518
Marshall	26,767	28,053	29,231	31,014	32,323	34,590	36,822
Maury	69,498	75,535	81,235	90,865	97,790	103,893	109,908
Meigs	11,086	11,450	11,798	12,337	12,680	13,868	15,126
Monroe	38,961	42,898	46,262	52,194	56,281	60,039	63,870
Montgomery	134,768	147,657	154,663	161,852	167,895	183,707	199,942
Moore	5,740	5,990	6,213	6,589	6,827	7,213	7,596
Morgan	19,757	20,070	20,488	21,071	21,438	21,865	22,172
Obion	32,450	31,855	31,094	29,397	28,034	27,985	27,851
Overton	20,118	20,460	20,813	21,546	21,963	22,513	23,016
Perry	7,631	7,595	7,581	7,536	7,480	7,762	8,026
Pickett	4,945	4,819	4,747	4,647	4,544	4,507	4,454
Polk	16,050	15,771	15,453	14,745	14,199	14,686	15,133
Putnam	62,315	67,102	70,627	77,372	81,792	85,630	89,576
Rhea	28,400	29,724	30,852	32,650	33,862	35,246	36,670
Roane	51,910	52,624	53,550	55,636	56,776	56,832	56,604
Robertson	54,433	59,938	64,972	73,002	78,938	85,690	92,591
Rutherford	182,023	219,839	251,596	307,184	347,974	383,836	420,465
Scott	21,127	21,699	22,173	22,578	22,890	23,605	24,237
Sequatchie	11,370	12,710	13,848	15,857	17,243	18,348	19,454
Sevier	71,170	79,593	86,374	98,578	106,928	115,878	124,788
Shelby	897,472	905,399	910,776	887,968	875,972	892,254	905,818
Smith	17,712	18,473	19,104	20,214	20,968	22,205	23,365
Stewart	12,370	12,887	13,168	13,702	14,032	15,315	16,696
Sullivan	153,048	152,092	150,962	149,343	147,465	145,737	143,378
Sumner	130,449	143,892	155,925	176,163	190,388	201,263	211,946
Tipton	51,271	55,202	58,187	62,837	66,124	71,161	76,138
Trousdale	7,259	7,429	7,472	7,526	7,544	7,932	8,297
Unicoi	17,667	17,581	17,663	18,108	18,252	17,959	17,561
Union	17,808	18,660	19,546	20,906	21,844	23,422	25,026
Van Buren	5,508	5,377	5,228	4,900	4,642	4,657	4,628
Warren	38,276	39,264	40,346	41,663	42,684	44,641	46,584
Washington	107,198	112,724	116,725	124,487	129,326	133,355	137,005

AGGREGATE PROJECTIONS FOR COUNTIES

County	Census 2000	2005	Projections 2010	2015	2020	2025	2030
Wayne	16,842	16,718	16,782	16,843	16,820	17,449	18,025
Weakley	34,895	33,541	31,686	28,328	25,974	26,175	26,290
White	23,102	24,260	25,282	27,303	28,620	29,357	30,044
Williamson	126,638	152,062	174,485	213,234	241,933	276,716	318,873
Wilson	88,809	99,771	109,234	125,379	136,792	146,324	155,930

Note: 2005 data are Vintage 2007 Census Bureau intercensal estimates.

Aggregate Projections for Municipalities Arrayed by County

AGGREGATE PROJECTIONS FOR MUNICIPALITIES ARRAYED BY COUNTY

County	Municipality	Census 2000	2005	Projections 2010	2015	2020	2025	2030
Anderson	Clinton city	9,409	9,326	9,407	9,525	9,559	9,479	9,368
	Lake City town (pt.)	1,858	1,800	1,799	1,806	1,803	1,780	1,756
	Norris city	1,446	1,426	1,408	1,398	1,380	1,345	1,305
	Oak Ridge city (pt.)	24,599	24,112	23,838	23,808	23,708	23,325	22,881
	Oliver Springs town (pt.)	2,308	2,270	2,281	2,311	2,329	2,318	2,298
	Unincorporated Anderson County	31,710	32,867	33,487	34,237	34,603	34,410	34,019
	Total	71,330	71,801	72,220	73,085	73,382	72,657	71,627
Bedford	Bell Buckle town	391	402	417	458	483	504	525
	Normandy town	152	149	167	194	214	230	248
	Shelbyville city	16,100	18,583	20,322	23,330	25,661	28,009	30,481
	Wartrace town	548	561	601	673	720	764	815
	Unincorporated Bedford County	20,395	22,268	24,384	27,897	30,451	32,857	35,387
	Total	37,586	41,963	45,891	52,552	57,529	62,364	67,456
Benton	Big Sandy town	518	511	495	484	476	481	481
	Camden city	3,828	3,698	3,602	3,541	3,493	3,537	3,573
	Unincorporated Benton County	12,191	12,065	12,001	11,956	11,815	11,920	11,940
	Total	16,537	16,274	16,098	15,981	15,784	15,938	15,994
Bledsoe	Pikeville city	1,781	1,832	1,886	1,982	2,044	2,184	2,326
	Unincorporated Bledsoe County	10,586	10,896	11,190	11,682	11,975	12,635	13,298
	Total	12,367	12,728	13,076	13,664	14,019	14,819	15,624
Blount	Alcoa city	7,734	8,413	8,909	9,972	10,682	11,115	11,522
	Friendsville city	890	919	980	1,101	1,181	1,226	1,264
	Louisville city	2,001	2,151	2,296	2,578	2,758	2,851	2,927
	Maryville city	23,119	25,727	27,734	31,589	34,373	36,283	38,155
	Rockford city	798	811	868	977	1,046	1,083	1,114
	Townsend city	248	264	259	265	262	254	248
	Vonore town (pt.)	0	0	0	0	0	0	0
	Unincorporated Blount County	71,033	76,976	82,784	93,563	100,716	105,015	108,981
	Total	105,823	115,261	123,830	140,045	151,018	157,827	164,211
Bradley	Charleston city	630	666	677	703	719	742	771
	Cleveland city	37,192	36,978	38,414	40,804	42,278	44,120	46,036
	Unincorporated Bradley County	50,143	54,644	56,664	59,473	61,539	64,055	66,434
	Total	87,965	92,288	95,755	100,980	104,536	108,917	113,241
Campbell	Caryville town	2,243	2,368	2,442	2,543	2,606	2,658	2,702
	Jacksboro town	1,887	1,982	2,015	2,067	2,092	2,108	2,112
	Jellico city	2,448	2,501	2,514	2,565	2,590	2,607	2,619
	LaFollette city	7,926	8,123	8,176	8,386	8,536	8,655	8,746
	Lake City town (pt.)	31	46	47	48	50	52	53
	Unincorporated Campbell County	25,319	25,416	26,018	26,975	27,505	27,798	27,928
	Total	39,854	40,436	41,212	42,584	43,379	43,878	44,160
Cannon	Auburntown town	252	254	257	266	271	284	296
	Woodbury town	2,428	2,492	2,506	2,572	2,617	2,733	2,847
	Unincorporated Cannon County	10,146	10,410	10,683	11,153	11,429	11,941	12,392
	Total	12,826	13,156	13,446	13,991	14,317	14,958	15,535
Carroll	Atwood town	1,000	965	947	931	913	898	883
	Bruceton town	1,554	1,465	1,451	1,442	1,433	1,430	1,427
	Clarksburg town	285	368	354	340	325	316	309
	Hollow Rock town	963	932	930	932	935	941	942
	Huntingdon town	4,349	4,131	4,092	4,064	4,050	4,063	4,063
	McKenzie city (pt.)	4,981	5,055	5,043	5,028	5,018	5,045	5,062
	McLemoresville town	259	309	297	287	276	267	258
	Trezevant town	901	879	857	840	824	816	807
	Unincorporated Carroll County	15,183	14,627	14,649	14,665	14,624	14,611	14,530
	Total	29,475	28,731	28,620	28,529	28,398	28,387	28,281
Carter	Elizabethton city	13,372	13,863	14,265	15,185	15,809	15,934	16,037
	Johnson City city (pt.)	1,143	1,222	1,276	1,372	1,437	1,455	1,469
	Watauga city (pt.)	330	351	366	394	411	414	415
	Unincorporated Carter County	41,897	43,248	44,825	47,989	49,948	50,075	49,895
	Total	56,742	58,684	60,732	64,940	67,605	67,878	67,816

AGGREGATE PROJECTIONS FOR MUNICIPALITIES ARRAYED BY COUNTY

County	Municipality	Census 2000	2005	Projections 2010	2015	2020	2025	2030
Cheatham	Ashland City town	3,641	4,481	4,702	5,045	5,296	5,684	6,071
	Kingston Springs town	2,773	2,831	2,967	3,156	3,290	3,498	3,692
	Pegram town	2,146	2,136	2,235	2,371	2,465	2,612	2,760
	Pleasant View city	2,934	3,404	3,615	3,895	4,104	4,418	4,735
	Unincorporated Cheatham County	24,418	25,201	26,468	28,227	29,454	31,368	33,236
	Total	35,912	38,053	39,987	42,694	44,609	47,580	50,494
Chester	Enville town (pt.)	230	237	227	222	215	219	224
	Henderson city	5,670	5,737	5,969	6,176	6,315	7,000	7,476
	Milledgeville town (pt.)	83	96	90	88	86	88	92
	Silerton town (pt.)	0	0	0	0	0	0	0
	Unincorporated Chester County	9,557	9,807	9,807	9,964	10,045	10,387	10,857
	Total	15,540	15,877	16,093	16,450	16,661	17,694	18,649
Claiborne	Cumberland Gap town	204	206	212	223	229	233	235
	Harrogate city	2,865	3,943	4,053	4,234	4,344	4,386	4,417
	New Tazewell town	2,871	2,860	2,931	3,078	3,180	3,225	3,255
	Tazewell town	2,165	2,131	2,159	2,230	2,256	2,247	2,234
	Unincorporated Claiborne County	21,757	21,705	22,252	23,306	23,915	24,024	23,968
	Total	29,862	30,845	31,607	33,071	33,924	34,115	34,109
Clay	Celina city	1,379	1,361	1,361	1,380	1,390	1,413	1,427
	Unincorporated Clay County	6,597	6,585	6,608	6,696	6,707	6,749	6,755
	Total	7,976	7,946	7,969	8,076	8,097	8,162	8,182
Cocke	Newport city	7,241	7,324	7,501	7,937	8,233	8,361	8,462
	Parrottsville town	210	226	235	253	269	279	288
	Unincorporated Cocke County	26,114	27,191	28,122	29,812	30,787	31,059	31,147
	Total	33,565	34,741	35,858	38,002	39,289	39,699	39,897
Coffee	Manchester city	8,294	9,546	9,908	10,593	11,060	11,455	11,860
	Tullahoma city (pt.)	16,970	17,791	18,591	20,023	21,028	21,868	22,703
	Unincorporated Coffee County	22,750	23,353	24,579	26,585	27,929	28,965	29,957
	Total	48,014	50,690	53,078	57,201	60,017	62,288	64,520
Crockett	Alamo town	2,392	2,337	2,299	2,237	2,199	2,269	2,344
	Bells city	2,171	2,269	2,288	2,276	2,280	2,386	2,487
	Friendship city	608	599	593	582	575	594	613
	Gadsden town	553	547	542	527	512	519	526
	Maury City town	704	696	681	655	634	641	650
	Unincorporated Crockett County	8,104	7,856	7,757	7,538	7,373	7,536	7,672
	Total	14,532	14,304	14,160	13,815	13,573	13,945	14,292
Cumberland	Crab Orchard city	838	897	985	1,146	1,261	1,346	1,421
	Crossville city	8,981	10,448	11,249	12,875	14,049	14,967	15,925
	Pleasant Hill town	544	592	537	518	502	503	522
	Unincorporated Cumberland County	36,439	38,975	41,480	46,573	49,531	51,415	53,381
	Total	46,802	50,912	54,251	61,112	65,343	68,231	71,249
Davidson	Belle Meade city	2,943	3,360	3,366	3,541	3,764	3,899	3,952
	Berry Hill city	674	735	773	802	803	777	754
	Forest Hills city	4,710	5,580	5,537	5,774	6,052	6,133	6,108
	Goodlettsville city (pt.)	9,135	10,814	11,336	12,128	12,749	12,964	13,153
	Lakewood city	2,341	2,594	2,694	2,845	2,975	3,022	3,064
	Oak Hill city	4,493	5,123	5,050	5,231	5,440	5,442	5,373
	Ridgetop city (pt.)	28	105	106	115	125	129	143
	Unincorporated Davidson County	545,567	579,102	613,086	667,224	704,698	717,842	731,595
	Total	569,891	607,413	641,948	697,660	736,606	750,208	764,142
Decatur	Decaturville town	859	830	822	815	810	827	839
	Parsons city	2,452	2,390	2,360	2,324	2,296	2,328	2,353
	Scotts Hill town (pt.)	345	339	337	336	337	344	351
	Unincorporated Decatur County	8,075	7,856	7,764	7,658	7,532	7,597	7,632
	Total	11,731	11,415	11,283	11,133	10,975	11,096	11,175
DeKalb	Alexandria town	814	859	897	977	1,039	1,110	1,180
	Dowelltown town	302	314	323	344	357	372	387
	Liberty town	367	381	395	419	432	444	452
	Smithville city	3,994	4,157	4,322	4,654	4,903	5,189	5,477
	Unincorporated DeKalb County	11,946	12,503	13,101	14,157	14,848	15,592	16,274
	Total	17,423	18,214	19,038	20,551	21,579	22,707	23,770

AGGREGATE PROJECTIONS FOR MUNICIPALITIES ARRAYED BY COUNTY

County	Municipality	Census 2000	2005	Projections 2010	2015	2020	2025	2030
Dickson	Burns town	1,366	1,396	1,460	1,558	1,622	1,691	1,758
	Charlotte town	1,153	1,150	1,203	1,287	1,348	1,418	1,487
	Dickson city	12,244	13,342	14,073	15,182	16,038	16,992	17,928
	Slayden town	185	198	198	203	201	201	203
	Vanleer town	310	313	320	338	348	360	371
	White Bluff town	2,142	2,361	2,465	2,621	2,718	2,832	2,940
	Unincorporated Dickson County	25,756	26,950	28,377	30,492	32,006	33,602	35,078
	Total	43,156	45,710	48,096	51,681	54,281	57,096	59,765
Dyer	Dyersburg city	17,452	17,372	17,531	17,610	17,729	18,104	18,412
	Newbern town	2,988	3,073	3,115	3,136	3,164	3,234	3,290
	Trimble town (pt.)	727	720	714	703	695	700	702
	Unincorporated Dyer County	16,112	16,440	16,471	16,328	16,147	16,178	16,151
	Total	37,279	37,605	37,831	37,777	37,735	38,216	38,555
Fayette	Braden town	274	283	324	400	449	453	452
	Gallaway city	666	708	811	1,005	1,141	1,168	1,192
	Grand Junction city (pt.)	0	0	0	0	0	0	0
	La Grange town	146	149	161	185	194	183	170
	Moscow city	422	532	601	733	821	834	847
	Oakland town	1,278	2,538	2,953	3,696	4,230	4,386	4,502
	Piperton city	589	1,084	1,143	1,296	1,346	1,258	1,173
	Rossville town	380	472	535	656	735	744	749
	Somerville town	2,518	2,875	3,236	3,955	4,463	4,566	4,661
	Williston city	341	352	410	514	586	601	611
	Unincorporated Fayette County	22,192	25,030	28,674	35,485	40,086	40,708	40,944
	Total	28,806	34,023	38,848	47,925	54,051	54,901	55,301
Fentress	Allardt city	642	652	650	656	654	649	642
	Jamestown city	1,839	1,852	1,838	1,860	1,869	1,865	1,858
	Unincorporated Fentress County	14,144	14,533	14,883	15,487	15,819	15,941	15,977
	Total	16,625	17,037	17,371	18,003	18,342	18,455	18,477
Franklin	Cowan city	1,771	1,786	1,809	1,910	1,983	2,066	2,147
	Decherd city	2,247	2,223	2,291	2,410	2,490	2,567	2,648
	Estill Springs town	2,153	2,308	2,366	2,493	2,574	2,649	2,720
	Huntland town	916	899	916	951	983	1,015	1,038
	Monteagle town (pt.)	12	39	38	43	48	51	56
	Tullahoma city (pt.)	1,024	1,078	1,112	1,170	1,210	1,254	1,290
	Winchester city	7,332	7,853	8,031	8,435	8,703	8,941	9,209
	Unincorporated Franklin County	23,815	24,371	25,216	26,691	27,540	28,290	28,927
	Total	39,270	40,557	41,779	44,103	45,531	46,833	48,035
Gibson	Bradford town	1,113	1,066	1,059	1,060	1,055	1,052	1,050
	Dyer city	2,406	2,403	2,385	2,389	2,407	2,435	2,457
	Gibson town	305	403	417	428	438	449	459
	Humboldt city (pt.)	9,442	9,186	9,208	9,282	9,332	9,405	9,473
	Kenton town (pt.)	752	740	738	738	737	739	742
	Medina city	969	1,280	1,306	1,345	1,380	1,416	1,443
	Milan city	7,664	7,782	7,806	7,876	7,948	8,062	8,168
	Rutherford town	1,272	1,236	1,229	1,230	1,231	1,235	1,240
	Trenton city	4,683	4,550	4,591	4,658	4,710	4,772	4,831
	Yorkville city	293	325	321	325	335	345	352
	Unincorporated Gibson County	19,253	18,918	18,994	19,124	19,111	19,085	18,995
	Total	48,152	47,889	48,054	48,455	48,684	48,995	49,210
Giles	Ardmore city (pt.)	995	1,013	989	958	932	943	948
	Elkton city	510	606	596	571	546	543	538
	Lynnville town	345	346	337	324	314	317	319
	Minor Hill city	437	447	439	432	428	441	454
	Pulaski city	7,871	7,884	7,739	7,549	7,426	7,583	7,705
	Unincorporated Giles County	19,289	18,801	18,641	18,249	17,869	18,090	18,198
	Total	29,447	29,097	28,741	28,083	27,515	27,917	28,162
Grainger	Bean Station city	3,250	2,967	3,121	3,402	3,590	3,713	3,819
	Blaine city	1,834	1,703	1,804	1,978	2,098	2,180	2,251
	Rutledge town	1,374	1,255	1,299	1,390	1,448	1,486	1,523
	Unincorporated Grainger County	14,201	16,184	17,050	18,596	19,625	20,290	20,850
	Total	20,659	22,109	23,274	25,366	26,761	27,669	28,443

AGGREGATE PROJECTIONS FOR MUNICIPALITIES ARRAYED BY COUNTY

County	Municipality	Census 2000	2005	Projections 2010	2015	2020	2025	2030
Greene	Baileyton town	504	501	501	513	519	520	521
	Greeneville town	15,198	15,278	15,479	16,057	16,420	16,660	16,891
	Mosheim town	1,749	2,027	2,058	2,124	2,148	2,152	2,151
	Tusculum city	2,004	2,199	2,228	2,290	2,303	2,296	2,302
	Unincorporated Greene County	43,454	44,859	46,148	48,418	49,765	50,557	51,159
	Total	62,909	64,864	66,414	69,402	71,155	72,185	73,024
Grundy	Altamont town	1,136	1,124	1,135	1,141	1,152	1,175	1,190
	Beersheba Springs town	553	550	543	531	518	511	506
	Coalmont city	948	954	967	975	984	1,000	1,011
	Gruetli-Laager city	1,867	1,873	1,896	1,901	1,912	1,940	1,964
	Monteagle town (pt.)	792	781	763	733	707	692	679
	Palmer town	726	711	695	678	661	648	636
	Tracy City town	1,679	1,665	1,648	1,615	1,590	1,584	1,577
	Unincorporated Grundy County	6,631	6,690	6,735	6,737	6,748	6,813	6,840
	Total	14,332	14,348	14,382	14,311	14,272	14,363	14,403
Hamblen	Morristown city (pt.)	24,960	26,739	27,340	28,092	28,676	29,725	30,805
	White Pine town (pt.)	0	0	0	0	0	0	0
	Unincorporated Hamblen County	33,168	33,278	34,028	34,888	35,377	36,249	37,082
	Total	58,128	60,017	61,368	62,980	64,053	65,974	67,887
Hamilton	Chattanooga city	155,554	163,864	164,959	165,870	166,048	166,788	167,275
	Collegedale city	6,514	8,290	8,740	9,171	9,329	9,511	9,637
	East Ridge city	20,640	20,099	20,001	19,710	19,512	19,426	19,258
	Lakesite city	1,845	1,940	1,965	1,988	2,003	2,019	2,007
	Lookout Mountain town	2,000	1,936	1,889	1,857	1,856	1,856	1,856
	Red Bank city	12,418	11,853	12,039	12,054	12,040	12,065	12,067
	Ridgeside city	389	391	376	365	359	357	345
	Signal Mountain town	7,429	7,318	7,129	7,032	7,030	7,024	6,985
	Soddy-Daisy city	11,530	12,158	12,277	12,279	12,248	12,249	12,235
	Walden town	1,960	2,050	2,053	2,033	2,043	2,056	2,033
	Unincorporated Hamilton County	87,617	93,527	94,676	95,306	95,822	96,163	95,667
	Total	307,896	323,426	326,104	327,665	328,290	329,514	329,365
Hancock	Sneedville town	1,257	1,315	1,308	1,297	1,288	1,271	1,256
	Unincorporated Hancock County	5,529	5,389	5,352	5,308	5,252	5,149	5,020
	Total	6,786	6,704	6,660	6,605	6,540	6,420	6,276
Hardeman	Bolivar city	5,799	5,693	5,692	5,616	5,590	5,837	6,063
	Grand Junction city (pt.)	301	316	306	296	289	296	303
	Hickory Valley town	136	132	125	118	112	112	111
	Hornsby town	306	299	301	297	294	306	314
	Middleton city	602	625	617	605	595	614	629
	Saulsbury town	100	115	108	103	102	105	107
	Silerton town (pt.)	70	79	89	86	87	95	101
	Toone town	330	372	366	357	346	355	360
	Whiteville town	3,147	4,187	4,175	3,978	3,819	3,968	4,104
	Unincorporated Hardeman County	17,314	16,014	15,940	15,636	15,461	16,090	16,634
	Total	28,105	27,832	27,719	27,092	26,695	27,778	28,726
Hardin	Adamsville town (pt.)	33	39	39	40	40	41	41
	Crump city	1,521	1,437	1,432	1,448	1,447	1,436	1,419
	Milledgeville town (pt.)	74	84	82	81	81	81	80
	Saltillo town	342	361	355	359	362	361	358
	Savannah city	6,917	7,163	7,168	7,296	7,368	7,405	7,396
	Unincorporated Hardin County	16,691	16,726	16,877	17,216	17,292	17,254	17,097
	Total	25,578	25,810	25,953	26,440	26,590	26,578	26,391
Hawkins	Bulls Gap town	714	714	730	761	776	792	813
	Church Hill city	5,916	6,370	6,592	6,978	7,204	7,430	7,638
	Kingsport city (pt.)	2,892	2,994	3,052	3,209	3,313	3,423	3,527
	Mount Carmel town	4,795	5,255	5,455	5,805	6,033	6,250	6,443
	Rogersville town	4,240	4,264	4,278	4,425	4,501	4,602	4,720
	Surgoinsville town	1,484	1,737	1,775	1,858	1,903	1,950	1,994
	Unincorporated Hawkins County	33,522	34,680	36,379	39,103	40,937	42,688	44,255
	Total	53,563	56,014	58,261	62,139	64,667	67,135	69,390
Haywood	Brownsville city	10,748	10,585	10,767	10,815	10,933	11,103	11,211
	Stanton town	615	596	604	602	606	614	622
	Unincorporated Haywood County	8,434	8,218	8,169	7,973	7,811	7,703	7,576
	Total	19,797	19,399	19,540	19,390	19,350	19,420	19,409

AGGREGATE PROJECTIONS FOR MUNICIPALITIES ARRAYED BY COUNTY

		Census		Projections				
County	**Municipality**	**2000**	**2005**	**2010**	**2015**	**2020**	**2025**	**2030**
Henderson	Lexington city	7,393	7,602	7,749	7,965	8,115	8,457	8,785
	Parker's Crossroads city	241	247	243	241	238	239	239
	Sardis town	445	450	443	443	441	450	460
	Scotts Hill town (pt.)	549	561	566	580	592	617	642
	Unincorporated Henderson County	16,894	17,313	17,690	18,243	18,613	19,381	20,076
	Total	25,522	26,173	26,691	27,472	27,999	29,144	30,202
Henry	Cottage Grove town	103	97	99	103	107	111	115
	Henry town	520	523	550	585	614	647	677
	McKenzie city (pt.)	73	92	93	96	99	103	106
	Paris city	9,761	9,819	9,827	10,028	10,198	10,495	10,770
	Puryear city	667	666	667	672	672	681	692
	Unincorporated Henry County	19,991	20,127	20,280	20,662	20,785	21,076	21,278
	Total	31,115	31,324	31,516	32,146	32,475	33,113	33,638
Hickman	Centerville town	3,793	3,937	4,049	4,313	4,500	4,853	5,231
	Unincorporated Hickman County	18,502	19,455	20,624	22,581	23,970	26,146	28,387
	Total	22,295	23,392	24,673	26,894	28,470	30,999	33,618
Houston	Erin city	1,490	1,434	1,417	1,382	1,357	1,413	1,464
	Tennessee Ridge town (pt.)	1,327	1,295	1,262	1,212	1,174	1,209	1,244
	Unincorporated Houston County	5,271	5,207	5,174	5,060	4,975	5,171	5,347
	Total	8,088	7,936	7,853	7,654	7,506	7,793	8,055
Humphreys	McEwen city	1,702	1,644	1,653	1,663	1,673	1,734	1,792
	New Johnsonville city	1,905	1,935	1,950	1,954	1,953	2,005	2,049
	Waverly city	4,028	4,073	4,031	3,981	3,940	4,028	4,114
	Unincorporated Humphreys County	10,294	10,289	10,318	10,278	10,198	10,419	10,610
	Total	17,929	17,941	17,952	17,876	17,764	18,186	18,565
Jackson	Gainesboro town	879	855	844	847	842	853	864
	Unincorporated Jackson County	10,105	10,129	10,256	10,599	10,764	11,101	11,362
	Total	10,984	10,984	11,100	11,446	11,606	11,954	12,226
Jefferson	Baneberry city	366	694	684	710	702	713	743
	Dandridge town	2,078	2,269	2,334	2,568	2,700	2,944	3,218
	Jefferson City city	7,761	8,436	9,184	10,496	11,364	12,615	13,974
	Morristown city (pt.)	0	0	0	0	0	0	0
	New Market town	1,234	1,277	1,354	1,498	1,587	1,731	1,888
	White Pine town (pt.)	1,996	1,980	2,103	2,346	2,520	2,786	3,087
	Unincorporated Jefferson County	30,859	33,257	35,502	39,660	42,538	46,761	51,418
	Total	44,294	47,913	51,161	57,278	61,411	67,550	74,328
Johnson	Mountain City town	2,383	2,411	2,445	2,577	2,645	2,649	2,660
	Unincorporated Johnson County	15,116	15,647	16,206	17,387	18,102	18,302	18,422
	Total	17,499	18,058	18,651	19,964	20,747	20,951	21,082
Knox	Farragut town (pt.)	17,718	19,709	20,054	21,149	22,062	22,379	22,386
	Knoxville city	173,890	174,948	183,490	197,560	205,806	210,868	215,554
	Unincorporated Knox County	190,424	214,459	221,689	234,455	244,044	249,214	253,160
	Total	382,032	409,116	425,233	453,164	471,912	482,461	491,100
Lake	Ridgely town	1,667	1,494	1,514	1,480	1,481	1,515	1,486
	Tiptonville town	2,439	3,971	4,094	3,927	3,863	3,895	3,810
	Unincorporated Lake County	3,848	2,056	1,865	1,983	2,000	1,979	2,125
	Total	7,954	7,521	7,473	7,390	7,344	7,389	7,421
Lauderdale	Gates town	901	861	873	855	850	900	944
	Halls town	2,311	2,220	2,178	2,068	2,005	2,091	2,170
	Henning town	970	1,299	1,292	1,245	1,227	1,301	1,374
	Ripley city	7,844	7,716	7,712	7,426	7,269	7,658	8,039
	Unincorporated Lauderdale County	15,075	14,480	14,195	13,323	12,727	13,191	13,634
	Total	27,101	26,576	26,250	24,917	24,078	25,141	26,161
Lawrence	Ethridge town	536	549	565	579	585	603	624
	Iron City city (pt.)	369	372	380	383	382	388	394
	Lawrenceburg city	10,795	10,792	10,829	10,869	10,922	11,250	11,596
	Loretto city	1,665	1,690	1,700	1,709	1,711	1,756	1,805
	St. Joseph city	829	849	866	877	881	905	930
	Unincorporated Lawrence County	25,732	26,443	27,145	27,798	28,344	29,485	30,567
	Total	39,926	40,695	41,485	42,215	42,825	44,387	45,916
Lewis	Hohenwald city	3,754	3,759	3,734	3,714	3,702	3,893	4,084
	Unincorporated Lewis County	7,613	7,582	7,691	7,749	7,769	8,169	8,536
	Total	11,367	11,341	11,425	11,463	11,471	12,062	12,620

AGGREGATE PROJECTIONS FOR MUNICIPALITIES ARRAYED BY COUNTY

County	Municipality	Census 2000	2005	Projections 2010	2015	2020	2025	2030
Lincoln	Ardmore city (pt.)	87	94	95	97	98	99	99
	Fayetteville city	6,994	6,985	6,984	7,113	7,209	7,329	7,457
	Petersburg town (pt.)	412	423	427	442	450	457	462
	Unincorporated Lincoln County	23,847	24,644	25,247	26,163	26,709	27,139	27,445
	Total	31,340	32,146	32,753	33,815	34,466	35,024	35,463
Loudon	Farragut town (pt.)	0	0	0	0	0	0	0
	Greenback city	954	1,020	1,106	1,273	1,389	1,449	1,500
	Lenoir City city	6,819	7,564	8,310	9,703	10,750	11,421	12,059
	Loudon town	4,476	4,825	5,183	5,918	6,427	6,703	6,956
	Philadelphia city	533	570	625	729	807	854	898
	Unincorporated Loudon County	26,304	29,263	31,536	35,873	38,390	39,216	39,870
	Total	39,086	43,242	46,760	53,496	57,763	59,643	61,283
McMinn	Athens city	13,220	13,798	14,310	15,204	15,863	16,505	17,108
	Calhoun town	496	510	515	528	532	535	538
	Englewood town	1,590	1,658	1,693	1,772	1,825	1,879	1,932
	Etowah city	3,663	3,715	3,755	3,906	4,009	4,104	4,201
	Niota city	781	792	811	847	866	880	896
	Sweetwater city (pt.)	0	0	0	0	0	0	0
	Unincorporated McMinn County	29,265	30,596	31,645	33,423	34,512	35,397	36,152
	Total	49,015	51,069	52,729	55,680	57,607	59,300	60,827
McNairy	Adamsville town (pt.)	1,950	2,009	2,009	2,033	2,053	2,096	2,140
	Bethel Springs town	763	763	773	790	808	834	858
	Eastview town	618	622	625	632	640	652	662
	Enville town (pt.)	0	0	0	0	0	0	0
	Finger city	350	353	370	389	405	428	449
	Guys town	483	488	500	511	513	520	527
	Michie town	647	654	653	658	658	663	668
	Milledgeville town (pt.)	130	158	154	153	155	159	163
	Ramer city	354	355	362	372	374	380	386
	Selmer town	4,541	4,550	4,572	4,618	4,640	4,723	4,806
	Stantonville town	312	353	350	351	351	356	362
	Unincorporated McNairy County	14,505	14,782	15,066	15,437	15,665	16,039	16,391
	Total	24,653	25,087	25,434	25,944	26,262	26,850	27,412
Macon	Lafayette city	3,885	4,175	4,219	4,387	4,482	4,728	4,990
	Red Boiling Springs city	1,023	1,043	1,070	1,121	1,152	1,217	1,286
	Unincorporated Macon County	15,478	16,021	16,881	18,242	19,214	20,721	22,184
	Total	20,386	21,239	22,170	23,750	24,848	26,666	28,460
Madison	Humboldt city (pt.)	25	31	32	32	33	34	36
	Jackson city	59,643	62,023	64,248	66,849	69,004	72,402	75,677
	Medon city	191	191	190	189	187	189	190
	Three Way city	1,375	1,350	1,390	1,445	1,490	1,550	1,598
	Unincorporated Madison County	30,603	31,332	31,880	32,618	33,070	33,985	34,758
	Total	91,837	94,927	97,740	101,133	103,784	108,160	112,259
Marion	Chattanooga city	0	0	0	0	0	0	0
	Jasper town	3,213	3,076	3,068	3,043	3,016	3,023	3,017
	Kimball town	1,312	1,351	1,351	1,336	1,318	1,311	1,296
	Monteagle town (pt.)	420	399	391	377	365	358	352
	New Hope city	1,043	1,024	1,037	1,044	1,045	1,054	1,056
	Orme town	128	138	138	137	135	134	132
	Powell's Crossroads town	1,286	1,218	1,233	1,240	1,246	1,263	1,270
	South Pittsburg city	3,294	3,122	3,101	3,074	3,060	3,089	3,105
	Whitwell city	1,660	1,600	1,575	1,541	1,510	1,501	1,489
	Unincorporated Marion County	15,420	15,814	15,933	15,910	15,809	15,858	15,801
	Total	27,776	27,742	27,827	27,702	27,504	27,591	27,518
Marshall	Chapel Hill town	943	1,211	1,232	1,279	1,314	1,394	1,476
	Cornersville town	962	926	959	1,019	1,068	1,150	1,235
	Lewisburg city	10,413	10,661	11,020	11,638	12,125	13,007	13,897
	Petersburg town (pt.)	168	179	184	194	202	216	230
	Unincorporated Marshall County	14,281	15,076	15,836	16,884	17,614	18,823	19,984
	Total	26,767	28,053	29,231	31,014	32,323	34,590	36,822
Maury	Columbia city	33,055	33,506	35,858	40,024	43,131	45,999	48,899
	Mount Pleasant city	4,491	4,416	4,719	5,256	5,641	5,995	6,365
	Spring Hill city (pt.)	2,580	6,431	7,128	8,245	9,134	9,911	10,625
	Unincorporated Maury County	29,372	31,182	33,530	37,340	39,884	41,988	44,019
	Total	69,498	75,535	81,235	90,865	97,790	103,893	109,908

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County	Municipality	Census 2000	2005	Projections 2010	2015	2020	2025	2030
Meigs	Decatur town	1,395	1,426	1,447	1,491	1,519	1,652	1,797
	Unincorporated Meigs County	9,691	10,024	10,351	10,846	11,161	12,216	13,329
	Total	11,086	11,450	11,798	12,337	12,680	13,868	15,126
Monroe	Madisonville city	3,939	4,324	4,613	5,181	5,580	5,963	6,363
	Sweetwater city (pt.)	5,585	6,168	6,551	7,303	7,830	8,341	8,874
	Tellico Plains town	859	924	985	1,097	1,166	1,226	1,295
	Vonore town (pt.)	1,161	1,372	1,468	1,641	1,757	1,868	1,985
	Unincorporated Monroe County	27,417	30,110	32,645	36,972	39,948	42,641	45,353
	Total	38,961	42,898	46,262	52,194	56,281	60,039	63,870
Montgomery	Clarksville city	103,455	112,513	118,577	124,771	129,737	142,435	155,647
	Unincorporated Montgomery County	31,313	35,144	36,086	37,081	38,158	41,272	44,295
	Total	134,768	147,657	154,663	161,852	167,895	183,707	199,942
Moore	Unincorporated Moore County	5,740	5,990	6,213	6,589	6,827	7,213	7,596
	Total	5,740	5,990	6,213	6,589	6,827	7,213	7,596
Morgan	Harriman city (pt.)	0	0	0	0	0	0	0
	Oakdale town	246	238	244	254	261	268	274
	Oliver Springs town (pt.)	52	60	61	62	63	65	67
	Sunbright city	577	587	603	623	638	654	665
	Wartburg city	890	909	917	932	943	961	978
	Unincorporated Morgan County	17,992	18,276	18,663	19,200	19,533	19,917	20,188
	Total	19,757	20,070	20,488	21,071	21,438	21,865	22,172
Obion	Hornbeak town	435	424	413	391	374	376	376
	Kenton town (pt.)	554	550	532	500	477	477	477
	Obion town	1,134	1,097	1,056	988	941	941	941
	Rives town	331	321	316	306	296	298	299
	Samburg town	260	268	256	238	226	226	223
	South Fulton city	2,517	2,422	2,335	2,192	2,088	2,086	2,079
	Trimble town (pt.)	0	0	0	0	0	0	0
	Troy town	1,273	1,232	1,196	1,130	1,083	1,090	1,092
	Union City city	10,876	10,676	10,465	9,936	9,517	9,556	9,577
	Woodland Mills city	296	302	297	282	267	265	261
	Unincorporated Obion County	14,774	14,563	14,228	13,434	12,765	12,670	12,526
	Total	32,450	31,855	31,094	29,397	28,034	27,985	27,851
Overton	Livingston town	3,498	3,478	3,480	3,549	3,583	3,655	3,727
	Unincorporated Overton County	16,620	16,982	17,333	17,997	18,380	18,858	19,289
	Total	20,118	20,460	20,813	21,546	21,963	22,513	23,016
Perry	Linden town	1,015	984	970	961	958	1,003	1,049
	Lobelville city	915	912	907	898	889	922	954
	Unincorporated Perry County	5,701	5,699	5,704	5,677	5,633	5,837	6,023
	Total	7,631	7,595	7,581	7,536	7,480	7,762	8,026
Pickett	Byrdstown town	903	873	861	847	831	827	824
	Unincorporated Pickett County	4,042	3,946	3,886	3,800	3,713	3,680	3,630
	Total	4,945	4,819	4,747	4,647	4,544	4,507	4,454
Polk	Benton town	1,138	1,169	1,149	1,104	1,077	1,131	1,183
	Copperhill city	511	476	456	426	405	413	422
	Ducktown city	427	404	380	348	324	326	330
	Unincorporated Polk County	13,974	13,722	13,468	12,867	12,393	12,816	13,198
	Total	16,050	15,771	15,453	14,745	14,199	14,686	15,133
Putnam	Algood town	2,942	3,109	3,244	3,537	3,748	3,943	4,151
	Baxter town	1,279	1,330	1,355	1,453	1,531	1,579	1,647
	Cookeville city	23,923	28,741	30,676	33,865	35,675	37,467	39,384
	Monterey town	2,717	2,784	2,886	3,149	3,322	3,463	3,630
	Unincorporated Putnam County	31,454	31,138	32,466	35,368	37,516	39,178	40,764
	Total	62,315	67,102	70,627	77,372	81,792	85,630	89,576
Rhea	Dayton city	6,180	6,452	6,767	7,273	7,632	8,041	8,477
	Graysville town	1,411	1,443	1,540	1,660	1,756	1,869	1,969
	Spring City town	2,025	2,027	2,051	2,114	2,168	2,241	2,313
	Unincorporated Rhea County	18,784	19,802	20,494	21,603	22,306	23,095	23,911
	Total	28,400	29,724	30,852	32,650	33,862	35,246	36,670
Roane [1]	Harriman city (pt.)	6,743	6,663	6,773	7,040	7,212	7,273	7,315
	Kingston city	5,264	5,399	5,424	5,603	5,727	5,754	5,752
	Oak Ridge city (pt.)	2,788	2,958	2,969	3,059	3,109	3,108	3,097
	Oliver Springs town (pt.)	943	929	947	989	1,019	1,030	1,037
	Rockwood city	5,774	5,403	5,460	5,651	5,751	5,756	5,744
	Unincorporated Roane County	30,398	31,272	31,977	33,294	33,958	33,911	33,659
	Total	51,910	52,624	53,550	55,636	56,776	56,832	56,604

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County	Municipality	Census 2000	2005	Projections 2010	2015	2020	2025	2030
Robertson	Adams city	566	584	630	707	768	837	910
	Cedar Hill city	298	308	335	378	410	448	487
	Coopertown town	3,027	3,199	3,456	3,862	4,152	4,480	4,803
	Cross Plains city	1,381	1,506	1,618	1,799	1,928	2,073	2,216
	Greenbrier town	4,940	6,004	6,620	7,541	8,240	9,042	9,884
	Millersville city (pt.)	976	1,095	1,210	1,375	1,493	1,625	1,762
	Orlinda city	594	633	681	757	805	862	922
	Portland city (pt.)	53	111	120	136	150	168	187
	Ridgetop city (pt.)	1,056	1,609	1,685	1,831	1,927	2,040	2,156
	Springfield city	14,329	15,789	17,057	19,175	20,776	22,631	24,579
	White House city (pt.)	3,120	3,790	4,186	4,778	5,235	5,745	6,262
	Unincorporated Robertson County	24,093	25,310	27,374	30,663	33,054	35,739	38,423
	Total	54,433	59,938	64,972	73,002	78,938	85,690	92,591
Rutherford	Eagleville city	464	464	516	616	683	740	802
	La Vergne city	18,687	26,158	30,032	37,004	42,419	47,150	51,815
	Murfreesboro city	68,816	87,512	100,962	123,367	139,626	154,567	170,469
	Smyrna town	25,569	33,680	38,371	46,806	53,077	58,527	64,002
	Unincorporated Rutherford County	68,487	72,025	81,715	99,391	112,169	122,852	133,377
	Total	182,023	219,839	251,596	307,184	347,974	383,836	420,465
Scott	Huntsville town	981	1,023	1,039	1,055	1,069	1,101	1,131
	Oneida town	3,615	3,815	3,844	3,879	3,917	4,035	4,138
	Winfield town	911	972	1,001	1,030	1,053	1,093	1,130
	Unincorporated Scott County	15,620	15,889	16,289	16,614	16,851	17,376	17,838
	Total	21,127	21,699	22,173	22,578	22,890	23,605	24,237
Sequatchie	Dunlap city	4,173	4,689	5,096	5,834	6,355	6,781	7,217
	Unincorporated Sequatchie County	7,197	8,021	8,752	10,023	10,888	11,567	12,237
	Total	11,370	12,710	13,848	15,857	17,243	18,348	19,454
Sevier	Gatlinburg city	3,382	4,443	4,634	5,059	5,247	5,438	5,597
	Pigeon Forge city	5,083	5,832	6,311	7,179	7,782	8,449	9,142
	Pittman Center town	477	569	603	669	706	744	782
	Sevierville city	11,757	14,897	16,136	18,413	20,037	21,852	23,724
	Unincorporated Sevier County	50,471	53,852	58,690	67,258	73,156	79,395	85,543
	Total	71,170	79,593	86,374	98,578	106,928	115,878	124,788
Shelby	Arlington town	2,569	3,575	3,515	3,357	3,266	3,268	3,267
	Bartlett city	40,543	46,731	46,499	44,892	43,953	44,334	44,440
	Collierville town	31,872	37,701	37,925	37,072	36,770	37,517	37,930
	Germantown city	37,348	37,469	36,723	35,035	33,906	33,791	33,445
	Lakeland city	6,862	7,894	7,895	7,575	7,369	7,402	7,420
	Memphis city	650,100	674,850	680,276	664,861	657,046	670,919	683,330
	Millington city	10,433	10,362	10,466	10,230	10,127	10,374	10,627
	Unincorporated Shelby County	117,745	86,817	87,477	84,946	83,535	84,649	85,359
	Total	897,472	905,399	910,776	887,968	875,972	892,254	905,818
Smith	Carthage town	2,251	2,251	2,276	2,368	2,430	2,554	2,679
	Gordonsville town	1,066	1,119	1,151	1,210	1,248	1,315	1,379
	South Carthage town	1,302	1,309	1,340	1,409	1,465	1,560	1,648
	Unincorporated Smith County	13,093	13,794	14,337	15,227	15,825	16,776	17,659
	Total	17,712	18,473	19,104	20,214	20,968	22,205	23,365
Stewart	Cumberland City town	316	320	320	334	345	380	418
	Dover city	1,443	1,486	1,464	1,474	1,481	1,596	1,723
	Tennessee Ridge town (pt.)	0	0	0	0	0	0	0
	Unincorporated Stewart County	10,611	11,081	11,384	11,894	12,206	13,339	14,555
	Total	12,370	12,887	13,168	13,702	14,032	15,315	16,696
Sullivan	Bluff City city	1,559	1,595	1,616	1,628	1,631	1,633	1,626
	Bristol city	24,821	25,065	24,865	24,616	24,366	24,182	23,908
	Johnson City city (pt.)	242	284	286	287	285	284	283
	Kingsport city (pt.)	42,013	41,114	40,440	39,808	39,293	38,901	38,378
	Unincorporated Sullivan County	84,413	84,034	83,755	83,004	81,890	80,737	79,183
	Total	153,048	152,092	150,962	149,343	147,465	145,737	143,378
Sumner [2]	Gallatin city	23,230	26,541	28,709	32,467	35,195	37,362	39,538
	Goodlettsville city (pt.)	4,645	5,295	5,711	6,423	6,902	7,258	7,609
	Hendersonville city	40,620	44,606	48,331	54,525	58,787	61,969	65,054
	Millersville city (pt.)	4,332	4,985	5,511	6,334	6,916	7,368	7,817
	Mitchellville city	207	213	228	257	279	297	318
	Portland city (pt.)	8,405	10,191	11,194	12,866	14,123	15,163	16,221
	Westmoreland town	2,093	2,147	2,324	2,633	2,854	3,029	3,207
	White House city (pt.)	4,100	4,895	5,418	6,244	6,849	7,332	7,814
	Unincorporated Sumner County	42,817	45,019	48,499	54,414	58,483	61,485	64,368
	Total	130,449	143,892	155,925	176,163	190,388	201,263	211,946

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County	Municipality	Census 2000	2005	Projections 2010	2015	2020	2025	2030
Tipton	Atoka town	3,235	5,864	6,267	6,842	7,255	7,839	8,405
	Brighton town	1,719	2,397	2,586	2,872	3,103	3,426	3,754
	Burlison town	453	437	445	464	471	492	511
	Covington city	8,463	8,891	9,341	10,104	10,706	11,632	12,588
	Garland town	309	311	319	336	344	364	382
	Gilt Edge city	489	476	496	527	543	572	599
	Mason town	1,089	1,237	1,254	1,305	1,334	1,400	1,459
	Munford city	4,708	5,558	5,888	6,391	6,748	7,277	7,800
	Unincorporated Tipton County	30,806	30,031	31,591	33,996	35,620	38,159	40,640
	Total	51,271	55,202	58,187	62,837	66,124	71,161	76,138
Trousdale	Hartsville town	0	0	0	0	0	0	0
	Unincorporated Trousdale County	7,259	7,429	7,472	7,526	7,544	7,932	8,297
	Total	7,259	7,429	7,472	7,526	7,544	7,932	8,297
Unicoi	Erwin town	5,610	5,797	5,728	5,808	5,830	5,729	5,608
	Unicoi town	3,519	3,565	3,636	3,770	3,820	3,763	3,677
	Unincorporated Unicoi County	8,538	8,219	8,299	8,530	8,602	8,467	8,276
	Total	17,667	17,581	17,663	18,108	18,252	17,959	17,561
Union	Luttrell town	915	934	975	1,039	1,082	1,159	1,236
	Maynardville city	1,782	1,875	1,968	2,113	2,223	2,402	2,589
	Plainview city	1,866	2,047	2,184	2,385	2,533	2,752	2,972
	Unincorporated Union County	13,245	13,804	14,419	15,369	16,006	17,109	18,229
	Total	17,808	18,660	19,546	20,906	21,844	23,422	25,026
Van Buren	Spencer town	1,713	1,665	1,612	1,500	1,414	1,414	1,403
	Unincorporated Van Buren County	3,795	3,712	3,616	3,400	3,228	3,243	3,225
	Total	5,508	5,377	5,228	4,900	4,642	4,657	4,628
Warren	Centertown town	257	262	271	282	291	305	320
	McMinnville city	12,749	13,080	13,375	13,793	14,180	14,934	15,710
	Morrison town	684	692	716	750	781	828	875
	Viola town	130	145	148	153	157	164	171
	Unincorporated Warren County	24,456	25,085	25,836	26,685	27,275	28,410	29,508
	Total	38,276	39,264	40,346	41,663	42,684	44,641	46,584
Washington	Johnson City city (pt.)	54,084	56,165	58,169	62,291	64,672	66,707	68,601
	Jonesborough town	4,168	4,651	4,732	4,961	5,103	5,183	5,300
	Watauga city (pt.)	73	90	92	100	105	109	115
	Unincorporated Washington County	48,873	51,818	53,732	57,135	59,446	61,356	62,989
	Total	107,198	112,724	116,725	124,487	129,326	133,355	137,005
Wayne	Clifton city	2,699	2,606	2,492	2,348	2,233	2,270	2,324
	Collinwood city	1,024	1,038	1,059	1,082	1,096	1,146	1,190
	Iron City city (pt.)	0	0	0	0	0	0	0
	Waynesboro city	2,228	2,170	2,165	2,171	2,171	2,252	2,327
	Unincorporated Wayne County	10,891	10,904	11,066	11,242	11,320	11,781	12,184
	Total	16,842	16,718	16,782	16,843	16,820	17,449	18,025
Weakley	Dresden town	2,855	2,602	2,427	2,124	1,954	1,946	1,957
	Gleason town	1,463	1,401	1,308	1,155	1,068	1,064	1,078
	Greenfield city	2,208	2,019	1,887	1,679	1,517	1,516	1,535
	McKenzie city (pt.)	241	227	211	183	168	169	166
	Martin city	10,515	10,594	10,230	9,446	8,694	8,986	9,064
	Sharon town	988	908	822	694	611	588	573
	Unincorporated Weakley County	16,625	15,790	14,801	13,047	11,962	11,906	11,917
	Total	34,895	33,541	31,686	28,328	25,974	26,175	26,290
White	Doyle town	525	552	566	601	620	628	634
	Sparta city	4,599	4,776	4,905	5,232	5,436	5,555	5,687
	Unincorporated White County	17,978	18,932	19,811	21,470	22,564	23,174	23,723
	Total	23,102	24,260	25,282	27,303	28,620	29,357	30,044
Williamson	Brentwood city	23,445	32,220	35,569	41,558	46,121	52,812	61,688
	Fairview city	5,800	7,160	8,399	10,559	12,219	14,143	16,388
	Franklin city	41,842	53,189	62,742	79,028	90,970	103,980	118,731
	Nolensville town	3,099	2,547	2,927	3,554	4,021	4,629	5,399
	Spring Hill city (pt.)	5,135	10,518	12,708	16,295	18,901	21,690	24,954
	Thompson's's Station town	1,283	1,429	1,608	1,934	2,166	2,443	2,767
	Unincorporated Williamson County	46,034	44,999	50,532	60,306	67,535	77,019	88,946
	Total	126,638	152,062	174,485	213,234	241,933	276,716	318,873
Wilson	Lebanon city	20,235	22,995	25,138	29,019	31,795	34,116	36,516
	Mt. Juliet city	12,366	17,956	19,984	23,244	25,683	27,811	29,938
	Watertown city	1,358	1,382	1,502	1,725	1,887	2,023	2,167
	Unincorporated Wilson County	54,850	57,438	62,610	71,391	77,427	82,374	87,309
	Total	88,809	99,771	109,234	125,379	136,792	146,324	155,930

Note: 2005 data are Vintage 2007 Census Bureau intercensal estimates.

[1] Midtown was unincorporated after the 2000 Census. This population has been assigned to the Unincorporated Area of Roane County

[2] Walnut Grove was unincorporated after the 2000 Census. This population has been assigned to the Unincorporated Area of Sumner County

Aggregate Projections for Municipalities Alphabetically

AGGREGATE PROJECTIONS FOR MUNICIPALITIES ALPHABETICALLY

Place	County	Census 2000	2005	Projections 2010	2015	2020	2025	2030
Adams city	Robertson	566	584	630	707	768	837	910
Adamsville town (pt.)	Hardin	33	39	39	40	40	41	41
Adamsville town (pt.)	McNairy	1,950	2,009	2,009	2,033	2,053	2,096	2,140
Alamo town	Crockett	2,392	2,337	2,299	2,237	2,199	2,269	2,344
Alcoa city	Blount	7,734	8,413	8,909	9,972	10,682	11,115	11,522
Alexandria town	DeKalb	814	859	897	977	1,039	1,110	1,180
Algood town	Putnam	2,942	3,109	3,244	3,537	3,748	3,943	4,151
Allardt city	Fentress	642	652	650	656	654	649	642
Altamont town	Grundy	1,136	1,124	1,135	1,141	1,152	1,175	1,190
Ardmore city (pt.)	Giles	995	1,013	989	958	932	943	948
Ardmore city (pt.)	Lincoln	87	94	95	97	98	99	99
Arlington town	Shelby	2,569	3,575	3,515	3,357	3,266	3,268	3,267
Ashland City town	Cheatham	3,641	4,481	4,702	5,045	5,296	5,684	6,071
Athens city	McMinn	13,220	13,798	14,310	15,204	15,863	16,505	17,108
Atoka town	Tipton	3,235	5,864	6,267	6,842	7,255	7,839	8,405
Atwood town	Carroll	1,000	965	947	931	913	898	883
Auburntown town	Cannon	252	254	257	266	271	284	296
Baileyton town	Greene	504	501	501	513	519	520	521
Baneberry city	Jefferson	366	694	684	710	702	713	743
Bartlett city	Shelby	40,543	46,731	46,499	44,892	43,953	44,334	44,440
Baxter town	Putnam	1,279	1,330	1,355	1,453	1,531	1,579	1,647
Bean Station city	Grainger	3,250	2,967	3,121	3,402	3,590	3,713	3,819
Beersheba Springs town	Grundy	553	550	543	531	518	511	506
Bell Buckle town	Bedford	391	402	417	458	483	504	525
Belle Meade city	Davidson	2,943	3,360	3,366	3,541	3,764	3,899	3,952
Bells city	Crockett	2,171	2,269	2,288	2,276	2,280	2,386	2,487
Benton town	Polk	1,138	1,169	1,149	1,104	1,077	1,131	1,183
Berry Hill city	Davidson	674	735	773	802	803	777	754
Bethel Springs town	McNairy	763	763	773	790	808	834	858
Big Sandy town	Benton	518	511	495	484	476	481	481
Blaine city	Grainger	1,834	1,703	1,804	1,978	2,098	2,180	2,251
Bluff City city	Sullivan	1,559	1,595	1,616	1,628	1,631	1,633	1,626
Bolivar city	Hardeman	5,799	5,693	5,692	5,616	5,590	5,837	6,063
Braden town	Fayette	274	283	324	400	449	453	452
Bradford town	Gibson	1,113	1,066	1,059	1,060	1,055	1,052	1,050
Brentwood city	Williamson	23,445	32,220	35,569	41,558	46,121	52,812	61,688
Brighton town	Tipton	1,719	2,397	2,586	2,872	3,103	3,426	3,754
Bristol city	Sullivan	24,821	25,065	24,865	24,616	24,366	24,182	23,908
Brownsville city	Haywood	10,748	10,585	10,767	10,815	10,933	11,103	11,211
Bruceton town	Carroll	1,554	1,465	1,451	1,442	1,433	1,430	1,427
Bulls Gap town	Hawkins	714	714	730	761	776	792	813
Burlison town	Tipton	453	437	445	464	471	492	511
Burns town	Dickson	1,366	1,396	1,460	1,558	1,622	1,691	1,758
Byrdstown town	Pickett	903	873	861	847	831	827	824
Calhoun town	McMinn	496	510	515	528	532	535	538
Camden city	Benton	3,828	3,698	3,602	3,541	3,493	3,537	3,573
Carthage town	Smith	2,251	2,251	2,276	2,368	2,430	2,554	2,679
Caryville town	Campbell	2,243	2,368	2,442	2,543	2,606	2,658	2,702
Cedar Hill city	Robertson	298	308	335	378	410	448	487
Celina city	Clay	1,379	1,361	1,361	1,380	1,390	1,413	1,427

AGGREGATE PROJECTIONS FOR MUNICIPALITIES ALPHABETICALLY

Place	County	Census 2000	2005	Projections 2010	2015	2020	2025	2030
Centertown town	Warren	257	262	271	282	291	305	320
Centerville town	Hickman	3,793	3,937	4,049	4,313	4,500	4,853	5,231
Chapel Hill town	Marshall	943	1,211	1,232	1,279	1,314	1,394	1,476
Charleston city	Bradley	630	666	677	703	719	742	771
Charlotte town	Dickson	1,153	1,150	1,203	1,287	1,348	1,418	1,487
Chattanooga city	Hamilton	155,554	163,864	164,959	165,870	166,048	166,788	167,275
Chattanooga city	Marion	0	0	0	0	0	0	0
Church Hill city	Hawkins	5,916	6,370	6,592	6,978	7,204	7,430	7,638
Clarksburg town	Carroll	285	368	354	340	325	316	309
Clarksville city	Montgomery	103,455	112,513	118,577	124,771	129,737	142,435	155,647
Cleveland city	Bradley	37,192	36,978	38,414	40,804	42,278	44,120	46,036
Clifton city	Wayne	2,699	2,606	2,492	2,348	2,233	2,270	2,324
Clinton city	Anderson	9,409	9,326	9,407	9,525	9,559	9,479	9,368
Coalmont city	Grundy	948	954	967	975	984	1,000	1,011
Collegedale city	Hamilton	6,514	8,290	8,740	9,171	9,329	9,511	9,637
Collierville town	Shelby	31,872	37,701	37,925	37,072	36,770	37,517	37,930
Collinwood city	Wayne	1,024	1,038	1,059	1,082	1,096	1,146	1,190
Columbia city	Maury	33,055	33,506	35,858	40,024	43,131	45,999	48,899
Cookeville city	Putnam	23,923	28,741	30,676	33,865	35,675	37,467	39,384
Coopertown town	Robertson	3,027	3,199	3,456	3,862	4,152	4,480	4,803
Copperhill city	Polk	511	476	456	426	405	413	422
Cornersville town	Marshall	962	926	959	1,019	1,068	1,150	1,235
Cottage Grove town	Henry	103	97	99	103	107	111	115
Covington city	Tipton	8,463	8,891	9,341	10,104	10,706	11,632	12,588
Cowan city	Franklin	1,771	1,786	1,809	1,910	1,983	2,066	2,147
Crab Orchard city	Cumberland	838	897	985	1,146	1,261	1,346	1,421
Cross Plains city	Robertson	1,381	1,506	1,618	1,799	1,928	2,073	2,216
Crossville city	Cumberland	8,981	10,448	11,249	12,875	14,049	14,967	15,925
Crump city	Hardin	1,521	1,437	1,432	1,448	1,447	1,436	1,419
Cumberland City town	Stewart	316	320	320	334	345	380	418
Cumberland Gap town	Claiborne	204	206	212	223	229	233	235
Dandridge town	Jefferson	2,078	2,269	2,334	2,568	2,700	2,944	3,218
Dayton city	Rhea	6,180	6,452	6,767	7,273	7,632	8,041	8,477
Decatur town	Meigs	1,395	1,426	1,447	1,491	1,519	1,652	1,797
Decaturville town	Decatur	859	830	822	815	810	827	839
Decherd city	Franklin	2,247	2,223	2,291	2,410	2,490	2,567	2,648
Dickson city	Dickson	12,244	13,342	14,073	15,182	16,038	16,992	17,928
Dover city	Stewart	1,443	1,486	1,464	1,474	1,481	1,596	1,723
Dowelltown town	DeKalb	302	314	323	344	357	372	387
Doyle town	White	525	552	566	601	620	628	634
Dresden town	Weakley	2,855	2,602	2,427	2,124	1,954	1,946	1,957
Ducktown city	Polk	427	404	380	348	324	326	330
Dunlap city	Sequatchie	4,173	4,689	5,096	5,834	6,355	6,781	7,217
Dyer city	Gibson	2,406	2,403	2,385	2,389	2,407	2,435	2,457
Dyersburg city	Dyer	17,452	17,372	17,531	17,610	17,729	18,104	18,412
Eagleville city	Rutherford	464	464	516	616	683	740	802
East Ridge city	Hamilton	20,640	20,099	20,001	19,710	19,512	19,426	19,258
Eastview town	McNairy	618	622	625	632	640	652	662
Elizabethton city	Carter	13,372	13,863	14,265	15,185	15,809	15,934	16,037
Elkton city	Giles	510	606	596	571	546	543	538

AGGREGATE PROJECTIONS FOR MUNICIPALITIES ALPHABETICALLY

Place	County	Census 2000	2005	Projections 2010	2015	2020	2025	2030
Englewood town	McMinn	1,590	1,658	1,693	1,772	1,825	1,879	1,932
Enville town (pt.)	Chester	230	237	227	222	215	219	224
Enville town (pt.)	McNairy	0	0	0	0	0	0	0
Erin city	Houston	1,490	1,434	1,417	1,382	1,357	1,413	1,464
Erwin town	Unicoi	5,610	5,797	5,728	5,808	5,830	5,729	5,608
Estill Springs town	Franklin	2,153	2,308	2,366	2,493	2,574	2,649	2,720
Ethridge town	Lawrence	536	549	565	579	585	603	624
Etowah city	McMinn	3,663	3,715	3,755	3,906	4,009	4,104	4,201
Fairview city	Williamson	5,800	7,160	8,399	10,559	12,219	14,143	16,388
Farragut town (pt.)	Knox	17,718	19,709	20,054	21,149	22,062	22,379	22,386
Farragut town (pt.)	Loudon	0	0	0	0	0	0	0
Fayetteville city	Lincoln	6,994	6,985	6,984	7,113	7,209	7,329	7,457
Finger city	McNairy	350	353	370	389	405	428	449
Forest Hills city	Davidson	4,710	5,580	5,537	5,774	6,052	6,133	6,108
Franklin city	Williamson	41,842	53,189	62,742	79,028	90,970	103,980	118,731
Friendship city	Crockett	608	599	593	582	575	594	613
Friendsville city	Blount	890	919	980	1,101	1,181	1,226	1,264
Gadsden town	Crockett	553	547	542	527	512	519	526
Gainesboro town	Jackson	879	855	844	847	842	853	864
Gallatin city	Sumner	23,230	26,541	28,709	32,467	35,195	37,362	39,538
Gallaway city	Fayette	666	708	811	1,005	1,141	1,168	1,192
Garland town	Tipton	309	311	319	336	344	364	382
Gates town	Lauderdale	901	861	873	855	850	900	944
Gatlinburg city	Sevier	3,382	4,443	4,634	5,059	5,247	5,438	5,597
Germantown city	Shelby	37,348	37,469	36,723	35,035	33,906	33,791	33,445
Gibson town	Gibson	305	403	417	428	438	449	459
Gilt Edge city	Tipton	489	476	496	527	543	572	599
Gleason town	Weakley	1,463	1,401	1,308	1,155	1,068	1,064	1,078
Goodlettsville city (pt.)	Davidson	9,135	10,814	11,336	12,128	12,749	12,964	13,153
Goodlettsville city (pt.)	Sumner	4,645	5,295	5,711	6,423	6,902	7,258	7,609
Gordonsville town	Smith	1,066	1,119	1,151	1,210	1,248	1,315	1,379
Grand Junction city (pt.)	Fayette	0	0	0	0	0	0	0
Grand Junction city (pt.)	Hardeman	301	316	306	296	289	296	303
Graysville town	Rhea	1,411	1,443	1,540	1,660	1,756	1,869	1,969
Greenback city	Loudon	954	1,020	1,106	1,273	1,389	1,449	1,500
Greenbrier town	Robertson	4,940	6,004	6,620	7,541	8,240	9,042	9,884
Greeneville town	Greene	15,198	15,278	15,479	16,057	16,420	16,660	16,891
Greenfield city	Weakley	2,208	2,019	1,887	1,679	1,517	1,516	1,535
Gruetli-Laager city	Grundy	1,867	1,873	1,896	1,901	1,912	1,940	1,964
Guys town	McNairy	483	488	500	511	513	520	527
Halls town	Lauderdale	2,311	2,220	2,178	2,068	2,005	2,091	2,170
Harriman city (pt.)	Morgan	0	0	0	0	0	0	0
Harriman city (pt.)	Roane	6,743	6,663	6,773	7,040	7,212	7,273	7,315
Harrogate city	Claiborne	2,865	3,943	4,053	4,234	4,344	4,386	4,417
Hartsville town	Trousdale	0	0	0	0	0	0	0
Henderson city	Chester	5,670	5,737	5,969	6,176	6,315	7,000	7,476
Hendersonville city	Sumner	40,620	44,606	48,331	54,525	58,787	61,969	65,054
Henning town	Lauderdale	970	1,299	1,292	1,245	1,227	1,301	1,374
Henry town	Henry	520	523	550	585	614	647	677
Hickory Valley town	Hardeman	136	132	125	118	112	112	111

AGGREGATE PROJECTIONS FOR MUNICIPALITIES ALPHABETICALLY

Place	County	Census 2000	2005	Projections 2010	2015	2020	2025	2030
Hohenwald city	Lewis	3,754	3,759	3,734	3,714	3,702	3,893	4,084
Hollow Rock town	Carroll	963	932	930	932	935	941	942
Hornbeak town	Obion	435	424	413	391	374	376	376
Hornsby town	Hardeman	306	299	301	297	294	306	314
Humboldt city (pt.)	Gibson	9,442	9,186	9,208	9,282	9,332	9,405	9,473
Humboldt city (pt.)	Madison	25	31	32	32	33	34	36
Huntingdon town	Carroll	4,349	4,131	4,092	4,064	4,050	4,063	4,063
Huntland town	Franklin	916	899	916	951	983	1,015	1,038
Huntsville town	Scott	981	1,023	1,039	1,055	1,069	1,101	1,131
Iron City city (pt.)	Lawrence	369	372	380	383	382	388	394
Iron City city (pt.)	Wayne	0	0	0	0	0	0	0
Jacksboro town	Campbell	1,887	1,982	2,015	2,067	2,092	2,108	2,112
Jackson city	Madison	59,643	62,023	64,248	66,849	69,004	72,402	75,677
Jamestown city	Fentress	1,839	1,852	1,838	1,860	1,869	1,865	1,858
Jasper town	Marion	3,213	3,076	3,068	3,043	3,016	3,023	3,017
Jefferson City city	Jefferson	7,761	8,436	9,184	10,496	11,364	12,615	13,974
Jellico city	Campbell	2,448	2,501	2,514	2,565	2,590	2,607	2,619
Johnson City city (pt.)	Carter	1,143	1,222	1,276	1,372	1,437	1,455	1,469
Johnson City city (pt.)	Sullivan	242	284	286	287	285	284	283
Johnson City city (pt.)	Washington	54,084	56,165	58,169	62,291	64,672	66,707	68,601
Jonesborough town	Washington	4,168	4,651	4,732	4,961	5,103	5,183	5,300
Kenton town (pt.)	Gibson	752	740	738	738	737	739	742
Kenton town (pt.)	Obion	554	550	532	500	477	477	477
Kimball town	Marion	1,312	1,351	1,351	1,336	1,318	1,311	1,296
Kingsport city (pt.)	Hawkins	2,892	2,994	3,052	3,209	3,313	3,423	3,527
Kingsport city (pt.)	Sullivan	42,013	41,114	40,440	39,808	39,293	38,901	38,378
Kingston Springs town	Cheatham	2,773	2,831	2,967	3,156	3,290	3,498	3,692
Kingston city	Roane	5,264	5,399	5,424	5,603	5,727	5,754	5,752
Knoxville city	Knox	173,890	174,948	183,490	197,560	205,806	210,868	215,554
La Grange town	Fayette	146	149	161	185	194	183	170
La Vergne city	Rutherford	18,687	26,158	30,032	37,004	42,419	47,150	51,815
Lafayette city	Macon	3,885	4,175	4,219	4,387	4,482	4,728	4,990
LaFollette city	Campbell	7,926	8,123	8,176	8,386	8,536	8,655	8,746
Lake City town (pt.)	Anderson	1,858	1,800	1,799	1,806	1,803	1,780	1,756
Lake City town (pt.)	Campbell	31	46	47	48	50	52	53
Lakeland city	Shelby	6,862	7,894	7,895	7,575	7,369	7,402	7,420
Lakesite city	Hamilton	1,845	1,940	1,965	1,988	2,003	2,019	2,007
Lakewood city	Davidson	2,341	2,594	2,694	2,845	2,975	3,022	3,064
Lawrenceburg city	Lawrence	10,795	10,792	10,829	10,869	10,922	11,250	11,596
Lebanon city	Wilson	20,235	22,995	25,138	29,019	31,795	34,116	36,516
Lenoir City city	Loudon	6,819	7,564	8,310	9,703	10,750	11,421	12,059
Lewisburg city	Marshall	10,413	10,661	11,020	11,638	12,125	13,007	13,897
Lexington city	Henderson	7,393	7,602	7,749	7,965	8,115	8,457	8,785
Liberty town	DeKalb	367	381	395	419	432	444	452
Linden town	Perry	1,015	984	970	961	958	1,003	1,049
Livingston town	Overton	3,498	3,478	3,480	3,549	3,583	3,655	3,727
Lobelville city	Perry	915	912	907	898	889	922	954
Lookout Mountain town	Hamilton	2,000	1,936	1,889	1,857	1,856	1,856	1,856
Loretto city	Lawrence	1,665	1,690	1,700	1,709	1,711	1,756	1,805
Loudon town	Loudon	4,476	4,825	5,183	5,918	6,427	6,703	6,956

AGGREGATE PROJECTIONS FOR MUNICIPALITIES ALPHABETICALLY

Place	County	Census 2000	2005	Projections 2010	2015	2020	2025	2030
Louisville city	Blount	2,001	2,151	2,296	2,578	2,758	2,851	2,927
Luttrell town	Union	915	934	975	1,039	1,082	1,159	1,236
Lynnville town	Giles	345	346	337	324	314	317	319
McEwen city	Humphreys	1,702	1,644	1,653	1,663	1,673	1,734	1,792
McKenzie city (pt.)	Carroll	4,981	5,055	5,043	5,028	5,018	5,045	5,062
McKenzie city (pt.)	Henry	73	92	93	96	99	103	106
McKenzie city (pt.)	Weakley	241	227	211	183	168	169	166
McLemoresville town	Carroll	259	309	297	287	276	267	258
McMinnville city	Warren	12,749	13,080	13,375	13,793	14,180	14,934	15,710
Madisonville city	Monroe	3,939	4,324	4,613	5,181	5,580	5,963	6,363
Manchester city	Coffee	8,294	9,546	9,908	10,593	11,060	11,455	11,860
Martin city	Weakley	10,515	10,594	10,230	9,446	8,694	8,986	9,064
Maryville city	Blount	23,119	25,727	27,734	31,589	34,373	36,283	38,155
Mason town	Tipton	1,089	1,237	1,254	1,305	1,334	1,400	1,459
Maury City town	Crockett	704	696	681	655	634	641	650
Maynardville city	Union	1,782	1,875	1,968	2,113	2,223	2,402	2,589
Medina city	Gibson	969	1,280	1,306	1,345	1,380	1,416	1,443
Medon city	Madison	191	191	190	189	187	189	190
Memphis city	Shelby	650,100	674,850	680,276	664,861	657,046	670,919	683,330
Michie town	McNairy	647	654	653	658	658	663	668
Middleton city	Hardeman	602	625	617	605	595	614	629
Milan city	Gibson	7,664	7,782	7,806	7,876	7,948	8,062	8,168
Milledgeville town (pt.)	Chester	83	96	90	88	86	88	92
Milledgeville town (pt.)	Hardin	74	84	82	81	81	81	80
Milledgeville town (pt.)	McNairy	130	158	154	153	155	159	163
Millersville city (pt.)	Robertson	976	1,095	1,210	1,375	1,493	1,625	1,762
Millersville city (pt.)	Sumner	4,332	4,985	5,511	6,334	6,916	7,368	7,817
Millington city	Shelby	10,433	10,362	10,466	10,230	10,127	10,374	10,627
Minor Hill city	Giles	437	447	439	432	428	441	454
Mitchellville city	Sumner	207	213	228	257	279	297	318
Monteagle town (pt.)	Franklin	12	39	38	43	48	51	56
Monteagle town (pt.)	Grundy	792	781	763	733	707	692	679
Monteagle town (pt.)	Marion	420	399	391	377	365	358	352
Monterey town	Putnam	2,717	2,784	2,886	3,149	3,322	3,463	3,630
Morrison town	Warren	684	692	716	750	781	828	875
Morristown city (pt.)	Hamblen	24,960	26,739	27,340	28,092	28,676	29,725	30,805
Morristown city (pt.)	Jefferson	0	0	0	0	0	0	0
Moscow city	Fayette	422	532	601	733	821	834	847
Mosheim town	Greene	1,749	2,027	2,058	2,124	2,148	2,152	2,151
Mount Carmel town	Hawkins	4,795	5,255	5,455	5,805	6,033	6,250	6,443
Mt. Juliet city	Wilson	12,366	17,956	19,984	23,244	25,683	27,811	29,938
Mount Pleasant city	Maury	4,491	4,416	4,719	5,256	5,641	5,995	6,365
Mountain City town	Johnson	2,383	2,411	2,445	2,577	2,645	2,649	2,660
Munford city	Tipton	4,708	5,558	5,888	6,391	6,748	7,277	7,800
Murfreesboro city	Rutherford	68,816	87,512	100,962	123,367	139,626	154,567	170,469
New Hope city	Marion	1,043	1,024	1,037	1,044	1,045	1,054	1,056
New Johnsonville city	Humphreys	1,905	1,935	1,950	1,954	1,953	2,005	2,049
New Market town	Jefferson	1,234	1,277	1,354	1,498	1,587	1,731	1,888
New Tazewell town	Claiborne	2,871	2,860	2,931	3,078	3,180	3,225	3,255
Newbern town	Dyer	2,988	3,073	3,115	3,136	3,164	3,234	3,290

AGGREGATE PROJECTIONS FOR MUNICIPALITIES ALPHABETICALLY

Place	County	Census 2000	2005	Projections 2010	2015	2020	2025	2030
Newport city	Cocke	7,241	7,324	7,501	7,937	8,233	8,361	8,462
Niota city	McMinn	781	792	811	847	866	880	896
Nolensville town	Williamson	3,099	2,547	2,927	3,554	4,021	4,629	5,399
Normandy town	Bedford	152	149	167	194	214	230	248
Norris city	Anderson	1,446	1,426	1,408	1,398	1,380	1,345	1,305
Oak Hill city	Davidson	4,493	5,123	5,050	5,231	5,440	5,442	5,373
Oak Ridge city (pt.)	Anderson	24,599	24,112	23,838	23,808	23,708	23,325	22,881
Oak Ridge city (pt.)	Roane	2,788	2,958	2,969	3,059	3,109	3,108	3,097
Oakdale town	Morgan	246	238	244	254	261	268	274
Oakland town	Fayette	1,278	2,538	2,953	3,696	4,230	4,386	4,502
Obion town	Obion	1,134	1,097	1,056	988	941	941	941
Oliver Springs town (pt.)	Anderson	2,308	2,270	2,281	2,311	2,329	2,318	2,298
Oliver Springs town (pt.)	Morgan	52	60	61	62	63	65	67
Oliver Springs town (pt.)	Roane	943	929	947	989	1,019	1,030	1,037
Oneida town	Scott	3,615	3,815	3,844	3,879	3,917	4,035	4,138
Orlinda city	Robertson	594	633	681	757	805	862	922
Orme town	Marion	128	138	138	137	135	134	132
Palmer town	Grundy	726	711	695	678	661	648	636
Paris city	Henry	9,761	9,819	9,827	10,028	10,198	10,495	10,770
Parker's Crossroads city	Henderson	241	247	243	241	238	239	239
Parrottsville town	Cocke	210	226	235	253	269	279	288
Parsons city	Decatur	2,452	2,390	2,360	2,324	2,296	2,328	2,353
Pegram town	Cheatham	2,146	2,136	2,235	2,371	2,465	2,612	2,760
Petersburg town (pt.)	Lincoln	412	423	427	442	450	457	462
Petersburg town (pt.)	Marshall	168	179	184	194	202	216	230
Philadelphia city	Loudon	533	570	625	729	807	854	898
Pigeon Forge city	Sevier	5,083	5,832	6,311	7,179	7,782	8,449	9,142
Pikeville city	Bledsoe	1,781	1,832	1,886	1,982	2,044	2,184	2,326
Piperton city	Fayette	589	1,084	1,143	1,296	1,346	1,258	1,173
Pittman Center town	Sevier	477	569	603	669	706	744	782
Plainview city	Union	1,866	2,047	2,184	2,385	2,533	2,752	2,972
Pleasant Hill town	Cumberland	544	592	537	518	502	503	522
Pleasant View city	Cheatham	2,934	3,404	3,615	3,895	4,104	4,418	4,735
Portland city (pt.)	Robertson	53	111	120	136	150	168	187
Portland city (pt.)	Sumner	8,405	10,191	11,194	12,866	14,123	15,163	16,221
Powell's Crossroads town	Marion	1,286	1,218	1,233	1,240	1,246	1,263	1,270
Pulaski city	Giles	7,871	7,884	7,739	7,549	7,426	7,583	7,705
Puryear city	Henry	667	666	667	672	672	681	692
Ramer city	McNairy	354	355	362	372	374	380	386
Red Bank city	Hamilton	12,418	11,853	12,039	12,054	12,040	12,065	12,067
Red Boiling Springs city	Macon	1,023	1,043	1,070	1,121	1,152	1,217	1,286
Ridgely town	Lake	1,667	1,494	1,514	1,480	1,481	1,515	1,486
Ridgeside city	Hamilton	389	391	376	365	359	357	345
Ridgetop city (pt.)	Davidson	28	105	106	115	125	129	143
Ridgetop city (pt.)	Robertson	1,056	1,609	1,685	1,831	1,927	2,040	2,156
Ripley city	Lauderdale	7,844	7,716	7,712	7,426	7,269	7,658	8,039
Rives town	Obion	331	321	316	306	296	298	299
Rockford city	Blount	798	811	868	977	1,046	1,083	1,114
Rockwood city	Roane	5,774	5,403	5,460	5,651	5,751	5,756	5,744
Rogersville town	Hawkins	4,240	4,264	4,278	4,425	4,501	4,602	4,720

AGGREGATE PROJECTIONS FOR MUNICIPALITIES ALPHABETICALLY

Place	County	Census 2000	2005	Projections 2010	2015	2020	2025	2030
Rossville town	Fayette	380	472	535	656	735	744	749
Rutherford town	Gibson	1,272	1,236	1,229	1,230	1,231	1,235	1,240
Rutledge town	Grainger	1,374	1,255	1,299	1,390	1,448	1,486	1,523
Saltillo town	Hardin	342	361	355	359	362	361	358
Samburg town	Obion	260	268	256	238	226	226	223
Sardis town	Henderson	445	450	443	443	441	450	460
Saulsbury town	Hardeman	100	115	108	103	102	105	107
Savannah city	Hardin	6,917	7,163	7,168	7,296	7,368	7,405	7,396
Scotts Hill town (pt.)	Decatur	345	339	337	336	337	344	351
Scotts Hill town (pt.)	Henderson	549	561	566	580	592	617	642
Selmer town	McNairy	4,541	4,550	4,572	4,618	4,640	4,723	4,806
Sevierville city	Sevier	11,757	14,897	16,136	18,413	20,037	21,852	23,724
Sharon town	Weakley	988	908	822	694	611	588	573
Shelbyville city	Bedford	16,100	18,583	20,322	23,330	25,661	28,009	30,481
Signal Mountain town	Hamilton	7,429	7,318	7,129	7,032	7,030	7,024	6,985
Silerton town (pt.)	Chester	0	0	0	0	0	0	0
Silerton town (pt.)	Hardeman	70	79	89	86	87	95	101
Slayden town	Dickson	185	198	198	203	201	201	203
Smithville city	DeKalb	3,994	4,157	4,322	4,654	4,903	5,189	5,477
Smyrna town	Rutherford	25,569	33,680	38,371	46,806	53,077	58,527	64,002
Sneedville town	Hancock	1,257	1,315	1,308	1,297	1,288	1,271	1,256
Soddy-Daisy city	Hamilton	11,530	12,158	12,277	12,279	12,248	12,249	12,235
Somerville town	Fayette	2,518	2,875	3,236	3,955	4,463	4,566	4,661
South Carthage town	Smith	1,302	1,309	1,340	1,409	1,465	1,560	1,648
South Fulton city	Obion	2,517	2,422	2,335	2,192	2,088	2,086	2,079
South Pittsburg city	Marion	3,294	3,122	3,101	3,074	3,060	3,089	3,105
Sparta city	White	4,599	4,776	4,905	5,232	5,436	5,555	5,687
Spencer town	Van Buren	1,713	1,665	1,612	1,500	1,414	1,414	1,403
Spring City town	Rhea	2,025	2,027	2,051	2,114	2,168	2,241	2,313
Spring Hill city (pt.)	Maury	2,580	6,431	7,128	8,245	9,134	9,911	10,625
Spring Hill city (pt.)	Williamson	5,135	10,518	12,708	16,295	18,901	21,690	24,954
Springfield city	Robertson	14,329	15,789	17,057	19,175	20,776	22,631	24,579
St. Joseph city	Lawrence	829	849	866	877	881	905	930
Stanton town	Haywood	615	596	604	602	606	614	622
Stantonville town	McNairy	312	353	350	351	351	356	362
Sunbright city	Morgan	577	587	603	623	638	654	665
Surgoinsville town	Hawkins	1,484	1,737	1,775	1,858	1,903	1,950	1,994
Sweetwater city (pt.)	McMinn	0	0	0	0	0	0	0
Sweetwater city (pt.)	Monroe	5,585	6,168	6,551	7,303	7,830	8,341	8,874
Tazewell town	Claiborne	2,165	2,131	2,159	2,230	2,256	2,247	2,234
Tellico Plains town	Monroe	859	924	985	1,097	1,166	1,226	1,295
Tennessee Ridge town (pt.)	Houston	1,327	1,295	1,262	1,212	1,174	1,209	1,244
Tennessee Ridge town (pt.)	Stewart	0	0	0	0	0	0	0
Thompson's's Station town	Williamson	1,283	1,429	1,608	1,934	2,166	2,443	2,767
Three Way city	Madison	1,375	1,350	1,390	1,445	1,490	1,550	1,598
Tiptonville town	Lake	2,439	3,971	4,094	3,927	3,863	3,895	3,810
Toone town	Hardeman	330	372	366	357	346	355	360
Townsend city	Blount	248	264	259	265	262	254	248
Tracy City town	Grundy	1,679	1,665	1,648	1,615	1,590	1,584	1,577
Trenton city	Gibson	4,683	4,550	4,591	4,658	4,710	4,772	4,831

AGGREGATE PROJECTIONS FOR MUNICIPALITIES ALPHABETICALLY

Place	County	Census 2000	2005	Projections 2010	2015	2020	2025	2030
Trezevant town	Carroll	901	879	857	840	824	816	807
Trimble town (pt.)	Dyer	727	720	714	703	695	700	702
Trimble town (pt.)	Obion	0	0	0	0	0	0	0
Troy town	Obion	1,273	1,232	1,196	1,130	1,083	1,090	1,092
Tullahoma city (pt.)	Coffee	16,970	17,791	18,591	20,023	21,028	21,868	22,703
Tullahoma city (pt.)	Franklin	1,024	1,078	1,112	1,170	1,210	1,254	1,290
Tusculum city	Greene	2,004	2,199	2,228	2,290	2,303	2,296	2,302
Unicoi town	Unicoi	3,519	3,565	3,636	3,770	3,820	3,763	3,677
Union City city	Obion	10,876	10,676	10,465	9,936	9,517	9,556	9,577
Vanleer town	Dickson	310	313	320	338	348	360	371
Viola town	Warren	130	145	148	153	157	164	171
Vonore town (pt.)	Blount	0	0	0	0	0	0	0
Vonore town (pt.)	Monroe	1,161	1,372	1,468	1,641	1,757	1,868	1,985
Walden town	Hamilton	1,960	2,050	2,053	2,033	2,043	2,056	2,033
Wartburg city	Morgan	890	909	917	932	943	961	978
Wartrace town	Bedford	548	561	601	673	720	764	815
Watauga city (pt.)	Carter	330	351	366	394	411	414	415
Watauga city (pt.)	Washington	73	90	92	100	105	109	115
Watertown city	Wilson	1,358	1,382	1,502	1,725	1,887	2,023	2,167
Waverly city	Humphreys	4,028	4,073	4,031	3,981	3,940	4,028	4,114
Waynesboro city	Wayne	2,228	2,170	2,165	2,171	2,171	2,252	2,327
Westmoreland town	Sumner	2,093	2,147	2,324	2,633	2,854	3,029	3,207
White Bluff town	Dickson	2,142	2,361	2,465	2,621	2,718	2,832	2,940
White House city (pt.)	Robertson	3,120	3,790	4,186	4,778	5,235	5,745	6,262
White House city (pt.)	Sumner	4,100	4,895	5,418	6,244	6,849	7,332	7,814
White Pine town (pt.)	Hamblen	0	0	0	0	0	0	0
White Pine town (pt.)	Jefferson	1,996	1,980	2,103	2,346	2,520	2,786	3,087
Whiteville town	Hardeman	3,147	4,187	4,175	3,978	3,819	3,968	4,104
Whitwell city	Marion	1,660	1,600	1,575	1,541	1,510	1,501	1,489
Williston city	Fayette	341	352	410	514	586	601	611
Winchester city	Franklin	7,332	7,853	8,031	8,435	8,703	8,941	9,209
Winfield town	Scott	911	972	1,001	1,030	1,053	1,093	1,130
Woodbury town	Cannon	2,428	2,492	2,506	2,572	2,617	2,733	2,847
Woodland Mills city	Obion	296	302	297	282	267	265	261
Yorkville city	Gibson	293	325	321	325	335	345	352

Note: 2005 data are Vintage 2007 Census Bureau intercensal estimates.

Aggregate Projections for Municipalities by Development District

AGGREGATE PROJECTIONS FOR MUNICIPALITIES BY DEVELOPMENT DISTRICT

County	Municipality	Census 2000	2005	Projections 2010	2015	2020	2025	2030
EAST TENNESSEE DEVELOPMENT DISTRICT		**1,045,366**	**1,111,025**	**1,160,916**	**1,250,034**	**1,309,049**	**1,353,114**	**1,393,742**
Anderson	Clinton city	9,409	9,326	9,407	9,525	9,559	9,479	9,368
	Lake City town (pt.)	1,858	1,800	1,799	1,806	1,803	1,780	1,756
	Norris city	1,446	1,426	1,408	1,398	1,380	1,345	1,305
	Oak Ridge city (pt.)	24,599	24,112	23,838	23,808	23,708	23,325	22,881
	Oliver Springs town (pt.)	2,308	2,270	2,281	2,311	2,329	2,318	2,298
	Unincorporated Anderson County	31,710	32,867	33,487	34,237	34,603	34,410	34,019
	Total	71,330	71,801	72,220	73,085	73,382	72,657	71,627
Blount	Alcoa city	7,734	8,413	8,909	9,972	10,682	11,115	11,522
	Friendsville city	890	919	980	1,101	1,181	1,226	1,264
	Louisville city	2,001	2,151	2,296	2,578	2,758	2,851	2,927
	Maryville city	23,119	25,727	27,734	31,589	34,373	36,283	38,155
	Rockford city	798	811	868	977	1,046	1,083	1,114
	Townsend city	248	264	259	265	262	254	248
	Vonore town (pt.)	0	0	0	0	0	0	0
	Unincorporated Blount County	71,033	76,976	82,784	93,563	100,716	105,015	108,981
	Total	105,823	115,261	123,830	140,045	151,018	157,827	164,211
Campbell	Caryville town	2,243	2,368	2,442	2,543	2,606	2,658	2,702
	Jacksboro town	1,887	1,982	2,015	2,067	2,092	2,108	2,112
	Jellico city	2,448	2,501	2,514	2,565	2,590	2,607	2,619
	LaFollette city	7,926	8,123	8,176	8,386	8,536	8,655	8,746
	Lake City town (pt.)	31	46	47	48	50	52	53
	Unincorporated Campbell County	25,319	25,416	26,018	26,975	27,505	27,798	27,928
	Total	39,854	40,436	41,212	42,584	43,379	43,878	44,160
Claiborne	Cumberland Gap town	204	206	212	223	229	233	235
	Harrogate city	2,865	3,943	4,053	4,234	4,344	4,386	4,417
	New Tazewell town	2,871	2,860	2,931	3,078	3,180	3,225	3,255
	Tazewell town	2,165	2,131	2,159	2,230	2,256	2,247	2,234
	Unincorporated Claiborne County	21,757	21,705	22,252	23,306	23,915	24,024	23,968
	Total	29,862	30,845	31,607	33,071	33,924	34,115	34,109
Cocke	Newport city	7,241	7,324	7,501	7,937	8,233	8,361	8,462
	Parrottsville town	210	226	235	253	269	279	288
	Unincorporated Cocke County	26,114	27,191	28,122	29,812	30,787	31,059	31,147
	Total	33,565	34,741	35,858	38,002	39,289	39,699	39,897
Grainger	Bean Station city	3,250	2,967	3,121	3,402	3,590	3,713	3,819
	Blaine city	1,834	1,703	1,804	1,978	2,098	2,180	2,251
	Rutledge town	1,374	1,255	1,299	1,390	1,448	1,486	1,523
	Unincorporated Grainger County	14,201	16,184	17,050	18,596	19,625	20,290	20,850
	Total	20,659	22,109	23,274	25,366	26,761	27,669	28,443
Hamblen	Morristown city (pt.)	24,960	26,739	27,340	28,092	28,676	29,725	30,805
	White Pine town (pt.)	0	0	0	0	0	0	0
	Unincorporated Hamblen County	33,168	33,278	34,028	34,888	35,377	36,249	37,082
	Total	58,128	60,017	61,368	62,980	64,053	65,974	67,887
Jefferson	Baneberry city	366	694	684	710	702	713	743
	Dandridge town	2,078	2,269	2,334	2,568	2,700	2,944	3,218
	Jefferson City city	7,761	8,436	9,184	10,496	11,364	12,615	13,974
	Morristown city (pt.)	0	0	0	0	0	0	0
	New Market town	1,234	1,277	1,354	1,498	1,587	1,731	1,888
	White Pine town (pt.)	1,996	1,980	2,103	2,346	2,520	2,786	3,087
	Unincorporated Jefferson County	30,859	33,257	35,502	39,660	42,538	46,761	51,418
	Total	44,294	47,913	51,161	57,278	61,411	67,550	74,328
Knox	Farragut town (pt.)	17,718	19,709	20,054	21,149	22,062	22,379	22,386
	Knoxville city	173,890	174,948	183,490	197,560	205,806	210,868	215,554
	Unincorporated Knox County	190,424	214,459	221,689	234,455	244,044	249,214	253,160
	Total	382,032	409,116	425,233	453,164	471,912	482,461	491,100

AGGREGATE PROJECTIONS FOR MUNICIPALITIES BY DEVELOPMENT DISTRICT

County	Municipality	Census 2000	2005	Projections 2010	2015	2020	2025	2030
Loudon	Farragut town (pt.)	0	0	0	0	0	0	0
	Greenback city	954	1,020	1,106	1,273	1,389	1,449	1,500
	Lenoir City city	6,819	7,564	8,310	9,703	10,750	11,421	12,059
	Loudon town	4,476	4,825	5,183	5,918	6,427	6,703	6,956
	Philadelphia city	533	570	625	729	807	854	898
	Unincorporated Loudon County	26,304	29,263	31,536	35,873	38,390	39,216	39,870
	Total	39,086	43,242	46,760	53,496	57,763	59,643	61,283
Monroe	Madisonville city	3,939	4,324	4,613	5,181	5,580	5,963	6,363
	Sweetwater city (pt.)	5,585	6,168	6,551	7,303	7,830	8,341	8,874
	Tellico Plains town	859	924	985	1,097	1,166	1,226	1,295
	Vonore town (pt.)	1,161	1,372	1,468	1,641	1,757	1,868	1,985
	Unincorporated Monroe County	27,417	30,110	32,645	36,972	39,948	42,641	45,353
	Total	38,961	42,898	46,262	52,194	56,281	60,039	63,870
Morgan	Harriman city (pt.)	0	0	0	0	0	0	0
	Oakdale town	246	238	244	254	261	268	274
	Oliver Springs town (pt.)	52	60	61	62	63	65	67
	Sunbright city	577	587	603	623	638	654	665
	Wartburg city	890	909	917	932	943	961	978
	Unincorporated Morgan County	17,992	18,276	18,663	19,200	19,533	19,917	20,188
	Total	19,757	20,070	20,488	21,071	21,438	21,865	22,172
Roane [1]	Harriman city (pt.)	6,743	6,663	6,773	7,040	7,212	7,273	7,315
	Kingston city	5,264	5,399	5,424	5,603	5,727	5,754	5,752
	Oak Ridge city (pt.)	2,788	2,958	2,969	3,059	3,109	3,108	3,097
	Oliver Springs town (pt.)	943	929	947	989	1,019	1,030	1,037
	Rockwood city	5,774	5,403	5,460	5,651	5,751	5,756	5,744
	Unincorporated Roane County	30,398	31,272	31,977	33,294	33,958	33,911	33,659
	Total	51,910	52,624	53,550	55,636	56,776	56,832	56,604
Scott	Huntsville town	981	1,023	1,039	1,055	1,069	1,101	1,131
	Oneida town	3,615	3,815	3,844	3,879	3,917	4,035	4,138
	Winfield town	911	972	1,001	1,030	1,053	1,093	1,130
	Unincorporated Scott County	15,620	15,889	16,289	16,614	16,851	17,376	17,838
	Total	21,127	21,699	22,173	22,578	22,890	23,605	24,237
Sevier	Gatlinburg city	3,382	4,443	4,634	5,059	5,247	5,438	5,597
	Pigeon Forge city	5,083	5,832	6,311	7,179	7,782	8,449	9,142
	Pittman Center town	477	569	603	669	706	744	782
	Sevierville city	11,757	14,897	16,136	18,413	20,037	21,852	23,724
	Unincorporated Sevier County	50,471	53,852	58,690	67,258	73,156	79,395	85,543
	Total	71,170	79,593	86,374	98,578	106,928	115,878	124,788
Union	Luttrell town	915	934	975	1,039	1,082	1,159	1,236
	Maynardville city	1,782	1,875	1,968	2,113	2,223	2,402	2,589
	Plainview city	1,866	2,047	2,184	2,385	2,533	2,752	2,972
	Unincorporated Union County	13,245	13,804	14,419	15,369	16,006	17,109	18,229
	Total	17,808	18,660	19,546	20,906	21,844	23,422	25,026

AGGREGATE PROJECTIONS FOR MUNICIPALITIES BY DEVELOPMENT DISTRICT

County	Municipality	Census 2000	2005	Projections 2010	2015	2020	2025	2030
FIRST TENNESSEE DEVELOPMENT DISTRICT		**475,412**	**486,721**	**496,068**	**514,988**	**525,757**	**531,620**	**535,532**
Carter	Elizabethton city	13,372	13,863	14,265	15,185	15,809	15,934	16,037
	Johnson City city (pt.)	1,143	1,222	1,276	1,372	1,437	1,455	1,469
	Watauga city (pt.)	330	351	366	394	411	414	415
	Unincorporated Carter County	41,897	43,248	44,825	47,989	49,948	50,075	49,895
	Total	56,742	58,684	60,732	64,940	67,605	67,878	67,816
Greene	Baileyton town	504	501	501	513	519	520	521
	Greeneville town	15,198	15,278	15,479	16,057	16,420	16,660	16,891
	Mosheim town	1,749	2,027	2,058	2,124	2,148	2,152	2,151
	Tusculum city	2,004	2,199	2,228	2,290	2,303	2,296	2,302
	Unincorporated Greene County	43,454	44,859	46,148	48,418	49,765	50,557	51,159
	Total	62,909	64,864	66,414	69,402	71,155	72,185	73,024
Hancock	Sneedville town	1,257	1,315	1,308	1,297	1,288	1,271	1,256
	Unincorporated Hancock County	5,529	5,389	5,352	5,308	5,252	5,149	5,020
	Total	6,786	6,704	6,660	6,605	6,540	6,420	6,276
Hawkins	Bulls Gap town	714	714	730	761	776	792	813
	Church Hill city	5,916	6,370	6,592	6,978	7,204	7,430	7,638
	Kingsport city (pt.)	2,892	2,994	3,052	3,209	3,313	3,423	3,527
	Mount Carmel town	4,795	5,255	5,455	5,805	6,033	6,250	6,443
	Rogersville town	4,240	4,264	4,278	4,425	4,501	4,602	4,720
	Surgoinsville town	1,484	1,737	1,775	1,858	1,903	1,950	1,994
	Unincorporated Hawkins County	33,522	34,680	36,379	39,103	40,937	42,688	44,255
	Total	53,563	56,014	58,261	62,139	64,667	67,135	69,390
Johnson	Mountain City town	2,383	2,411	2,445	2,577	2,645	2,649	2,660
	Unincorporated Johnson County	15,116	15,647	16,206	17,387	18,102	18,302	18,422
	Total	17,499	18,058	18,651	19,964	20,747	20,951	21,082
Sullivan	Bluff City city	1,559	1,595	1,616	1,628	1,631	1,633	1,626
	Bristol city	24,821	25,065	24,865	24,616	24,366	24,182	23,908
	Johnson City city (pt.)	242	284	286	287	285	284	283
	Kingsport city (pt.)	42,013	41,114	40,440	39,808	39,293	38,901	38,378
	Unincorporated Sullivan County	84,413	84,034	83,755	83,004	81,890	80,737	79,183
	Total	153,048	152,092	150,962	149,343	147,465	145,737	143,378
Unicoi	Erwin town	5,610	5,797	5,728	5,808	5,830	5,729	5,608
	Unicoi town	3,519	3,565	3,636	3,770	3,820	3,763	3,677
	Unincorporated Unicoi County	8,538	8,219	8,299	8,530	8,602	8,467	8,276
	Total	17,667	17,581	17,663	18,108	18,252	17,959	17,561
Washington	Johnson City city (pt.)	54,084	56,165	58,169	62,291	64,672	66,707	68,601
	Jonesborough town	4,168	4,651	4,732	4,961	5,103	5,183	5,300
	Watauga city (pt.)	73	90	92	100	105	109	115
	Unincorporated Washington County	48,873	51,818	53,732	57,135	59,446	61,356	62,989
	Total	107,198	112,724	116,725	124,487	129,326	133,355	137,005

AGGREGATE PROJECTIONS FOR MUNICIPALITIES BY DEVELOPMENT DISTRICT

County	Municipality	Census 2000	2005	Projections 2010	2015	2020	2025	2030
GREATER NASHVILLE REGIONAL COUNCIL		**1,411,725**	**1,560,528**	**1,687,351**	**1,895,607**	**2,046,262**	**2,181,646**	**2,325,761**
Cheatham	Ashland City town	3,641	4,481	4,702	5,045	5,296	5,684	6,071
	Kingston Springs town	2,773	2,831	2,967	3,156	3,290	3,498	3,692
	Pegram town	2,146	2,136	2,235	2,371	2,465	2,612	2,760
	Pleasant View city	2,934	3,404	3,615	3,895	4,104	4,418	4,735
	Unincorporated Cheatham County	24,418	25,201	26,468	28,227	29,454	31,368	33,236
	Total	35,912	38,053	39,987	42,694	44,609	47,580	50,494
Davidson	Belle Meade city	2,943	3,360	3,366	3,541	3,764	3,899	3,952
	Berry Hill city	674	735	773	802	803	777	754
	Forest Hills city	4,710	5,580	5,537	5,774	6,052	6,133	6,108
	Goodlettsville city (pt.)	9,135	10,814	11,336	12,128	12,749	12,964	13,153
	Lakewood city	2,341	2,594	2,694	2,845	2,975	3,022	3,064
	Oak Hill city	4,493	5,123	5,050	5,231	5,440	5,442	5,373
	Ridgetop city (pt.)	28	105	106	115	125	129	143
	Unincorporated Davidson County	545,567	579,102	613,086	667,224	704,698	717,842	731,595
	Total	569,891	607,413	641,948	697,660	736,606	750,208	764,142
Dickson	Burns town	1,366	1,396	1,460	1,558	1,622	1,691	1,758
	Charlotte town	1,153	1,150	1,203	1,287	1,348	1,418	1,487
	Dickson city	12,244	13,342	14,073	15,182	16,038	16,992	17,928
	Slayden town	185	198	198	203	201	201	203
	Vanleer town	310	313	320	338	348	360	371
	White Bluff town	2,142	2,361	2,465	2,621	2,718	2,832	2,940
	Unincorporated Dickson County	25,756	26,950	28,377	30,492	32,006	33,602	35,078
	Total	43,156	45,710	48,096	51,681	54,281	57,096	59,765
Houston	Erin city	1,490	1,434	1,417	1,382	1,357	1,413	1,464
	Tennessee Ridge town (pt.)	1,327	1,295	1,262	1,212	1,174	1,209	1,244
	Unincorporated Houston County	5,271	5,207	5,174	5,060	4,975	5,171	5,347
	Total	8,088	7,936	7,853	7,654	7,506	7,793	8,055
Humphreys	McEwen city	1,702	1,644	1,653	1,663	1,673	1,734	1,792
	New Johnsonville city	1,905	1,935	1,950	1,954	1,953	2,005	2,049
	Waverly city	4,028	4,073	4,031	3,981	3,940	4,028	4,114
	Unincorporated Humphreys County	10,294	10,289	10,318	10,278	10,198	10,419	10,610
	Total	17,929	17,941	17,952	17,876	17,764	18,186	18,565
Montgomery	Clarksville city	103,455	112,513	118,577	124,771	129,737	142,435	155,647
	Unincorporated Montgomery County	31,313	35,144	36,086	37,081	38,158	41,272	44,295
	Total	134,768	147,657	154,663	161,852	167,895	183,707	199,942
Robertson	Adams city	566	584	630	707	768	837	910
	Cedar Hill city	298	308	335	378	410	448	487
	Coopertown town	3,027	3,199	3,456	3,862	4,152	4,480	4,803
	Cross Plains city	1,381	1,506	1,618	1,799	1,928	2,073	2,216
	Greenbrier town	4,940	6,004	6,620	7,541	8,240	9,042	9,884
	Millersville city (pt.)	976	1,095	1,210	1,375	1,493	1,625	1,762
	Orlinda city	594	633	681	757	805	862	922
	Portland city (pt.)	53	111	120	136	150	168	187
	Ridgetop city (pt.)	1,056	1,609	1,685	1,831	1,927	2,040	2,156
	Springfield city	14,329	15,789	17,057	19,175	20,776	22,631	24,579
	White House city (pt.)	3,120	3,790	4,186	4,778	5,235	5,745	6,262
	Unincorporated Robertson County	24,093	25,310	27,374	30,663	33,054	35,739	38,423
	Total	54,433	59,938	64,972	73,002	78,938	85,690	92,591
Rutherford	Eagleville city	464	464	516	616	683	740	802
	La Vergne city	18,687	26,158	30,032	37,004	42,419	47,150	51,815
	Murfreesboro city	68,816	87,512	100,962	123,367	139,626	154,567	170,469
	Smyrna town	25,569	33,680	38,371	46,806	53,077	58,527	64,002
	Unincorporated Rutherford County	68,487	72,025	81,715	99,391	112,169	122,852	133,377
	Total	182,023	219,839	251,596	307,184	347,974	383,836	420,465

AGGREGATE PROJECTIONS FOR MUNICIPALITIES BY DEVELOPMENT DISTRICT

County	Municipality	Census 2000	2005	Projections 2010	2015	2020	2025	2030
Stewart	Cumberland City town	316	320	320	334	345	380	418
	Dover city	1,443	1,486	1,464	1,474	1,481	1,596	1,723
	Tennessee Ridge town (pt.)	0	0	0	0	0	0	0
	Unincorporated Stewart County	10,611	11,081	11,384	11,894	12,206	13,339	14,555
	Total	12,370	12,887	13,168	13,702	14,032	15,315	16,696
Sumner [2]	Gallatin city	23,230	26,541	28,709	32,467	35,195	37,362	39,538
	Goodlettsville city (pt.)	4,645	5,295	5,711	6,423	6,902	7,258	7,609
	Hendersonville city	40,620	44,606	48,331	54,525	58,787	61,969	65,054
	Millersville city (pt.)	4,332	4,985	5,511	6,334	6,916	7,368	7,817
	Mitchellville city	207	213	228	257	279	297	318
	Portland city (pt.)	8,405	10,191	11,194	12,866	14,123	15,163	16,221
	Westmoreland town	2,093	2,147	2,324	2,633	2,854	3,029	3,207
	White House city (pt.)	4,100	4,895	5,418	6,244	6,849	7,332	7,814
	Unincorporated Sumner County	42,817	45,019	48,499	54,414	58,483	61,485	64,368
	Total	130,449	143,892	155,925	176,163	190,388	201,263	211,946
Trousdale	Hartsville town	0	0	0	0	0	0	0
	Unincorporated Trousdale County	7,259	7,429	7,472	7,526	7,544	7,932	8,297
	Total	7,259	7,429	7,472	7,526	7,544	7,932	8,297
Williamson	Brentwood city	23,445	32,220	35,569	41,558	46,121	52,812	61,688
	Fairview city	5,800	7,160	8,399	10,559	12,219	14,143	16,388
	Franklin city	41,842	53,189	62,742	79,028	90,970	103,980	118,731
	Nolensville town	3,099	2,547	2,927	3,554	4,021	4,629	5,399
	Spring Hill city (pt.)	5,135	10,518	12,708	16,295	18,901	21,690	24,954
	Thompson's's Station town	1,283	1,429	1,608	1,934	2,166	2,443	2,767
	Unincorporated Williamson County	46,034	44,999	50,532	60,306	67,535	77,019	88,946
	Total	126,638	152,062	174,485	213,234	241,933	276,716	318,873
Wilson	Lebanon city	20,235	22,995	25,138	29,019	31,795	34,116	36,516
	Mt. Juliet city	12,366	17,956	19,984	23,244	25,683	27,811	29,938
	Watertown city	1,358	1,382	1,502	1,725	1,887	2,023	2,167
	Unincorporated Wilson County	54,850	57,438	62,610	71,391	77,427	82,374	87,309
	Total	88,809	99,771	109,234	125,379	136,792	146,324	155,930

AGGREGATE PROJECTIONS FOR MUNICIPALITIES BY DEVELOPMENT DISTRICT

County	Municipality	Census 2000	2005	Projections 2010	2015	2020	2025	2030
MEMPHIS AREA ASSOCIATION OF GOVERNMENTS		**1,004,650**	**1,021,200**	**1,034,061**	**1,023,647**	**1,020,225**	**1,043,457**	**1,063,418**
Fayette	Braden town	274	283	324	400	449	453	452
	Gallaway city	666	708	811	1,005	1,141	1,168	1,192
	Grand Junction city (pt.)	0	0	0	0	0	0	0
	La Grange town	146	149	161	185	194	183	170
	Moscow city	422	532	601	733	821	834	847
	Oakland town	1,278	2,538	2,953	3,696	4,230	4,386	4,502
	Piperton city	589	1,084	1,143	1,296	1,346	1,258	1,173
	Rossville town	380	472	535	656	735	744	749
	Somerville town	2,518	2,875	3,236	3,955	4,463	4,566	4,661
	Williston city	341	352	410	514	586	601	611
	Unincorporated Fayette County	22,192	25,030	28,674	35,485	40,086	40,708	40,944
	Total	28,806	34,023	38,848	47,925	54,051	54,901	55,301
Lauderdale	Gates town	901	861	873	855	850	900	944
	Halls town	2,311	2,220	2,178	2,068	2,005	2,091	2,170
	Henning town	970	1,299	1,292	1,245	1,227	1,301	1,374
	Ripley city	7,844	7,716	7,712	7,426	7,269	7,658	8,039
	Unincorporated Lauderdale County	15,075	14,480	14,195	13,323	12,727	13,191	13,634
	Total	27,101	26,576	26,250	24,917	24,078	25,141	26,161
Shelby	Arlington town	2,569	3,575	3,515	3,357	3,266	3,268	3,267
	Bartlett city	40,543	46,731	46,499	44,892	43,953	44,334	44,440
	Collierville town	31,872	37,701	37,925	37,072	36,770	37,517	37,930
	Germantown city	37,348	37,469	36,723	35,035	33,906	33,791	33,445
	Lakeland city	6,862	7,894	7,895	7,575	7,369	7,402	7,420
	Memphis city	650,100	674,850	680,276	664,861	657,046	670,919	683,330
	Millington city	10,433	10,362	10,466	10,230	10,127	10,374	10,627
	Unincorporated Shelby County	117,745	86,817	87,477	84,946	83,535	84,649	85,359
	Total	897,472	905,399	910,776	887,968	875,972	892,254	905,818
Tipton	Atoka town	3,235	5,864	6,267	6,842	7,255	7,839	8,405
	Brighton town	1,719	2,397	2,586	2,872	3,103	3,426	3,754
	Burlison town	453	437	445	464	471	492	511
	Covington city	8,463	8,891	9,341	10,104	10,706	11,632	12,588
	Garland town	309	311	319	336	344	364	382
	Gilt Edge city	489	476	496	527	543	572	599
	Mason town	1,089	1,237	1,254	1,305	1,334	1,400	1,459
	Munford city	4,708	5,558	5,888	6,391	6,748	7,277	7,800
	Unincorporated Tipton County	30,806	30,031	31,591	33,996	35,620	38,159	40,640
	Total	51,271	55,202	58,187	62,837	66,124	71,161	76,138

AGGREGATE PROJECTIONS FOR MUNICIPALITIES BY DEVELOPMENT DISTRICT

County	Municipality	Census 2000	2005	Projections 2010	2015	2020	2025	2030
NORTHWEST TENNESSEE DEVELOPMENT DISTRICT		**233,684**	**230,252**	**227,219**	**221,446**	**216,832**	**219,065**	**220,484**
Benton	Big Sandy town	518	511	495	484	476	481	481
	Camden city	3,828	3,698	3,602	3,541	3,493	3,537	3,573
	Unincorporated Benton County	12,191	12,065	12,001	11,956	11,815	11,920	11,940
	Total	16,537	16,274	16,098	15,981	15,784	15,938	15,994
Carroll	Atwood town	1,000	965	947	931	913	898	883
	Bruceton town	1,554	1,465	1,451	1,442	1,433	1,430	1,427
	Clarksburg town	285	368	354	340	325	316	309
	Hollow Rock town	963	932	930	932	935	941	942
	Huntingdon town	4,349	4,131	4,092	4,064	4,050	4,063	4,063
	McKenzie city (pt.)	4,981	5,055	5,043	5,028	5,018	5,045	5,062
	McLemoresville town	259	309	297	287	276	267	258
	Trezevant town	901	879	857	840	824	816	807
	Unincorporated Carroll County	15,183	14,627	14,649	14,665	14,624	14,611	14,530
	Total	29,475	28,731	28,620	28,529	28,398	28,387	28,281
Crockett	Alamo town	2,392	2,337	2,299	2,237	2,199	2,269	2,344
	Bells city	2,171	2,269	2,288	2,276	2,280	2,386	2,487
	Friendship city	608	599	593	582	575	594	613
	Gadsden town	553	547	542	527	512	519	526
	Maury City town	704	696	681	655	634	641	650
	Unincorporated Crockett County	8,104	7,856	7,757	7,538	7,373	7,536	7,672
	Total	14,532	14,304	14,160	13,815	13,573	13,945	14,292
Dyer	Dyersburg city	17,452	17,372	17,531	17,610	17,729	18,104	18,412
	Newbern town	2,988	3,073	3,115	3,136	3,164	3,234	3,290
	Trimble town (pt.)	727	720	714	703	695	700	702
	Unincorporated Dyer County	16,112	16,440	16,471	16,328	16,147	16,178	16,151
	Total	37,279	37,605	37,831	37,777	37,735	38,216	38,555
Giles	Ardmore city (pt.)	995	1,013	989	958	932	943	948
	Elkton city	510	606	596	571	546	543	538
	Lynnville town	345	346	337	324	314	317	319
	Minor Hill city	437	447	439	432	428	441	454
	Pulaski city	7,871	7,884	7,739	7,549	7,426	7,583	7,705
	Unincorporated Giles County	19,289	18,801	18,641	18,249	17,869	18,090	18,198
	Total	29,447	29,097	28,741	28,083	27,515	27,917	28,162
Henry	Cottage Grove town	103	97	99	103	107	111	115
	Henry town	520	523	550	585	614	647	677
	McKenzie city (pt.)	73	92	93	96	99	103	106
	Paris city	9,761	9,819	9,827	10,028	10,198	10,495	10,770
	Puryear city	667	666	667	672	672	681	692
	Unincorporated Henry County	19,991	20,127	20,280	20,662	20,785	21,076	21,278
	Total	31,115	31,324	31,516	32,146	32,475	33,113	33,638
Lake	Ridgely town	1,667	1,494	1,514	1,480	1,481	1,515	1,486
	Tiptonville town	2,439	3,971	4,094	3,927	3,863	3,895	3,810
	Unincorporated Lake County	3,848	2,056	1,865	1,983	2,000	1,979	2,125
	Total	7,954	7,521	7,473	7,390	7,344	7,389	7,421

AGGREGATE PROJECTIONS FOR MUNICIPALITIES BY DEVELOPMENT DISTRICT

County	Municipality	Census 2000	2005	Projections 2010	2015	2020	2025	2030
Obion	Hornbeak town	435	424	413	391	374	376	376
	Kenton town (pt.)	554	550	532	500	477	477	477
	Obion town	1,134	1,097	1,056	988	941	941	941
	Rives town	331	321	316	306	296	298	299
	Samburg town	260	268	256	238	226	226	223
	South Fulton city	2,517	2,422	2,335	2,192	2,088	2,086	2,079
	Trimble town (pt.)	0	0	0	0	0	0	0
	Troy town	1,273	1,232	1,196	1,130	1,083	1,090	1,092
	Union City city	10,876	10,676	10,465	9,936	9,517	9,556	9,577
	Woodland Mills city	296	302	297	282	267	265	261
	Unincorporated Obion County	14,774	14,563	14,228	13,434	12,765	12,670	12,526
	Total	32,450	31,855	31,094	29,397	28,034	27,985	27,851
Weakley	Dresden town	2,855	2,602	2,427	2,124	1,954	1,946	1,957
	Gleason town	1,463	1,401	1,308	1,155	1,068	1,064	1,078
	Greenfield city	2,208	2,019	1,887	1,679	1,517	1,516	1,535
	Martin city	10,515	10,594	10,230	9,446	8,694	8,986	9,064
	McKenzie city (pt.)	241	227	211	183	168	169	166
	Sharon town	988	908	822	694	611	588	573
	Unincorporated Weakley County	16,625	15,790	14,801	13,047	11,962	11,906	11,917
	Total	34,895	33,541	31,686	28,328	25,974	26,175	26,290

AGGREGATE PROJECTIONS FOR MUNICIPALITIES BY DEVELOPMENT DISTRICT

County	Municipality	Census 2000	2005	Projections 2010	2015	2020	2025	2030
SOUTH CENTRAL TENNESSEE DEVELOPMENT DISTRICT		**404,428**	**422,564**	**440,180**	**469,545**	**490,233**	**513,859**	**537,215**
Bedford	Bell Buckle town	391	402	417	458	483	504	525
	Normandy town	152	149	167	194	214	230	248
	Shelbyville city	16,100	18,583	20,322	23,330	25,661	28,009	30,481
	Wartrace town	548	561	601	673	720	764	815
	Unincorporated Bedford County	20,395	22,268	24,384	27,897	30,451	32,857	35,387
	Total	37,586	41,963	45,891	52,552	57,529	62,364	67,456
Coffee	Manchester city	8,294	9,546	9,908	10,593	11,060	11,455	11,860
	Tullahoma city (pt.)	16,970	17,791	18,591	20,023	21,028	21,868	22,703
	Unincorporated Coffee County	22,750	23,353	24,579	26,585	27,929	28,965	29,957
	Total	48,014	50,690	53,078	57,201	60,017	62,288	64,520
Franklin	Cowan city	1,771	1,786	1,809	1,910	1,983	2,066	2,147
	Decherd city	2,247	2,223	2,291	2,410	2,490	2,567	2,648
	Estill Springs town	2,153	2,308	2,366	2,493	2,574	2,649	2,720
	Huntland town	916	899	916	951	983	1,015	1,038
	Monteagle town (pt.)	12	39	38	43	48	51	56
	Tullahoma city (pt.)	1,024	1,078	1,112	1,170	1,210	1,254	1,290
	Winchester city	7,332	7,853	8,031	8,435	8,703	8,941	9,209
	Unincorporated Franklin County	23,815	24,371	25,216	26,691	27,540	28,290	28,927
	Total	39,270	40,557	41,779	44,103	45,531	46,833	48,035
Gibson	Bradford town	1,113	1,066	1,059	1,060	1,055	1,052	1,050
	Dyer city	2,406	2,403	2,385	2,389	2,407	2,435	2,457
	Gibson town	305	403	417	428	438	449	459
	Humboldt city (pt.)	9,442	9,186	9,208	9,282	9,332	9,405	9,473
	Kenton town (pt.)	752	740	738	738	737	739	742
	Medina city	969	1,280	1,306	1,345	1,380	1,416	1,443
	Milan city	7,664	7,782	7,806	7,876	7,948	8,062	8,168
	Rutherford town	1,272	1,236	1,229	1,230	1,231	1,235	1,240
	Trenton city	4,683	4,550	4,591	4,658	4,710	4,772	4,831
	Yorkville city	293	325	321	325	335	345	352
	Unincorporated Gibson County	19,253	18,918	18,994	19,124	19,111	19,085	18,995
	Total	48,152	47,889	48,054	48,455	48,684	48,995	49,210
Hickman	Centerville town	3,793	3,937	4,049	4,313	4,500	4,853	5,231
	Unincorporated Hickman County	18,502	19,455	20,624	22,581	23,970	26,146	28,387
	Total	22,295	23,392	24,673	26,894	28,470	30,999	33,618
Lawrence	Ethridge town	536	549	565	579	585	603	624
	Iron City city (pt.)	369	372	380	383	382	388	394
	Lawrenceburg city	10,795	10,792	10,829	10,869	10,922	11,250	11,596
	Loretto city	1,665	1,690	1,700	1,709	1,711	1,756	1,805
	St. Joseph city	829	849	866	877	881	905	930
	Unincorporated Lawrence County	25,732	26,443	27,145	27,798	28,344	29,485	30,567
	Total	39,926	40,695	41,485	42,215	42,825	44,387	45,916
Lewis	Hohenwald city	3,754	3,759	3,734	3,714	3,702	3,893	4,084
	Unincorporated Lewis County	7,613	7,582	7,691	7,749	7,769	8,169	8,536
	Total	11,367	11,341	11,425	11,463	11,471	12,062	12,620
Lincoln	Ardmore city (pt.)	87	94	95	97	98	99	99
	Fayetteville city	6,994	6,985	6,984	7,113	7,209	7,329	7,457
	Petersburg town (pt.)	412	423	427	442	450	457	462
	Unincorporated Lincoln County	23,847	24,644	25,247	26,163	26,709	27,139	27,445
	Total	31,340	32,146	32,753	33,815	34,466	35,024	35,463
Marshall	Chapel Hill town	943	1,211	1,232	1,279	1,314	1,394	1,476
	Cornersville town	962	926	959	1,019	1,068	1,150	1,235
	Lewisburg city	10,413	10,661	11,020	11,638	12,125	13,007	13,897
	Petersburg town (pt.)	168	179	184	194	202	216	230
	Unincorporated Marshall County	14,281	15,076	15,836	16,884	17,614	18,823	19,984
	Total	26,767	28,053	29,231	31,014	32,323	34,590	36,822

AGGREGATE PROJECTIONS FOR MUNICIPALITIES BY DEVELOPMENT DISTRICT

County	Municipality	Census 2000	2005	Projections 2010	2015	2020	2025	2030
Maury	Columbia city	33,055	33,506	35,858	40,024	43,131	45,999	48,899
	Mount Pleasant city	4,491	4,416	4,719	5,256	5,641	5,995	6,365
	Spring Hill city (pt.)	2,580	6,431	7,128	8,245	9,134	9,911	10,625
	Unincorporated Maury County	29,372	31,182	33,530	37,340	39,884	41,988	44,019
	Total	69,498	75,535	81,235	90,865	97,790	103,893	109,908
Moore	Unincorporated Moore County	5,740	5,990	6,213	6,589	6,827	7,213	7,596
	Total	5,740	5,990	6,213	6,589	6,827	7,213	7,596
Perry	Linden town	1,015	984	970	961	958	1,003	1,049
	Lobelville city	915	912	907	898	889	922	954
	Unincorporated Perry County	5,701	5,699	5,704	5,677	5,633	5,837	6,023
	Total	7,631	7,595	7,581	7,536	7,480	7,762	8,026
Wayne	Clifton city	2,699	2,606	2,492	2,348	2,233	2,270	2,324
	Collinwood city	1,024	1,038	1,059	1,082	1,096	1,146	1,190
	Iron City city (pt.)	0	0	0	0	0	0	0
	Waynesboro city	2,228	2,170	2,165	2,171	2,171	2,252	2,327
	Unincorporated Wayne County	10,891	10,904	11,066	11,242	11,320	11,781	12,184
	Total	16,842	16,718	16,782	16,843	16,820	17,449	18,025

AGGREGATE PROJECTIONS FOR MUNICIPALITIES BY DEVELOPMENT DISTRICT

County	Municipality	Census 2000	2005	Projections 2010	2015	2020	2025	2030
SOUTHEAST TENNESSEE DEVELOPMENT DISTRICT		**566,257**	**591,256**	**601,824**	**615,591**	**624,212**	**636,652**	**647,361**
Bledsoe	Pikeville city	1,781	1,832	1,886	1,982	2,044	2,184	2,326
	Unincorporated Bledsoe County	10,586	10,896	11,190	11,682	11,975	12,635	13,298
	Total	12,367	12,728	13,076	13,664	14,019	14,819	15,624
Bradley	Charleston city	630	666	677	703	719	742	771
	Cleveland city	37,192	36,978	38,414	40,804	42,278	44,120	46,036
	Unincorporated Bradley County	50,143	54,644	56,664	59,473	61,539	64,055	66,434
	Total	87,965	92,288	95,755	100,980	104,536	108,917	113,241
Grundy	Altamont town	1,136	1,124	1,135	1,141	1,152	1,175	1,190
	Beersheba Springs town	553	550	543	531	518	511	506
	Coalmont city	948	954	967	975	984	1,000	1,011
	Gruetli-Laager city	1,867	1,873	1,896	1,901	1,912	1,940	1,964
	Monteagle town (pt.)	792	781	763	733	707	692	679
	Palmer town	726	711	695	678	661	648	636
	Tracy City town	1,679	1,665	1,648	1,615	1,590	1,584	1,577
	Unincorporated Grundy County	6,631	6,690	6,735	6,737	6,748	6,813	6,840
	Total	14,332	14,348	14,382	14,311	14,272	14,363	14,403
Hamilton	Chattanooga city	155,554	163,864	164,959	165,870	166,048	166,788	167,275
	Collegedale city	6,514	8,290	8,740	9,171	9,329	9,511	9,637
	East Ridge city	20,640	20,099	20,001	19,710	19,512	19,426	19,258
	Lakesite city	1,845	1,940	1,965	1,988	2,003	2,019	2,007
	Lookout Mountain town	2,000	1,936	1,889	1,857	1,856	1,856	1,856
	Red Bank city	12,418	11,853	12,039	12,054	12,040	12,065	12,067
	Ridgeside city	389	391	376	365	359	357	345
	Signal Mountain town	7,429	7,318	7,129	7,032	7,030	7,024	6,985
	Soddy-Daisy city	11,530	12,158	12,277	12,279	12,248	12,249	12,235
	Walden town	1,960	2,050	2,053	2,033	2,043	2,056	2,033
	Unincorporated Hamilton County	87,617	93,527	94,676	95,306	95,822	96,163	95,667
	Total	307,896	323,426	326,104	327,665	328,290	329,514	329,365
McMinn	Athens city	13,220	13,798	14,310	15,204	15,863	16,505	17,108
	Calhoun town	496	510	515	528	532	535	538
	Englewood town	1,590	1,658	1,693	1,772	1,825	1,879	1,932
	Etowah city	3,663	3,715	3,755	3,906	4,009	4,104	4,201
	Niota city	781	792	811	847	866	880	896
	Sweetwater city (pt.)	0	0	0	0	0	0	0
	Unincorporated McMinn County	29,265	30,596	31,645	33,423	34,512	35,397	36,152
	Total	49,015	51,069	52,729	55,680	57,607	59,300	60,827
Marion	Chattanooga city	0	0	0	0	0	0	0
	Jasper town	3,213	3,076	3,068	3,043	3,016	3,023	3,017
	Kimball town	1,312	1,351	1,351	1,336	1,318	1,311	1,296
	Monteagle town (pt.)	420	399	391	377	365	358	352
	New Hope city	1,043	1,024	1,037	1,044	1,045	1,054	1,056
	Orme town	128	138	138	137	135	134	132
	Powell's Crossroads town	1,286	1,218	1,233	1,240	1,246	1,263	1,270
	South Pittsburg city	3,294	3,122	3,101	3,074	3,060	3,089	3,105
	Whitwell city	1,660	1,600	1,575	1,541	1,510	1,501	1,489
	Unincorporated Marion County	15,420	15,814	15,933	15,910	15,809	15,858	15,801
	Total	27,776	27,742	27,827	27,702	27,504	27,591	27,518
Meigs	Decatur town	1,395	1,426	1,447	1,491	1,519	1,652	1,797
	Unincorporated Meigs County	9,691	10,024	10,351	10,846	11,161	12,216	13,329
	Total	11,086	11,450	11,798	12,337	12,680	13,868	15,126
Polk	Benton town	1,138	1,169	1,149	1,104	1,077	1,131	1,183
	Copperhill city	511	476	456	426	405	413	422
	Ducktown city	427	404	380	348	324	326	330
	Unincorporated Polk County	13,974	13,722	13,468	12,867	12,393	12,816	13,198
	Total	16,050	15,771	15,453	14,745	14,199	14,686	15,133
Rhea	Dayton city	6,180	6,452	6,767	7,273	7,632	8,041	8,477
	Graysville town	1,411	1,443	1,540	1,660	1,756	1,869	1,969
	Spring City town	2,025	2,027	2,051	2,114	2,168	2,241	2,313
	Unincorporated Rhea County	18,784	19,802	20,494	21,603	22,306	23,095	23,911
	Total	28,400	29,724	30,852	32,650	33,862	35,246	36,670
Sequatchie	Dunlap city	4,173	4,689	5,096	5,834	6,355	6,781	7,217
	Unincorporated Sequatchie County	7,197	8,021	8,752	10,023	10,888	11,567	12,237
	Total	11,370	12,710	13,848	15,857	17,243	18,348	19,454

AGGREGATE PROJECTIONS FOR MUNICIPALITIES BY DEVELOPMENT DISTRICT

County	Municipality	Census 2000	2005	Projections 2010	2015	2020	2025	2030
SOUTHWEST TENNESSEE DEVELOPMENT DISTRICT		**242,763**	**246,520**	**250,453**	**255,054**	**258,316**	**266,720**	**274,223**
Chester	Enville town (pt.)	230	237	227	222	215	219	224
	Henderson city	5,670	5,737	5,969	6,176	6,315	7,000	7,476
	Milledgeville town (pt.)	83	96	90	88	86	88	92
	Silerton town (pt.)	0	0	0	0	0	0	0
	Unincorporated Chester County	9,557	9,807	9,807	9,964	10,045	10,387	10,857
	Total	15,540	15,877	16,093	16,450	16,661	17,694	18,649
Decatur	Decaturville town	859	830	822	815	810	827	839
	Parsons city	2,452	2,390	2,360	2,324	2,296	2,328	2,353
	Scotts Hill town (pt.)	345	339	337	336	337	344	351
	Unincorporated Decatur County	8,075	7,856	7,764	7,658	7,532	7,597	7,632
	Total	11,731	11,415	11,283	11,133	10,975	11,096	11,175
Hardeman	Bolivar city	5,799	5,693	5,692	5,616	5,590	5,837	6,063
	Grand Junction city (pt.)	301	316	306	296	289	296	303
	Hickory Valley town	136	132	125	118	112	112	111
	Hornsby town	306	299	301	297	294	306	314
	Middleton city	602	625	617	605	595	614	629
	Saulsbury town	100	115	108	103	102	105	107
	Silerton town (pt.)	70	79	89	86	87	95	101
	Toone town	330	372	366	357	346	355	360
	Whiteville town	3,147	4,187	4,175	3,978	3,819	3,968	4,104
	Unincorporated Hardeman County	17,314	16,014	15,940	15,636	15,461	16,090	16,634
	Total	28,105	27,832	27,719	27,092	26,695	27,778	28,726
Hardin	Adamsville town (pt.)	33	39	39	40	40	41	41
	Crump city	1,521	1,437	1,432	1,448	1,447	1,436	1,419
	Milledgeville town (pt.)	74	84	82	81	81	81	80
	Saltillo town	342	361	355	359	362	361	358
	Savannah city	6,917	7,163	7,168	7,296	7,368	7,405	7,396
	Unincorporated Hardin County	16,691	16,726	16,877	17,216	17,292	17,254	17,097
	Total	25,578	25,810	25,953	26,440	26,590	26,578	26,391
Haywood	Brownsville city	10,748	10,585	10,767	10,815	10,933	11,103	11,211
	Stanton town	615	596	604	602	606	614	622
	Unincorporated Haywood County	8,434	8,218	8,169	7,973	7,811	7,703	7,576
	Total	19,797	19,399	19,540	19,390	19,350	19,420	19,409
Henderson	Lexington city	7,393	7,602	7,749	7,965	8,115	8,457	8,785
	Parker's Crossroads city	241	247	243	241	238	239	239
	Sardis town	445	450	443	443	441	450	460
	Scotts Hill town (pt.)	549	561	566	580	592	617	642
	Unincorporated Henderson County	16,894	17,313	17,690	18,243	18,613	19,381	20,076
	Total	25,522	26,173	26,691	27,472	27,999	29,144	30,202
Madison	Humboldt city (pt.)	25	31	32	32	33	34	36
	Jackson city	59,643	62,023	64,248	66,849	69,004	72,402	75,677
	Medon city	191	191	190	189	187	189	190
	Three Way city	1,375	1,350	1,390	1,445	1,490	1,550	1,598
	Unincorporated Madison County	30,603	31,332	31,880	32,618	33,070	33,985	34,758
	Total	91,837	94,927	97,740	101,133	103,784	108,160	112,259
McNairy	Adamsville town (pt.)	1,950	2,009	2,009	2,033	2,053	2,096	2,140
	Bethel Springs town	763	763	773	790	808	834	858
	Eastview town	618	622	625	632	640	652	662
	Enville town (pt.)	0	0	0	0	0	0	0
	Finger city	350	353	370	389	405	428	449
	Guys town	483	488	500	511	513	520	527
	Michie town	647	654	653	658	658	663	668
	Milledgeville town (pt.)	130	158	154	153	155	159	163
	Ramer city	354	355	362	372	374	380	386
	Selmer town	4,541	4,550	4,572	4,618	4,640	4,723	4,806
	Stantonville town	312	353	350	351	351	356	362
	Unincorporated McNairy County	14,505	14,782	15,066	15,437	15,665	16,039	16,391
	Total	24,653	25,087	25,434	25,944	26,262	26,850	27,412

AGGREGATE PROJECTIONS FOR MUNICIPALITIES BY DEVELOPMENT DISTRICT

County	Municipality	Census 2000	2005	Projections 2010	2015	2020	2025	2030
UPPER CUMBERLAND DEVELOPMENT DISTRICT		**304,998**	**319,243**	**331,492**	**354,574**	**369,345**	**384,643**	**399,566**
Cannon	Auburntown town	252	254	257	266	271	284	296
	Woodbury town	2,428	2,492	2,506	2,572	2,617	2,733	2,847
	Unincorporated Cannon County	10,146	10,410	10,683	11,153	11,429	11,941	12,392
	Total	12,826	13,156	13,446	13,991	14,317	14,958	15,535
Clay	Celina city	1,379	1,361	1,361	1,380	1,390	1,413	1,427
	Unincorporated Clay County	6,597	6,585	6,608	6,696	6,707	6,749	6,755
	Total	7,976	7,946	7,969	8,076	8,097	8,162	8,182
Cumberland	Crab Orchard city	838	897	985	1,146	1,261	1,346	1,421
	Crossville city	8,981	10,448	11,249	12,875	14,049	14,967	15,925
	Pleasant Hill town	544	592	537	518	502	503	522
	Unincorporated Cumberland County	36,439	38,975	41,480	46,573	49,531	51,415	53,381
	Total	46,802	50,912	54,251	61,112	65,343	68,231	71,249
DeKalb	Alexandria town	814	859	897	977	1,039	1,110	1,180
	Dowelltown town	302	314	323	344	357	372	387
	Liberty town	367	381	395	419	432	444	452
	Smithville city	3,994	4,157	4,322	4,654	4,903	5,189	5,477
	Unincorporated DeKalb County	11,946	12,503	13,101	14,157	14,848	15,592	16,274
	Total	17,423	18,214	19,038	20,551	21,579	22,707	23,770
Fentress	Allardt city	642	652	650	656	654	649	642
	Jamestown city	1,839	1,852	1,838	1,860	1,869	1,865	1,858
	Unincorporated Fentress County	14,144	14,533	14,883	15,487	15,819	15,941	15,977
	Total	16,625	17,037	17,371	18,003	18,342	18,455	18,477
Jackson	Gainesboro town	879	855	844	847	842	853	864
	Unincorporated Jackson County	10,105	10,129	10,256	10,599	10,764	11,101	11,362
	Total	10,984	10,984	11,100	11,446	11,606	11,954	12,226
Macon	Lafayette city	3,885	4,175	4,219	4,387	4,482	4,728	4,990
	Red Boiling Springs city	1,023	1,043	1,070	1,121	1,152	1,217	1,286
	Unincorporated Macon County	15,478	16,021	16,881	18,242	19,214	20,721	22,184
	Total	20,386	21,239	22,170	23,750	24,848	26,666	28,460
Overton	Livingston town	3,498	3,478	3,480	3,549	3,583	3,655	3,727
	Unincorporated Overton County	16,620	16,982	17,333	17,997	18,380	18,858	19,289
	Total	20,118	20,460	20,813	21,546	21,963	22,513	23,016
Pickett	Byrdstown town	903	873	861	847	831	827	824
	Unincorporated Pickett County	4,042	3,946	3,886	3,800	3,713	3,680	3,630
	Total	4,945	4,819	4,747	4,647	4,544	4,507	4,454
Putnam	Algood town	2,942	3,109	3,244	3,537	3,748	3,943	4,151
	Baxter town	1,279	1,330	1,355	1,453	1,531	1,579	1,647
	Cookeville city	23,923	28,741	30,676	33,865	35,675	37,467	39,384
	Monterey town	2,717	2,784	2,886	3,149	3,322	3,463	3,630
	Unincorporated Putnam County	31,454	31,138	32,466	35,368	37,516	39,178	40,764
	Total	62,315	67,102	70,627	77,372	81,792	85,630	89,576
Smith	Carthage town	2,251	2,251	2,276	2,368	2,430	2,554	2,679
	Gordonsville town	1,066	1,119	1,151	1,210	1,248	1,315	1,379
	South Carthage town	1,302	1,309	1,340	1,409	1,465	1,560	1,648
	Unincorporated Smith County	13,093	13,794	14,337	15,227	15,825	16,776	17,659
	Total	17,712	18,473	19,104	20,214	20,968	22,205	23,365
Van Buren	Spencer town	1,713	1,665	1,612	1,500	1,414	1,414	1,403
	Unincorporated Van Buren County	3,795	3,712	3,616	3,400	3,228	3,243	3,225
	Total	5,508	5,377	5,228	4,900	4,642	4,657	4,628
Warren	Centertown town	257	262	271	282	291	305	320
	McMinnville city	12,749	13,080	13,375	13,793	14,180	14,934	15,710
	Morrison town	684	692	716	750	781	828	875
	Viola town	130	145	148	153	157	164	171
	Unincorporated Warren County	24,456	25,085	25,836	26,685	27,275	28,410	29,508
	Total	38,276	39,264	40,346	41,663	42,684	44,641	46,584
White	Doyle town	525	552	566	601	620	628	634
	Sparta city	4,599	4,776	4,905	5,232	5,436	5,555	5,687
	Unincorporated White County	17,978	18,932	19,811	21,470	22,564	23,174	23,723
	Total	23,102	24,260	25,282	27,303	28,620	29,357	30,044

Note: 2005 data are Vintage 2007 Census Bureau intercensal estimates.

[1] Midtown was unincorporated after the 2000 Census. This population has been assigned to the Unincorporated Area of Roane County.

[2] Walnut Grove was unincorporated after the 2000 Census. This population has been assigned to the Unincorporated Area of Sumner County.

Aggregate Projections for Tennessee Counties within MSAs

AGGREGATE PROJECTIONS FOR TENNESSEE COUNTIES WITHIN MSAS

MSA	County	Census 2000	2005	Projections 2010	2015	2020	2025	2030
CHATTANOOGA, TN-GA								
	Hamilton	307,896	323,426	326,104	327,665	328,290	329,514	329,365
	Marion	27,776	27,742	27,827	27,702	27,504	27,591	27,518
	Sequatchie	11,370	12,710	13,848	15,857	17,243	18,348	19,454
	Catoosa, GA	53,282	0	0	0	0	0	0
	Dade, GA	15,154	0	0	0	0	0	0
	Walker, GA	61,053	0	0	0	0	0	0
CLARKSVILLE, TN-KY								
	Montgomery	134,768	147,657	154,663	161,852	167,895	183,707	199,942
	Stewart	12,370	12,887	13,168	13,702	14,032	15,315	16,696
	Christian, KY	72,265	0	0	0	0	0	0
	Trigg, KY	12,597	0	0	0	0	0	0
CLEVELAND								
	Bradley	87,965	92,288	95,755	100,980	104,536	108,917	113,241
	Polk	16,050	15,771	15,453	14,745	14,199	14,686	15,133
JACKSON								
	Chester	15,540	15,877	16,093	16,450	16,661	17,694	18,649
	Madison	91,837	94,927	97,740	101,133	103,784	108,160	112,259
JOHNSON CITY								
	Carter	56,742	58,684	60,732	64,940	67,605	67,878	67,816
	Unicoi	17,667	17,581	17,663	18,108	18,252	17,959	17,561
	Washington	107,198	112,724	116,725	124,487	129,326	133,355	137,005
KINGSPORT-BRISTOL-BRISTOL,TN-VA								
	Hawkins	53,563	56,014	58,261	62,139	64,667	67,135	69,390
	Sullivan	153,048	152,092	150,962	149,343	147,465	145,737	143,378
	Scott, VA	23,403	0	0	0	0	0	0
KNOXVILLE								
	Anderson	71,330	71,801	72,220	73,085	73,382	72,657	71,627
	Blount	105,823	115,261	123,830	140,045	151,018	157,827	164,211
	Knox	382,032	409,116	425,233	453,164	471,912	482,461	491,100
	Loudon	39,086	43,242	46,760	53,496	57,763	59,643	61,283
	Union	17,808	18,660	19,546	20,906	21,844	23,422	25,026
MEMPHIS,TN-MS-AR								
	Fayette	28,806	34,023	38,848	47,925	54,051	54,901	55,301
	Shelby	897,472	905,399	910,776	887,968	875,972	892,254	905,818
	Tipton	51,271	55,202	58,187	62,837	66,124	71,161	76,138
	Crittenden, AR	50,866	0	0	0	0	0	0
	Desoto, MS	107,199	0	0	0	0	0	0
	Marshall, MS	34,993	0	0	0	0	0	0
	Tate, MS	25,370	0	0	0	0	0	0
	Tunica, MS	9,227	0	0	0	0	0	0
MORRISTOWN								
	Grainger	20,659	22,109	23,274	25,366	26,761	27,669	28,443
	Hamblen	58,128	60,017	61,368	62,980	64,053	65,974	67,887
	Jefferson	44,294	47,913	51,161	57,278	61,411	67,550	74,328

AGGREGATE PROJECTIONS FOR TENNESSEE COUNTIES WITHIN MSAS

MSA	County	Census 2000	2005	Projections 2010	2015	2020	2025	2030
NASHVILLE-DAVIDSON-MURFREESBORO-FRANKLIN								
	Cannon	12,826	13,156	13,446	13,991	14,317	14,958	15,535
	Cheatham	35,912	38,053	39,987	42,694	44,609	47,580	50,494
	Davidson	569,891	607,413	641,948	697,660	736,606	750,208	764,142
	Dickson	43,156	45,710	48,096	51,681	54,281	57,096	59,765
	Hickman	22,295	23,392	24,673	26,894	28,470	30,999	33,618
	Macon	20,386	21,239	22,170	23,750	24,848	26,666	28,460
	Robertson	54,433	59,938	64,972	73,002	78,938	85,690	92,591
	Rutherford	182,023	219,839	251,596	307,184	347,974	383,836	420,465
	Smith	17,712	18,473	19,104	20,214	20,968	22,205	23,365
	Sumner	130,449	143,892	155,925	176,163	190,388	201,263	211,946
	Trousdale	7,259	7,429	7,472	7,526	7,544	7,932	8,297
	Williamson	126,638	152,062	174,485	213,234	241,933	276,716	318,873
	Wilson	88,809	99,771	109,234	125,379	136,792	146,324	155,930

Note: 2005 data are Vintage 2007 Census Bureau intercensal estimates.

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Technical Appendix

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Cohort Component Method

The approach used to generate the population projections in this report is the cohort component method. Implementing this method depends on two kinds of data: an accurate count of the number of people at the beginning of a projection period, and a way to reliably predict the components of population change - births, deaths and migration. The application of the model proceeds in two conceptual steps. First, we construct the *cohort* - a group of individuals who were born within the same 5-year period, disaggregated by sex and place of residence. Next, we apply age-specific birth, death and migration rates to each cohort, which results in the total population 5 years in the future.

The initial cohorts are constructed using data from the 2000 Census – the last year in which there was a complete enumeration of the population by age, sex and place of residence. Determining which data to use for constructing the fertility, mortality and migration rates is less straight-forward. The approach for fertility and mortality was to select rates that best predict the number of births and deaths, by county, from 2000 to 2004. Migration rates also apply to the county-level. A more detailed explanation of the methods employed to select county-appropriate rates is described below.

There is no single agency that collects and releases this information at the same geographic scale (counties and places) or time scale (some rates are before the year 2000 and some after) as the Census data. Like the nation as a whole, Tennessee's fertility rates have recently reached their highest levels in over a decade. In mortality the state contradicts national trends - while many states have experienced decreases in mortality rates in recent years, Tennessee has not. Whether the high fertility and mortality rates over the last few years will continue is unknown; anticipating the timing and magnitude of these changes requires additional modeling that is outside the scope of this report. As described in the section below, some efforts have been made to account for county-level differences in fertility and mortality - these rates are time-invariant, but they do reflect some of the differences in fertility and mortality in the state of Tennessee.

From County to Place to Growth Boundaries

Creating sub-county population projections is difficult due to a lack of data, small population counts, and yearly fluctuations in births, deaths and migrants. The Census publishes population estimates for cities and towns (Census places) annually. However, the more time that has passed since the last decennial Census, the more error in these estimates as illustrated by examining the place estimates the year of a Census versus the actual place-based Census counts.

The sub-county population projections occurred in two steps. First we created county-level population projections by 5-year age group and sex in 5-year intervals from 2000 to 2030. We weighted the 2005 population projections to be equal to the 2005 county-level estimates reported by the Census Bureau. Next, we generated place-based population projections, in the same sex and age groups as the county-level projections, using the 2000 Census place data as the baseline. We weighted these estimates so that the place-based projections were equal to the county-based projections for every age and sex combination. For example, the total count of 10-14 year old boys for all places in a county in 2015 will be equal to the county total of 10-14 year old boys in 2015.

Baseline Population

Census Bureau data for 2000 was used to construct the baseline population, including the population count by age, sex and county. When used to predict future population, these counts needed to be modified to reflect special populations, i.e. those residing in group quarters such as prisons, nursing

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homes and military bases, and those enrolled in colleges. Special consideration is necessary for these populations because they experience life events differently than the non-group quarter population. For example, consider counties with a large college student population. Without changing the base population to reflect that most college students move to school, graduate or drop out, then move away, a "bulge" of 15-24 year olds stays in the county, leading to a higher number of births than expected and, in 5 years' time, a higher number of 20-29 year olds than expected. To account for these changes, the special populations are subtracted from the baseline population, fertility, mortality and migration rates are applied, and the special population totals are then added back in to obtain each county's (or place's) total population.

The total number of individuals residing in group quarters is available by age (under 18, 18-64 and 65 plus), sex and county. To be used in the cohort component model, the group quarters data need to be allocated across 5-year age groups. The assumptions made in distributing the group quarters data into the appropriate age categories are described below.

College population

In those counties where the undergraduate population represented 5 percent or more of the local population, special Census tabulations were used for establishing a count of college students. In these counties, 25 percent of the undergraduate population was assigned to the 15-19 age group, and 75 percent was assigned to the 20-24 age group.

Group Quarters population

The under-18 group quarters population was equally distributed across the 10-14 and 15-19 age groups. In the 18-64 group quarters population, most individuals lived in college dormitories, correctional facilities or military bases. Those listed as living in college dormitories were already accounted for in the undergraduate student population. The non-college dormitory population, which includes those in prison and those living on military bases, was distributed across age groups according to a 2008 Census of the prison population by the Tennessee Department of Corrections for prisons[1], and according to a Census of military personnel for those residing on military bases[2]. The over-65 group quarters population was largely comprised of those living in nursing homes. This population was distributed to age groups according to a nursing home statistics reported by the National Center for Health Statistics[3].

When the cohort component model is implemented, the college/group quarters population totals estimated here are subtracted from the base population. Next, the fertility, mortality and migration rates are applied to the amended population totals. This results in the initial population projection. Finally, the college/group quarters population is added back to the initial population projections in order to obtain the final total population.

[1] The prison population was distributed across age groups according to the report "FY08 Statistical Abstract" prepared by the Tennessee Department of Corrections. Available online: http://www.state.tn.us/correction/pdf/2008%20Statabs.pdf

[2] The population on military bases was distributed by age group according to Appendix B "Active Component Enlisted Accessions, Enlisted Force, Officer Accessions, and Officer Corps Tables," included in the report "Population Representation in the Military Services, 2006." Available online: http://www.defenselink.mil/prhome/PopRep_FY06/download.html

[3] The nursing home population was distributed to age groups according to Table 104 in the report "Health, United States, 2007," published by the United States Department of Health and Human Services. Available online: http://www.cdc.gov/nchs/data/hus/hus07.pdf#104

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Mortality

When predicting the number of deaths that will occur over a 5-year time period, the cohort component method uses survival rates derived from life tables rather than age-specific mortality rates. Constructing life tables is more labor-intensive than simply using mortality rates, and these data are not released at the sub-state level for Tennessee. Three life table survival rates were considered when modeling mortality; state-level data for Tennessee from 1989-1991 (this is the last year in which the United States' National Center for Health Statistics released state-level life tables), national-level data for the United States for 1999-2001 created by the National Center for Health Statistics, and state-level data released by the Tennessee Department Health for 1995. For purposes of creating projections, state-level survival rates calculated by the state and the federal government were considered. The survival rate that best predicted the number of county-level deaths from 2000 to 2004 was selected.

Migration

Measuring past and future migration flows to Tennessee are complicated by their high variability. Two sets of net migration rates were consulted for constructing migration: Census-constructed net migration rates from 1990 and 2000 by age, sex, and county, and CBER-calculated net migration rates between 2000 and 2005 by age, sex and county. The CBER-calculated rates were derived by applying birth and fertility rates to the 2000 Census population to generate the 2005 population. The difference between the 2005 Census county population estimates and the modeled 2005 population was assumed to be net migration. The 1990-2000 Census migration rates were combined with the 2000 to 2005 CBER net migration rates to establish an average 5-year net migration rate. To reflect current economic conditions, to be consistent with the Census' long-term estimate of migration, and to dampen the effects of the particularly high migration from 1990 to 2000, the net migration rate decreases over time.

Fertility

The Tennessee Department of Health reports county-level fertility rates annually. Due to the yearly variability in fertility rates, selecting which rates to use is difficult. A list of possible fertility rates was available from the Tennessee Department of Vital Statistics that included both state- and county-level fertility rates. Three-year state-level averages included the years 1991-1993, 1994-1996, 1997-1999, 2000-2002, and 2003-2005, while county-level rates for 1990-1994, 1995-1999, and 2000-2004 were considered.

The average rate that best predicted the number of county-level births from 2000 to 2004 was selected for projecting total births in all subsequent projection periods.

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Total Projections for Municipalities

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Place	Census 2000	2005	Projections 2010	2015	2020	2025	2030
Adams city	566	584	630	707	768	837	910
Adamsville town	1,983	2,048	2,048	2,073	2,093	2,137	2,181
Alamo town	2,392	2,337	2,299	2,237	2,199	2,269	2,344
Alcoa city	7,734	8,413	8,909	9,972	10,682	11,115	11,522
Alexandria town	814	859	897	977	1,039	1,110	1,180
Algood town	2,942	3,109	3,244	3,537	3,748	3,943	4,151
Allardt city	642	652	650	656	654	649	642
Altamont town	1,136	1,124	1,135	1,141	1,152	1,175	1,190
Ardmore city	1,082	1,107	1,084	1,055	1,030	1,042	1,047
Arlington town	2,569	3,575	3,515	3,357	3,266	3,268	3,267
Ashland City town	3,641	4,481	4,702	5,045	5,296	5,684	6,071
Athens city	13,220	13,798	14,310	15,204	15,863	16,505	17,108
Atoka town	3,235	5,864	6,267	6,842	7,255	7,839	8,405
Atwood town	1,000	965	947	931	913	898	883
Auburntown town	252	254	257	266	271	284	296
Baileyton town	504	501	501	513	519	520	521
Baneberry city	366	694	684	710	702	713	743
Bartlett city	40,543	46,731	46,499	44,892	43,953	44,334	44,440
Baxter town	1,279	1,330	1,355	1,453	1,531	1,579	1,647
Bean Station city	3,250	2,967	3,121	3,402	3,590	3,713	3,819
Beersheba Springs town	553	550	543	531	518	511	506
Bell Buckle town	391	402	417	458	483	504	525
Belle Meade city	2,943	3,360	3,366	3,541	3,764	3,899	3,952
Bells city	2,171	2,269	2,288	2,276	2,280	2,386	2,487
Benton town	1,138	1,169	1,149	1,104	1,077	1,131	1,183
Berry Hill city	674	735	773	802	803	777	754
Bethel Springs town	763	763	773	790	808	834	858
Big Sandy town	518	511	495	484	476	481	481
Blaine city	1,834	1,703	1,804	1,978	2,098	2,180	2,251
Bluff City city	1,559	1,595	1,616	1,628	1,631	1,633	1,626
Bolivar city	5,799	5,693	5,692	5,616	5,590	5,837	6,063
Braden town	274	283	324	400	449	453	452
Bradford town	1,113	1,066	1,059	1,060	1,055	1,052	1,050
Brentwood city	23,445	32,220	35,569	41,558	46,121	52,812	61,688
Brighton town	1,719	2,397	2,586	2,872	3,103	3,426	3,754
Bristol city	24,821	25,065	24,865	24,616	24,366	24,182	23,908
Brownsville city	10,748	10,585	10,767	10,815	10,933	11,103	11,211
Bruceton town	1,554	1,465	1,451	1,442	1,433	1,430	1,427
Bulls Gap town	714	714	730	761	776	792	813
Burlison town	453	437	445	464	471	492	511
Burns town	1,366	1,396	1,460	1,558	1,622	1,691	1,758
Byrdstown town	903	873	861	847	831	827	824
Calhoun town	496	510	515	528	532	535	538
Camden city	3,828	3,698	3,602	3,541	3,493	3,537	3,573
Carthage town	2,251	2,251	2,276	2,368	2,430	2,554	2,679

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Place	Census 2000	2005	Projections 2010	2015	2020	2025	2030
Caryville town	2,243	2,368	2,442	2,543	2,606	2,658	2,702
Cedar Hill city	298	308	335	378	410	448	487
Celina city	1,379	1,361	1,361	1,380	1,390	1,413	1,427
Centertown town	257	262	271	282	291	305	320
Centerville town	3,793	3,937	4,049	4,313	4,500	4,853	5,231
Chapel Hill town	943	1,211	1,232	1,279	1,314	1,394	1,476
Charleston city	630	666	677	703	719	742	771
Charlotte town	1,153	1,150	1,203	1,287	1,348	1,418	1,487
Chattanooga city	155,554	163,864	164,959	165,870	166,048	166,788	167,275
Church Hill city	5,916	6,370	6,592	6,978	7,204	7,430	7,638
Clarksburg town	285	368	354	340	325	316	309
Clarksville city	103,455	112,513	118,577	124,771	129,737	142,435	155,647
Cleveland city	37,192	36,978	38,414	40,804	42,278	44,120	46,036
Clifton city	2,699	2,606	2,492	2,348	2,233	2,270	2,324
Clinton city	9,409	9,326	9,407	9,525	9,559	9,479	9,368
Coalmont city	948	954	967	975	984	1,000	1,011
Collegedale city	6,514	8,290	8,740	9,171	9,329	9,511	9,637
Collierville town	31,872	37,701	37,925	37,072	36,770	37,517	37,930
Collinwood city	1,024	1,038	1,059	1,082	1,096	1,146	1,190
Columbia city	33,055	33,506	35,858	40,024	43,131	45,999	48,899
Cookeville city	23,923	28,741	30,676	33,865	35,675	37,467	39,384
Coopertown town	3,027	3,199	3,456	3,862	4,152	4,480	4,803
Copperhill city	511	476	456	426	405	413	422
Cornersville town	962	926	959	1,019	1,068	1,150	1,235
Cottage Grove town	103	97	99	103	107	111	115
Covington city	8,463	8,891	9,341	10,104	10,706	11,632	12,588
Cowan city	1,771	1,786	1,809	1,910	1,983	2,066	2,147
Crab Orchard city	838	897	985	1,146	1,261	1,346	1,421
Cross Plains city	1,381	1,506	1,618	1,799	1,928	2,073	2,216
Crossville city	8,981	10,448	11,249	12,875	14,049	14,967	15,925
Crump city	1,521	1,437	1,432	1,448	1,447	1,436	1,419
Cumberland City town	316	320	320	334	345	380	418
Cumberland Gap town	204	206	212	223	229	233	235
Dandridge town	2,078	2,269	2,334	2,568	2,700	2,944	3,218
Dayton city	6,180	6,452	6,767	7,273	7,632	8,041	8,477
Decatur town	1,395	1,426	1,447	1,491	1,519	1,652	1,797
Decaturville town	859	830	822	815	810	827	839
Decherd city	2,247	2,223	2,291	2,410	2,490	2,567	2,648
Dickson city	12,244	13,342	14,073	15,182	16,038	16,992	17,928
Dover city	1,443	1,486	1,464	1,474	1,481	1,596	1,723
Dowelltown town	302	314	323	344	357	372	387
Doyle town	525	552	566	601	620	628	634
Dresden town	2,855	2,602	2,427	2,124	1,954	1,946	1,957
Ducktown city	427	404	380	348	324	326	330
Dunlap city	4,173	4,689	5,096	5,834	6,355	6,781	7,217

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Place	Census 2000	2005	Projections 2010	2015	2020	2025	2030
Dyer city	2,406	2,403	2,385	2,389	2,407	2,435	2,457
Dyersburg city	17,452	17,372	17,531	17,610	17,729	18,104	18,412
Eagleville city	464	464	516	616	683	740	802
East Ridge city	20,640	20,099	20,001	19,710	19,512	19,426	19,258
Eastview town	618	622	625	632	640	652	662
Elizabethton city	13,372	13,863	14,265	15,185	15,809	15,934	16,037
Elkton city	510	606	596	571	546	543	538
Englewood town	1,590	1,658	1,693	1,772	1,825	1,879	1,932
Enville town	230	237	227	222	215	219	224
Erin city	1,490	1,434	1,417	1,382	1,357	1,413	1,464
Erwin town	5,610	5,797	5,728	5,808	5,830	5,729	5,608
Estill Springs town	2,153	2,308	2,366	2,493	2,574	2,649	2,720
Ethridge town	536	549	565	579	585	603	624
Etowah city	3,663	3,715	3,755	3,906	4,009	4,104	4,201
Fairview city	5,800	7,160	8,399	10,559	12,219	14,143	16,388
Farragut town	17,718	19,709	20,054	21,149	22,062	22,379	22,386
Fayetteville city	6,994	6,985	6,984	7,113	7,209	7,329	7,457
Finger city	350	353	370	389	405	428	449
Forest Hills city	4,710	5,580	5,537	5,774	6,052	6,133	6,108
Franklin city	41,842	53,189	62,742	79,028	90,970	103,980	118,731
Friendship city	608	599	593	582	575	594	613
Friendsville city	890	919	980	1,101	1,181	1,226	1,264
Gadsden town	553	547	542	527	512	519	526
Gainesboro town	879	855	844	847	842	853	864
Gallatin city	23,230	26,541	28,709	32,467	35,195	37,362	39,538
Gallaway city	666	708	811	1,005	1,141	1,168	1,192
Garland town	309	311	319	336	344	364	382
Gates town	901	861	873	855	850	900	944
Gatlinburg city	3,382	4,443	4,634	5,059	5,247	5,438	5,597
Germantown city	37,348	37,469	36,723	35,035	33,906	33,791	33,445
Gibson town	305	403	417	428	438	449	459
Gilt Edge city	489	476	496	527	543	572	599
Gleason town	1,463	1,401	1,308	1,155	1,068	1,064	1,078
Goodlettsville city	13,780	16,109	17,047	18,551	19,651	20,222	20,762
Gordonsville town	1,066	1,119	1,151	1,210	1,248	1,315	1,379
Grand Junction city	301	316	306	296	289	296	303
Graysville town	1,411	1,443	1,540	1,660	1,756	1,869	1,969
Greenback city	954	1,020	1,106	1,273	1,389	1,449	1,500
Greenbrier town	4,940	6,004	6,620	7,541	8,240	9,042	9,884
Greeneville town	15,198	15,278	15,479	16,057	16,420	16,660	16,891
Greenfield city	2,208	2,019	1,887	1,679	1,517	1,516	1,535
Gruetli-Laager city	1,867	1,873	1,896	1,901	1,912	1,940	1,964
Guys town	483	488	500	511	513	520	527
Halls town	2,311	2,220	2,178	2,068	2,005	2,091	2,170
Harriman city	6,743	6,663	6,773	7,040	7,212	7,273	7,315

APPENDIX

Place	Census 2000	2005	Projections 2010	2015	2020	2025	2030
Harrogate city	2,865	3,943	4,053	4,234	4,344	4,386	4,417
Hartsville town	0	0	0	0	0	0	0
Henderson city	5,670	5,737	5,969	6,176	6,315	7,000	7,476
Hendersonville city	40,620	44,606	48,331	54,525	58,787	61,969	65,054
Henning town	970	1,299	1,292	1,245	1,227	1,301	1,374
Henry town	520	523	550	585	614	647	677
Hickory Valley town	136	132	125	118	112	112	111
Hohenwald city	3,754	3,759	3,734	3,714	3,702	3,893	4,084
Hollow Rock town	963	932	930	932	935	941	942
Hornbeak town	435	424	413	391	374	376	376
Hornsby town	306	299	301	297	294	306	314
Humboldt city	9,467	9,217	9,240	9,314	9,365	9,439	9,509
Huntingdon town	4,349	4,131	4,092	4,064	4,050	4,063	4,063
Huntland town	916	899	916	951	983	1,015	1,038
Huntsville town	981	1,023	1,039	1,055	1,069	1,101	1,131
Iron City city	369	372	380	383	382	388	394
Jacksboro town	1,887	1,982	2,015	2,067	2,092	2,108	2,112
Jackson city	59,643	62,023	64,248	66,849	69,004	72,402	75,677
Jamestown city	1,839	1,852	1,838	1,860	1,869	1,865	1,858
Jasper town	3,213	3,076	3,068	3,043	3,016	3,023	3,017
Jefferson City city	7,761	8,436	9,184	10,496	11,364	12,615	13,974
Jellico city	2,448	2,501	2,514	2,565	2,590	2,607	2,619
Johnson City city	55,469	57,671	59,731	63,950	66,394	68,446	70,353
Jonesborough town	4,168	4,651	4,732	4,961	5,103	5,183	5,300
Kenton town	1,306	1,290	1,270	1,238	1,214	1,216	1,219
Kimball town	1,312	1,351	1,351	1,336	1,318	1,311	1,296
Kingsport city	44,905	44,108	43,492	43,017	42,606	42,324	41,905
Kingston city	5,264	5,399	5,424	5,603	5,727	5,754	5,752
Kingston Springs town	2,773	2,831	2,967	3,156	3,290	3,498	3,692
Knoxville city	173,890	174,948	183,490	197,560	205,806	210,868	215,554
La Grange town	146	149	161	185	194	183	170
La Vergne city	18,687	26,158	30,032	37,004	42,419	47,150	51,815
Lafayette city	3,885	4,175	4,219	4,387	4,482	4,728	4,990
LaFollette city	7,926	8,123	8,176	8,386	8,536	8,655	8,746
Lake City town	1,889	1,846	1,846	1,854	1,853	1,832	1,809
Lakeland city	6,862	7,894	7,895	7,575	7,369	7,402	7,420
Lakesite city	1,845	1,940	1,965	1,988	2,003	2,019	2,007
Lakewood city	2,341	2,594	2,694	2,845	2,975	3,022	3,064
Lawrenceburg city	10,795	10,792	10,829	10,869	10,922	11,250	11,596
Lebanon city	20,235	22,995	25,138	29,019	31,795	34,116	36,516
Lenoir City city	6,819	7,564	8,310	9,703	10,750	11,421	12,059
Lewisburg city	10,413	10,661	11,020	11,638	12,125	13,007	13,897
Lexington city	7,393	7,602	7,749	7,965	8,115	8,457	8,785
Liberty town	367	381	395	419	432	444	452
Linden town	1,015	984	970	961	958	1,003	1,049

APPENDIX

Place	Census 2000	2005	Projections 2010	2015	2020	2025	2030
Livingston town	3,498	3,478	3,480	3,549	3,583	3,655	3,727
Lobelville city	915	912	907	898	889	922	954
Lookout Mountain town	2,000	1,936	1,889	1,857	1,856	1,856	1,856
Loretto city	1,665	1,690	1,700	1,709	1,711	1,756	1,805
Loudon town	4,476	4,825	5,183	5,918	6,427	6,703	6,956
Louisville city	2,001	2,151	2,296	2,578	2,758	2,851	2,927
Luttrell town	915	934	975	1,039	1,082	1,159	1,236
Lynnville town	345	346	337	324	314	317	319
McEwen city	1,702	1,644	1,653	1,663	1,673	1,734	1,792
McKenzie city	5,295	5,374	5,347	5,307	5,285	5,317	5,334
McLemoresville town	259	309	297	287	276	267	258
McMinnville city	12,749	13,080	13,375	13,793	14,180	14,934	15,710
Madisonville city	3,939	4,324	4,613	5,181	5,580	5,963	6,363
Manchester city	8,294	9,546	9,908	10,593	11,060	11,455	11,860
Martin city	10,515	10,594	10,230	9,446	8,694	8,986	9,064
Maryville city	23,119	25,727	27,734	31,589	34,373	36,283	38,155
Mason town	1,089	1,237	1,254	1,305	1,334	1,400	1,459
Maury City town	704	696	681	655	634	641	650
Maynardville city	1,782	1,875	1,968	2,113	2,223	2,402	2,589
Medina city	969	1,280	1,306	1,345	1,380	1,416	1,443
Medon city	191	191	190	189	187	189	190
Memphis city	650,100	674,850	680,276	664,861	657,046	670,919	683,330
Michie town	647	654	653	658	658	663	668
Middleton city	602	625	617	605	595	614	629
Milan city	7,664	7,782	7,806	7,876	7,948	8,062	8,168
Milledgeville town	287	338	326	322	322	328	335
Millersville city	5,308	6,080	6,721	7,709	8,409	8,993	9,579
Millington city	10,433	10,362	10,466	10,230	10,127	10,374	10,627
Minor Hill city	437	447	439	432	428	441	454
Mitchellville city	207	213	228	257	279	297	318
Monteagle town	1,224	1,219	1,192	1,153	1,120	1,101	1,087
Monterey town	2,717	2,784	2,886	3,149	3,322	3,463	3,630
Morrison town	684	692	716	750	781	828	875
Morristown city	24,960	26,739	27,340	28,092	28,676	29,725	30,805
Moscow city	422	532	601	733	821	834	847
Mosheim town	1,749	2,027	2,058	2,124	2,148	2,152	2,151
Mount Carmel town	4,795	5,255	5,455	5,805	6,033	6,250	6,443
Mount Pleasant city	4,491	4,416	4,719	5,256	5,641	5,995	6,365
Mountain City town	2,383	2,411	2,445	2,577	2,645	2,649	2,660
Mt. Juliet city	12,366	17,956	19,984	23,244	25,683	27,811	29,938
Munford city	4,708	5,558	5,888	6,391	6,748	7,277	7,800
Murfreesboro city	68,816	87,512	100,962	123,367	139,626	154,567	170,469
New Hope city	1,043	1,024	1,037	1,044	1,045	1,054	1,056
New Johnsonville city	1,905	1,935	1,950	1,954	1,953	2,005	2,049
New Market town	1,234	1,277	1,354	1,498	1,587	1,731	1,888

APPENDIX

Place	Census 2000	2005	Projections 2010	2015	2020	2025	2030
New Tazewell town	2,871	2,860	2,931	3,078	3,180	3,225	3,255
Newbern town	2,988	3,073	3,115	3,136	3,164	3,234	3,290
Newport city	7,241	7,324	7,501	7,937	8,233	8,361	8,462
Niota city	781	792	811	847	866	880	896
Nolensville town	3,099	2,547	2,927	3,554	4,021	4,629	5,399
Normandy town	152	149	167	194	214	230	248
Norris city	1,446	1,426	1,408	1,398	1,380	1,345	1,305
Oak Hill city	4,493	5,123	5,050	5,231	5,440	5,442	5,373
Oak Ridge city	27,387	27,070	26,807	26,867	26,817	26,433	25,978
Oakdale town	246	238	244	254	261	268	274
Oakland town	1,278	2,538	2,953	3,696	4,230	4,386	4,502
Obion town	1,134	1,097	1,056	988	941	941	941
Oliver Springs town	3,303	3,259	3,289	3,362	3,411	3,413	3,402
Oneida town	3,615	3,815	3,844	3,879	3,917	4,035	4,138
Orlinda city	594	633	681	757	805	862	922
Orme town	128	138	138	137	135	134	132
Palmer town	726	711	695	678	661	648	636
Paris city	9,761	9,819	9,827	10,028	10,198	10,495	10,770
Parker's Crossroads city	241	247	243	241	238	239	239
Parrottsville town	210	226	235	253	269	279	288
Parsons city	2,452	2,390	2,360	2,324	2,296	2,328	2,353
Pegram town	2,146	2,136	2,235	2,371	2,465	2,612	2,760
Petersburg town	580	602	611	636	652	673	692
Philadelphia city	533	570	625	729	807	854	898
Pigeon Forge city	5,083	5,832	6,311	7,179	7,782	8,449	9,142
Pikeville city	1,781	1,832	1,886	1,982	2,044	2,184	2,326
Piperton city	589	1,084	1,143	1,296	1,346	1,258	1,173
Pittman Center town	477	569	603	669	706	744	782
Plainview city	1,866	2,047	2,184	2,385	2,533	2,752	2,972
Pleasant Hill town	544	592	537	518	502	503	522
Pleasant View city	2,934	3,404	3,615	3,895	4,104	4,418	4,735
Portland city	8,458	10,302	11,314	13,002	14,273	15,331	16,408
Powell's Crossroads town	1,286	1,218	1,233	1,240	1,246	1,263	1,270
Pulaski city	7,871	7,884	7,739	7,549	7,426	7,583	7,705
Puryear city	667	666	667	672	672	681	692
Ramer city	354	355	362	372	374	380	386
Red Bank city	12,418	11,853	12,039	12,054	12,040	12,065	12,067
Red Boiling Springs city	1,023	1,043	1,070	1,121	1,152	1,217	1,286
Ridgely town	1,667	1,494	1,514	1,480	1,481	1,515	1,486
Ridgeside city	389	391	376	365	359	357	345
Ridgetop city	1,084	1,714	1,791	1,946	2,052	2,169	2,299
Ripley city	7,844	7,716	7,712	7,426	7,269	7,658	8,039
Rives town	331	321	316	306	296	298	299
Rockford city	798	811	868	977	1,046	1,083	1,114
Rockwood city	5,774	5,403	5,460	5,651	5,751	5,756	5,744

APPENDIX

Place	Census 2000	2005	Projections 2010	2015	2020	2025	2030
Rogersville town	4,240	4,264	4,278	4,425	4,501	4,602	4,720
Rossville town	380	472	535	656	735	744	749
Rutherford town	1,272	1,236	1,229	1,230	1,231	1,235	1,240
Rutledge town	1,374	1,255	1,299	1,390	1,448	1,486	1,523
Saltillo town	342	361	355	359	362	361	358
Samburg town	260	268	256	238	226	226	223
Sardis town	445	450	443	443	441	450	460
Saulsbury town	100	115	108	103	102	105	107
Savannah city	6,917	7,163	7,168	7,296	7,368	7,405	7,396
Scotts Hill town	894	900	903	916	929	961	993
Selmer town	4,541	4,550	4,572	4,618	4,640	4,723	4,806
Sevierville city	11,757	14,897	16,136	18,413	20,037	21,852	23,724
Sharon town	988	908	822	694	611	588	573
Shelbyville city	16,100	18,583	20,322	23,330	25,661	28,009	30,481
Signal Mountain town	7,429	7,318	7,129	7,032	7,030	7,024	6,985
Silerton town	70	79	89	86	87	95	101
Slayden town	185	198	198	203	201	201	203
Smithville city	3,994	4,157	4,322	4,654	4,903	5,189	5,477
Smyrna town	25,569	33,680	38,371	46,806	53,077	58,527	64,002
Sneedville town	1,257	1,315	1,308	1,297	1,288	1,271	1,256
Soddy-Daisy city	11,530	12,158	12,277	12,279	12,248	12,249	12,235
Somerville town	2,518	2,875	3,236	3,955	4,463	4,566	4,661
South Carthage town	1,302	1,309	1,340	1,409	1,465	1,560	1,648
South Fulton city	2,517	2,422	2,335	2,192	2,088	2,086	2,079
South Pittsburg city	3,294	3,122	3,101	3,074	3,060	3,089	3,105
Sparta city	4,599	4,776	4,905	5,232	5,436	5,555	5,687
Spencer town	1,713	1,665	1,612	1,500	1,414	1,414	1,403
Spring City town	2,025	2,027	2,051	2,114	2,168	2,241	2,313
Spring Hill city	7,715	16,949	19,836	24,540	28,035	31,601	35,579
Springfield city	14,329	15,789	17,057	19,175	20,776	22,631	24,579
St. Joseph city	829	849	866	877	881	905	930
Stanton town	615	596	604	602	606	614	622
Stantonville town	312	353	350	351	351	356	362
Sunbright city	577	587	603	623	638	654	665
Surgoinsville town	1,484	1,737	1,775	1,858	1,903	1,950	1,994
Sweetwater city	5,585	6,168	6,551	7,303	7,830	8,341	8,874
Tazewell town	2,165	2,131	2,159	2,230	2,256	2,247	2,234
Tellico Plains town	859	924	985	1,097	1,166	1,226	1,295
Tennessee Ridge town	1,327	1,295	1,262	1,212	1,174	1,209	1,244
Thompson's's Station town	1,283	1,429	1,608	1,934	2,166	2,443	2,767
Three Way city	1,375	1,350	1,390	1,445	1,490	1,550	1,598
Tiptonville town	2,439	3,971	4,094	3,927	3,863	3,895	3,810
Toone town	330	372	366	357	346	355	360
Townsend city	248	264	259	265	262	254	248
Tracy City town	1,679	1,665	1,648	1,615	1,590	1,584	1,577

APPENDIX

Place	Census 2000	2005	Projections 2010	2015	2020	2025	2030
Trenton city	4,683	4,550	4,591	4,658	4,710	4,772	4,831
Trezevant town	901	879	857	840	824	816	807
Trimble town	727	720	714	703	695	700	702
Troy town	1,273	1,232	1,196	1,130	1,083	1,090	1,092
Tullahoma city	17,994	18,869	19,703	21,193	22,238	23,122	23,993
Tusculum city	2,004	2,199	2,228	2,290	2,303	2,296	2,302
Unicoi town	3,519	3,565	3,636	3,770	3,820	3,763	3,677
Union City city	10,876	10,676	10,465	9,936	9,517	9,556	9,577
Vanleer town	310	313	320	338	348	360	371
Viola town	130	145	148	153	157	164	171
Vonore town	1,161	1,372	1,468	1,641	1,757	1,868	1,985
Walden town	1,960	2,050	2,053	2,033	2,043	2,056	2,033
Wartburg city	890	909	917	932	943	961	978
Wartrace town	548	561	601	673	720	764	815
Watauga city	403	441	458	494	516	523	530
Watertown city	1,358	1,382	1,502	1,725	1,887	2,023	2,167
Waverly city	4,028	4,073	4,031	3,981	3,940	4,028	4,114
Waynesboro city	2,228	2,170	2,165	2,171	2,171	2,252	2,327
Westmoreland town	2,093	2,147	2,324	2,633	2,854	3,029	3,207
White Bluff town	2,142	2,361	2,465	2,621	2,718	2,832	2,940
White House city	7,220	8,685	9,604	11,022	12,084	13,077	14,076
White Pine town	1,996	1,980	2,103	2,346	2,520	2,786	3,087
Whiteville town	3,147	4,187	4,175	3,978	3,819	3,968	4,104
Whitwell city	1,660	1,600	1,575	1,541	1,510	1,501	1,489
Williston city	341	352	410	514	586	601	611
Winchester city	7,332	7,853	8,031	8,435	8,703	8,941	9,209
Winfield town	911	972	1,001	1,030	1,053	1,093	1,130
Woodbury town	2,428	2,492	2,506	2,572	2,617	2,733	2,847
Woodland Mills city	296	302	297	282	267	265	261
Yorkville city	293	325	321	325	335	345	352

Note: 2005 data are Vintage 2007 Census Bureau intercensal estimates.

Appendix 4
CPWS Water Projections

Table A4: CPWS Water Projections

CPWS Fiscal Year	Peak Day Raw Water Withdrawal from Duck River at Different PFs, mgd	
	Average Precipitation	Extreme Drought
2025	19.56	22.00
2026	20.30	22.78
2027	20.90	23.46
2028	22.90	25.74
2029	24.60	27.68
2030	24.94	28.10
2031	25.31	28.56
2032	25.70	29.03
2033	26.12	29.54
2034	26.56	30.07
2035	27.03	30.63

Appendix 5
2000 TVA Programmation Environmental Impact Statement



Final Programmatic Environmental Impact Statement

Future Water Supply Needs in the Upper Duck River Basin

Index No: 597
Title: Future Water Supply Needs in the Upper Duck River Basin

TVA

DECEMBER 2000

Future Water Supply Needs in the Upper Duck River Basin

( ) Draft (X) Final Environmental Impact Statement

Lead Agency:
Tennessee Valley Authority (TVA)

Cooperating Agencies:
TN Duck River Development Agency
TN Department of Environment and Conservation
U.S. Army Corps of Engineers
U.S. Fish and Wildlife Service

Abstract: TVA and the cooperating agencies have prepared this Analysis and programmatic Environmental Impact Statement to document the evaluation of the need for water in the upper Duck River watershed over a 50-year planning period (to the year 2050), to identify potential ways to meet any identified water need in part or all of this river basin, and to evaluate the environmental and socioeconomic impacts of several possible ways to meet the future water needs within the basin. A Needs Analysis report, issued in August 1998, indicated that the minimum flow being provided by Normandy Dam is expected to meet the water supply and water quality control needs of the Bedford County and Marshall County water service areas throughout the study period. Future demand in the Maury/southern Williamson County Water Service Area above 40 cfs (increasingly likely to occur in the years after 2015) would have to be met from other water supply sources which would have to be able to supply as much as 22 cfs of water by 2050. The four conceptual alternatives developed to meet this water supply need include two which could be implemented within the service area (a reservoir on Fountain Creek, and a downstream intake on the Duck River), one that would affect other parts of the Duck River watershed (raise the Normandy pool level), and one that would affect an area outside of the Duck River basin (a pipeline from Tims Ford Reservoir). In general, the extent of potential environmental effects of the action alternatives would be related to the amount of land area that would be modified or disturbed. The two alternatives which would involve the least amount of land disturbance (Downstream Water Intake, and Tims Ford Pipeline) also appear likely to have the least potential for adverse effects on the environment (almost exclusively short-term effects associated with construction of the pipelines and other facilities). Both of the other alternatives (Fountain Creek Reservoir, and Raise Normandy Pool Level) would involve modifications in much larger areas and would have substantially more potential for adverse environmental effects. Each of the action alternatives also would result in some benefits to water quality, aquatic life, and recreation on parts of the Duck River where the minimum flow would be higher than under the No Action alternative. TVA has concluded the preferred alternative in this programmatic EIS is that one or more action alternatives should be pursued to meet the future water needs in the Maury/southern Williamson County Water Service Area. TVA is not proposing to design or construct any of these facilities; however, as a regional water resource agency, TVA can assist in evaluating available alternatives and encourage cooperation among all communities that are dependent on common water resources. Local utilities, government agencies in the upper Duck River watershed, and other interested parties will be the ones to actually decide which alternative(s) should be pursued to meet their future water needs.

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EXECUTIVE SUMMARY

The Tennessee Valley Authority (TVA), Tennessee Duck River Development Agency (DRDA), Tennessee Department of Environment and Conservation (TDEC), U.S. Army Corps of Engineers (USACE), and U.S. Fish and Wildlife Service have cooperated to prepare this analysis and programmatic Environmental Impact Statement (EIS). Members of the public and various other agencies have participated in this process by attending public meetings and providing comments on the scope of the EIS. TVA is the lead agency in the preparation of this document.

This document has three related purposes. It evaluates the need for water in the upper Duck River watershed over a 50-year planning period (to the year 2050), identifies potential ways to meet any identified water need in part or all of this river basin, and evaluates the environmental and socioeconomic impacts of several possible ways to meet the future water needs within the basin. The project area includes parts of Bedford, Marshall, Maury, and Williamson counties in southern middle Tennessee.

In an initial step, TVA worked with the local water utilities, the TDEC Divisions of Water Supply and Water Pollution Control, DRDA, USACE, and the U.S. Geological Survey to analyze the water supply needs in the Bedford, Marshall, and Maury/southern Williamson County water service areas. That Needs Analysis Report, issued in August 1998, described the present level of water use in the area, the water sources involved, and up-to-date projections of water supply demand for these three water service areas through the year 2050. The needs analysis indicated that the minimum flow being provided by Normandy Dam is expected to meet the water supply and water quality control needs of the Bedford County and Marshall County water service areas during worst case flow conditions throughout the study period (to the year 2050). The minimum flow being provided by Normandy Dam, accompanied by anticipated future return flows from wastewater treatment plants in the area, can be expected to supply up to 40 cubic feet per second (cfs) for water supply use to the Maury/southern Williamson County Water Service Area. Future demand above 40 cfs (increasingly likely to occur in the years after 2015) would have to be met from other water supply sources. By the year 2050, those other sources would have to be able to supply as much as 22 cfs.

The four action alternatives developed to meet the water supply need in the Maury/southern Williamson County Water Service Area include two which could be implemented within the service area (a reservoir on Fountain

Creek, and a downstream intake on the Duck River), one that would affect other parts of the Duck River watershed (raise the Normandy pool level), and one that would affect an area outside of the Duck River basin (a pipeline from Tims Ford Reservoir). These alternatives would provide water at different locations along the length of the Duck River. Each of these action alternatives assumes that future water demand in these water service areas would not adversely affect the flow projections in the river made in the Needs Analysis; assumes that Normandy Dam would continue to discharge up to 165 cfs for water quality control and water supply use in the Bedford County Water Service Area; and assumes that no new, large, water-consuming industries would locate in any of the water service areas in the upper Duck River basin.

In this programmatic EIS, these action alternatives have been generally described in light of their conceptual nature at this early stage. If and when a decision is made to provide some additional water for the Maury/southern Williamson County Water Service Area, the sponsors would determine the specific purposes of each project and would develop site-specific plans for the various facilities. As those plans are developed and proposals are made, detailed, site-specific evaluations of environmental effects would be conducted, if required and as appropriate, under the National Environmental Policy Act.

Adoption of **Alternative A** would mean that no new source of water would be developed to meet the projected future needs of the Maury/southern Williamson County Water Service Area. More than likely, the Spring Hill and Columbia water treatment plants would be expanded to withdraw and treat as much water from the river as possible; however, the worst case needs of this water service area are projected to exceed the available flow in the river during drought conditions some time after 2015. As the demand for water approached the available supply, treatment of area wastewater would become more difficult and expensive, and economic growth in the area probably would slow or stop. If the demand for water continued to rise and no additional water supply source for the area was developed, drought conditions probably would bring the imposition of water conservation measures and pleas to TDEC for permission to withdraw more water from the river. Large withdrawals from the river during drought conditions would result in adverse effects to aquatic life and recreational use of the river for several miles downstream from the Columbia water supply intake. Eventually, the increasing demand is likely to lead to the development of one or more additional water sources for the Columbia area.

Adoption of **Alternative B** would result in the construction of a water supply reservoir in the downstream part of the Fountain Creek watershed and an approximate 5-mile pipeline to transport water from this reservoir to a new treatment plant and on to the existing water distribution system. If this reservoir was built with a full pool at elevation 629 feet and if it included all of the adjacent land up to the probable maximum flood level, the project would affect approximately 3,600 acres, of which 800 acres is not already in public ownership and would have to be acquired. Construction of this project would create a relatively small, nutrient-rich reservoir which would have to be grouted to avoid significant leakage into the ground water. The reservoir would substantially change aquatic habitats, terrestrial habitats, land use, visual character, and recreational activities in the immediate area; however, the nature and extent of some of those changes would depend on how the reservoir and surrounding land were managed. The reservoir would support much lower diversity of aquatic life than the existing creeks; however, some species capable of living in standing-water habitats would be more abundant in the area than they are now. Construction of the reservoir could result in a net loss in local wetland functions and significant adverse effects on the extensive archaeological resources that are likely to be present in the area. If all of the future water demands of the Columbia area were to be met from the Fountain Creek reservoir, the flow not withdrawn from the river would help maintain acceptable water quality conditions for fish and aquatic life and recreational uses downstream from the water intake, as well as provide more initial dilution for the Columbia wastewater treatment plant discharge. If constructed and operated appropriately, this reservoir could meet all of the projected water supply needs of the Maury/southern Williamson County Water Service Area through at least 2050 and would not impede the anticipated level of local economic growth.

Adoption of **Alternative C** would lead to the construction of a water supply intake and pumping station on the Duck River downstream from the mouth of Catheys Creek (possibly near River Mile 104) and an associated 13-mile pipeline and booster station to transport water to a new treatment plant and to the existing water distribution system. If this project was constructed as described, it would have only short-term and minor effects on ground water, wetlands, floodplains, terrestrial life, endangered species, land use, visual character, natural areas, and cultural resources. Operation of the project would not be likely to cause any adverse effects on water quality or aquatic life at the intake site and the flow not withdrawn from the river would help maintain aquatic life and recreation downstream from the Columbia water intake during drought conditions. If withdrawals from the river between

Normandy and the Columbia area did not exceed present projections, this intake and pipeline could provide enough additional water to meet the anticipated water supply needs of the Maury/southern Williamson County Water Service Area through 2050 and would not impede the anticipated level of local economic growth.

Adoption of **Alternative D** would result in raising the pool level on Normandy Reservoir and increasing the minimum discharge from Normandy Dam. If this project was constructed as described, it would have only short-term and minor effects on terrestrial life, endangered species, and land use, and could result in minor beneficial effects on water quality and aquatic life in the Duck River downstream from Normandy Dam. Raising the pool level in Normandy Reservoir is likely to result in minor adverse effects on wetlands and cultural resources around the reservoir and significant adverse effects on visual character, existing recreation facilities around the reservoir, and on three acres supporting important features in the Short Springs State Natural Area. If constructed and operated appropriately, these modifications to Normandy Reservoir and its discharge could make additional water available in the Duck River. If withdrawals from the river between Normandy and the Columbia area did not exceed present projections, the augmented minimum flow in the river would provide up to 56 cfs for water supply to the Maury/southern Williamson County Water Service Area, enough to meet the water demand estimated to occur in that area around the year 2035. Water conservation and/or some other supply source would be required to meet the projected additional 6 cfs of demand by 2050 without impeding the anticipated level of local economic growth.

Adoption of **Alternative E** would lead to the construction of a water supply intake and pumping station on a northern embayment of Tims Ford Reservoir and an associated 20-mile pipeline and booster station to transport water to a discharge point on the Duck River near Shelbyville. If this project was constructed and operated as described, it would have only short-term and minor effects on ground water, wetlands, floodplains, terrestrial life, endangered species, land use, visual character, recreation, natural areas, and cultural resources. When this water transfer system was operating (only during drought conditions), it could have beneficial effects on surface water quality and aquatic life in the Duck River downstream from the discharge point. If withdrawals from the river between the discharge point and the Maury/southern Williamson County Water Service Area did not exceed present projections, this alternative would provide enough additional water to meet drought-condition needs of the service area

through 2050 without impeding the anticipated level of local economic growth.

In general, the extent of potential environmental effects of the four action alternatives seem to be related to the amount of land area that would be modified or disturbed. The two alternatives which would involve the least amount of land disturbance (Alternative C: Downstream Water Intake, and Alternative E: Tims Ford Pipeline) also appear likely to have the least potential for adverse effects on the environment (almost exclusively short-term effects associated with construction of the pipelines and other facilities). Both of the other alternatives (Alternative B: Fountain Creek Reservoir, and Alternative D: Raise Normandy Pool Level) would involve modifications in much larger areas and would have substantially more potential for adverse environmental effects. Each of the action alternatives also would result in some level of benefits to water quality, aquatic life, and recreation on parts of the Duck River where at least the minimum flow would be higher than under the No Action alternative.

TVA has concluded that one or more action alternatives should be pursued to meet the future water needs in the Maury/southern Williamson County Water Service Area. This is the TVA preferred alternative in this programmatic EIS. TVA is not proposing to design or construct any of these facilities; however, as a regional water resource agency, TVA can assist in evaluating available alternatives and encourage cooperation among all communities that are dependent on common water resources. Local utilities, government agencies in the upper Duck River watershed, and other interested parties will be the ones to actually decide which water supply alternative(s) should be pursued. Those local agencies and the publics they serve must determine how they want to address water needs in this river basin and how those systems will be operated.

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CHAPTER 1 - INTRODUCTION

1.1 PURPOSE

The Tennessee Valley Authority (TVA), Tennessee Duck River Development Agency (DRDA), Tennessee Department of Environment and Conservation (TDEC), U.S. Army Corps of Engineers (USACE), and U.S. Fish and Wildlife Service (USFWS) have cooperated to prepare this analysis and Environmental Impact Statement (EIS). TVA is the lead agency in preparing this document.

This analysis and EIS document has three related purposes. The first purpose is to evaluate the need for water in the upper Duck River watershed over a 50-year planning period (to the year 2050). A second purpose is to identify potential ways to meet any identified water need for part or all of this river basin. The third purpose is to evaluate the environmental and socioeconomic impacts of several possible ways to meet the future water needs for communities within this river basin. As a whole, this document is intended to present facts and figures about the future demand for water in the upper Duck River basin and evaluations of several possible ways of meeting the projected needs.

The EIS evaluation has been conducted at a rather general (programmatic) level because specific locations and facility designs have not been proposed for any of the possible water supply projects and each project would affect only a relatively small part of a wide geographic area. In addition, several of the alternatives would not have to be built for a number of years. A programmatic review such as this can identify the types of environmental and socioeconomic issues which could be affected by each of the alternatives and the relative amount of impact each alternative could have. This level of review can help agencies and the public make basic decisions about the kind of project which should be built. Such a review also can serve as an early warning about the important environmental and socioeconomic issues which should be considered and addressed during the design and detailed review of a project intended to meet the overall need.

TVA and many of the same cooperating agencies have recently completed a related EIS on alternative uses of the land that TVA acquired to be part of Columbia Dam and Reservoir. The final Land Use EIS was issued in April 1999 (TVA, 1999). Work on both of these EIS documents is being conducted in accordance with NEPA, Council of Environmental Quality regulations, and TVA implementing procedures.

1.2. COLUMBIA PROJECT HISTORY

Much of the pertinent history of the Columbia Dam Project is presented in the Land Use EIS (TVA, 1999). The following extract of that history is focused on the water supply aspects.

Duck River Project

In 1964, the leaders in Maury, Marshall, Bedford, and Coffee Counties (Figure 1) organized the Upper Duck River Development Association to request assistance under the TVA tributary area development program. Local leaders also saw the need to develop an organization with broad legal powers which had official recognition in the governmental structure of the area. In response to that need, the Tennessee Legislature created the Tennessee Upper Duck River Development Agency (later expanded to become the Duck River Development Agency - DRDA) in March 1965 and gave it broad responsibilities for formulating and carrying out plans and programs for improving the economy of the area.

In 1966, DRDA proposed the development of a water supply grid system to serve the four-county area. It included plans for interconnecting the five major cities (Columbia, Lewisburg, Shelbyville, Tullahoma, and Manchester) for greater economy, to aid industries requiring treated water, and to supply water to small communities and rural areas of the four counties. Federal grants, supplemented by municipal bonds, were obtained to construct the grid system which is now partially completed. With the local organizations concentrating on the water grid system and other concerns, TVA was requested to investigate water resource development.

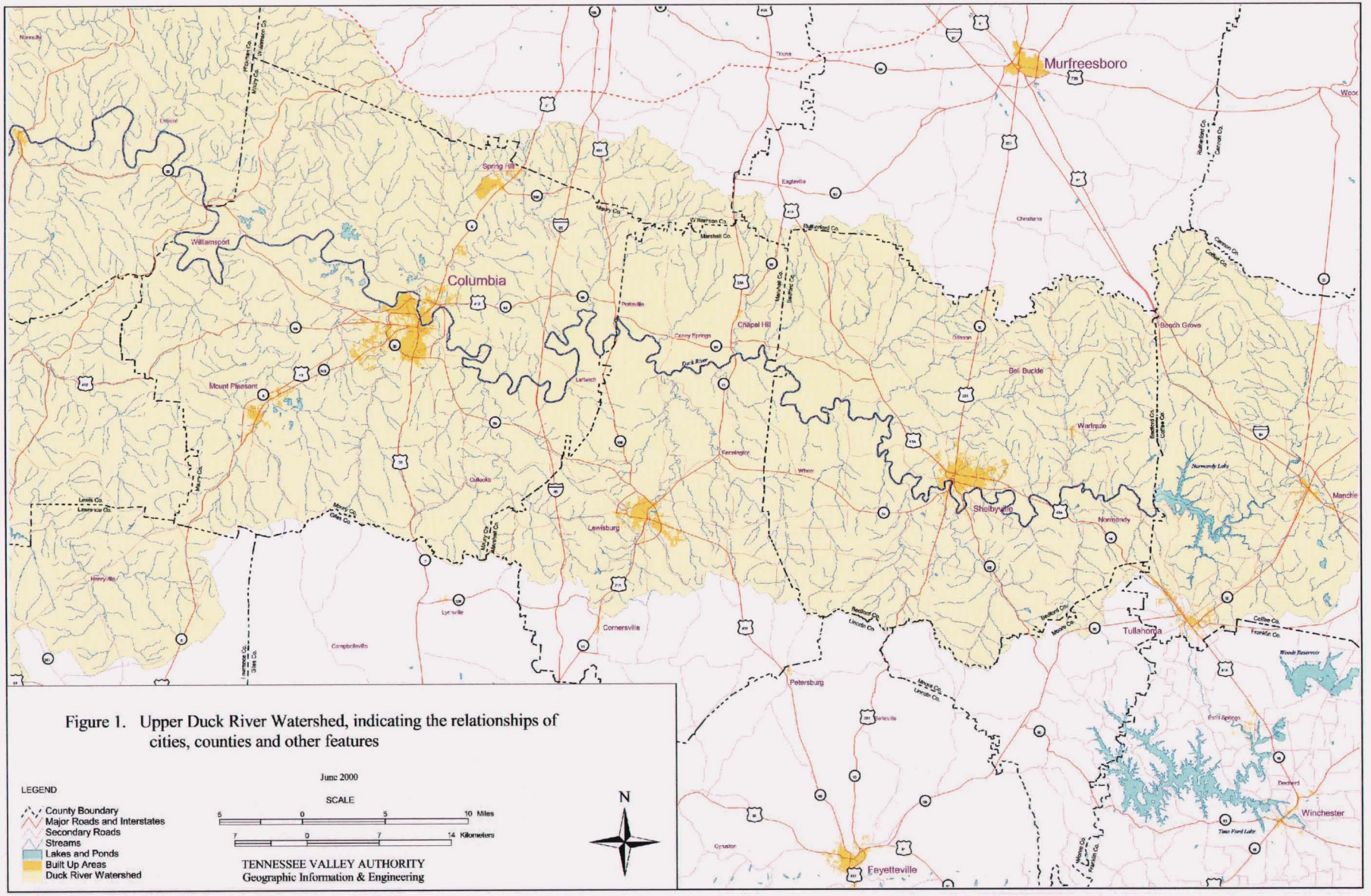


Figure 1. Upper Duck River Watershed, indicating the relationships of cities, counties and other features

TVA determined that multipurpose reservoir development on the main stem of the Duck River offered the best potential. A reconnaissance study in 1965 identified three dam sites on the Duck River which, if developed, could control the river and provide new opportunities for recreation and lakeshore development. These sites were the Columbia site at River Mile 136.7, the County Line site at River Mile 191.3, and the Normandy site at River Mile 248.6. Feasibility appraisals indicated that the Columbia and Normandy sites should be considered in more detail. The County Line site was less attractive because of apparent foundation problems and was eliminated from further consideration.

A planning report issued by TVA in August 1967 recommended building a dam at Columbia. Further studies proved the feasibility of a dam and reservoir at the Normandy site. The two dam and reservoir projects were then presented as units of the Duck River Project in a 1968 planning report (TVA, 1968). In that report the project was justified on the basis of enhanced employment (29 percent), recreation (25 percent), water supply (16 percent), flood control (7 percent), and water quality control (7 percent). The original construction cost of the Duck River Project was estimated at $73.5 million, of which $50 million was for the Columbia Dam and Reservoir. The benefit-cost ratio for the two-unit project was estimated at 1.2 to 1. For the Columbia unit, the benefit-cost ratio was 1 to 1. Congress began appropriating money for the Duck River Project in December 1969.

In 1971, TVA entered into an agreement with DRDA covering local participation in the overall project. In part, this agreement recognized a TVA commitment to include provisions for certain projected water supply needs in the area in the project design. The DRDA, in turn, committed to repay TVA a portion of the costs of the project. This payment was to consist of proceeds from the sale of specified quantities of water to the cities of Manchester, Tullahoma, Shelbyville, Lewisburg, and Columbia for a period of 50 years. A 5 cent per thousand gallon surcharge for water use has been charged since January 1972 to cover this repayment obligation. The DRDA total repayment obligation was set at $16.2 million, with $5.7 million due ten years after completion of Normandy Dam and the remaining amount of the principal due ten years after completion of Columbia Dam.

Following enactment of NEPA in 1970, TVA issued a draft EIS on the Duck River Project in June 1971. A public hearing on the project was held in August 1971 and a final EIS on the project was published in April 1972 (TVA, 1972). A supplement to the final EIS was issued in June 1974 (TVA, 1974).

Construction of Normandy Dam and Reservoir began in June 1972 and was completed in 1976, at a cost of $37.4 million. Since closure in January 1976, operation of Normandy Dam has reduced a number of downstream floods on agricultural land and at Shelbyville, Tennessee, and has supplemented low flows as necessary to meet water supply and water quality control needs at Shelbyville. In addition, Normandy Dam has assisted in meeting water quality control requirements and provided additional flow for water supply at Columbia.

Construction of the Columbia Dam and Reservoir was begun in August 1973. Original plans for Columbia called for a multipurpose reservoir to serve Maury and Marshall Counties with a summer pool at elevation 630 feet mean sea level and a winter drawdown to elevation 603 feet. The drawdown was to have sufficient flood detention capacity in the reservoir to reduce the flood of record at the city of Columbia to essentially a non-damaging stage. The reservoir also was intended to serve as a water supply source for Maury County, including an extensive industrial complex then located downstream from the city. Water released from Normandy Reservoir for water quality control requirements, together with additional water from storage in Columbia Reservoir, was to be released as necessary to help meet future water quality control and water supply needs in Maury County. Columbia Reservoir, with four times the surface area of Normandy Reservoir during the summer months, was expected to attract a diversity of recreational activity.

Endangered Species Act

Following passage of the Endangered Species Act (in 1973), the USFWS began listing species determined to be either endangered or threatened throughout all or a significant portion of their ranges. In 1976 and 1977, the USFWS added a number of freshwater mussels to the list of endangered species, including five species that had been known to occur in the Duck River. Consultation between TVA and USFWS resulted in a February 1977 Biological Opinion (USFWS, 1977a) which indicated that

completion of the Columbia Dam project would jeopardize the continued existence of two endangered mussels (the birdwing pearlymussel, *Conradilla caelata* [= *Lemiox rimosus*]; and the Cumberland monkeyface pearlymussel, *Quadrula intermedia*).

In 1978, the Office of Management and Budget (OMB) asked TVA to examine alternatives to completing Columbia Reservoir as originally planned that would provide project benefits but would not jeopardize the endangered species. In the report on that study (TVA, 1979), TVA found the two alternatives evaluated (a river development option and a low pool option at elevation 600 feet) to be unacceptable. The description of the project as planned (at elevation 630 feet) outlined a conservation program that could be implemented to benefit the endangered species and other endemic mollusks. As part of a September 1979 revision of the Biological Opinion (USFWS, 1979), the USFWS accepted the conservation program concept and made it a component of a reasonable and prudent alternative that would allow completion of a full-pool Columbia Reservoir. A significant constraint associated with this alternative was that the conservation program for the two endangered species had to be proven successful before the reservoir could be filled. In 1984, TVA and USFWS concluded that the conservation program was not likely to succeed because several established criteria had not been met.

Clean Water Act

TVA requested a Clean Water Act Section 404 permit for Columbia Dam from the USACE in October 1977. The USACE delayed action on the permit because of questions about water quality and endangered species. In December 1979, the Tennessee Commissioner of Public Health certified to the USACE that completion of Columbia Dam would not violate Tennessee water quality standards. The certification was appealed by the Environmental Defense Fund, Inc., and others to the State Water Quality Control Board. In April 1981, the state board issued a decision which found that the construction and operation of Columbia Dam would not violate state water quality standards nor cause any water quality degradation.

In August 1981, USACE issued the Section 404 permit for the Columbia Dam Project. Consistent with the Section 404 permit and the USFWS Biological Opinion, construction resumed on the project; however, the work was limited to roads and bridges which would be useful even if the project was not completed. The approved work was finished in September 1983 and all construction was halted.

Present Status

From 1983 through 1998, the Columbia Dam segment of the Duck River Project remained about 45 percent complete. The concrete portion of the dam was about 92 percent complete and the earth-filled section was about 60 percent complete. Approximately 46 percent of the land required for the reservoir (12,800 of 27,500 acres) had been acquired, and approximately half of the 45 miles of roads affected by the reservoir had been relocated. (However, the major relocation, replacing two Interstate 65 bridges crossing the Duck River, had not been started.) Through fiscal year 1984, some $80 million had been spent on the Columbia Project. When last calculated (in 1986), the total project cost was estimated to be approximately $238 million based on a 1992 completion date. At that time, the remaining cost to complete the project was around $123 million.

Early in 1995, TVA determined that the Columbia Dam Project could not be completed as a dam and reservoir due to the presence of endangered species and lack of present national support for projects of its kind. That decision prompted the preparation of the Land Use EIS to consider the potential environmental effects of various alternative uses for the land, and the preparation of this EIS to evaluate the effects of alternative ways to meet future water needs in the Columbia area. As part of the association between these two documents, TVA agreed that each alternative in the Land Use EIS would include the potential for using the land holdings in the Fountain Creek watershed as part of a water supply project. This EIS includes an evaluation of that alternative.

1.3 DECISIONS TO BE MADE

TVA will use the results of this analysis and EIS to make decisions both now and at pertinent times in the future. Results of the Needs Analysis (discussed in Chapter 2) will allow TVA to determine if various parts of the upper Duck River basin are likely to need additional water some time in the future. If a future need for water does exist in part or all of this basin, results of the EIS will help TVA understand the potential environmental effects of several alternatives being evaluated in detail. Results of the EIS also will help TVA decide which alternatives to recommend to DRDA, water systems in the area, and other local interests as reasonable ways to meet some or all of the projected water needs. If a specific proposal is made to build one or more water supply projects in the upper Duck River basin, the results of this EIS will provide substantial information to help TVA evaluate the potential effects associated with modifying part of the Tennessee River system and the issuance of permits under Section 26a of the TVA Act.

DRDA, area water systems, and a variety of government agencies in the upper part of the Duck River watershed are likely to use the results of this evaluation to help determine which of the alternatives should be pursued to meet any future water needs. At some point in time, those organizations will have to decide how and where to construct any facilities required to provide additional water for their customers.

TDEC, USACE, and USFWS are likely to use the results of this evaluation to clarify the potential environmental effects if and when any of the water supply alternatives are proposed. Information presented in this document should assist these regulatory agencies (among others) in making or evaluating long-term water development plans for the upper Duck River watershed.

1.4 SCOPING PROCESS

Public participation in determining the scope of the Water Supply EIS began on March 9, 1995, when TVA published a Notice of Intent in the *Federal Register* (TVA, 1995a). The Notice indicated that TVA intended to prepare this EIS and invited comments on the scope. The Notice also provided background information on the reason for the EIS and

presented initial ideas about alternatives and issues it was likely to include. In addition, the Notice announced that a public meeting would be held on May 2, 1995, to receive oral comments, and that written comments should be submitted before June 5, 1995.

The Water Supply EIS public meeting was conducted on May 2, 1995, at the Culleoka School in southeastern Maury County. During that meeting, 130 people filled out registration cards. Participants in the meeting had the opportunity to look at a variety of exhibits describing the project and pick up several handouts. After a short overview presentation, the attendees were invited to provide comments in one of five breakout sessions. Facilitators helped people record their comments on flip chart pages and, at times, noted when people endorsed comments which had already been recorded.

A similar Notice of Intent for the Land Use EIS was published in the *Federal Register on* February 25, 1995, and a public meeting about that EIS was conducted at the Culleoka School on April 18, 1995. That meeting, which followed the same format as the Water Supply public meeting, had 119 registered participants.

Another form of public participation on this project involved members of the Columbia Project Steering Committee. TVA invited representatives from federal, state, and local entities to review various aspects of Columbia-related projects and provide their individual perspectives as those projects moved forward. About the time the Notice of Intent was published, Steering Committee members were briefed on the intent of the Water Supply EIS. They offered a number of useful comments.

In addition to providing comments at the public meetings, agencies and members of the public sent a number of letters to TVA about Columbia Dam and these two EIS evaluations. By June 20, 1995, TVA had received a total of 364 letters commenting on these actions. These letters came from three federal agencies, seven state agencies, two municipalities, eight state-level non-governmental agencies, four local-level non-governmental agencies, and 339 individuals. The comments included in those letters were given the same consideration as comments made during the public meetings in setting the scope of this EIS.

Many of the written and oral comments addressed issues related to both the Water Supply EIS and the Land Use EIS. Once TVA realized this combining and mixing had occurred, all of the Columbia-related comments and letters were reviewed to help establish the scope of both documents.

The public identified a number of perspectives and environmental issues to be addressed in the Water Supply EIS. These perspectives and issues were summarized in a draft scoping document which was reviewed by members of the Columbia Projects Steering Committee. Comments from the Committee members were used to prepare a final scoping document that was printed and distributed in October 1995 (TVA, 1995b).

Major Themes in Public Comments

Several recurring thoughts were present in the oral and written comments concerning these two EIS projects. Many of these thoughts were based on different perspectives about completion of Columbia Dam and the need for additional water in the Columbia area. With regard to this EIS, the following thoughts were present:

- The region needs additional water.
- The area does not need additional water, especially if the Columbia wastewater treatment plant, aboveground storage capacity, and pumps are upgraded.
- Columbia Dam should be completed at elevation 630 feet or, if absolutely necessary, at elevation 600 feet.
- Columbia Dam should not be completed at all.
- An impoundment on Fountain Creek might meet area water needs.
- Land acquisition and disposition issues will have to be addressed.
- Conflicts between existing facilities and uses, as well as future needs and resources will have to be covered.
- Personal and family ties to farms and land acquired for the Columbia Reservoir cannot be ignored as this project continues to evolve.
- Resolution of these issues should be thorough, accurate, and completed in a timely manner.

All of these thoughts were considered as the scope of this evaluation was developed and, as appropriate, have been addressed in this EIS.

1.5 ISSUES TO BE ADDRESSED IN DETAIL

While this EIS includes information on a wide variety of subject areas, only a few subjects are focus points within the document. Discussions among TVA staff and various comments from the local water systems, other agencies, and individuals suggests that the following issues should be addressed in detail in this EIS:

Water Supply - The primary focus of this EIS is the future water supply needs in the Columbia area. As part of this evaluation, a needs analysis has been conducted to determine if, when, and how much water would be required to meet projected residential, commercial, and industrial water needs in the middle reach of the Duck River watershed throughout the next 50 years. The results of the needs analysis (discussed in Chapter 2) form the basis for completing the remainder of this evaluation.

Water Quality - Good water quality is important to the human population in this area because the Duck River is the source of several area water supplies and the potential focus of substantial recreational development. The quality of water in the Duck River system also is important to the survival of aquatic life in the area, including several endangered species.

Socioeconomic Effects - An adequate water supply is essential for the continued viability and economic growth of the region. This Water Supply EIS also should address the socioeconomic effects of each alternative approach to meeting the additional water supply needs.

Recreation - The impacts of each alternative on recreation and recreational opportunities should be identified and compared, in part because much local recreation is focused on the river.

Archaeological, Cultural, and Historic Resources - The Duck River watershed contains an abundance of prehistoric and historic cultural resources. Federal agencies are required to consider the impacts of various alternatives on these important resources.

Endangered Species - Several endangered or threatened species are known to occur in the counties which could be affected by water supply development for the Columbia area. Federal agencies are required to determine the possible effects of their activities on listed species and to protect and promote the recovery of listed species whenever possible.

1.6 STUDY AREA

The geographic focus of this evaluation is Columbia, Tennessee, and the surrounding Maury/southern Williamson County Water Service Area (Figure 1); however, a wider geographic area has been included in this evaluation to cover several ways of meeting the anticipated water need. Many of the resource areas covered in this EIS include all of the Duck River watershed from the Hickman/Maury county line (on the west) upstream to Normandy Reservoir in Coffee County (on the east). The northern and southern boundaries of this study area typically are the limits of the Duck River watershed, extended to include the southern part of Williamson County served as a part of the Maury/southern Williamson County Water Service Area, and two embayments on Tims Ford Reservoir (in Moore County) which are being evaluated as a possible water supply source. The geographic scope of this study area is illustrated on Figure 1. The reach of the Duck River included in this study area extends from approximately River Mile 100, at the Hickman County Line, upstream to the headwaters of Normandy Reservoir, River Mile 267.

1.7 RELATED DOCUMENTS

Several documents include information pertinent to the subjects covered in this EIS. These documents include:

- 1968 TVA Duck River Project planning report (TVA, 1968).
- 1972 Final EIS on the Duck River Project (TVA, 1972).
- 1999 Final EIS on alternative uses of the Columbia Project lands (TVA, 1999).
- U. S. Geological Survey report on future water demand in the upper Duck River basin (USGS, 1996).

- U. S. Army Corps of Engineers report on hydrology and hydraulics of a possible Fountain Creek reservoir (USACE, 1997a).
- U. S. Army Corps of Engineers report on geologic conditions in the area of the possible Fountain Creek Dam (USACE, 1997b).
- TVA Water Supply Needs Analysis for part of the upper Duck River watershed (TVA, 1998a).
- TVA and TDEC draft EIS on the use of land surrounding Tims Ford Reservoir (TVA and TDEC, 1999).

Pertinent information in these documents is incorporated by reference in sections throughout this EIS. Full citations for each of these documents is provided in Section 6.3, References.

1.8 REVIEW AND CONSULTATION REQUIREMENTS

A number of federal, state, and local laws and regulations would apply to the construction and operation of any of the action alternatives considered in this EIS. These laws and regulations are intended to provide safeguards against various types of impacts to the environment and other resources or activities in the area. Most of these laws and regulations would apply whether TVA, a state agency, a private company, or an individual was proposing a specific development action; however, the nature of the reviews and restrictions could vary depending on the kind of action that was being proposed and, at times, the type of agency proposing to build and operate the project. Many of these restrictions also include opportunities for public review and comment.

National Environmental Policy Act (NEPA)

NEPA, 42 U.S.C. 4321 et seq., requires all federal agencies, including TVA, to consider the potential environmental impacts of proposed actions before deciding whether to proceed. Under the TVA procedures for implementing NEPA and the regulations promulgated by the Council on Environmental Quality, there are three levels of environmental review: categorical exclusions, environmental assessments, and environmental impact statements (EIS). The kind of action and significance of the potential impacts dictate which level of review is to be used. Analyses become more detailed and public involvement more

extensive as an agency moves from a review for a categorical exclusion to an environmental impact statement.

This programmatic EIS includes only general evaluations of the potential environmental effects associated with the action alternatives. These evaluations are based on a variety of assumptions about the likely components of each project and assume that environmental, regulatory, and economic conditions would remain unchanged until each project was constructed. If and when a federal agency participates in building one or more of these alternatives, a subsequent NEPA document would have to be prepared. That categorical exclusion, environmental assessment, or EIS document would confirm or revise the potential environmental effects of the specific activities that were, then, proposed to be built and operated.

Construction Permit Reviews

The state of Tennessee requires potential dischargers of stormwater to obtain a National Pollutant Discharge Elimination System (NPDES) storm water runoff permit before site preparation and construction activities can commence. NPDES permit limits are set to protect water quality and water uses that have been identified by the state for stream reaches. The Environmental Protection Agency (EPA) has an opportunity to review and comment on proposed NPDES permits, as does the general public.

Under each of the action alternatives, appropriate NPDES stormwater permits would have to be obtained once specific components of the projects were developed. Compliance with NPDES construction and operational permit conditions would be required and monitored by the state.

Protection of Wetlands and Floodplains

Because of their biological value, wetlands receive special protection under federal law. Before most wetlands can be disturbed, a permit must be obtained from the USACE under Section 404 of the Clean Water Act. The EPA and the public typically have opportunities to review and comment on the proposed permits. As part of the permitting process, Tennessee would be asked to determine whether the proposed action would violate state water quality standards. Under Executive Order No.

11990 (Protection of Wetlands), federal agencies are required to avoid impacting wetlands with new construction to the extent practicable and to otherwise minimize potential wetland impacts. Alteration of streams and wetlands are controlled at the state level by the Tennessee Aquatic Resource Alteration Permit program.

Under Executive Order No. 11988 (Floodplain Management), federal agencies are directed to avoid occupying or modifying floodplains to the extent practicable and to otherwise minimize potential impacts to floodplain values. At the local level, Maury, Marshall, and Moore counties, and Columbia and Shelbyville have adopted regulations that control development in floodplains.

This EIS includes general evaluations of the action alternatives on wetlands and floodplains based on present assumptions about the likely components of each project. If and when one or more of these water supply alternatives are proposed to be built, more detailed reviews of the potential impacts on wetlands and floodplains would have to be conducted in accordance with regulations in effect at that time.

Cultural Resources

A number of federal laws protect cultural and archaeological resources, including the National Historic Preservation Act and the Archaeological Resources Protective Act. Before disturbing cultural and archaeological resources that have historical significance, TVA and other federal agencies are required to consult with the State Historic Preservation Officer and, in some circumstances, the Federal Advisory Council on Historic Preservation. The state of Tennessee also has adopted archaeological resource protection requirements for lands under the control of the state or local governments and for the excavation of the remains of Native Americans. While very general evaluations of the potential for adverse effects on cultural resources are presented in this EIS, more detailed review of the specific locations which could be disturbed would have to be conducted when one or more of the action alternatives was proposed to be built.

Endangered Species

Under the Endangered Species Act, 16 U.S.C. 1536 et. seq., federal agencies are to ensure that their actions are not likely to jeopardize the

continued existence of any endangered or threatened species or adversely modify any critical habitat of such sensitive species. If a proposed action may affect an endangered or threatened species, the agency must consult with the USFWS and obtain that agency's determination of the potential for impacting these species. In addition to the responsibilities of federal agencies, the Endangered Species Act prohibits the "taking" (harming) of listed species by any person. The state of Tennessee also has established regulatory protections for state-listed species which would apply to private developments.

This EIS identifies the federal- and state-listed endangered and threatened species which are known or are considered likely to occur in this general project area. The EIS also includes general evaluations of the potential effects of the action alternatives on these species. These evaluations would have to be reviewed when one or more of the action alternatives were further defined and proposed to be built. The evaluations also would have to be focused on the species protected at the federal and state level at that time and comply with the laws and regulations as then in existence.

Farmland Protection

Under the Farmland Protection Policy Act, federal agencies are required to identify and take into account potential adverse effects of a proposed action on farmlands. In addition, the state of Tennessee has enacted the Agricultural District and Farmland Preservation Act, TCA §§43-34-101 - 108 (1995), which provides limited protection of farmlands that have been specially designated under the act. This EIS includes general evaluations of the likely effects of the action alternatives on farmlands; however, those results would have to be updated or revised when one or more of the action alternatives was proposed to be built.

Environmental Justice

Executive Order (EO 12898) directs some federal agencies to consider whether the effects of their actions would cause a disproportionate burden on the health or environment of any segment of the human population. While TVA is not required to comply with Executive Order 12898, this EIS includes a discussion about where low income and minority groups live in the general project area and an evaluation of the likely effects of the alternatives on those segments of the population.

That evaluation probably would be reviewed and updated when one or more of the action alternatives were proposed to be built.

Other Review and Permit Processes

A number of other review and permit processes may be pertinent to one or more of the action alternatives, depending on the nature of the specific development proposals or their potential environmental effects. These include reviews under or involving:

- structures in or along the Duck River or its tributaries (River and Harbor Act and the TVA Act, Section 26a),
- the federal Safe Drinking Water Act and Tennessee drinking water regulations,
- the federal Clean Air Act,
- the federal Toxic Substances Control Act,
- the federal Insecticide, Fungicide, and Rodenticide Act,
- the federal Comprehensive Environmental Response, Compensation, and Liability Act,
- solid and hazardous waste laws and regulations, and
- city and county zoning regulations.

Appropriate review and compliance actions might be required under these and other pertinent federal, state, and local laws and regulations before one or more water supply projects could be constructed and/or operated.

1.9 EIS OVERVIEW

In many ways, this document follows a fairly standard EIS format. Chapter 2 is a somewhat atypical part of an EIS because it presents a summary of the information included in the water supply needs analysis for the upper Duck River basin. Chapter 3 indicates how the water supply alternatives were developed, describes each alternative evaluated in detail, and presents a summary of their potential environmental effects. Chapter 4 is a systematic description of the existing environmental features within the study area, and Chapter 5 is a parallel description of the potential effects on those features which could occur if each alternative was built. Chapter 6 provides supporting information, primarily the list of preparers of this text, a glossary of terms, and the references used in this evaluation.

Five appendices follow the EIS text. The first three include detailed information about water quality (Appendix A), aquatic life (Appendix B), and endangered and threatened species (Appendix C) not available from other sources. The fourth appendix (Appendix D) presents all of the public and agency comments that were received concerning the draft EIS and TVA responses to those comments. The final appendix (Appendix E) includes copies of letters from the U.S. Fish and Wildlife Service and the Tennessee Historic Preservation Office indicating that preparation of this programmatic EIS has complied with requirements of the Endangered Species Act and the National Historic Preservation Act.

CHAPTER 2 - NEEDS ANALYSIS

2.1 INTRODUCTION

Many people in the Columbia area believe they have an extremely limited water supply. The widespread nature and depth of feelings about this need for water was clearly indicated in comments submitted during the public review of the draft Land Use EIS (TVA, 1999). However, before examining ways to augment a water supply, planners need to know the answers to two fundamental questions: 1) how much additional water does the area need, and 2) when will it be needed. As an initial step in preparing this EIS, TVA worked with the local water utilities, the TDEC divisions of Water Supply and Water Pollution Control, DRDA, USACE, and U.S. Geological Survey to analyze the water supply needs in the Bedford, Marshall, and Maury/southern Williamson County water service areas. That report, issued in August 1998 (TVA, 1998a), describes the present level of water use in the area, the water sources involved, and up-to-date projections of water supply demand for these three water service areas through the year 2050. The following information, largely derived from the Needs Analysis, indicates how the analysis was conducted and what it means with regard to future water needs in this part of the Duck River watershed.

2.2 WATER BACKGROUND

The upper Duck River watershed receives over 50 inches of rainfall in a typical year. The wettest months usually are December, March, April, and May, while the driest months are August, September, and October. From 1900 to 1995, there have been nine droughts in the Columbia area when the total annual rainfall was 39 inches or less. During seven of these droughts, the cumulative rainfall for the four-month period from July through October was less than 10 inches. In 1953, for example, the total rainfall in the Columbia area during August, September, and October was 3.55 inches.

Soils in the three Tennessee counties bordering the Duck River between Shelbyville and Columbia (Bedford, Marshall, and Maury Counties, Figure 1) are relatively shallow, have a high clay content, and retain very

little ground water. In addition, the limestone bedrock which underlies most of this area contains many solution channels that quickly carry away ground water. The lack of groundwater storage means that relatively few of the tributary streams in this part of the Duck River basin flow all year. In October 1953, during that summer drought, the USGS found there was no flow in any tributary entering the Duck River within the river reach between Shelbyville and Columbia.

Before Normandy Reservoir was completed, the seasonal rainfall pattern; shallow, porous soils; and lack of groundwater discharge could combine to produce very low flows in the Duck River at Columbia. Prior to the closure of Normandy Dam, the seven-day, ten-year minimum flow in the Duck River at Shelbyville was estimated to be 50 cubic feet per second (cfs). The comparable pre-Normandy estimated seven-day, ten-year minimum flow at Columbia was 30 cfs, even though Columbia is 90 river miles further downstream and receives water from a drainage area 800 square miles larger than above Normandy. During drought conditions before Normandy Reservoir was built, the Duck River would actually contain less water at Columbia than it would near Shelbyville.

2.3 OPERATIONAL EFFECTS OF NORMANDY DAM

Normandy Reservoir was designed to provide a variety of recreation, flood protection, water supply, and water quality benefits both upstream and downstream from the dam. Water users upstream from Normandy Dam (primarily Tullahoma and Manchester) are served from a water intake located in Normandy Reservoir. For downstream water users, Normandy was designed to provide an instantaneous minimum flow of up to 165 cfs at Shelbyville (up to 10 cfs for water supply and 155 cfs for water quality control). The water quality control volume to be provided at Shelbyville also would meet most of the water quality control need at Columbia.

Normandy Dam was closed in January 1976 and has been operated to meet its water supply objectives at Manchester, Tullahoma, and Shelbyville, and its water quality control objectives at Shelbyville and Columbia. Stream gauges operated by the USGS near Shelbyville and Columbia show that the extreme low flows characteristic of the Duck

River prior to the closure of Normandy Dam no longer occur, and that the minimum flow objective for the Duck River at Shelbyville is consistently being met. Normandy Reservoir does not have a specific minimum flow objective to be met at Columbia; however, meeting the objective at Shelbyville results in at least 135 cfs of flow in the river at Columbia. This is a significant increase over the 30 cfs of minimum flow at Columbia that would have occurred before Normandy Reservoir was built.

Two changes have been made in the minimum discharge objectives for Normandy Dam since it started operating. During a drought in 1980-1981, the Tennessee Division of Water Pollution Control concurred with a TVA decision to reduce the winter and early spring (December through May) minimum flow objective at Shelbyville from 155 to 80 cfs. This change was made so that more water could be held in the reservoir for water supply, recreation, and to benefit fish and aquatic life. In 1991, in response to a request from the city of Shelbyville, TVA increased the minimum flow during the winter and early spring months from 80 to 120 cfs. This level of minimum flow helps the Shelbyville wastewater treatment plant meet discharge permit requirements. Neither of these changes has had an adverse effect on the water in the Duck River at Columbia because higher runoff from the land and colder water temperatures, both of which normally occur in winter, help maintain flow and water quality in the river. The minimum flow objective from Normandy Dam from June through November has remained unchanged (to provide up to 10 cfs for water supply use in the Shelbyville area and 155 cfs downstream from the Shelbyville wastewater discharge for water quality control).

Since Normandy Dam started maintaining a minimum flow in the Duck River, the Division of Water Pollution Control has regulated the Columbia wastewater discharge (located at River Mile 127.2) based on a minimum flow of 130 cfs in the river. The use of this flow rate has allowed the city to spend less on wastewater treatment compared to what the cost would have been if only the pre-Normandy minimum flow (30 cfs) was present in the river.

During 1996, in response to questions about the ability of the Duck River to meet additional water supply needs, the TDEC Division of Water

Pollution Control evaluated the minimum instream flow required to maintain recreation and fish and aquatic life uses in the Duck River at Columbia. Their analysis resulted in a requirement that the one-day average streamflow should not fall below 100 cfs at Duck River Mile 132.8, just downstream from the Columbia water supply intake (at River Mile 133.9). This minimum flow requirement establishes a state-identified limit below which no additional water should be withdrawn from the river. This 100 cfs requirement at River Mile 132.8 was recognized as a control point in the Needs Analysis.

2.4 EXISTING WATER USES

The sources and users of water in this part of Tennessee can be thought of as occurring in three water service areas (Figure 2). These areas, which roughly correspond to the county boundaries and the limits of the Duck River watershed, are the Bedford County, Marshall County, and Maury/southern Williamson County Water Service Areas. Public water supplies serve approximately 116,000 people in these three service areas (Table 1).

Four small water distributors listed in Table 1 (Wartrace, Bell Buckle, Chapel Hill, and Mount Pleasant) use wells or springs as their supply sources. All four of these distributors will likely continue to use ground water as their primary water source in the future. Together, these systems served about 7,900 people and withdrew about 1.66 million gallons of water per day (mgd) in 1993.

The Duck River is the source of drinking water for the other 108,000 people served by public water supplies in these three water service areas. The four public water supply intakes located on the Duck River between Shelbyville and Columbia (indicated by the **bold** entries in Table 1), withdrew a total of 16.4 mgd in 1996. These four water distributors, plus six other systems which purchase water from them, serve all of these people and the commercial and industrial users.

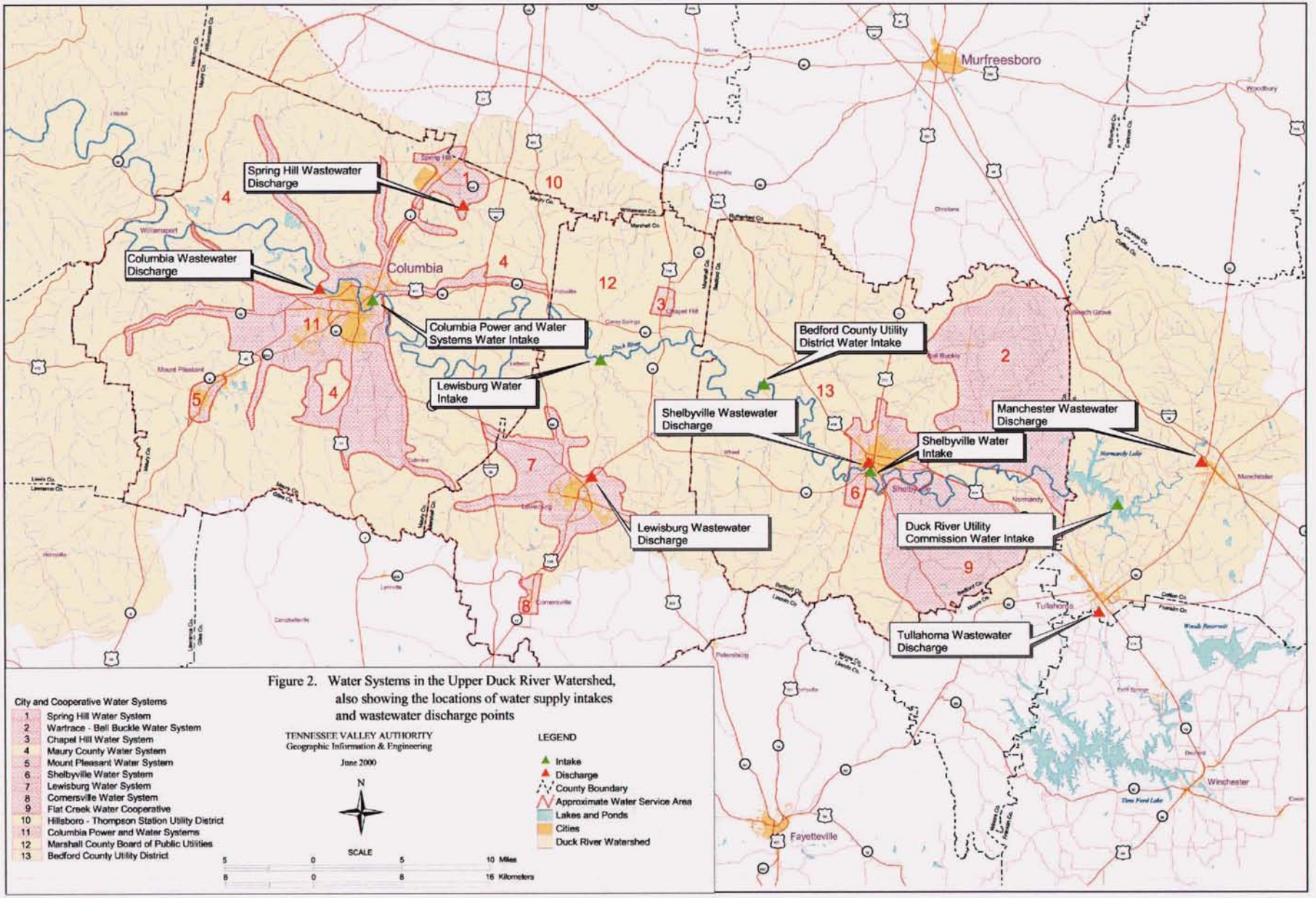


Figure 2. Water Systems in the Upper Duck River Watershed, also showing the locations of water supply intakes and wastewater discharge points

Table 1. Public water supplies in the Bedford County, Marshall County, and Maury/southern Williamson County Water Service Areas.

Water Service Area Water System	Population Served (in 1996)	Average Daily Use in 1996 (mgd)	Water Source
Bedford County Water Service Area			
Shelbyville Pwr., Wtr., & Sew.	15,000	**3.93**	**Duck River Mile 221.9**
Bedford Co. Utility District	13,000	**0.75**	**Duck River Mile 202.4**
		0.24	Purchased from Shelbyville
Flat Creek Water Cooperative	1,460	0.13	Purchased from Shelbyville
Wartrace Water System	*	*	Cascade Spring
Bell Buckle Water System	*	*	Purchased from Wartrace
Marshall County Water Service Area			
Lewisburg Water System	10,075	**2.30**	**Duck River Mile 181.04**
Marshall Co. Bd. of Pub. Util.	4,250	0.43	Purchased from Lewisburg
Cornersville Water System	1,030	0.12	Purchased from Lewisburg
Chapel Hill Water System	*	*	Well
Maury/so. Williamson Co. Water Service Area			
Columbia Power & Water Sys.	42,800	**9.48**	**Duck River Mile 133.92**
Maury County Water System	9,120	0.88	Purchased from Columbia
Spring Hill Water System	5,500	0.83	Purchased from Columbia
Mount Pleasant Water System	*	*	Springs
Hillsboro/Thompson Sta. Util. Dist.	5,000	0.36	Purchased from Spring Hill

* Information for 1996 not obtained

The Needs Analysis report provides specific information about each water supply system and wastewater treatment system in this part of the Duck River watershed. The majority of this information was supplied by the water distribution and wastewater treatment systems in response to questionnaires and interviews provided by TVA.

No self-supplied industrial water users withdraw water from the Duck River between Shelbyville and Columbia. The amount of water withdrawn for agricultural irrigation is not known, but given the intensive agricultural land use in the three-county area, significant amounts could be withdrawn during an extended drought.

The amount of water in the Duck River near Columbia is affected by all of the inflows and withdrawals which occur further upstream. During low rainfall periods in late summer and fall, most of the flow in the river

comes from the minimum release supplied by Normandy Dam, accompanied by return flows from the Shelbyville and Lewisburg wastewater treatment plants. Summer flow in the river is reduced by evaporation, irrigation, and withdrawals at the Shelbyville, Bedford County, Lewisburg, and Columbia water treatment plants. Planners considering new water withdrawals from the river need to be aware of all existing and proposed water uses, both upstream and downstream from their proposed withdrawal site.

2.5 FUTURE WATER NEEDS

In 1990 and 1993, the USGS gathered population statistics, economic data, and water use information from the area, then used modeling techniques to estimate the likely demand for water in each of the three water service areas at various dates in the future (USGS, 1996). These estimates, which cover a 50-year period from the year 2000 to the year 2050, are for municipal demand (including residential, commercial, industrial users, and public/unaccounted use).

The USGS estimates of future water demand in the three water service areas are presented in Table 2. The USGS calculated single sets of estimates for the Bedford County Water Service Area and for the Marshall County Water Service Area, assuming steady growth in each of these areas throughout the 50-year period. However, for the Maury/southern Williamson County Water Service Area, the potential for additional industrial and residential development suggested that two scenarios might be more appropriate: one reflecting a growth pattern comparable to that calculated for the Bedford County and Marshall County areas, and an "Additional Development" scenario to reflect an expectation of additional residential and industrial growth in the area. Beyond the projected growth rates, the USGS estimates did not include any water for new, self-supplied industries or major expansions of agricultural water use in any of the three water service areas. If a new, large volume water user (beyond the capacity increases described in Table 2) was to locate along this part of the Duck River, the demand for water in the area could increase beyond the estimates calculated by the USGS.

Table 2. Estimated water demand in the Bedford County, Marshall County, and Maury/southern Williamson County Water Service Areas over the period 2000 through 2050 (data from USGS, 1996).

Sector	2000	2015	2025	2035	2050
	in million gallons per day (mgd)				
Bedford County Water Service Area - Steady Growth					
Residential	2.2	3.3	--	--	--
Commercial	1.0	1.3	--	--	--
Industrial	1.2	1.3	--	--	--
Public/unaccounted	0.8	1.0	--	--	--
Total water demand	5.2	6.9	7.6	8.2	9.4
Maximum daily use	7.8	10.0	11.0	12.0	14.0
Marshall County Water Service Area - Steady Growth					
Residential	1.3	2.1	--	--	--
Commercial	0.6	0.8	--	--	--
Industrial	0.5	0.9	--	--	--
Public/unaccounted	0.4	0.7	--	--	--
Total water demand	2.8	4.5	4.8	5.2	6.0
Maximum daily use	4.2	6.8	7.2	7.8	9.0
Maury/so. Williamson Co. Water Service Area - Steady Growth					
Residential	5.0	7.3	--	--	--
Commercial	1.6	2.0	--	--	--
Industrial	3.2	3.9	--	--	--
Public/unaccounted	1.7	2.3	--	--	--
Total water demand	12.0	16.0	17.0	19.0	22.0
Maximum daily use	18.0	24.0	26.0	29.0	33.0
Maury/so. Williamson Co. Water Service Area - Additional Development					
Residential	5.5	8.1	--	--	--
Commercial	1.6	2.0	--	--	--
Industrial	3.4	4.2	--	--	--
Public/unaccounted	1.9	2.5	--	--	--
Total water demand	12.0	17.0	20.0	23.0	27.0
Maximum daily use	19.0	26.0	30.0	35.0	40.0

The estimates presented in Table 2 indicate, for example, that water demand in the Bedford County Water Service Area could be 6.9 mgd by 2015, and 9.4 mgd by 2050. Using the assumption that maximum daily use is about 1.5 times the average use, the maximum daily use for the Bedford County Water Service Area (also presented in Table 2) is estimated to be 10 mgd by 2015 and 14 mgd by 2050. Similarly, the Additional Development estimates for the Maury/southern Williamson

County Water Service Area presented in Table 2 indicate that water demand in that area could be 17 mgd by 2015 (with a maximum daily use of 26 mgd) and 27 mgd by 2050 (with a maximum daily use of 40 mgd). The maximum daily use values are important parts of these estimates because they indicate the maximum withdrawals from the river which could occur during extended hot and dry conditions.

2.6 EFFECTS ON RIVER FLOW - 1996

Table 3 was prepared to help determine if the Duck River could provide the water needed to meet these projected future demands. In Table 3, the maximum daily use volume for each of the three water service areas has been linked to where the water would be withdrawn from the river (one location each in the Marshall County and Maury/southern Williamson County Service Areas, but two locations in the Bedford County Service Area). Similarly, the volumes of average future wastewater discharges (estimated using conservatively low rates of wastewater collection system expansion in the service areas) have been linked to where the water would reenter the river. These estimates of how the various water systems actually would operate in some specific future year are based on the locations and capacities of the present systems and plans provided by the systems concerning their future capabilities.

The value of the estimates provided in Table 3 is that they can be used to calculate what the flow in various parts of the river could be at critical low-flow times in the future (presented in Table 4). As a baseline, the 1996 column in Table 4 indicates the flow in the Duck River which would have occurred in a (hypothetical) drought period during August or September 1996. This would have been a time when Normandy Dam was meeting its summer minimum flow objectives, Fountain Creek was the only tributary with any natural flow, all of the water distributors were withdrawing enough water to meet their maximum daily use needs, and wastewater systems were discharging average amounts of treated effluent. This would be a worst case situation so far as flow in the river is concerned; however, that is when potential water use problems could occur.

Table 3. Estimated Duck River maximum daily water withdrawals and wastewater discharges during the period 1996 through 2050. Volumes are presented in both millions of gallons per day and cubic feet per second (in parentheses).

Water Service Area	Actual	Estimates for the Years				
Water System	1996	2000	2015	2025	2035	2050
Bedford County Service Area						
Shelbyville						
Water Supply Intake (River Mile 221.9)	5.9 (9.1)	5.7 (8.8)	6.0 (9.2)	6.6 (10.2)	7.2 (11.1)	8.0 (12.3)
Wastewater Discharge (River Mile 221.3)	2.7 (4.2)	2.7 (4.2)	3.8 (5.9)	4.4 (6.7)	4.9 (7.6)	4.9 (7.6)
Bedford County Utility District						
Water Supply Intake (River Mile 202.4)	1.1 (1.7)	2.1 (3.2)	4.0 (6.2)	4.4 (6.8)	4.8 (7.4)	6.0 (9.2)
Marshall County Service Area						
Lewisburg						
Water Supply Intake (River Mile 181.0)	3.4 (5.3)	4.2 (6.5)	6.8 (10.5)	7.2 (11.1)	7.8 (12.0)	9.0 (13.9)
Wastewater Discharge (Rock Creek Mile 16)	1.2 (1.9)	1.3 (2.0)	1.4 (2.1)	1.4 (2.2)	1.4 (2.2)	1.5 (2.3)
Maury/southern Williamson County Service Area						
Columbia						
Water Supply Intake (River Mile 133.9)	14.3 (22.0)	19.0 (29.3)	26.0 (40.0)	30.0 (46.2)	35 (53.9)	40.0 (61.6)
Wastewater Discharge (River Mile 127.2)	5.2 (8.0)	5.8 (9.0)	10.0 (15.4)	11.0 (17.0)	12.0 (18.5)	14.0 (21.6)
Spring Hill						
Wastewater Discharge (Rutherford Creek Mile 19)	0	0.3 (0.4)	1.0 (1.5)	1.5 (2.3)	2.0 (3.1)	2.5 (3.9)

Table 4. Estimated maximum daily water withdrawals, average daily wastewater plant discharges, and flow volumes in the Duck River which could occur during drought conditions in various years within this study period (1996 - 2050).

Duck River Mile	Activity	1996		2000		2015		2025		2035		2050	
		Flow (cfs) in (+) or out (-)	Flow in River (cfs)	Flow (cfs) in (+) or out (-)	Flow in River (cfs)	Flow (cfs) in (+) or out (-)	Flow in River (cfs)	Flow (cfs) in (+) or out (-)	Flow in River (cfs)	Flow (cfs) in (+) or out (-)	Flow in River (cfs)	Flow (cfs) in (+) or out (-)	Flow in River (cfs)
222.0	upstream of Shelbyville		164.1		163.8		164.2		165.0		165.0		165.0
221.9	Shelbyville withdrawal	- 9.1	155.0	- 8.8	155.0	- 9.2	155.0	- 10.2	154.8	- 11.1	153.9	- 12.3	152.7
221.3	Shelbyville discharge	+ 4.2	159.2	+ 4.2	159.2	+ 5.9	160.9	+ 6.7	161.5	+ 7.6	161.5	+ 7.6	160.3
202.4	Bedford Co. withdrawal	- 1.7	157.5	- 3.2	156.0	- 6.2	154.7	- 6.8	154.7	- 7.4	154.1	- 9.2	151.1
181.0	Lewisburg withdrawal	- 5.3	152.2	- 6.5	149.5	- 10.5	144.2	- 11.1	143.6	- 12.0	142.1	- 13.9	137.2
180.4	Big Rock Creek inflow	+ 1.9	154.1	+ 2.0	151.5	+ 2.1	146.3	+ 2.2	145.8	+ 2.2	144.3	+ 2.3	139.5
166.0	Spring Hill withdrawal	- 0.0	154.1	- 0.0	151.5	- 4.6	141.7	- 5.8	140.0	- 7.5	136.8	- 9.2	130.3
145.9	Fountain Creek inflow	+ 1.7	155.8	+ 1.7	153.2	+ 1.7	143.4	+ 1.7	141.7	+ 1.7	138.5	+ 1.7	132.0
133.9	Columbia withdrawal	- 22.0	133.8	- 29.3	*123.9*	- 35.4	*108.0*	- 40.4	*101.3*	- 46.4	***92.1***	- 52.7	***79.6***
130.4	Rutherford Creek inflow	+ 0.0	133.8	+ 0.4	*124.3*	+ 1.5	*109.5*	+ 2.3	*103.6*	+ 3.1	***95.2***	+ 3.9	***83.5***
127.2	Columbia discharge	+ 8.0	141.8	+ 9.0	133.3	+ 15.4	*124.9*	+ 17.0	*120.6*	+ 18.5	*113.7*	+ 21.6	*105.1*

As indicated in Table 4, the flow in the river during this hypothetical drought period would have been 159 cfs downstream from the Shelbyville wastewater discharge (River Mile 221.3) and 134 cfs at the Columbia gauge (River Mile 132.8). [For comparison purposes, the average flow at Columbia during the driest month of the year (September) is 470 cfs, 3.5 times what it could be during a severe drought.] In this hypothetical 1996 drought, the flow at the Columbia gauge would have been 134 cfs, 34 cfs more than the Division of Water Pollution Control one-day minimum flow requirement (100 cfs), and very close to the 130 cfs level presently used by the Division to establish treatment requirements at the Columbia wastewater plant.

2.7 NEW SPRING HILL FACILITIES

As indicated in Section 2.4, the town of Spring Hill presently purchases water from the Columbia Power and Water System. Spring Hill also sells some of this water to the Hillsboro-Thompson Station Utility District. In the fall of 2000, Spring Hill decided to develop its own water intake and treatment system and, once those facilities are in operation, to discontinue purchasing water from the Columbia system. The Hillsboro-Thompson Station Utility District is likely to continue to be served by Spring Hill when the new system becomes operational. The proposed new system would include a raw water intake and pumping station at Duck River Mile 166.0, an 18-inch diameter, 9-mile long pipeline to transport water to a water treatment plant near town, and an initial plant capacity of 3 mgd (4.6 cfs). Spring Hill has approval from TDEC to withdraw up to 6 mgd (9.2 cfs) from the Duck River at River Mile 166.0 and the treatment plant probably would be expanded up to this capacity as demand grows. Spring Hill now plans to start construction of this new system in mid-April 2001 and to have the water treatment plant in operation in October 2002.

This new water treatment system would not result in any changes in the future use projections made by the U.S. Geological Survey because the water demand for both the Spring Hill and the Hillsboro-Thompson Station Utility districts already were included in the estimates for the Maury/southern Williamson County Water Service Area (presented in Tables 2 and 3). The construction and use of this intake would add a

new withdrawal point at River Mile 166.0 and would affect flows in the river between there and the Columbia withdrawal point (River Mile 133.9). Estimated future water withdrawals at the existing Columbia Power and Water System intake would be reduced by the amount of water that would be withdrawn at Duck River Mile 166.0. The effects of these changes have been made in Table 4 and are incorporated in the remainder of this chapter. As indicated, the new capacity of the Spring Hill water treatment plant would reduce the demand presently being met by the existing Columbia Power and Water System treatment plant.

2.8 EFFECTS ON RIVER FLOW - FUTURE YEARS

The other columns in Table 4 present estimated flows in the river during similar worst case conditions in the years 2000, 2015, 2025, 2035, and 2050, respectively. In the year 2000, the flow downstream from the Shelbyville discharge is projected to be essentially unchanged from the 1996 value (approximately 159 cfs), and the flow at Columbia would be approximately 123 cfs, roughly 20 cfs above the 100 cfs one-day minimum flow requirement. The flow at the Columbia gauge would be 7 cfs below the 130 cfs minimum presently used by the Division of Water Pollution Control to establish treatment requirements at the Columbia wastewater treatment plant.

In the year 2015, the flow downstream from the Shelbyville wastewater discharge is projected to be slightly above 160 cfs, largely because of an anticipated increase in the discharge volume at the Shelbyville wastewater treatment plant. At the Columbia gauge, the flow is projected to be just under 110 cfs, very near the 100 cfs minimum flow requirement. Given the accuracy of streamflow measurements and the likelihood of some loss from the river just upstream from Columbia, this amount of withdrawal (40 cfs) would appear to be all that could be removed from the river without taking a chance of going below the 100 cfs one-day minimum flow limit. This estimated drought condition flow also would be used as a base for treatment requirements at the Columbia wastewater treatment plant.

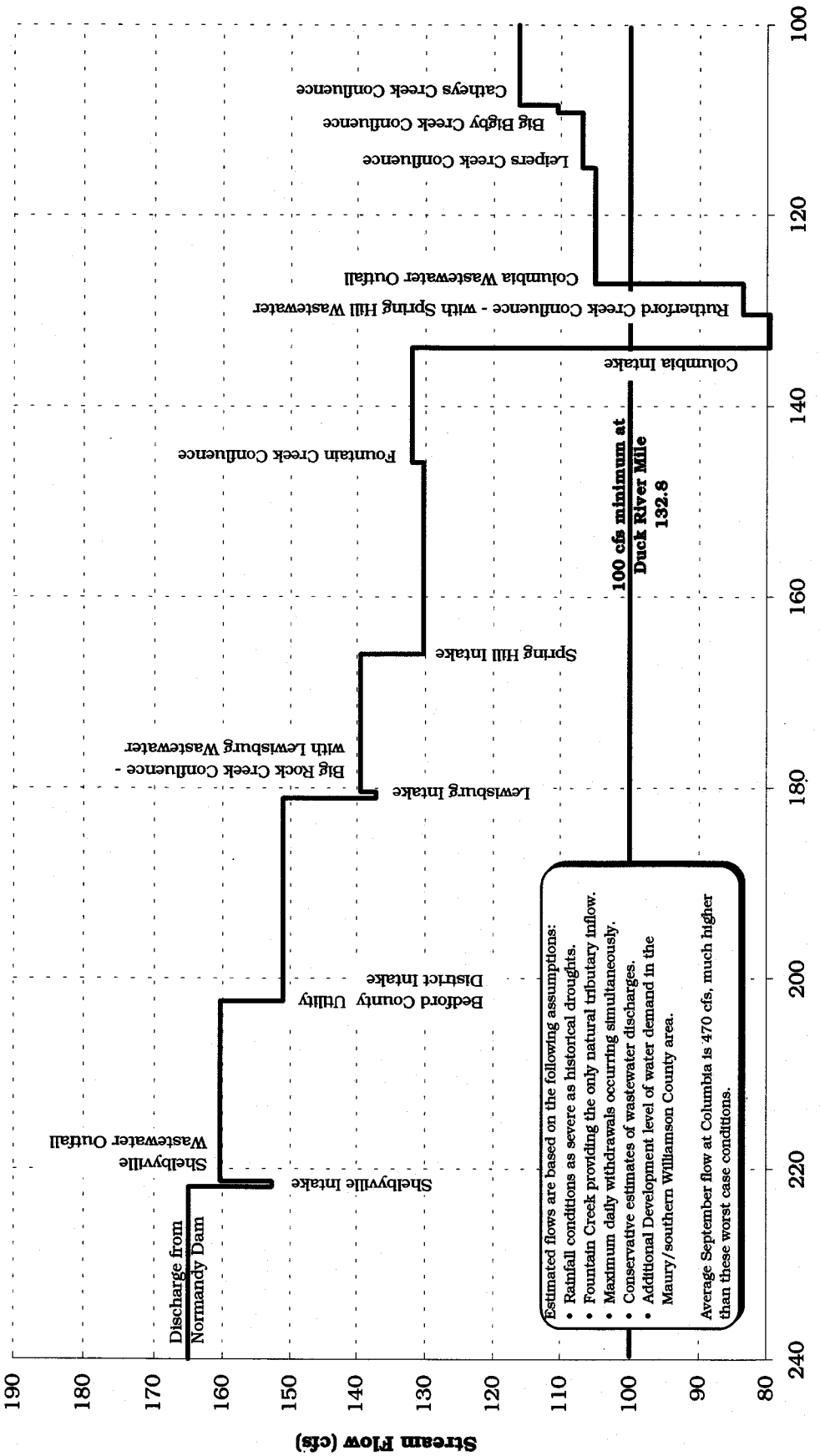


Figure 3. The potential effects of anticipated water supply withdrawals and wasterwater discharges on flows in the Duck River during possible drought conditions in 2050.

The columns in Table 4 labeled 2025, 2035, and 2050 indicate that the minimum flows from Normandy Reservoir, supplemented with the discharge from the Shelbyville wastewater treatment plant, could meet the anticipated maximum drought condition demands for the Bedford County and Marshall County Water Service Areas during in each of those years and still not adversely affect other uses of the river. However, future demands of the Maury/southern Williamson County Water Service Area above the estimated 2015 withdrawal volume (40 cfs) could not be met without taking a risk of going below the 100 cfs one-day minimum flow limit at the Columbia gauge (River Mile 133.8). In 2025, the part of the maximum use demand (46.2 cfs) which could not be met would be approximately 6 cfs. By 2035, the unmet demand would be approximately 14 cfs, and by 2050, the unmet demand would be approximately 22 cfs. Throughout this entire period, the flow in the Duck River during drought conditions would be much less than the 130 cfs minimum presently being used to establish treatment requirements at the Columbia wastewater treatment plant.

Figure 3 is a graph illustrating what the potential flow levels in the Duck River could be during severe drought conditions in 2050. As indicated in Figure 3, the effects of the water withdrawals and discharges in the Bedford County and Marshall County Water Service Areas would reduce the initial discharge from Normandy Dam down to about 140 cfs from the mouth of Big Rock Creek downstream to the Spring Hill intake (River Mile 166) and down to about 130 cfs from there to the Columbia area (River Mile 133). If the Spring Hill intake was withdrawing its proposed maximum of 9.2 cfs and all of the remaining demand for water in the Maury/southern Williamson County Water Service Area would be met by withdrawing water from the river at the present Columbia Power and Water withdrawal site, the remaining flow would be around 80 cfs in the six-mile reach from the Columbia water intake downstream to the Columbia wastewater discharge. From there, the flow in the river would rise with the input from several creeks to about 138 cfs at River Mile100.

2.9 EFFECTS ON NORMANDY RESERVOIR

The projections about flow in the Duck River during future years assume that Normandy Reservoir could always provide 165 cfs of flow at Shelbyville during low rainfall periods. Normandy Reservoir also is where the Duck River Utility Commission (DRUC) withdraws water to meet the needs of Tullahoma and Manchester, in Coffee County. Water demand in Coffee County also will continue to grow in future years, and those potentially competing demands have to be included in this evaluation.

During the drought of 1987-1988, the annual rainfall total for the Duck River watershed above Normandy Dam was less than 30 inches (an historic low). Discharges from the dam to meet downstream flow objectives caused the water level in the reservoir to drop nearly 10 feet below its normal operating target by late fall 1987. Reductions in the discharge volume during the winter months of 1987-1988 helped to minimize the decline in lake level. In spite of the drought, DRUC was able to meet its average daily withdrawal of 3.8 mgd (5.9 cfs) in both 1987 and 1988.

By 1996, the DRUC average daily withdrawal from Normandy Reservoir had grown to 4.7 mgd (7.3 cfs) and the system was considering an expansion to 15 mgd (23.2 cfs). TVA evaluated what would happen to the reservoir elevation if DRUC had been withdrawing 15 mgd for water supply during the 1987-1988 drought. This evaluation assumed that the present level of minimum discharges from Normandy Dam were in effect (120 cfs in winter, 165 cfs in summer). The results showed that the water level in Normandy Reservoir would have been drawn down to 12 feet below the normal operating target by November 1, 1988. This water level would not have prevented DRUC from meeting its water demand; however, poor water quality conditions existing in the deeper water of Normandy Reservoir might have made treatment more difficult and more expensive. These results show that, even during a severe drought, Normandy Reservoir is capable of providing 165 cfs of water to meet downstream flow objectives and supplying water to meet the future demands of Coffee County.

2.10 CONCLUSIONS

The Needs Analysis documented that the minimum flow being provided by Normandy Reservoir, supplemented by wastewater treatment plant discharges, is expected to meet the water supply and water quality control needs of the Bedford County and Marshall County Water Service Areas during worst case flow conditions throughout the study period (to the year 2050). Even at the end of this 50-year period, the flow remaining in the river downstream from the Lewisburg water withdrawal point would be at least 139 cfs, which should be sufficient to ensure that classified uses in that part of the river are not precluded or threatened.

The minimum flow being provided by Normandy Dam, accompanied by anticipated future return flows from wastewater treatment plants, is expected to supply up to 40 cfs for water supply use to the Maury/southern Williamson County Water Service Area. This level of demand is projected to occur in this service area during drought conditions starting after the year 2015. Withdrawals equivalent to the estimated 2015 demand would reduce the worst case river flow to 108 cfs downstream from the Columbia water supply intake, all that could be withdrawn from the river without taking a chance of going below the 100 cfs one-day instream flow limit. Future demand above 40 cfs (increasingly likely to occur in the years after 2015) would have to be met by other water supply alternatives. If the additional future demand was to be met from one or more water supply sources, the estimates indicate that the new sources would need to supply as much as 14 mgd (22 cfs) by the year 2050.

During drought conditions, water demand in the Maury/southern Williamson County Water Service Area is estimated to reach 20 mgd (30 cfs) after the year 2000. If the Spring Hill intake and water treatment plant are brought into service and are operated as presently proposed, the demand on the Columbia Power and Water plant could reach this volume during drought conditions some time between 2000 and 2015. Information provided by Columbia Power and Water Systems indicates that space limitations may prevent expansion of their existing water treatment plant beyond about 20 mgd capacity. This space limitation may become an important consideration during any discussion about alternative ways to meet the future water needs of the service area.

Around the year 2000, withdrawals to meet the water supply needs of the Maury/southern Williamson County Water Service Area during drought conditions may cause the flow in the Duck River to drop below the 130 cfs level now used to regulate the Columbia wastewater plant discharge. If flow in the river at the wastewater discharge point does fall below 130 cfs, the plant may need to meet more stringent (and more expensive) wastewater treatment requirements.

Overall, the Needs Analysis indicates that the Duck River can meet the water supply needs in the Bedford County and Marshall County Water Service Areas throughout the 50-year study period. For the Maury/southern Williamson County Service Area, the analysis identified both when unmet needs would begin to occur (after about 2015) and the estimated additional need for water that would have to be met in some way during various years (as much as 4 mgd [6 cfs] in 2025, 9 mgd [14 cfs] in 2035, and 14 mgd [22 cfs] in 2050). These amounts of water would be needed only during extended drought conditions, when demand was at its maximum and nearly all of the flow in the river was supplied by the minimum discharge from Normandy Dam.

CHAPTER 3 - ALTERNATIVES

3.1 INTRODUCTION

This chapter focuses on what has been done to identify and evaluate alternatives that would meet the future needs for water in the Maury/southern Williamson County Water Service Area. Four action alternatives have been evaluated in detail, and each of those alternatives is described, along with the no action alternative. The chapter includes a comparison of these alternatives and a summary of their potential environmental effects. The last section in this chapter indicates the present status concerning the identification of a preferred alternative for meeting future water needs in this service area.

3.2 ALTERNATIVES CONSIDERED

Draft results of the needs analysis were reviewed and discussed by TVA staff and representatives from several federal, state, local, and water supply agencies before the final version of that report was prepared. All of the individuals who reviewed the Needs Analysis report were invited to suggest ways of meeting the additional water supply needs it identified. Once similar concepts were combined, the list of possibilities included 37 different suggestions. These suggestions were sorted into groups based on whether they would apply within the Maury/southern Williamson County Water Service Area, within the remainder of the Duck River basin, or involve some area outside of this watershed (Table 5). Brief descriptions of these suggestions were evaluated by TVA staff members familiar with water supply issues to identify the most viable suggestions based on whether they would provide sufficient water to the Columbia area without involving obviously unacceptable impacts on the environment or the local economy.

The four alternatives that developed during this evaluation process included two which would be implemented within the local water service area (a reservoir in the Fountain Creek watershed, and a downstream intake on the Duck River), one that would affect other parts of the Duck River watershed (raise the Normandy pool level), and one that would affect an area outside of the Duck River basin (an intake on Tims Ford

Table 5. Suggested ways of meeting the anticipated need for additional water supply in the Maury/southern Williamson County Water Service Area.

Suggestions within the Maury/southern Williamson County Water Service Area

- Finish Columbia Dam
- Build Fountain Creek Reservoir [at Elevation 630]
- Build some other full-pool reservoir in the area
- Build a run-of-the-creek reservoir on Fountain Creek [elev. 600]
- Increase capacity of the pool upstream from the existing Columbia City dam
- Construct a water intake at River Mile 163 to supply the Maury County and southern Williamson County water systems
- Construct a water intake at River Mile 108 to help supply this service area
- Ground water - intercept 5 to 10 cfs loss along Duck River
- Improve the river habitat downstream from River Mile 133 and request a wavier from the State for that reach during droughts [down to 80 cfs]
- Discharge the Columbia wastewater closer to the water intake
- Pump water downstream of the sewage outfall to the Columbia City dam pool
- Recycle waste water
- Go to a closed-loop system at Columbia

Suggestions within the Duck River watershed

- Higher discharge from Normandy Reservoir
- Re-evaluate Normandy guide curve
- Raise Normandy pool elevation
- Build off-stream storage to harvest flood water (active or passive filling)
- Raise and repair Lillard Mill dam to augment its use as a source
- Relocate the Lewisburg wastewater outfall to the Duck River
- Drill wells in the watershed
- Reduce irrigation withdrawals and develop a plan to compensate farmers
- Require industrial water conservation
- Require return of all withdrawals from the Duck River
- Impose mandatory reductions during droughts
- Water conservation through pricing and other measures; withdrawal charges
- Water rates - Jack price up past 7000 gpd use; index to rainfall records
- Promote better cooperation between water systems (consolidations?)
- Water allocation formula - consensus approach
- Manage future growth; recognize water limits
- Restrict future growth
- Educate the public about the integrated nature of water use
- Establish an [annual] intensive water use/availability assessment program

Suggestions involving a wider area

- Pipe water in from some other source (inter-basin transfer)
- Pipeline between Tims Ford and Normandy Reservoirs
- Discharge Arnold Engineering cooling water into Duck
- Buy water from nearby systems
- Search for nearby groundwater source(s)

Reservoir). These alternatives would provide water at different locations along the length of the Duck River. Each of these four action alternatives, along with the no action alternative, is described in a following section of this chapter.

All of the action alternatives included in this evaluation incorporate three basic assumptions. Each of these alternatives assumes that future water demand in these water service areas will not exceed the projections made by the USGS (USGS, 1996) or adversely affect the flow projections in the river made in the Needs Analysis (TVA, 1998, summarized in Chapter 2). These alternatives also assume that Normandy Dam will continue to discharge at least 155 cfs for water quality control at Shelbyville and up to 10 cfs for water supply use in the Bedford County Water Service Area. Finally, these alternatives, like the USGS projections, assume that no new, large, water-consuming industries would locate in any of the water service areas in the upper Duck River basin. If any of these assumptions cease to apply during the remainder of the planning period (through 2050), the amount of water available for use in the Columbia area could be reduced. Each action alternative includes the flexibility to adjust to the actual water demand during earlier years of the planning period; however, the amount of water each alternative could provide would be limited by the water source or the capacity of the supply system, especially later in the planning period.

The descriptions of the action alternatives presented in this programmatic EIS are not as detailed as descriptions in other, more specific EIS documents for two reasons: 1) none of these projects would have to be in operation until water demand in the Columbia area exceeds the available minimum supply (some time after 2015), and 2) TVA is not proposing to design or construct any of these facilities. In this EIS, these action alternatives have been generally described in light of their conceptual nature at this early stage. If and when a decision is made to provide some additional water for the Maury/southern Williamson County Water Service Area, the sponsors would determine the specific purposes of each project and would develop site-specific plans for the various facilities. As those plans are developed and proposals are made, detailed, site-specific evaluations of environmental effects would be conducted, if required and as appropriate, under NEPA.

If the basic plans for that project are similar to one of the alternatives covered in this programmatic EIS, many parts of that evaluation could use information presented here.

As indicated in Section 1.1, the purposes of this EIS are to evaluate the need for water in the upper Duck River area, identify possible ways to meet that need, and to evaluate the potential environmental effects of several viable alternatives. Exhaustive detail about the possible components of these alternatives is not required to complete this preliminary evaluation (programmatic review) of their potential effects on natural and cultural resources present in the area.

3.3 ALTERNATIVE A - CONTINUE TO USE PRESENT SOURCES (NO ACTION)

Under this alternative, no additional sources would be used to augment the existing water supply for the Maury/southern Williamson County Water Service Area. The Spring Hill water treatment plant probably would come on line and would expand to its proposed design capacity of 6 mgd (9 cfs). Columbia Power and Water Systems probably would increase the capacity of the existing water treatment plant as much as the available space would allow (up to 20 mgd [30 cfs]). If the demand for water increases beyond either the capacity of the treatment plant or the 26 mgd (40 cfs) available from the minimum flow in the Duck River provided by the releases at Normandy Dam, local officials would have to use rationing or other conservation measures to maintain water service during drought conditions. Under severe drought conditions, TDEC might consider additional withdrawals from the river, leaving less than 100 cfs of minimum flow to support instream uses. By 2050, drought condition flows in the river could be similar to what is illustrated in Figure 3.

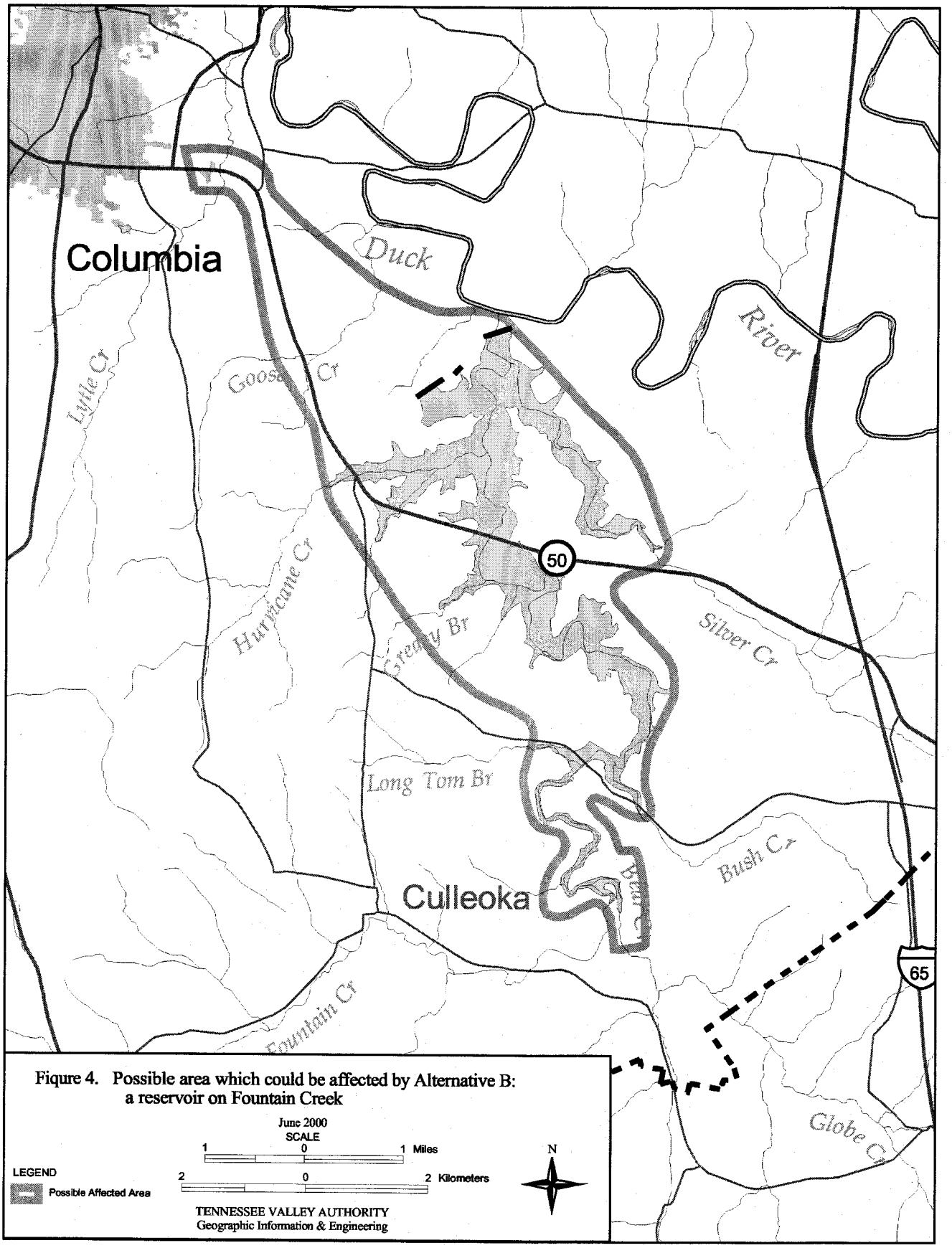
Adoption of this alternative would not have any definable additional cost; however, it also would not supply any additional water to meet projected needs of this water service area. Some expense would be required to expand the existing water treatment plant in Columbia to handle all of the water presently available in the river.

3.4 ALTERNATIVE B - FOUNTAIN CREEK RESERVOIR

Under this alternative, a reservoir would be constructed on Fountain Creek with sufficient storage capacity to meet the future water supply demand of the Maury/southern Williamson County Water Service Area. The possible project evaluated in this EIS assumes that a dam would be constructed at Fountain Creek Mile 0.2, just upstream from its mouth at Duck River Mile 145.8. At that location, the Fountain Creek watershed includes approximately 102 square miles (USACE, 1997a). The main dam would be about 1500 feet long and two saddle dams would have to be built across low points west of the main dam. All three of these dams probably would be earthfill or rockfill structures; however, the source of the fill material has not yet been identified. A spillway would be constructed, perhaps excavated in rock just east of the main dam site.

If the normal full pool of this reservoir was at elevation 629 feet, it would cover approximately 2,200 acres of land when filled. Because earthfill and rockfill dam structures are not designed to be overtopped during floods, the reservoir also would have to include the capacity to hold flood water and pass it over the spillway. Preliminary studies suggest that the reservoir property would have to include enough land to contain the water during a possible maximum flood (USACE, 1997a). This would increase the total reservoir property to include approximately 3,600 acres of land. Approximately 2,800 acres of this land already is in public ownership because it was acquired to be part of Columbia Reservoir. The remaining approximately 800 acres of land required for this concept of a Fountain Creek reservoir would have to be acquired from private owners. The likely area in which this project would be built is illustrated in Figure 4.

Actual construction of the reservoir would involve both clearing activities over at least 2,200 acres and extensive construction work at specific sites. Buildings, bridges, and other potential underwater hazards in the proposed reservoir pool area would be removed or leveled. The existing vegetation in the pool area would be knocked down or cut, marketable timber would be sold, and much of the remaining woody debris would be burned. Each of the dam structures would be constructed by moving rock and earth from the borrow sites to the desired location, where it would be placed and shaped appropriately. During each part of the



Fiqure 4. Possible area which could be affected by Alternative B: a reservoir on Fountain Creek

construction process, a variety of erosion control measures would be used to minimize impacts to the adjacent streams and as required by the NPDES permits for the project.

This reservoir would likely be required to provide a continuous release of at least five cfs to support existing uses in the short reach of Fountain Creek downstream from the dam. Preliminary evaluations indicate that, even with the five cfs continuous release, the reservoir would be capable of supplying a constant water withdrawal of 48 mgd (74 cfs), including during severe drought conditions (USACE, 1997a). This amount of water production from the reservoir assumes that appropriate measures would be taken to minimize potential water losses through leakage into the ground (USACE, 1997b). The water supply intake would need to be a multi-level structure located in the deepest part of the reservoir. Water from this intake probably would be piped to a new treatment facility, then to the existing finished water distribution system. While no location for the new water treatment plant has been identified, the length of the probable 54-inch pipeline would be about five miles. The techniques that would be used to build this pipeline would be the same as those described under Alternative C (Section 3.5).

An order of magnitude cost of this alternative (in FY 2000 dollars) is $50 million, including the cost of buying the additional land and building the reservoir, the multi-level intake, and the pipeline. This estimate does not include the costs of the additional water treatment plant or any operational costs. It does include acquiring approximately 800 acres of land for the reservoir, approximately 20 acres of permanent pipeline easement, and approximately 30 acres of construction easement along the pipeline route. The anticipated 48 mgd of sustained withdrawal available from this reservoir would be enough water (by itself) to meet the projected needs of the Maury/southern Williamson County Water Service Area through at least 2050. The possible effects of this alternative on flows in the Duck River during drought conditions in 2050 are illustrated on Figure 5.

DRDA and the local water systems are beginning to consider a possible variation of this alternative that would modify where and how water would be withdrawn and treated. Under this variation, the dam would be modified to include a multi-level intake structure and more than a

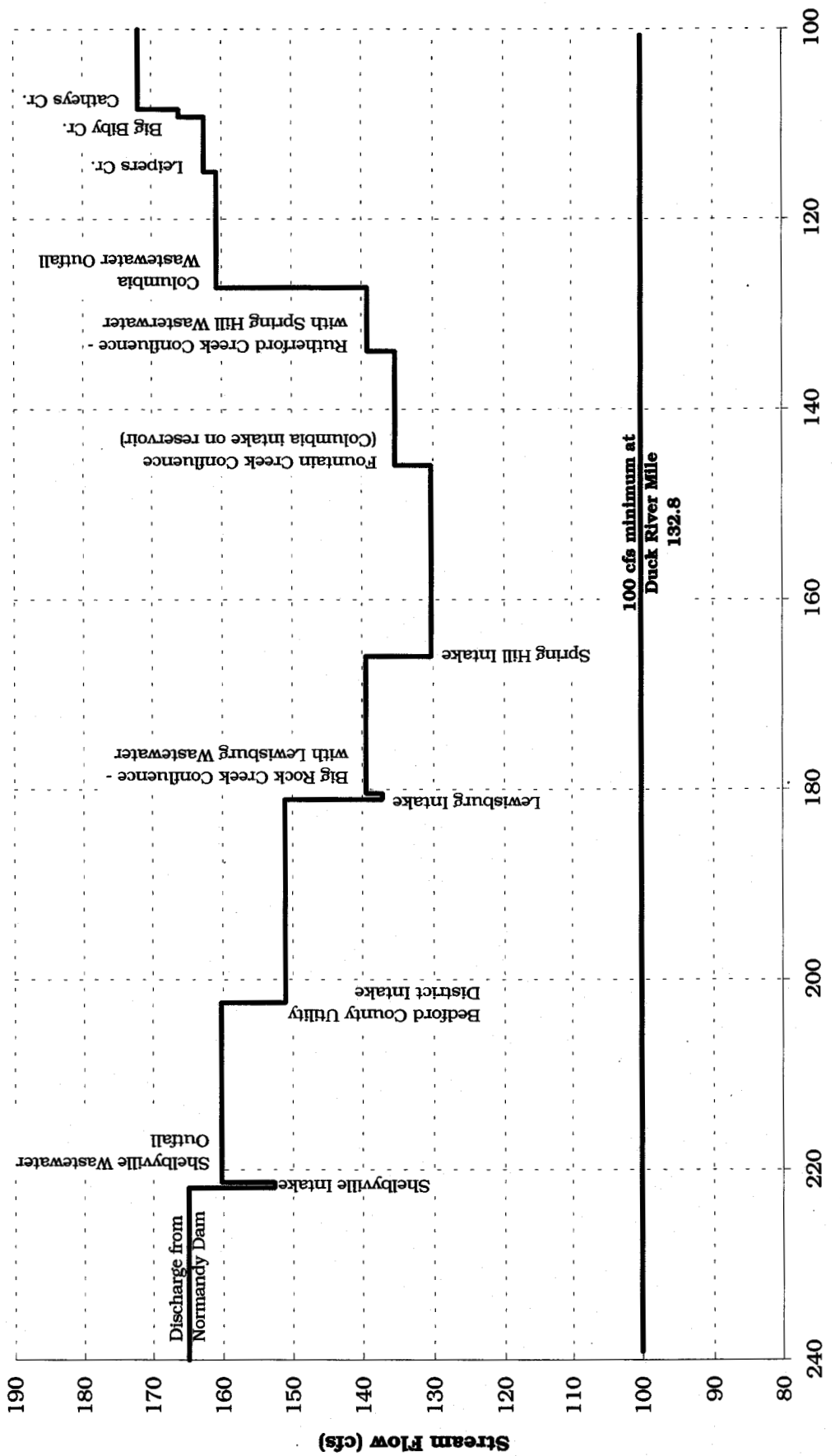


Figure 5. The potential effects of Fountain Creek Reservoir water supply source (Alternative B) on flows in the Duck River during possible drought conditions in 2050.

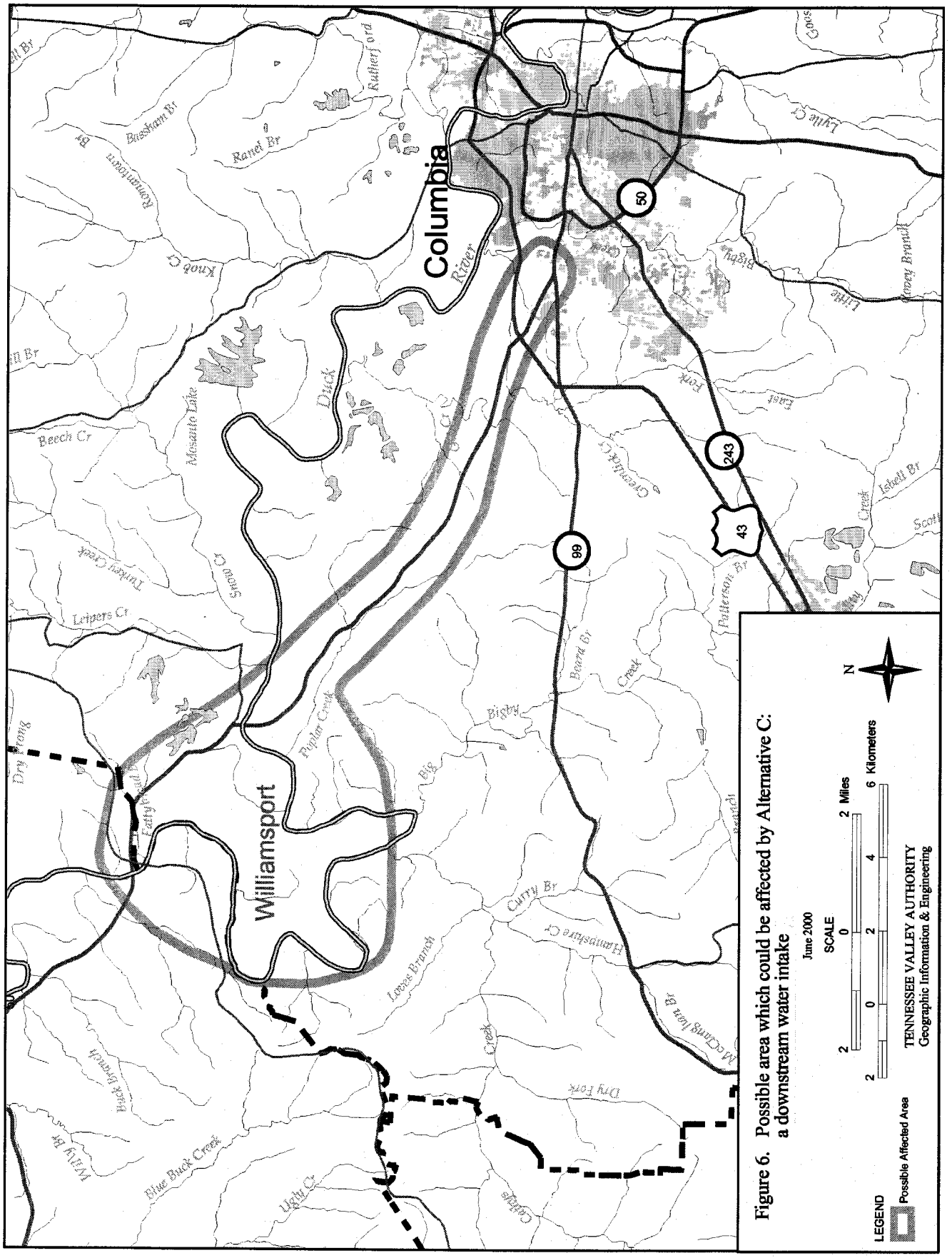
minimum amount of water would be discharged into the lower part of Fountain Creek and the Duck River. The additional water would be withdrawn from the river at or near the existing raw water intake in Columbia and would be treated in or near the existing treatment plant.

No new raw water pipeline would be required; however, additional intake and treatment capacity would have to be constructed at or near the site of the existing treatment plant. This variation has not been evaluated in this EIS because no projections have yet been made concerning the necessary changes in the design of the dam or how the reservoir would be operated during normal and drought conditions. If the basic concept of building a water supply reservoir in the Fountain Creek watershed is pursued, this and other variations could and should be evaluated as part of the development of the detailed project proposal.

3.5 ALTERNATIVE C - DOWNSTREAM WATER INTAKE

Under this alternative, future water needs in the Columbia area would be met by withdrawing water at two locations along the length of the Duck River. Columbia Power and Water Systems Systems would continue to use the water supply intake at Duck River Mile 133.9 to the maximum capacity of that treatment plant (20 mgd after planned modifications). When water demand grows beyond this capacity, a raw water intake structure and an associated pumping station would be constructed on the Duck River somewhere downstream from the mouth of Catheys Creek (Duck River Mile 108.4), perhaps in the vicinity of Kettle Mill, Duck River Mile 104. A pipeline (approximately 13 miles long) would be built from the intake location to the site of a new water treatment plant and to connect to the existing water distribution system. More than likely, a booster station also would have to be built to move the water over a high point along the pipeline route. The new water treatment plant could be constructed at any suitable location along the pipeline route, and could be built in phases, to reach the anticipated 20 mgd (31 cfs) capacity by 2050. The area likely to be affected by this alternative is illustrated in Figure 6.

The intake and pumping station would occupy approximately one acre of land adjacent to the river. The booster station also would occupy an approximate one acre site. Construction of the intake would involve


Columbia
Williamsport
Duck River
Mosanic Lake
Beech Cr
Tinker Creek
Leipers Cr
Snow Cr
Knob Cr
Rutherford
Rainel Br
Bastham Br
Kenmboam Br
Dry Prong
Earhart Br
Poplar Creek
Big Bigby Creek
Beard Br
Patterson Br
Curry Br
Hamshire Cr
Lucas Branch
Dry Fork
McCamy Hart Br
Blue Buck Creek
Ugly Cr
Cattle Creek
Black Branch
Wally Br
Greenbrier Cr
Little Bigby Creek
Little Creek
Isbell Br
East Fork
Lytle Cr
Grassy Branch
50
99
43
243
Figure 6. Possible area which could be affected by Alternative C: a downstream water intake
June 2000
SCALE
2 0 2 4 6 Kilometers
2 0 2 Miles
N
LEGEND
Possible Affected Area
TENNESSEE VALLEY AUTHORITY
Geographic Information & Engineering

disturbing a small area in and along the shore of the river and building a concrete or similar structure in the water. Both pumping stations would be fairly typical buildings constructed to house two or more pumps, electrical controls, and, probably, backup power generation equipment.

The pipeline that would connect these facilities to the new treatment plant and existing water distribution system probably would be built more or less along the State Highway 50 right-of-way. If this pipeline did follow State Highway 50, it would cross the Duck River near Williamsport and various smaller streams in the Poplar Creek and Greenlick Creek watersheds. To be capable of supplying up to 20 mgd of water, this pipeline would need to be approximately 36 inches in diameter.

This pipeline (and the pipelines described as parts of other alternatives) would likely be built using ductile iron pipe completely buried in the ground. The pipeline would likely require a permanent easement approximately 30 feet in width and a short-term construction easement about 50 feet wide.

During construction of the pipeline, appropriate erosion control measures, such as silt fencing and hay bales, would be installed in accordance with applicable best management practices and terms of the required NPDES construction stormwater discharge permits. Trees and brush within the right of way would be cleared, marketable timber would be sold, and other woody debris would be burned or buried. Backhoes, trenching machines, mechanical rippers, and/or drilling and blasting would be used to excavate a trench about six feet deep. Soil removed from the trench would be stockpiled for later use and, in agricultural areas, topsoil would be segregated from deeper soil layers.

Once the trench was dug, segments of pipe would be laid end to end using special stringing equipment. Crews would connect individual segments together to form longer sections which would be lowered into the trench by side-boom tractors. Rock and soil removed during trenching would be used to fill the ditch, then the surface would be graded and revegetated to approximate original contour and to meet specific agreements with the landowners.

Different construction techniques would be required where the pipeline would have to be laid across major roadways, railroads, or streams. Boring and directional drilling techniques, often used to cross linear features such as major roads or railroads, would allow the pipeline to be built without disturbing activities on the ground surface. The flume crossing technique, sometimes used to cross flowing creeks, involves building temporary dams upstream and downstream from the crossing site and passing the stream flow through flumes during the short period of time when the pipeline is being built using a fairly conventional trenching technique.

Before various parts of the pipeline would be placed in service, they would be flushed and hydrostatically tested. Water would be pumped into the line and pressurized for several hours to determine if any leaks were present. Most likely, water for this hydrostatic testing would be drawn from the future supply source.

The order of magnitude cost of this alternative (in FY 2000 dollars) is $11 million. This estimate includes the cost of building the intake, the pumping station, booster station, and the 13-mile pipeline but excludes the cost of the new water treatment plant. Approximately one acre of land for the intake, approximately one acre of land for the booster station, approximately 50 acres of permanent pipeline easement, and approximately 80 acres of construction easement would have to be acquired. Much of the pipeline could be built along existing highway rights-of-way; however, some easements over private property would have to be acquired. If withdrawals from the river between Normandy and the Columbia area did not exceed the projections described in Section 2.8, the 20 mgd capacity of this pipeline could provide enough additional water to meet the projected needs of the Maury/southern Williamson County Water Service Area through 2050. The possible effects of this alternative on flows in the Duck River during drought conditions in 2050 are illustrated on Figure 7.

3.6 ALTERNATIVE D - RAISE NORMANDY POOL LEVEL

This alternative would provide more water to the Columbia area by increasing the minimum flow that could be released from Normandy

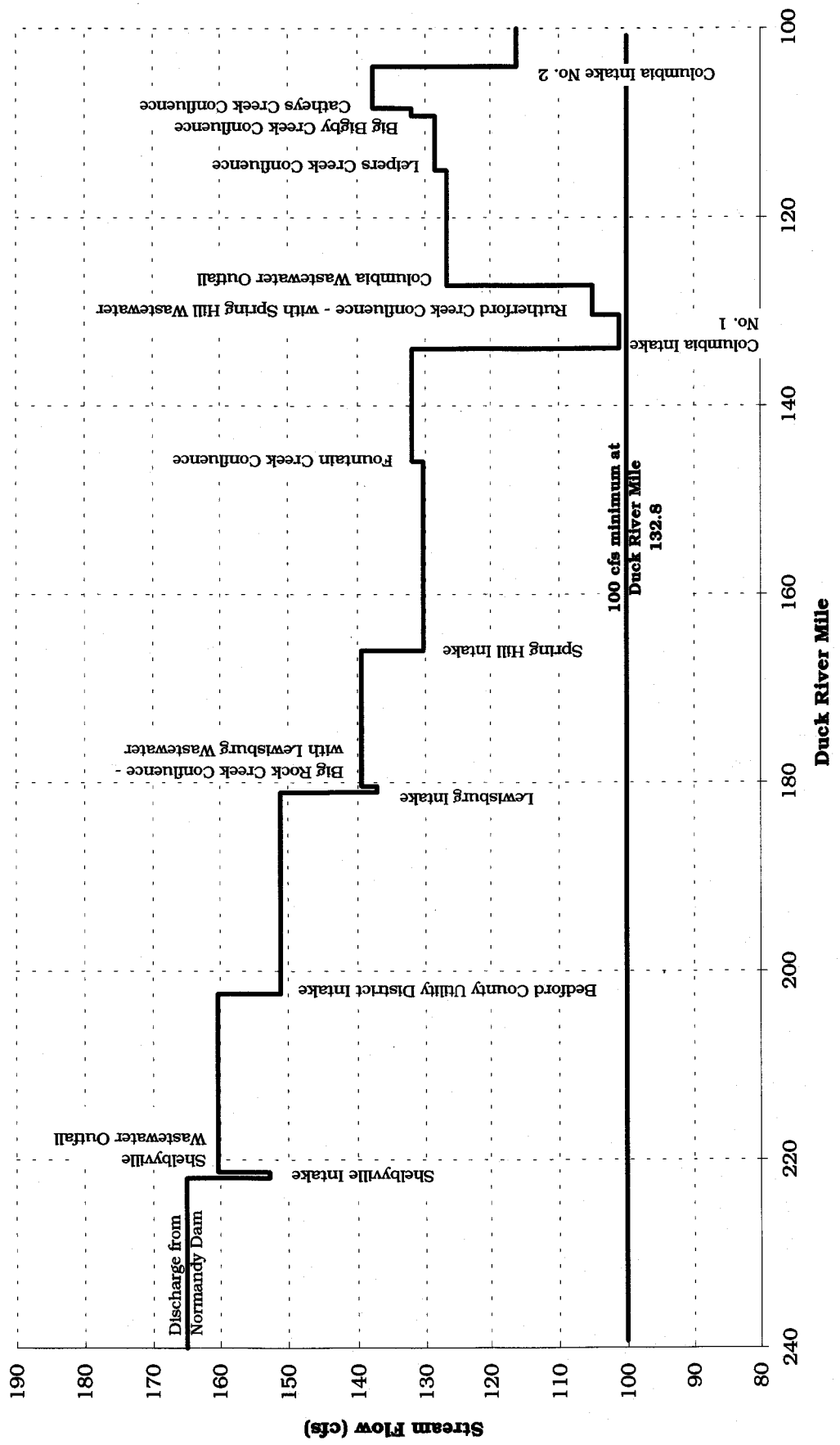


Figure 7. The potential effects of a downstream water supply source (Alternative C) on flows in the Duck River during possible drought conditions in 2050.

Reservoir. The additional flow would be made possible by raising the height of Normandy Dam, increasing the volume of water that could be stored in the reservoir, and using that additional water to increase the minimum discharge to the Duck River. If the earthen and concrete portions of Normandy Dam were raised by five feet (from elevation 895 to 900 feet), the normal maximum pool elevation of the reservoir could be increased from 875 to 880 feet and the normal minimum pool elevation would be increased from 864 to 869 feet. The surface area of the full pool reservoir would increase by 230 acres (from 3,230 acres to 3,460 acres). The increase in the volume of the reservoir would provide the space to store an additional 5,500 million gallons of water, which could be used to increase the minimum summer season discharge from 165 to 181 cfs. The area affected by this alternative is illustrated on Figure 8.

Adoption of this alternative would involve construction activity at Normandy Dam and at locations all around the margins of the reservoir. At Normandy Dam, additional earth and rock would be added to raise the height and strengthen the earthfill part of the dam. In addition, the concrete spillway would be rebuilt to raise it to the new operating height. At present, the quantities of concrete and fill material required for this work have not been determined and the source of the fill material has not been identified.

A variety of roads and recreational facilities around Normandy Reservoir would have to be modified or relocated if the normal pool level was raised. The Riley Creek Road bridge over the reservoir would have to be raised, along with the approaches to that bridge. Some of the roads and buildings in the Barton Springs and Cedar Point public use areas would have to be raised or relocated. At least some of the six existing boat launching ramps and associated parking lots around the reservoir would have to be modified or relocated. In addition, the band of existing shoreline all around the reservoir which would become part of the normal pool would have to be cleared. All of this construction activity would be conducted using appropriate methods to minimize the potential impacts and comply with the construction NPDES permits.

Preliminary TVA modeling studies suggest that, even during a severe drought, this alternative could provide an additional 16 cfs of minimum flow in the river without drawing the Normandy Reservoir pool elevation

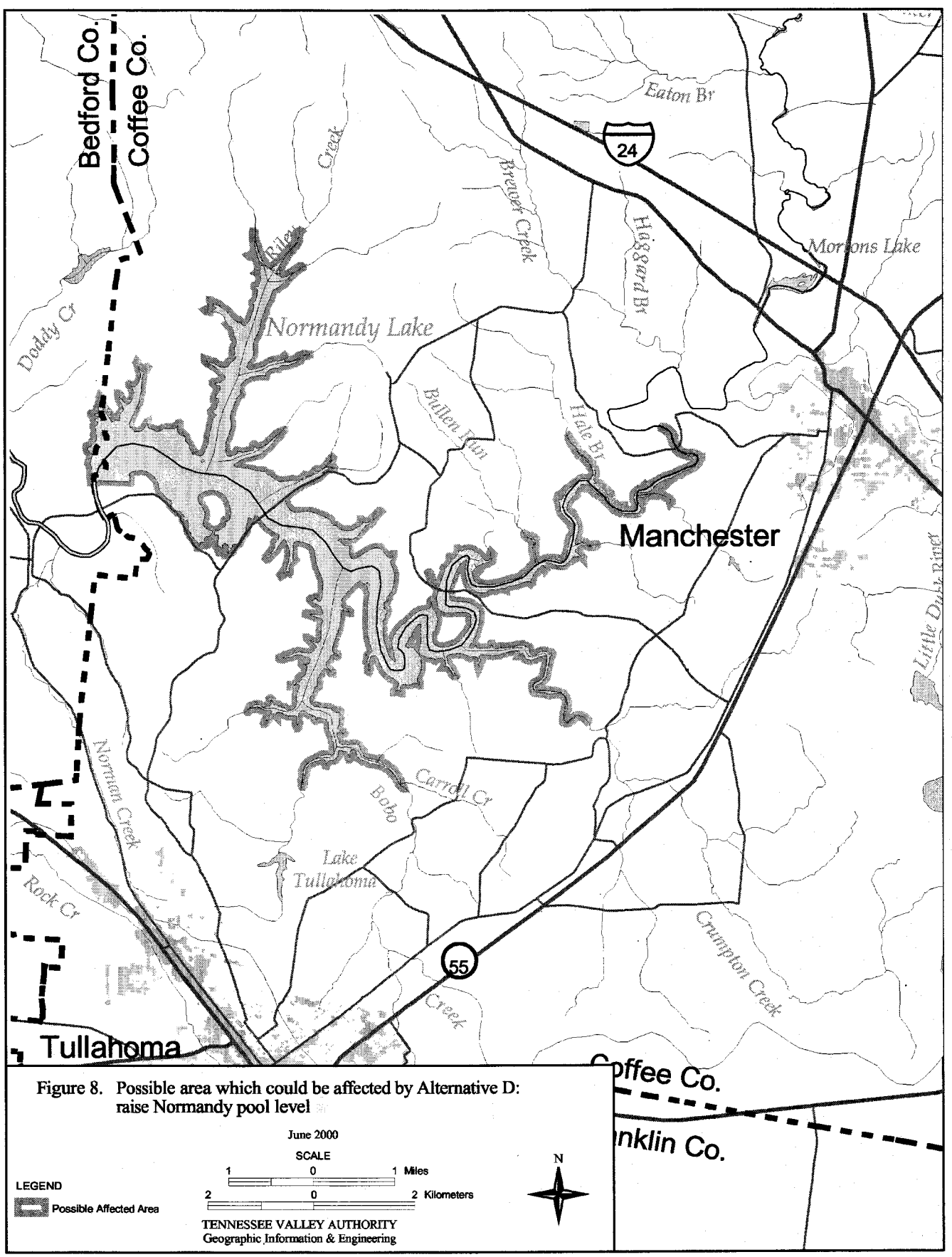


Figure 8. Possible area which could be affected by Alternative D: raise Normandy pool level

any lower in October and November than would occur under present conditions. If withdrawals from the river between Normandy and the Columbia area did not exceed the projections described in Section 2.8, the increased minimum flow in the river could provide up to 36 mgd (56 cfs) for water supply to the Columbia area, enough to meet the water demand estimated to occur in that service area around the year 2035 (Table 4). This level of minimum flow, however, would be 4 mgd (6 cfs) short of the total demand in the Maury/southern Williamson County Water Service Area that is estimated to occur by 2050. When the full 40 mgd (62 cfs) demand does occur, other supply or conservation measures would have to be developed to meet the last 10 percent of this need. The potential effects of this alternative on flows in the Duck River during drought conditions in 2050 are illustrated on Figure 9.

An order of magnitude cost of this alternative (in FY 2000 dollars) is $8 million. This estimate includes all necessary structural modifications to Normandy Dam and all associated roadway and facility changes around Normandy Reservoir. The estimate excludes the cost of any additional water treatment capacity. No additional land would have to be acquired to implement this alternative because all of the affected area is part of the Normandy Dam reservation.

3.7 ALTERNATIVE E - TIMS FORD PIPELINE

This alternative would involve meeting the future demand in the Maury/southern Williamson County Water Service Area by augmenting the flow of the Duck River with water from Tims Ford Reservoir (in the Elk River watershed). Under this alternative, a raw water intake and pumping station would be constructed on either of two northern arms of Tims Ford Reservoir (the Lost Creek or Hurricane Creek embayments). In addition, an approximate 20-mile pipeline would be constructed to move the water to a suitable discharge point on the Duck River, perhaps near the State Highway 82 bridge crossing near Shelbyville (River Mile 224). A second pumping station would be required to boost the water over the Elk/Duck watershed divide. Likely areas to be affected by this alternative are illustrated in Figure 10.

Construction of this alternative would include building the intake, initial pumping station, booster station, pipeline, and discharge. The multi-

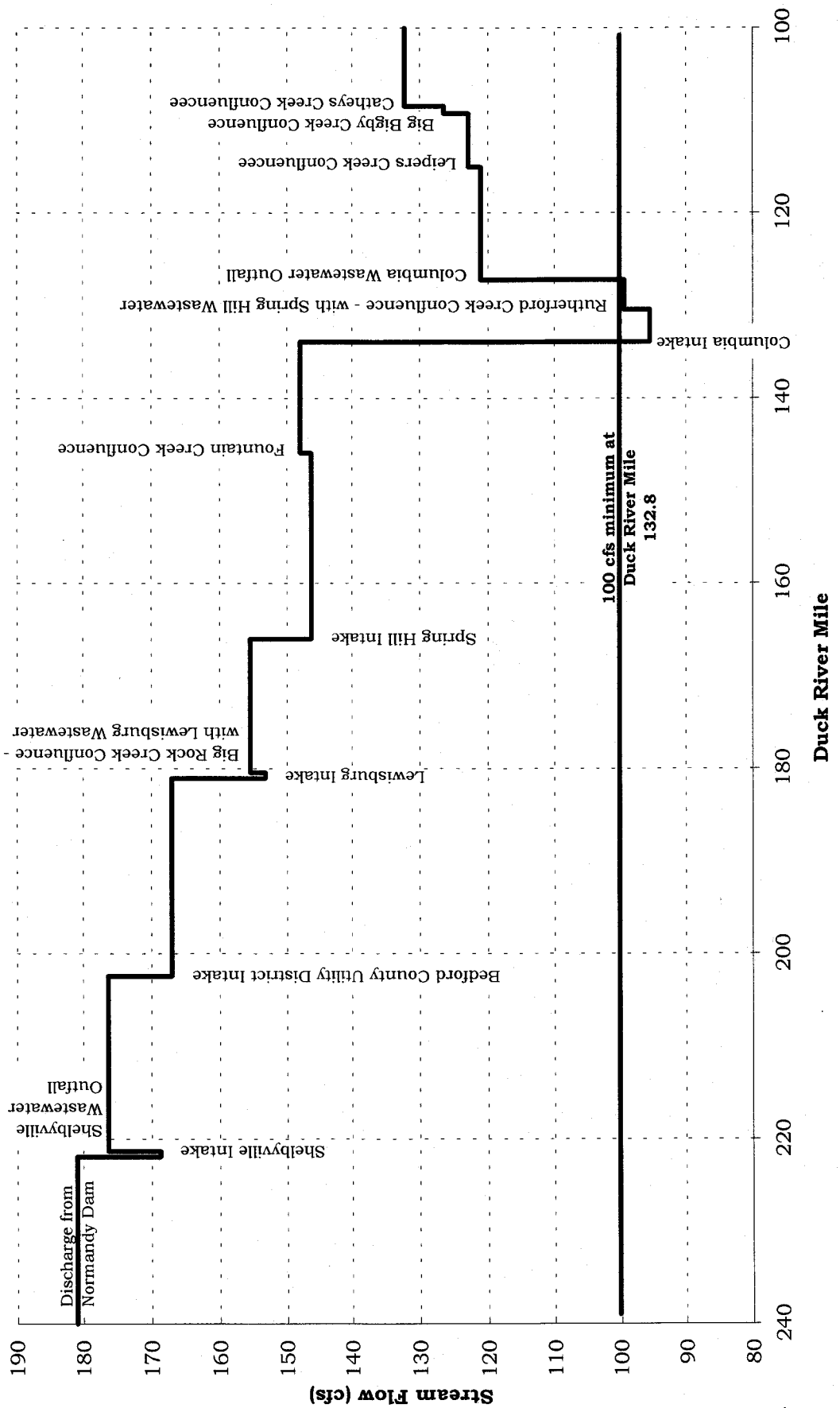


Figure 9. The potential effects of raising the Normandy pool level (Alternative D) on flows in the Duck River during possible drought conditions in 2050.

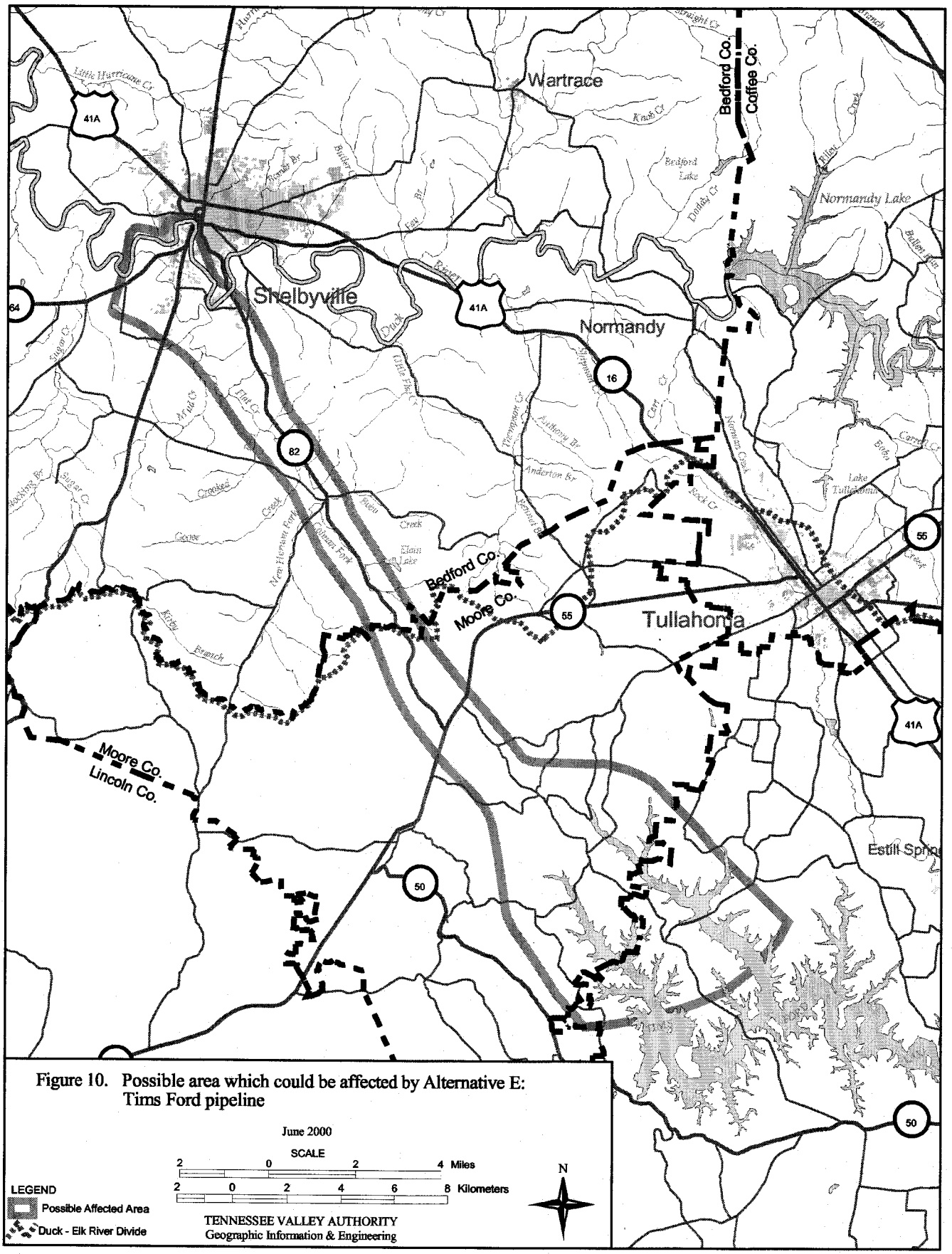


Figure 10. Possible area which could be affected by Alternative E: Tims Ford pipeline

level intake would be built out in the embayment and the associated pumping station would be built on high groundalong the shore. Construction of the intake would involve disturbing a small area in the reservoir where a concrete or similar structure would be built. The pumping station would be a fairly typical building constructed to house two or more pumps, electrical controls, and, probably, backup power generation equipment. The booster station, to be located at a convenient site along the pipeline route, would be similar to the pumping station along the reservoir.

The pipeline probably would be built more or less along existing road rights-of-way, including State Highway 80. If this pipeline was routed to follow State Highway 80, it would cross East Fork Mulberry Creek and several small tributaries in the Flat Creek watershed. This pipeline probably would need to be about 30 inches in diameter to transport up to the 22 cfs of additional water projected to be needed by the year 2050. The techniques that would be used to build this pipeline would be the same as those described under Alternative C (Section 3.5). All of the construction activities associated with this alternative would be conducted in ways that would minimize the potential impacts to streams and comply with their NPDES permits.

The purpose of this water transfer system would be to augment the minimum flow in the reach of the Duck River near Columbia. Water would be withdrawn from Tims Ford Reservoir only in event of severe drought; it would not be required on a routine basis. The frequency of these droughts is about one in every ten years, and then typically only during the period from June through October. Preliminary TVA modeling studies suggest the use of this pipeline to transfer as much as 22 cfs of water to the Duck River during even an extended drought would not affect releases from Tims Ford Dam but would lower the pool elevation in Tims Ford Reservoir by about eight inches over what would occur without the transfer. If withdrawals from the Duck River between the discharge point and the Maury/southern Williamson County Water Service Area did not exceed the projections described in Section 2.8, this alternative would provide enough additional water to meet drought-condition needs of the Columbia area through 2050. Figure 11 illustrates the likely effects of this alternative on flows in the Duck River during drought conditions in 2050.

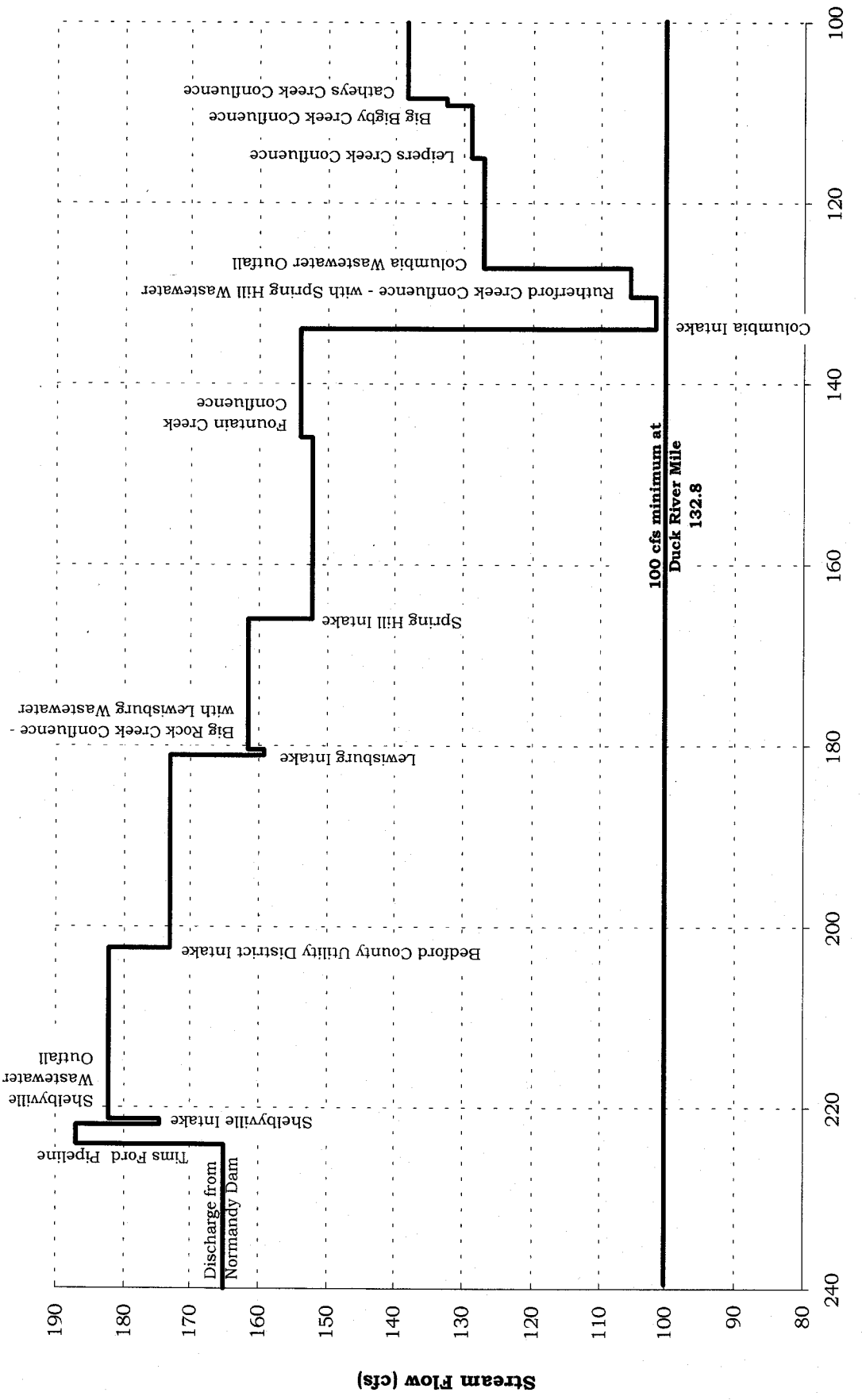


Figure 11. The potential effects of a pipeline from Tims Ford Reservoir (Alternative E) on flows in the Duck River during possible drought conditions in 2050.

An order of magnitude cost of this alternative is $13 million (in FY 2000 dollars). This estimate includes construction of the intake, pumping stations, pipeline, and discharge, but excludes the cost of operating the pipeline and of any additional water treatment capacity. The intake and associated pumping station would likely be built on existing public land along Tims Ford Reservoir; however, approximately one acre of land would have to be acquired for the booster station. Approximately 75 acres of permanent easement and approximately 125 acres of temporary (construction) easement would have to be acquired. Much of the pipeline could be built along existing highway rights-of-way; however, some easements over private property would have to be acquired.

3.8 ALTERNATIVES NOT EVALUATED IN DETAIL

The 37 suggested ways to meet the water supply needs of the Columbia area presented in Table 5 include several groups of ideas that were not selected for detailed evaluation in this EIS. The reasons these suggestions were excluded from detailed analysis are presented in the following paragraphs.

Finish Columbia Dam

Many people who commented on the scope of this EIS spoke or wrote forcefully in favor of completing the Columbia Reservoir as it had been proposed initially -- an impoundment on the Duck River with a full pool at elevation 630 feet. If the reservoir could not be completed at elevation 630 feet, some indicated they would settle for a Duck River reservoir filled to elevation 600 feet. Both of these alternatives have been evaluated previously, first with regard to their impacts on endangered species (USFWS, 1979) and, later, with regard to benefits and costs (TVA, 1986). In both respects, these alternatives were found to include negative effects which would impede completion of the impoundment. Economic aspects of these alternatives have not been reviewed in recent years, but a 1988 survey of aquatic endangered species (Jenkinson, 1988) indicated the potential adverse effects of a reservoir at either elevation had become more severe because an additional endangered species was found in a part of the river both alternatives would impound. In 1995, TVA concluded that a reservoir could not be built on the Duck River upstream from Columbia and, in 1999, the concrete part of the dam was demolished.

Build Some Other Reservoir

If a reservoir cannot be built on this part of the Duck River, several commenters on the scope of this EIS and some of the ideas presented in Table 5 suggest that a water supply reservoir could be built on Fountain Creek or some other tributary watershed near Columbia. As indicated in the Land Use EIS (TVA, 1999), TVA acquired approximately 3,800 acres of land in the Fountain Creek watershed, some of which could be used as part of a water supply project. As indicated in Section 3.4, construction of a water supply reservoir on Fountain Creek is evaluated as part of this EIS. The closeness of the Fountain Creek watershed to Columbia and the fact that some of the land already is in federal ownership makes a tributary reservoir on Fountain Creek the most logical representative of these suggestions to be evaluated in detail.

Withdraw/Capture Additional Water from the Duck River

Some of the ideas presented in Table 5 suggest that new intakes could be built or modifications could be made to existing structures on the Duck River to increase the amount of water that could be withdrawn to meet the needs of the Columbia area. Several of these ideas could be implemented; however, the initial evaluation indicated they would either not result in capturing any additional water (beyond what is already available in the river) or they were not likely to capture enough water to meet the estimated additional needs of the area. The one idea which might capture a substantial quantity of water (off-stream storage) would require so much storage area that it would become a reservoir, a suggestion considered to be adequately represented by the Fountain Creek Reservoir alternative.

Use Ground Water

The idea of using ground water sources is represented in all three parts of the list included in Table 5. This set of suggestions has been excluded because the available information (summarized in USGS, 1996, and in Section 4.3 of this EIS) indicates that an adequate ground water source is quite unlikely to be found in or adjacent to the upper Duck River basin.

Use Water Conservation

Virtually all of the remaining ideas presented in Table 5 involve one method or another of addressing the projected future water needs by

reducing the demand or, otherwise, conserving the water that already is available in the Columbia area. Water conservation is just beginning to emerge as an issue (and an opportunity) in Tennessee and other eastern states and, in the future, may become an important component in water resource planning. Water conservation has proven to be effective in reducing water demand in areas with constrained water sources and allows water systems to save money by deferring or avoiding investments in water infrastructure. Basic measures which can be conducted include universal metering, water accounting and loss control, costing and pricing reform, and public education. Additional measures beyond the basic level could include water use audits, retrofits of inefficient plumbing fixtures, pressure management, and the promotion of low water use landscaping. Conservation measures probably could produce at least a ten percent reduction in water use in the Duck River region. This would preserve some of the valuable water resources; however, it would not prevent the need for additional water supply before 2050. In addition, if water conservation measures were not adopted throughout a broad geographic area in middle Tennessee, residents in the Maury/southern Williamson County Water Service Area would be unlikely to accept strictly local, long-term water use restrictions as a viable alternative to augmenting their water supply.

3.9 COMPARISON OF ALTERNATIVES

Table 6 presents a brief summary of the concepts and components of each of the five water supply alternatives. The abbreviated entries in this table are derived from the information presented in Sections 3.3 through 3.7. The geographic areas likely to be affected by all four of the action alternatives are indicated on Figure 12.

The following paragraphs and the entries in Table 7 present a summary of the potential effects of the alternatives on the full range of environmental resources. All of the effects information in these summaries is derived from the discussions presented in Chapter 5. These summaries also assume that the various projects would be built subject to present laws, regulations, and knowledge about the status of resources in the project areas. The concluding paragraphs in this section present a comparison of the likely environmental effects of these alternatives.

Table 6. Summary comparison of the five water supply alternatives being evaluated in detail. Table entries are derived from information presented in Sections 3.3 through 3.7.

Components	A: Use Present Sources (No Action)	B: Fountain Creek Reservoir	C: Downstream Water Intake	D: Raise Normandy Pool Level	E: Tims Ford Pipeline
Basic Concept	No new source	Build a water supply reservoir	Add another Duck River intake	Augment minimum river flow	Augment minimum river flow
Additional Water Source	None	Fountain Creek Reservoir	Duck River ~ River Mile 100	Enlarged Normandy Reservoir	Tims Ford Reservoir
Additional Water Volume	None	74 cfs	46 cfs	16 cfs	22 cfs
Would Meet Water Needs Through	2015	2050 +	2050 +	2035	2050
New Treatment Capacity Required?	Yes	Yes	Yes	Yes	Yes
Estimated Pipeline Length	None	5 miles	13 miles	None	20 miles
Additional Land Required	None	800 acres (+ 2,800 acres already in public ownership); also 50 acres of easements along pipeline route	2 acres; also 130 acres of easements along pipeline route	None (affected areas already in public ownership)	1 acre (+ 1 acre already in public ownership); also 200 acres of easements along pipeline route
Order of Magnitude Construction Cost (FY 2000 $)	None	$ 50 Million	$ 11 Million	$ 8 Million	$ 13 Million
Estimated Added Cost to Operate	None	Not Determined	Not Determined	None	Not Determined

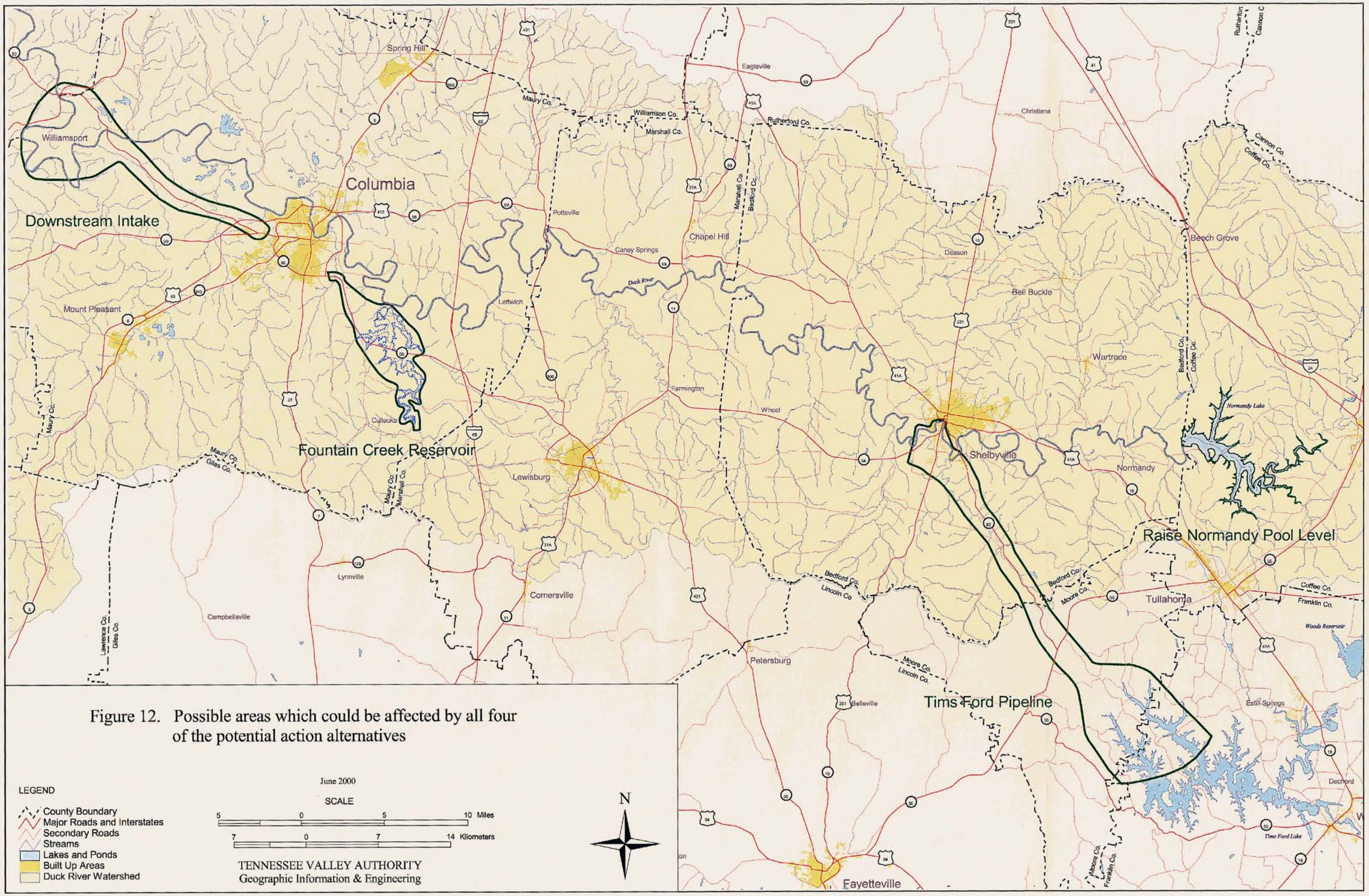


Figure 12. Possible areas which could be affected by all four of the potential action alternatives

Table 7. Summary of the potential environmental effects of the five water supply alternatives being evaluated in detail. Table entries are derived from the identified sections in Chapter 5.

Resource Areas	A: Use Present Sources (No Action)	B: Fountain Creek Reservoir	C: Downstream Water Intake	D: Raise Normandy Pool Level	E: Tims Ford Pipeline
Ground Water (Section 5.3)	No immediate effects	Higher local ground water; lower quality	Probably minimal construction effects	Probably minimal effects	Probably minimal construction effects
Surface Water (Section 5.4)	No immediate effects; potential drought impacts	Nutrient-rich small reservoir; need to protect supply use	Probably minimal construction effects; flow benefits	Probably minimal construction effects; flow benefits	Probably minimal construction effects; flow benefits
Aquatic Life (Section 5.5)	No immediate effects; potential drought impacts	Species diversity in reservoir would be lower than streams	Probably minimal construction effects; some flow benefits	Possible community changes in reservoir and downstream	Probably minimal construction effects; flow benefits
Wetlands (Section 5.6)	No effects	Net loss in wetland areas and functions	Probably minimal construction effects	Possible changes in wetland sites	Probably minimal construction effects
Floodplains (Section 5.7)	No effects	Higher upstream flood levels; lower levels downstream	Probably minimal construction effects	Probably minor changes in flood elevations	Probably minimal construction effects
Terrestrial Life (Section 5.8)	No immediate effects	Significant change in area habitats	Probably minimal construction effects	Some local changes in area effects	Probably minimal construction effects
Endangered and Threatened Species (Section 5.9)	No immediate effects	Possible effects related to changes in area habitats	Probably minimal construction and operational effects	Probably minimal construction and habitat effects	Probably minimal construction effects
Land Use/ Prime Farmland/ Community Noise (Section 5.10)	No immediate effects	Approx. 800 acres would be acquired; major changes in use on 3,600 acres	Probably minimal construction and operational effects	Only local changes in use would occur	Probably minimal construction and operational effects
Visual/Recreation/ Natural Areas (Section 5.11)	No immediate effects	Significant local changes in character and use	Probably minimal construction and operational effects	Significant changes in character, facilities and a natural area	Probably minimal construction and operational effects
Cultural Resources (Section 5.12)	No immediate effects	Potential for significant effects at sites on 3,600 acres	Probably minimal construction effects	Potential for adverse effects at sites on 230 acres	Probably minimal construction effects
Socioeconomics (Section 5.13)	Potential future limit on economic growth	Most construction employment benefit	Minor construction employment benefit	Some construction employment benefit	Minor construction employment benefit

Adoption of **Alternative A** would mean that no new source of water would be developed to meet the projected future needs of the Maury/southern Williamson County Water Service Area. More than likely, the Spring Hill and Columbia water treatment plants would be expanded to withdraw and treat as much water in the river as possible; however, the worst case needs of this water service area are projected to exceed the available flow in the river during drought conditions some time after 2015 (Sections 2.8 and 5.4). As the demand for water approached the available supply, treatment of area wastewater would become more difficult and expensive (Section 5.4), and economic growth in the area probably would slow or stop (Section 5.13). If the demand for water continued to rise and no additional water supply source for the area was developed, drought conditions probably would bring the imposition of water conservation measures and pleas to TDEC for permission to withdraw more water from the river (Section 5.4). Large withdrawals from the river during drought conditions would result in adverse effects to aquatic life and recreational use of the river for several miles downstream from the Columbia water supply intake (Sections 5.5 and 5.11). Eventually, the increasing demand is likely to lead to the development of one or more additional water sources for the Columbia area.

Adoption of **Alternative B** would result in the construction of a water supply reservoir in the downstream part of the Fountain Creek watershed and an approximate 5-mile pipeline to transport water from this reservoir to a new treatment plant and on to the existing water distribution system. If this reservoir was built with a full pool at elevation 629 feet and if it included all of the adjacent land up to the probable maximum flood level, the project would affect a total area of approximately 3,600 acres, of which 800 acres is not already in public ownership and would have to be acquired (Section 3.4). Construction of the reservoir would create a relatively small, nutrient-rich reservoir (Section 5.4) which would have to be grouted to avoid significant leakage to the ground water (Section 5.3). The reservoir would substantially change aquatic habitats, terrestrial habitats, land use, visual character, and recreational activities in the immediate area (Sections 5.5, 5.8, 5.10, and 5.11); however, the nature and extent of some of those changes would depend on how the reservoir and surrounding land were managed (Sections 5.4, 5.10, and 5.11). The reservoir would support much lower

diversity of aquatic life than the existing creeks; however, some species capable of living in standing-water habitats would be more abundant in the area than they are now (Section 5.5). Construction of the reservoir could result in a net loss in local wetland functions (Section 5.6) and significant adverse effects on the extensive archaeological resources that are likely to be present in the area (Section 5.12). If all of the future water demands of the Columbia area were to be met from the Fountain Creek reservoir, the flow not withdrawn from the river would help maintain acceptable water quality conditions for fish and aquatic life and recreational uses downstream from the water intake, as well as provide more initial dilution for the Columbia wastewater treatment plant discharge (Section 5.4). If this alternative was pursued, future planning for the reservoir would have to include ways to avoid or minimize potential adverse effects on ground water, surface water, aquatic life, wetlands, terrestrial life, endangered species, land use, recreation, natural areas, and cultural resources (Sections 5.3, 5.4, 5.5, 5.6, 5.8, 5.9, 5.10, 5.11, and 5.12). If constructed and operated appropriately, this reservoir could meet all of the projected water supply needs of the Maury/southern Williamson County Water Service Area through at least 2050 (Section 3.4) and would not impede the anticipated level of local economic growth (Section 5.13).

Adoption of **Alternative C** would lead to the construction of a water supply intake and pumping station on the Duck River downstream from the mouth of Catheys Creek (possibly near River Mile 104) and an associated 13-mile pipeline and booster station to transport water to a new treatment plant and to the existing water distribution system. If this project was constructed as indicated in Section 3.5, it would have only short-term and minor effects on ground water, wetlands, floodplains, terrestrial life, endangered species, land use, visual character, natural areas, and cultural resources (Sections 5.3, 5.6, 5.7, 5.8, 5.9, 5.10, 5.11, and 5.12). Operation of the project would not be likely to cause any adverse effects on water quality or aquatic life at the intake site and the flow not withdrawn from the river would help maintain aquatic life and recreation downstream from the Columbia water intake during drought conditions (Sections 5.4, 5.5, and 5.11). If this alternative was pursued, future planning for the project would have to include ways to avoid or minimize potential adverse effects on ground water, surface water, aquatic life, wetlands, terrestrial life, endangered

species, land use, visual character, and cultural resources (Sections 5.3, 5.4, 5.5, 5.6, 5.8, 5.9, 5.10, 5.11, and 5.12). If withdrawals from the river between Normandy and the Columbia area did not exceed the projections described in Section 2.8, this intake and pipeline could provide enough additional water to meet the anticipated water supply needs of the Maury/southern Williamson County Water Service Area through 2050 (Section 3.6) and would not impede the anticipated level of local economic growth (Section 5.13).

Adoption of **Alternative D** would result in raising the pool level on Normandy Reservoir and increasing the minimum discharge from Normandy Dam. If this project was constructed as indicated in Section 3.6, it would have only short-term and minor effects on terrestrial life, endangered species, and land use (Sections 5.8, 5.9 and 5.10), and could result in minor beneficial effects on water quality and aquatic life in the Duck River downstream from Normandy Dam (Sections 5.4 and 5.5). Raising the pool level in Normandy Reservoir is likely to result in minor adverse effects on wetlands and cultural resources around the reservoir (Sections 5.6 and 5.12) and significant adverse effects on visual character, existing recreation facilities around the reservoir, and on three acres supporting important features in the Short Springs State Natural Area (Section 5.11). Future planning for this project would have to include more detailed evaluations of the potential effects on ground water, surface water, aquatic life, flood elevations upstream from Normandy Dam, visual character, recreation facilities, and natural areas (Sections 5.3, 5.4, 5.5, 5.7, and 5.11). If constructed and operated appropriately, these modifications to Normandy Reservoir and its discharge could make additional water available in the Duck River (Section 3.6). If withdrawals from the river between Normandy and the Columbia area did not exceed the projections described in Section 2.8, the augmented minimum flow in the river could provide up to 36 mgd (56 cfs) for water supply to the Maury/southern Williamson County Water Service Area, enough to meet the water demand estimated to occur in that area around the year 2035 (Section 3.6). Water conservation and/or some other supply source would be required to meet the projected additional 6 cfs of demand by 2050 without impeding the anticipated level of local economic growth (Sections 5.4 and 5.13).

Adoption of **Alternative E** would lead to the construction of a water supply intake and pumping station on a northern embayment of Tims Ford Reservoir and an associated 20-mile pipeline and booster station to transport water to a discharge point on the Duck River near Shelbyville. If this project was constructed and operated as described in Section 3.7, it would have only short-term and minor effects on ground water, wetlands, floodplains, terrestrial life, endangered species, land use, visual character, recreation, natural areas, and cultural resources (Sections 5.3, 5.6, 5.7, 5.8, 5.9, 5.10, 5.11, and 5.12). When this water transfer system was operating (only during drought conditions), it would have only minimal effects on the water level in Tims Ford Reservoir and could have beneficial effects on surface water quality and aquatic life in the Duck River downstream from the discharge point (Sections 5.4 and 5.5). If this alternative was pursued, future planning for the project would have to include ways to avoid or minimize potential adverse effects on ground water, surface water, aquatic life, wetlands, terrestrial life, endangered species, land use, visual character, recreation, and cultural resources (Sections 5.3, 5.4, 5.5, 5.6, 5.8, 5.9, 5.10, 5.11, and 5.12). If withdrawals from the river between the discharge point and the Maury/southern Williamson County Water Service Area did not exceed the projections described in Section 2.8, this alternative would provide enough additional water to meet drought-condition needs of the service area through 2050 (Section 3.7) without impeding the anticipated level of local economic growth (Section 5.13).

Comparison

In general, the extent of potential construction effects of each of the four action alternatives seem to be related to the amount of land area that would be modified or disturbed and the flexibility available when locating specific project components. Construction or modification of a reservoir (Alternatives B and D) would affect all of the land within a fixed project area. Under both of these alternatives, it would be difficult to avoid having some impact on any resource feature that existed within the project area. In contrast, the construction of intakes, pumping stations, discharges, and pipelines (Alternatives C and E) would affect only narrow corridors of land within a general project area. The locations of the end point facilities and the route of the pipeline could be adjusted to avoid or minimize potential impacts to many types of resource features.

In similar general terms, operation of these alternatives would result in effects on resources based primarily on when, where, and how much the water flow would be changed in the affected streams and rivers. Alternative C would essentially recirculate some water within a relatively short reach of the Duck River. Alternatives B and D would involve harvesting more water in the Duck River basin during high flow events and discharging or using that water during minimum flow periods. Alternative E would involve using water from the Elk River basin to augment the minimum flow in the Duck River from the Shelbyville area downstream to Columbia. In virtually all cases, increasing the flow in some part of the Duck River would benefit water quality, aquatic life, and recreation in that area. The overall effects of reducing or modifying the flow at the water sources would depend on how much the preexisting conditions would be changed.

3.10 PREFERRED ALTERNATIVE

As indicated in Section 1.3, TVA, DRDA, a variety of local water systems, and other agencies have participated in completing this analysis and programmatic EIS to achieve three purposes. These purposes are: 1) to document if one or more of the three water service areas in the upper Duck River basin has a projected need for additional water before about 2050, 2) to identify various ways that would meet the future additional need for water in one or more of those service areas, and 3) to determine the likely environmental effects of the five conceptual alternatives that have been evaluated in detail.

The first of these purposes has been met by gathering and evaluating information about existing water use, anticipated population growth, and future demands for water in the upper Duck River area. The results from the Needs Analysis (summarized in Section 2.10) indicate that the present releases from Normandy Dam would be sufficient to meet the projected water needs in the Bedford County and Marshall County water service areas through 2050. The Needs Analysis also indicated that additional water supply would be required to meet future needs in the Maury/southern Williamson County Water Service Area, starting some time after 2015. Given these results, TVA has concluded that one or more action alternatives should be pursued to meet the future water

needs in the Maury/southern Williamson County Water Service Area. This is the TVA preferred alternative in this programmatic EIS.

The second and third purposes have been met by gathering ideas and conducting a generic evaluation of four different ways to meet the projected water needs in the Maury/southern Williamson County Water Service Area. Three of the four alternatives evaluated in detail would provide enough additional water to meet the projected needs through at least 2050, while the present concept of the fourth alternative (Raise Normandy Pool Level) would meet the needs through at least 2035. Local utilities, government agencies in the upper Duck River watershed, and other interested parties will be the ones to actually decide which water supply alternative(s) should be pursued. Those local agencies and the publics they serve must determine how they want to address water needs in this river basin and how those systems will be operated. TVA is not proposing to design or construct any of these facilities; however as a regional water resource agency, TVA can assist in evaluating available alternatives and encourage cooperation among all communities that are dependent on common water resources.

CHAPTER 4 - AFFECTED ENVIRONMENT

4.1 INTRODUCTION

This chapter presents descriptions of the variety of environmental resources and local features which exist in areas that could be affected by one or more of the water supply alternatives. Some resources or features that are unlikely to affect or be affected by the alternatives (e.g., climate and geology) are described rather briefly while resources or features identified during the scoping process as important issues are described in much more detail. The arrangement of topics and the numbering of sections in this chapter is the same as the arrangement of these topics and section numbers used in Chapter 5 (Environmental Consequences).

4.2 CLIMATE, GEOLOGY, AND SOILS

Climate

Maury, Marshall, Bedford, and adjacent counties in middle Tennessee are affected by warm, humid summers and cool winters. Average precipitation is 53.6 inches per year, with the heaviest rainfall (4.5 to 6 inches per month) occurring in March, April, May, and December (TVA, 1998a). About 50 to 70 percent of precipitation is returned to the atmosphere by evaporation from the land and plants (USGS, 1995). Winds are relatively light, especially in the summer and early fall. Climate statistics, presented in Table 8, characterize temperature, precipitation, snowfall, relative humidity, thunderstorm events, and wind speed in this area. The Lewisburg agricultural experiment station is the most representative weather station for the area, but the information collected there is limited to temperature, precipitation, and snowfall (U.S. Department of Commerce, 1961-1994). For the other three variables in the table, data for the Nashville, Tennessee, and Huntsville, Alabama, National Weather Service stations are provided (U.S. Department of Commerce, 1994b; 1994c). Of the two, Nashville is the more representative station for the study area.

Geology

Most of the area that could be affected be the action alternatives is located within the Central Basin Section of the Interior Low Plateau Physiographic

Table 8. Climate statistics representing the Columbia Project area. Data from U.S. Department of Commerce sources.

Month	Temperature Normals Lewisburg (1961-1990)		Precipitation Normals Lewisburg (1961-1990)		Average Snowfall Lewisburg (1961-1994)		Average Relative Humidity (%) at four selected times of the day (CST) Nashville (1966-1994)				Huntsville (1968-1994)				Average Thunderstorm Days Nashville (1942-1994)	Huntsville (1968-1994)	Average Wind Speed Nashville (1942-1994)		Huntsville (1968-1994)	
	°F	°C	inches	cm	inches	cm	00	06	12	18	00	06	12	18			mph	km/h	mph	km/h
Jan	34.8	1.6	4.49	11.4	2.9	7.4	75	80	63	65	78	82	64	68	1.2	1.1	9.1	14.6	9.3	14.9
Feb	38.5	3.6	4.12	10.5	1.6	4.1	73	80	59	60	75	81	59	61	1.6	2.1	9.3	14.9	9.7	15.6
Mar	47.7	8.7	5.97	15.2	0.5	1.3	71	78	53	54	73	81	56	57	4.0	4.3	9.9	15.9	10.1	16.2
Apr	57.1	13.9	4.67	11.9	T		72	80	51	52	75	83	52	52	5.1	4.7	9.3	14.9	9.3	14.9
May	65.3	18.5	5.66	14.4	0.0		82	86	55	58	83	87	56	60	7.2	7.1	7.6	12.2	8.1	13.0
Jun	73.3	22.9	3.85	9.8	0.0		84	87	55	59	85	88	56	61	8.2	8.5	7.1	11.4	7. 0	11.3
Jul	76.9	24.9	5.19	13.2	0.0		85	89	57	62	87	90	59	65	9.5	10.3	6.5	10.5	6.3	10.1
Aug	76.0	24.4	3.25	8.3	0.0		85	90	57	62	87	91	58	66	7.7	8.2	6.2	10.0	5.9	9.5
Sept	69.7	20.9	3.79	9.6	0.0		85	90	58	64	87	91	59	68	3.6	4.9	6.5	10.5	6.8	10.9
Oct	58.0	14.4	3.81	9.7	0.0		81	86	54	60	83	87	55	65	1.6	2.1	6.8	10.9	7.5	12.1
Nov	48.4	9.1	4.85	12.3	0.5	1.3	77	81	59	64	79	84	58	65	1.7	2.3	8.4	13.5	8.6	13.8
Dec	39.1	3.9	5.05	12.8	0.8	2.0	76	80	63	67	78	82	63	69	1.1	1.1	8.9	14.3	9.3	14.9
Annual	57.1	13.9	54.70	138.9	6.3	16.0	79	84	57	61	81	86	58	63	52.6	56.9	8.0	12.9	8.2	13.2

Province as described by Fenneman (1938). The northwestern and southwestern corners of Maury County and nearly all of Coffee County are located in the western and eastern parts of the Highland Rim (respectively), also sections of the Interior Low Plateau. The Interior Low Plateau is a relatively level area; however, some sections have been substantially eroded. This eroded plateau extends from the Cumberland Plateau (on the east) to the Mississippi embayment of the Coastal Plain Physiographic Province (on the west). The Interior Low Plateau is bordered on the north by the Till Plains section of the Central Lowlands Physiographic Province.

The Central Basin is a plain with an elevation of 550 to 700 feet which is completely surrounded by the Highland Rim. Geologically, this Basin was formed when part of the Highland Rim was pushed up and began to erode faster than the surrounding area. Because this erosion is incomplete, the Central Basin contains knobs and ridges which rise as much as 200 feet above the basin floor.

The rocks of the Central Basin and adjacent parts of the Highland Rim consist of massive, clayey limestones and dolomites, some of which include thin lenses of brown shale. Several different geologic formations are present in different parts of the area (Figure 13). Nearly flat rocky areas with very little soil, commonly called glades, occur throughout the Central Basin. The thick limestone layers often include fractures which may have been eroded and enlarged by the moving water. In some locations, sinkholes or caves of various sizes may exist. Only a few larger caves are known to exist in this area.

Soils

The U.S. Department of Agriculture has conducted surveys of the soils in Maury and Bedford Counties (U.S. Department of Agriculture, 1959; and 1947, respectively). Soil surveys have not been conducted in Marshall and other adjacent counties in the area; however, the general patterns within this part of the Duck River basin are likely to be quite similar.

Soils in both Maury and Bedford counties can be grouped into classes, generally related to streams and terrain. The soils in the bottoms along the Duck River are Huntingdon-Lindside-Armour (Terrace Phases)-Egam soils which are well- to moderately well-drained, silty, loamy soils. These are moderately to highly productive agricultural soils and are suitable for most row

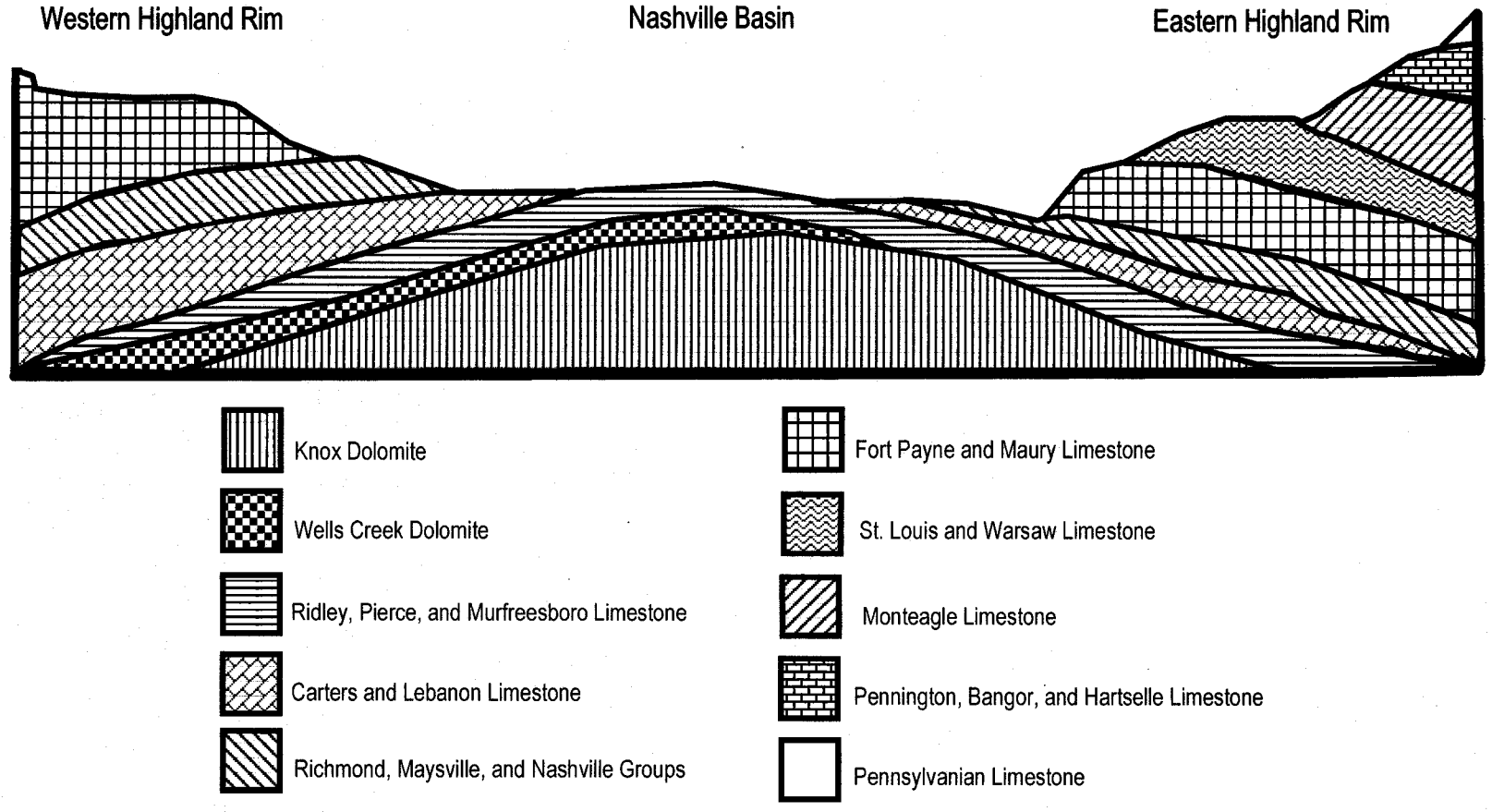


Figure 13. Upper Duck Region, Schematic Geologic Cross Section. Redrawn from Duck River Project Final Environmental Impact Statement figure, April 28, 1972, TVA Office of Health and Environmental Science.

crops. Some Huntingdon and Armour soils are considered prime farmland soils (see Section 4.10).

Scattered along both sides of the river are fairly large pockets of Etowah-Huntingdon (local alluvial phosphatic phases)-Emory soils. They occur in gently sloping areas and are well-drained, moderately deep to deep, silty, loamy soils. These soils are very productive and are suitable for a wide variety of crops and pasture.

Two soil associations cover the majority of the upland areas within the inner Central Basin in the eastern quarter of Maury County. These are the Rockland-Talbott-Hagerstown (Rocky) and the Talbott-Hagerstown-Rockland association. These are similar rocky and thin soils with limestone outcrops and, as the names imply, differ only in the percentage of each soil type present. They are generally covered with red cedars and drought resistant hardwoods. Although some areas are suitable for small grains, the predominant uses of cleared areas are hay and pasture.

The predominate soils of the east-central part of Maury County are of the Inman-Culleoka-Hicks-Maury (coarse phases) association. These soils are acidic, high in phosphorus, and moderately low in other plant nutrients. They occupy sloping to steep parts of ridges of the outer Central Basin and extend into the lower lying inner Central Basin.

The Braxton-Maury-Armour association covers most of the central portion of Maury County. These soils are deep, well-drained, productive, high in phosphorus, organic matter, and plant nutrients. They occur within the outer Central Basin. Many parts of this area have been commercially mined for phosphate, particularly near Columbia and Mount Pleasant, TN.

The predominate soils surrounding the Braxton-Maury-Armour area are of the Dellrose-Frankstone-Mimosa (cherty) association. These soils occupy cherty knobs, steep slopes, and narrow cherty valleys of the outer Central Basin. They are acid, medium to high in phosphorus, and medium to low in other plant nutrients. Most of these soils have moderate to rapid drainage, although the lower subsoil of the Mimosa soils are more clayey and less permeable.

The Bodine-Mountview (shallow phases) -Pace and Mountview-Dickson associations occupy the Highland Rim area of the northwestern and

southwestern portions of Maury County. These soils are low in lime, natural fertility, and moisture-supplying capacity. They are generally shallow and cherty.

Upland soils predominate in Bedford County. They are characterized by the Highland Rim escarpment soil association, the outer Central Basin soil association, and the inner Central Basin soil association. Colluvial lands cover the smallest portion of the county. Soils of the terraces are mostly weathered limestones. Bottomland soils are derived from recently deposited alluvial materials largely washed from soils underlain by limestone. Generally, bottomland soils are medium acid; Central Basin upland soils are medium to strongly acid; and soils of the Highland Rim escarpment are strongly to very strongly acid.

4.3 GROUND WATER

As indicated in Section 4.2, this part of the Duck River basin receives an average of 53.6 inches of precipitation per year. Information presented in Section 4.4 indicates that runoff in this area averages from 20 to 30 inches per year. At least some of the rest of the rain and snow moves down through soil and rock and becomes part of the ground water. Because rain water is slightly acidic, as it moves into the ground it dissolves the limestone and other carbonate rocks along existing cracks and layers. Springs are common in the outer Central Basin and ground water makes up an important part of the low flow in the streams in this part of the watershed.

The geology of the groundwater system in central Tennessee is relatively well defined. Most of the area is underlain by carbonate rocks, primarily limestone with some dolomite. Some shale zones exist in these rocks, as well as phosphate-rich layers and several thin clayey beds. Shale and clay beds can block or redirect the movement of water in the bedrock. Most of the water in limestone and dolomite rocks is stored and moves through solution fractures. The amount of space water could occupy in these beds is estimated to be less than 0.5 percent of total rock volume (USGS, 1995). The flow system is generally limited to the top 300 feet or less below the ground surface (USGS, 1986). In general, the number of connected cracks and spaces through which water could move decreases with depth into the ground.

The principal water-bearing rocks underlying this area include the Ridley, Lebanon, and Carters limestone formations (Figure 13). The Ridley limestone is considered a local aquifer which generally produces low well yields. The Lebanon limestone also is considered a local aquifer, but shale zones can restrict ground water movement in this formation. Water yields from the Carters limestone are highly variable. Although the formation generally provides low yields (less than 5 gpm) to domestic wells, yields in excess of 100 gpm have been encountered (USGS, 1986).

Ground water is used throughout the area as a source for domestic and farm use. Present usage is approximately 6,300 cubic meters per day (1.66 mgd), which supplies about 7,900 people (TVA, 1998a). Data furnished by the Tennessee Division of Water Supply based on drillers' records for the three-county area are summarized in Table 9. A few cautionary notes are in order to put these data into perspective:

- All information has been supplied by individual well drillers without any independent verification.
- Many of the wells were installed over 30 years ago. It is unknown how many of these wells remain in operation.
- Reported results reflect conditions at the time of installation. Conditions, particularly related to well yield, can change over time.

The information summarized in Table 9, indicates that well drilling results are relatively similar in all three counties. Average well depth is shallowest in Bedford County (165 feet) and deepest in Maury County (342 feet). Average well yield (11 to 14 gpm) is very similar in all three counties. In all three counties, between one and two percent of the wells (about which the yield is known) have been reported to produce 100 gpm or more (0.1 mgd), and fewer than one-tenth of one percent produce 500 gpm or more (0.7 mgd). Between 10 and 20 percent of the documented wells (about which the yield is known) produced less than one gpm. Seventy percent of all wells were reported to be used for domestic water supply and three percent were listed to be used for municipal, community, or multi-family water supplies. While previous investigations have identified several sites within the area with potential for additional ground water development (USGS, 1993), even the largest reported yields from wells in these three counties (0.7 mgd) suggest there is little

likelihood of drilling individual wells that could provide enough ground water to supply large communities.

Table 9. Summary of drill records for water wells in Maury, Marshall, and Bedford Counties. Most values in the table are averages, with minimum and maximum values presented in parentheses. (Tennessee Division of Water Supply unpublished data)

Statistics	Maury County	Marshall County	Bedford County
Number of well records	2,095	2,364	1,896
Average Well Depth (feet)	342 (21 - 6400)	237 (5 - 1400)	165 (0 - 1500)
Average Depth to Water Bearing Zone (feet)	267 (0 - 1630)	163 (0 - 1340)	115 (0 - 1175)
Average Yield (gallons per minute - gpm)	11 (0 - 500)	11 (0 - 406)	14 (0 - 500)
Wells yielding less than 1 gpm (unknowns excluded)	173 (10.4 %)	441 (21.6 %)	336 (20.5 %)
Wells yielding 100 gpm or more (unknowns excluded)	27 (1.6 %)	36 (1.2 %)	32 (2.0 %)
Wells yielding 500 gpm or more (unknowns excluded)	2 (0.1 %)	0	2 (0.1 %)

Very little information is available on the quality of ground water in the region. Because the groundwater table tends to be close to ground surface throughout much of the area, generally with little soil cover, groundwater quality tends to resemble surface water quality (personal communication Gordon Corruthers, TDEC Groundwater Management Section, 1999). Surface runoff moves through cracks or solution features into the shallow aquifers.

Ground water in the region tends to be highly mineralized, possibly due to the presence of soluble salts in the limestone. The USGS measured hardness levels (in ppm of $CaCO_3$) in the Lebanon limestone from locations throughout this project area (USGS, 1936). Results were from 310 to greater than 500 ppm in Maury County, from 20 to greater than 600 ppm in Marshall County,

and from 10 to 320 ppm in Bedford County. In a later study (USGS, 1986), water having total dissolved solids levels greater than 10,000 mg/L was found in the same formation within several miles of water with concentrations less than 500 mg/L. In addition to hardness, high levels of hydrogen sulfide have been found in many wells. This indicates that the quality of ground water within the project area can vary from location to location.

More recent data are available from Bedford County (Roman-Mas, et al., 1991). Water samples from 89 wells were analyzed for pH, fecal coliform and streptococcus bacteria, nitrate, chloride, sulfate and specific conductance. Most pH values were in the neutral range (6.5 - 7.5), bacterial levels ranged from less than 1 to "too numerous to count", nitrate levels ranged from less than 1 to 26.1 mg/L (with most values less than 5 mg/L), chloride levels ranged from 1.5 to 75.8 mg/L, sulfate levels from less than 2 to 1,697 mg/L (with most values less than 50 mg/L), and specific conductance levels (an indirect measure of dissolved solids) ranged from 12 to 2550 μS/cm. This information adds to the idea that there is considerable variation in the quality of ground water in the area.

Groundwater quality data available from the state are very generalized, and wells are described based on substances which can be found in a water sample, such as lime, iron, sulfur, salt, oil, gas, or "other." In addition, the water quality is listed as bad, fair, or good. The most common substances found in ground water in Maury County were either hydrogen sulfide or something that fell into the "other" category. Hydrogen sulfide was found in many wells across the county and in neighboring counties, and was generally independent of well depth (Tennessee Division of Water Supply, unpublished data).

Much of the land in the area contains sinkholes which provide avenues of direct groundwater recharge. Sinkholes also sometimes are used as disposal sites for trash and other wastes. Material dumped or allowed to flow into sinkholes can contaminate ground water and any surface water into which it flows. The amount of present dumping into sinkholes in this part of the Duck River basin is unknown and no information is available about any contamination of ground water which might be occurring from sinkhole sources.

To summarize, in this project area ground water is used predominantly for individual home and agricultural purposes. Most wells provide low yields, generally less than 10 gpm, and very few wells produce more than 20 gpm. In addition, the quality of ground water varies throughout the area, at times including total dissolved solids, bacteria, and hydrogen sulfide. While sufficient ground water seems to be present to supply individual residences, there is very little likelihood of drilling wells that could produce enough high quality ground water to supply large communities.

4.4 SURFACE WATER

The surface water resources involved in this evaluation include the upper Duck River watershed and a small part of the Elk River watershed. The Duck River watershed upstream from the Hickman/Maury county line includes an area of approximately 1,700 square miles. Much of this watershed consists of small streams that drain directly into the Duck River; however, the basin does include five tributaries that each drain 100 square miles or more (Garrison Fork [130 square miles], Big Bigby Creek [129], Big Rock Creek [121], Rutherford Creek [116], and Fountain Creek [103]). Normandy Reservoir is the only large impoundment in the watershed [3,230 acres at full pool); however, at least four run-of-the-river dams still impound some water on the mainstem (from downstream: Columbia City Dam, Lillard Mill Dam, Shelbyville Dam, and Courtner's Mill Dam).

After Normandy Reservoir was completed in 1976, the average annual flow in the Duck River has been 843 cfs at Shelbyville and 2155 cfs at Columbia. TVA operates Normandy Dam to provide a continuous minimum flow of 40 cfs immediately downstream from the dam, and 155 cfs of minimum flow at Shelbyville. The 40 cfs of minimum flow downstream from Normandy Dam helps maintain aquatic life in the upper part of the river. The 155 cfs at Shelbyville maintains water quality below the Shelbyville wastewater discharge. As indicated in Section 2.2, Normandy Reservoir has sufficient storage to provide up to an additional 10 cfs of flow to meet water supply needs at Shelbyville. During drought conditions, the water released from Normandy Dam is essentially the only streamflow available in the Duck River to maintain aquatic life and meet water supply and recreational uses. During drought conditions, all but one of the tributary streams between Shelbyville and

Columbia cease to flow and water withdrawals and evaporative losses result in a reduction in streamflow in the 90-mile reach (TVA, 1998a).

The Duck River is considered a warmwater stream except for the 4.6 mile reach just downstream from Normandy Dam which is maintained as a coldwater reach. Dissolved oxygen concentrations in the river are normally 5.0 mg/L or higher, especially upstream from Columbia. Downstream from about Duck River Mile 160, the slope of the river becomes very flat (1.3 feet per mile) and the river is very sluggish. During dry months, natural oxygen replenishment is low in this reach and the combination of high sediment oxygen demand and extensive algal growth reduce dissolved oxygen levels, particularly in long pools.

The parts of the Elk River watershed involved in this evaluation include two embayments of Tims Ford Reservoir and an adjacent reach of East Fork Mulberry Creek. Tims Ford Dam, located at Elk River Mile 133.3, forms a 10,600 acre reservoir that receives water from an area of 529 square miles. The two larger embayments on the northwestern edge of this reservoir, Lost Creek and Hurricane Creek embayments, are separated by Chestnut Ridge. The Jack Daniel Distillery and Lynchburg, Tennessee, operate a joint water intake on the Lost Creek embayment of Tims Ford Reservoir. East Fork Mulberry Creek runs along State Route 55 northeast of Lynchburg, and drains approximately 17 square miles of area just west of the Lost Creek and Hurricane Creek basins. The East Fork flows southwest into Mulberry Creek, which empties into the Elk River near Fayetteville (at River Mile 101).

Water Use

As indicated in Chapter 2, the Duck River is the most important water source for people living in this area. Municipal water intakes are located at Duck River Miles 133.9 (Columbia), 202.4 (Bedford County), 221.9 (Shelbyville), and 255.0 (Duck River Utility Commission) (see Figure 2).

The Duck River also receives most of the discharge from municipal wastewater treatment systems in the area. Wastewater discharges on the river are located at Duck River Miles 127.2 (Columbia), 221.3 (Shelbyville), and 268.5 (Manchester). In addition, the Spring Hill wastewater is discharged into Rutherford Creek 19 miles upstream from its mouth at Duck River Mile 130.4, and the Lewisburg wastewater is discharged into Big Rock Creek 16 miles upstream from its mouth at Duck River Mile 180.4. The only operating

industrial wastewater discharge in the area is located on Big Bigby Creek about 15 miles above its confluence with the Duck River at River Mile 109.2. Several organic and inorganic chemicals regulated under the Safe Drinking Water Act as primary drinking water contaminants are present in the industrial effluent. The company provides a high treatment level for its wastewater, including carbon absorption, to remove organics. The volume of wastewater is small (0.13 cfs) in comparison with the low flow of the creek (3.6 cfs) and the treatment protects the use of Big Bigby Creek for water supply.

As more and more water is withdrawn from the Duck River, the amount of water available for assimilation of treated wastewater is reduced and water supply and waste assimilation actually begin to compete with each other. Furthermore, instream flow needs to maintain recreation and aquatic life also are in competition for the limited remaining water. In recognition of the need to balance all of these uses, TDEC has determined that future water withdrawal at Columbia should not reduce the one-day average flow in the Duck River below 100 cfs (TVA, 1998a).

Classified Uses

TDEC has identified beneficial uses for all surface waters in the state of Tennessee and has established water quality criteria which specify the minimum level of quality necessary to support each use. Nearly all of the Duck River from River Mile 71.5 upstream to its origin has been classified for the following uses: domestic water supply, industrial water supply, fish and aquatic life, recreation, irrigation, and livestock watering and wildlife. Two of the three exceptions along the river are short reaches just downstream from the municipal wastewater discharges at Columbia and Shelbyville. The domestic water supply use classification was excluded in these areas because TDEC previously considered stream reaches immediately downstream from municipal wastewater discharges to be unsuitable for domestic water supply withdrawal. TDEC no longer considers the first five miles of stream reach downstream from a wastewater discharge to be unsuitable for domestic water supply use and would reclassify the reach to protect that use if requested to do so. The third exception is the 4.6-mile reach of the Duck River just downstream from Normandy Dam. This reach is classified as a trout stream and is expected to have higher dissolved oxygen levels and a lower maximum temperature than water classified for warmwater fish and aquatic life.

All tributary streams flowing into the Duck River within this project area have been classified for the following uses: fish and aquatic life, recreation, irrigation, and livestock watering and wildlife. In addition, six of the larger tributaries (Garrison Fork, Big Rock Creek, Rutherford Creek, Little Bigby Creek, Big Bigby Creek, and Catheys Creek) have been classified for domestic and industrial water supply use. Although these streams are classified for these uses, the mainstem Duck River is the only stream in this part of the watershed that is presently being used as a domestic or industrial water supply source. The classification means that the quality of water in these streams should be maintained at a level capable of supporting all of the identified uses, in this case including domestic and industrial water supply.

As a whole, Tims Ford Reservoir is classified for the following uses: domestic water supply, industrial water supply, fish and aquatic life, recreation, irrigation, and livestock watering and wildlife. The specific parts of Tims Ford Reservoir in the Hurricane Creek and Lost Creek embayments are classified for the following uses: fish and aquatic life, recreation, irrigation, and livestock watering and wildlife. East Fork Mulberry Creek is classified for industrial water supply, fish and aquatic life, recreation, irrigation, and livestock watering and wildlife.

Water Quality - Upper Duck River Watershed

TDEC regularly evaluates water quality conditions in streams to determine if conditions are capable of supporting the classified uses. In the 1998 assessment (TDEC,1998), several stream reaches in the upper Duck River watershed were identified as having some degree of use impairment. These stream reaches, their recent ratings, and the listed reasons why water uses are not being fully met are presented in Table 10. All of the other reaches of the Duck River and its tributaries in this project area were found to be fully supporting their classified uses.

Although several tributary streams in this project area only partially support their classified uses, these effects are typically confined to the tributaries themselves and have little impact on the mainstem Duck River. Like many other parts of Tennessee, soil erosion along roadsides, cropland, and denuded stream banks cause widespread fluctuations in turbidity, suspended solids, and other water quality indicators in this watershed. Soil erosion in several of the tributaries also contributes to the high turbidity levels observed in the river following major runoff events.

Table 10. Stream segments in the upper Duck River watershed that were not supporting their classified uses in 1998 (TDEC, 1998).

Stream Segment	Rating	Apparent Cause
Coffee County		
Duck River mainstem below the mouth of the Little Duck River	Not Supporting	bacteria contamination from the Manchester municipal wastewater collection system, urban runoff
Bedford County		
Duck River below Normandy Dam to (the upper) Flat Creek	Partially Supporting	non-point sources, high levels of iron and manganese in releases from Normandy Dam
Doddy Creek	Partially Supporting	agricultural non-point sources
Wartace Creek	Partially Supporting	agricultural non-point sources, Bell Buckle municipal wastewater treatment plant discharge
Bell Buckle Creek	Partially Supporting	agricultural non-point sources, Bell Buckle municipal wastewater treatment plant discharge
Thompson Creek (including Bennett Branch and Anderton Branch)	Partially Supporting	agricultural non-point sources, landfill leachate
Fall Creek	Partially Supporting	agricultural non-point sources
North Fork Creek	Partially Supporting	agricultural non-point sources
Alexander Creek	Partially Supporting	agricultural non-point sources
Weakley Creek	Partially Supporting	agricultural non-point sources
Clem Creek	Partially Supporting	agricultural non-point sources
Spring Creek	Partially Supporting	agricultural non-point sources
Caney Creek	Partially Supporting	agricultural non-point sources
Marshall County		
Big Rock Creek	Partially Supporting	Lewisburg municipal wastewater treatment plant, urban runoff
Maury County		
Fountain Creek (including Silver and Globe creeks)	Partially Supporting	agricultural non-point sources
Catheys Creek (including Curry Branch)	Partially Supporting	agricultural non-point sources
unnamed tributary to Little Bigby Creek	Not Supporting	urban non-point sources from Columbia
Lytle Creek	Partially Supporting	industrial point sources
unnamed tributary to Lytle Creek	Not Supporting	industrial point sources
Rutherford Creek	Partially Supporting	industrial point sources, mining
Sugar Creek	Not Supporting	landfills, an industrial point source, and mining

Nitrogen and phosphorus levels in the upper Duck River watershed, consistently in the upper range of values observed in Tennessee River watersheds (TVA, 1984), strongly suggest contributions from non-point sources. Total iron and total manganese concentrations also are high in comparison to other watersheds in the Tennessee Valley (Parr, 1991). Most of the iron and manganese is in a relatively insoluble form and can be easily removed from drinking water by conventional treatment processes. High levels of bacteria in tributary streams are a major source of bacteria observed in the Duck River after rainfall events.

Organic compounds from point and non-point sources, combined with inputs from natural sources such as tree leaves and algae, can cause high levels of organic material to be present periodically in the streams within the upper Duck River watershed. When water suppliers add chlorine to the water as part of their treatment procedures, the chlorine reacts with the organic material to form disinfection byproducts such as trihalomethanes and haloacetic acids. New, more stringent standards resulting from the 1996 amendments to the Safe Drinking Water Act are scheduled to go into effect in December 2001 for larger water treatment systems and in December 2003 for smaller systems. Some water systems which use the Duck River as a water source may not be able to reach the new standards without modifying their present treatment methods. Two water systems have already been identified by TDEC as not being able to meet the new standards using their present treatment methods.

On a more site-specific basis, starting at the upstream end of the watershed, water quality impacts have been identified in the Little Duck River and Duck River as a result of sewage collection system problems at Manchester. The state of Tennessee advises against water contact in the Little Duck and Duck rivers in the vicinity of Old Stone Fork State Park.

TVA has monitored the ecological health of Normandy Reservoir several times since 1993 (TVA, 1998b). The ecological health of this reservoir has consistently been rated fair each time it has been evaluated, largely because of severe dissolved oxygen depletion and poor rating for the benthic community. Typically from late May through October, the dissolved oxygen concentrations in the reservoir are below 1mg/L in all but the upper 15 feet of the water column. Normandy Reservoir has one of the worst dissolved oxygen depletion problems in the TVA reservoir system. The absence of dissolved oxygen also causes an increase in dissolved iron and manganese levels in the deeper water

of Normandy Reservoir and in the water released from the dam. High concentrations of iron and manganese also make water in the lower part of the reservoir less desirable for water supply withdrawal. In 1998, the average summer chlorophyll-a concentration was 12.6 ug/L which was higher than in any of the other previous year and indicates a higher degree of algae production than in the past (TVA, 1998b).

Bacteriological sampling conducted in the summer of 1999 at two Normandy Reservoir recreation areas indicated some contamination at both sites. At the Barton Springs Public Use Area, two samples collected in June exceeded the state of Tennessee water quality recreation individual sample criterion (1,000/100mL fecal coliform). This criterion also was exceeded once in June at the Cedar Point Public Use Area. The other Tennessee water quality recreational site bacterial criterion (geometric mean value of 200/100mL of 10 samples taken over a 30-day period) was not exceeded at either of these sites. These occasional episodes of bacterial contamination may be associated with the large number of waterfowl that congregate around both of these public use areas.

During summer and fall, the releases from Normandy Reservoir produce high levels of iron and manganese in the Duck River just downstream from the dam. Iron and manganese coatings on river rock extend as far downstream as Duck River Mile 239.9 (Tennessee Technological University, 1983). Iron and manganese impact the use of the Duck River for water supply and aquatic life from Normandy Dam to the confluence of Garrison Fork (Duck River Mile 239.6). In 1993, bacteriological testing by TVA at four locations between Normandy Dam and Shelbyville (Duck River Mile 221.4) showed that fecal coliform bacteria levels exceeded the Tennessee water quality criterion for recreational use. Bacterial levels were highest after rainfall, suggesting non-point source contributions. As indicated in Table 10, TDEC has determined that the Duck River from River Mile 236.9 to 219.1 is only partially supporting its recreation and aquatic life use classifications due to bacteria and siltation from agricultural and urban non-point sources.

Agricultural activities are extensive in the upper Duck River watershed, primarily in Marshall and Bedford Counties. Runoff from dairy and livestock operations, along with soil erosion from roadsides, cropland, and denuded stream banks, are the principal non-point sources in this part of the watershed. These sources cause wide fluctuations in water quality indicators

such as turbidity, suspended solids, and fecal coliform bacteria. Residential development in the watershed area also has been linked to bacteria contamination in the surface waters. The substantial bacterial contamination observed in Fall Creek and North Fork Creek (Table 10) appear to be the result of a combination of agricultural and septic system non-point sources. Bacteriological sampling conducted by TVA during the summer of 1995 indicated that similar increases occur in eastern Maury County (TVA, 1999). Those data also indicated that almost every increase in bacterial counts in the water could be traced to a rainfall event upstream from the sampling location. Reductions in bacterial numbers to low levels following one or two days of dry weather suggested that non-point sources were responsible for the high levels.

Big Rock Creek is impacted periodically by the Lewisburg wastewater discharge. During dry months, the very low flow in Big Rock Creek provides insufficient initial dilution for the assimilation of the municipal wastewater discharge. This results in low dissolved oxygen concentrations and organic enrichment impacts downstream from the treatment plant; however, these impacts do not extend into the Duck River downstream from the mouth of Big Rock Creek.

As indicated in Table 10, TDEC has determined that water quality criteria are being exceeded in the Fountain Creek watershed, apparently from agricultural non-point sources. During the summer of 1998, TVA measured water quality in Fountain Creek and at six tributary sites. The data collected during this study are presented in Appendix A. Results from that study indicated that fecal coliform bacteria at two sites on Fountain Creek exceeded the Tennessee water quality criterion of 1,000/100mL in an individual sample on three different sampling dates. The same criterion was exceeded at a site on South Fork on two sampling dates. Other sampling locations showed elevated levels of bacteria suggesting impacts from agricultural non-point sources. The study was conducted during an extended dry period in August-November so the observed bacteria levels were probably lower than what would have been observed during or immediately following a rainfall event.

TDEC monitors water quality at Duck River Mile 113.9 in Maury County on a quarterly basis. Results since 1990 show that fecal coliform levels have periodically exceeded 1,000/100mL during and immediately following major rainfall events. These high bacterial levels probably are related to the large number of farm animals present in the watershed and their accessibility to the

river system. High levels of fecal coliform bacteria indicate the potential for disease-causing organisms to be present and are a concern for recreation and water supply uses.

Water Quality - Tims Ford Reservoir Area

TDEC has determined that all streams in the Elk River watershed area covered by this analysis, as well as Tims Ford Reservoir, are fully supporting designated uses. Bacteriological sampling in June 1999 at four recreation sites on Tims Ford Reservoir showed all sites met the Tennessee water quality criteria for water contact recreation use (TVA, 1999).

TVA has monitored the ecological health of Tims Ford Reservoir several times since 1992 (TVA, 1998b). The resulting ecological health ratings for Tims Ford Reservoir have declined from fair in 1992, 1993, 1994 and 1995 to poor in 1996 and 1998. Recent poor ratings are the result of low concentrations of dissolved oxygen during the months of June through October, poor benthic community results, and increased chlorophyll-a levels over previous years. Dissolved oxygen levels were less than 2 mg/L throughout most of the lower water column and at or near zero on the bottom of the reservoir from July to October. The consistent low dissolved oxygen levels at the bottom of the reservoir help explain the poor condition of the aquatic organisms living there. Low concentrations of dissolved oxygen would extend into deeper portions of the Hurricane Creek and Lost Creek embayments of Tims Ford Reservoir. Also, increased levels of dissolved iron and manganese would be expected to be associated with low concentrations of dissolved oxygen.

4.5 AQUATIC LIFE

Information presented in the Columbia Land Use EIS (TVA, 1999) indicates that the Duck River supports some of the most species-rich aquatic communities in North America. Most recent surveys of aquatic life conducted in this watershed, however, have focused on the middle reach of the Duck River, the part that would have been affected by completion of the Columbia Reservoir Project. The four action alternatives included in this EIS could affect other parts of the mainstem Duck River, ranging from near the Hickman County Line (River Mile 100) upstream to Normandy Reservoir (as far upstream as River Mile 265). In addition, these alternatives could affect some Duck River tributary streams and, under the Tims Ford Pipeline Alternative, small parts of the upper Elk River watershed.

The following discussion covers the aquatic life present in this study area but uses a number of techniques to abbreviate and clarify the presentation for most general readers. The discussion is divided into two major parts: the Duck River and other "big water" habitats, and Fountain Creek and the other tributary streams. Within each of these parts, individual paragraphs describe what is known about the major groups of aquatic plants and animals that are present. This text is accompanied by just two tables which summarize the data; however, all of the supporting lists of species are presented in Appendix B. The intent of this section is to describe the types of aquatic habitats that are present in this study area and to indicate the diversity of species that occur in each of them.

River and Reservoir Habitats

The Duck River is the major aquatic habitat within this study area; however, various parts of the river have different habitat characteristics and support different types of aquatic communities. For this discussion, the Duck River is considered to consist of three parts: a more downstream reach, a middle reach, and an upstream reach. The downstream reach included in this evaluation extends from near the Hickman/Maury County line (about River Mile 100) upstream through the City of Columbia and the pool of the Columbia City Dam (to approximately River Mile 135). As indicated in Section 4.4, this 35-mile reach of the river has a rather low gradient and consists of long pools and well-defined runs or riffles. Near its upstream end, this river reach also receives wastewater and other discharges from the developed areas around Columbia.

The middle reach of the Duck River included in this evaluation extends from the upstream end of the Columbia City impoundment (around River Mile 136) upstream to Lillard Mill Dam (River Mile 179). This 44-mile river reach consists of somewhat shorter pools and a large number of well-defined riffles, runs, and island complexes. At its upstream end, Lillard Mill Dam forms a barrier to upstream fish movement (except under high flow conditions). Much of this reach meanders through the Columbia Project lands, relatively little of which has been cultivated or affected by extensive human development since most of the land was acquired about 20 years ago.

The upstream of these Duck River reaches extends from above Lillard Mill Dam (about River Mile 180) upstream to Normandy Dam (River Mile 249). The physical habitat in this 70-mile river reach is similar to the middle reach; however, the flow regime and temperature of the water are both affected by releases from Normandy Dam (See Section 4.3). This reach also receives wastewater and other discharges from the area around Shelbyville.

Two additional habitats are included in this part of the discussion, primarily out of convenience. Normandy Reservoir is an impoundment on the Duck River located at River Mile 249. As indicated in Sections 1.2 and 4.4, Normandy Dam was closed in 1976, and forms a 3,230-acre impoundment. At the summer pool level, this reservoir is 87 feet deep; however, the level is drawn down 11 feet during the winter.

Tims Ford Reservoir is an impoundment on the Elk River at River Mile 133. As indicated in Section 4.4, this reservoir is located in Moore County, just south of Bedford County and the upstream part of the Duck River basin. Tims Ford Dam, which was closed in 1970, forms a 10,600-acre reservoir at summer pool and is 130 feet deep adjacent to the dam. The winter drawdown is 23 feet.

Table 11 presents a summary of the numbers of species or other taxonomic levels that have been encountered in each of these five river or reservoir reaches during the last 30 years. As indicated in this table, between 44 and 436 different forms of aquatic life have been identified from these areas. The following paragraphs address several of the major groups of plants and animals that are included.

Table 11. Summary of numbers of aquatic species known from three reaches of the Duck River, Normandy Reservoir, and Tims Ford Reservoir. Supporting data and references are presented in Appendix B.

Plant and Animal Groups	**DRM 100 - 135**	**DRM 136-179**	**DRM 180 - 249**	**Normandy Reservoir**	**Tims Ford Reservoir**
Plankton	NS	123	118	NS	NS
Plants	NS	10	12	NS	NS
Insects	NS	142	81	3	7
Other Invertebrates	NS	27	17	5	5
Mollusks	22+	54	23	1+	NS
Fish	56	80	72	35	36
Totals	**78+**	**436**	**323**	**44+**	**48+**

NS - Community not sampled in this reach

Plankton and Periphyton

The small (generally microscopic) plants and animals which live floating in the water make up the plankton community. Some of these same microscopic species or genera also live in the periphyton, the thin layer of living things that forms on rocks, twigs, and other material in the water. Between 1979 and 1983, TVA staff conducted a great deal of biological work in the Duck River (and elsewhere) as part of the Cumberlandian Mollusk Conservation Program (CMCP, see Section 1.2). Two of 15 sites examined in detail as part of the CMCP work were located in the Columbia Reservoir area (Sowell Ford, River Mile 156; and Lillard Mill, River Mile 179). Two other CMCP sites (Halls Mill, River Mile 202; and Dement Bridge, River Mile 243) were located between the proposed reservoir area and Normandy Dam. During the CMCP evaluation, plankton and periphyton samples were collected monthly at the four Duck River CMCP sites from July through September 1980, and from April and June through September 1981 (Wade and Webb, 1986). No detailed plankton or periphyton identification data are available from the Duck River downstream of Columbia or in either Normandy or Tims Ford reservoirs.

The names of the various species or genera found in these two river reaches are presented in Appendix B (Tables B-1 and B-2) and the numbers of species are summarized in Table 11. With regard to the overall number of species or genera present, about the same number of plankton plants and animals were found in the middle and upper river reaches (123 and 118 taxa, respectively). The more detailed data presented in Tables B-1 and B-2 indicate that about 25 percent more types of planktonic plants were found in the middle reach than upstream but about 20 percent more types of planktonic animals were found in the upstream reach than in the middle one. These differences could be caused by a number of things; however, colder water might limit the variety of planktonic plants that could live in the upstream reach, and a wide variety of fish predators (see below) might reduce the abundance of planktonic animals in the middle reach.

Macrophytes

During the CMCP evaluation, TVA staff also identified the larger plants which routinely live in the water (the aquatic macrophytes). The macrophytes which occurred in the river in the vicinity of each CMCP site were examined during a float survey, and the plants at the specific evaluation sites were carefully documented during a mapping study (Wade and Webb, 1986).

The macrophyte species found at or near the four Duck River CMCP sites are presented in Appendix B, Table B-3, and are summarized in the middle and upper reach columns in Table 11. No comparable sampling has been conducted in the downstream stream reach or in either of the reservoirs. The detailed data show that eight plant species were found in both the middle and upper river reaches, suggesting a fairly uniform aquatic plant community in at least those two parts of the river.

Insects and Other Invertebrates (except Mollusks)

The larger aquatic insects and other types of animals without backbones (invertebrates) which live in the middle reach of the Duck River have been examined several times in recent years by TVA staff and others. Much of this work was done in the early 1980s as part of the CMCP evaluations (primarily Barr et al., 1986); however, other studies were conducted both earlier (TVA, 1975) and later (e.g., Ahlstedt and Saylor, 1992). The bottom-dwelling (benthic) invertebrates present in both Normandy and Tims Ford reservoirs have been sampled several times during the 1990s as part of the TVA Vital Signs Monitoring Program (Dycus, et al., 1999). Unfortunately, neither of these groups of invertebrates have been sampled in the downstream reach of the Duck River included in this assessment. Usually, the animals were preserved in the field and, later, identified using a variety of references. The ease with which these animals could be identified down to the genus or species level depended on the taxonomic group involved, the expertise of the staff making the identifications, and the purpose of the specific project. In virtually all of these groups, there are probably many more species present than have been identified.

The extensive lists of invertebrate species (or higher taxonomic categories) which have been found in at least some of these river and reservoir reaches are presented in Appendix B, Table B-4. All of these records are summarized in two rows of Table 11, in part to help identify some of the differences that are present. The summary numbers for both the insects and the other invertebrates indicate that the most taxa were encountered in the middle reach of the Duck River (142 and 27 taxa, respectively), just over half that many taxa were found in the upstream reach, and very few taxa were found in either of the reservoirs (for example, only three insect taxa and five other invertebrate taxa have been found in Normandy Reservoir). The very few types of insects and other invertebrates encountered in these two reservoirs is typical of tributary reservoirs within the Tennessee Valley (and elsewhere), and probably

indicates the small number of bottom-dwelling species which are able to survive in the slow-moving, relatively cold, at times oxygen-deficient habitats that occur in those reservoirs. The fewer number of taxa present in the upstream reach may be related to effects of the relatively low temperature of the water released from Normandy Dam, perhaps accompanied by some effects from the farms and businesses in the upstream part of the watershed.

Mollusks

Freshwater mollusks are represented in the Duck and Elk River basins by river snails, native mussels, fingernail clams, and the Asiatic clam. These typically large aquatic invertebrates are seldom collected with the dredge or net sampling techniques routinely used to sample insects and other bottom-dwelling invertebrates. During the last 30 years, TVA staff and a few others have conducted several surveys specifically to document the distribution and abundance of the mussels and, occasionally, the aquatic snails which live in the middle and upper reaches of the Duck River. As part of the preparations for this EIS, TVA staff sampled the native mussel species present at two locations in the downstream reach of the river. The results of these studies are summarized in Table 11, and the details are presented in Appendix B, Table B-5.

The numbers of mollusk species presented in Table 11 indicate that the most species (54) were found in the middle reach of the river, approximately half that many were found in both the downstream and upstream reaches, and only one mollusk species was encountered in Normandy Reservoir. Very few mollusks probably occur in the reservoirs for the same reasons few other bottom-dwelling invertebrates are found there; they are not adapted to the slow-moving, relatively cold, sometimes oxygen-deficient habitats that exist in tributary reservoirs. The relatively large number of mussel and snail species found in the middle reach have been known to occur in that part of the Duck River for a long time (e.g., Isom and Yokley, 1968) and represent much of the diversity that was present at least 100 years ago (Ortmann, 1924). The lower numbers of species present in the downstream and upstream river reaches appear to represent reductions from the original diversity probably caused by past pollution events and human disturbances in the watershed (van der Schalie, 1973).

Fish

The fish species which occur in the Duck River have been surveyed more extensively and more often than any other parts of the aquatic communities. The most intensive of these surveys were conducted as part of the CMCP work (summarized in Barr et al, 1986); however, a variety of other surveys or site visits also have contributed many occurrence records (especially Burr et al., 1993; Nieland, 1982; and Scott and Gardner, 1995). During the 1990s, TVA crews also have sampled the fish communities in Normandy and Tims Ford reservoirs as part of the Vital Signs Monitoring Program (Dycus, et al., 1999). All of the fish species encountered during these surveys are listed in Appendix B Table B-6. A summary of this information is included in Table 11.

The numbers of fish species presented in Table 11 indicate more similarity among the river reaches and reservoirs than was apparent for the insects, other invertebrates, or mollusks. The middle reach still yielded the most species (80), but the upstream and downstream reaches were found to have only slightly fewer (72 and 56 species, respectively), and the reservoirs yielded nearly half as many as the middle reach (35 and 36 species). In this case, the raw numbers are somewhat misleading, especially with regard to the reservoirs. The detailed data (presented in Appendix Table B-6) indicate that 25 fish species were found in four or all five of these river or reservoir areas; however, most of the other 77 species occurred only in reaches with more restricted types of habitats. Two families of fishes (the minnows and the darters) were represented by many more species in the river reaches (together between 28 and 42 species) than in the reservoirs (5 or 8 species). Conversely, a few fishes were found only in the reservoirs (e.g., threadfin shad, yellow bass, and yellow perch). In general, the middle reach of the river yielded the most species, with additions or deletions in the other areas depending on the presence or absence of different habitat characteristics (e.g., rainbow trout were found only in the upstream reach, the reach receiving the cold water discharge from Normandy Dam).

River and Reservoir Summary

The total numbers of species (and other taxonomic levels) encountered in these three reaches of the Duck River and Normandy and Tims Ford reservoirs are presented at the bottom of Table 11. These numbers indicate that the middle reach of the river supports the most types of aquatic life (436), followed relatively closely by the upstream reach (323). The numbers of species known from the downstream reach and the two reservoirs are much lower, in part because some major aquatic groups have not been sampled in those areas.

Information presented in the previous paragraphs indicates that, where sufficient sampling has been done, the reservoir habitats support many fewer species than any of the flowing water reaches. Among the three reaches of the Duck River, the upstream reach supports more planktonic animals than the middle reach but fewer species of planktonic plants, insects, other invertebrates, mollusks, and fishes. The most often mentioned possible reason for these differences is the cold water released from Normandy Dam. The downstream reach is represented only by numbers for mollusks and fishes and, in both cases, yielded fewer species than either the middle or upstream reaches. At least with regard to the mollusks, this reach seems not to have completely recovered from the effects of earlier pollution and other human disturbances in the area.

Tributary Habitats

The four action alternatives included in this evaluation could affect several Duck River tributaries if one or more of them were adopted. Poplar and Greenlick creeks occur along the most likely pipeline route from a downstream intake site to the City of Columbia, Fountain Creek and several of its tributaries exist in the watershed which could be impounded to form a Fountain Creek reservoir, and Flat Creek flows along the most likely route of a pipeline between a Tims Ford intake and the closest part of the Duck River (near Shelbyville). Of these streams, Fountain Creek drains the largest watershed (103 square miles), followed by Flat Creek (50 square miles), Greenlick Creek (23.6 square miles), and Poplar Creek is the smallest (6.4 square miles) (TVA, 1970).

Existing and new information about the aquatic life present in these three groups of Duck River tributaries is summarized in Table 12. The detailed information upon which this summary is based is presented in Appendix B, Tables B-7 through B-14. As indicated in Table 12, several taxonomic groups have not been sampled in some of these tributary streams. The information that is available, however, is sufficient to indicate the general quality of these communities and the types of aquatic life that is present.

The numbers of species or other taxonomic levels of the plankton, insects and other invertebrates in the Fountain Creek watershed is derived from sampling conducted by University of Tennessee staff at the Tennessee Route 50A bridge (east of Culleoka) in September 1981 and June 1982 (Etnier, et al., 1983). As indicated in Appendix B Table B-7, the plankton sampling included only the

microscopic plants; the planktonic animals were not sampled. While no similar survey information is available for these parts of the aquatic communities from the downstream or upstream tributaries, incidental observations about the more obvious representatives of these groups was made during rather focused sampling for mollusks and fishes that was conducted by TVA staff in June 1999. For comparative purposes, the numbers of insects and other invertebrates encountered in Fountain Creek (a total of 100 taxa) is comparable to the total for these groups found in the upstream reach of the Duck River (98 taxa, total) but is substantially less than was found in the middle reach of the river (169 taxa).

Table 12. Summary of numbers of aquatic species known from three groups of Duck River tributaries. Supporting data and references are presented in Appendix B.

Plant and Animal Groups	**Greenlick and Poplar Creeks**	**Fountain Creek Watershed**	**Flat Creek Watershed**
Plankton	NS	27+	NS
Plants	NS	NS	NS
Insects	NS	88	NS
Other Invertebrates	NS	12	NS
Mollusks	2	5	8
Fish	25	50	38
Totals	**27+**	**182+**	**46+**

NS - Community not sampled in this reach

Mollusks and fishes in the downstream creeks and Flat Creek were sampled during June 1999 (TVA unpublished data). Mollusk information from the Fountain Creek watershed was collected during the University of Tennessee study (Etnier, et al., 1983) and a TVA survey conducted in 1990 (TVA unpublished data). Most of the mollusks encountered in these creeks were snails; Flat Creek was the only one of these streams found to support as many as four freshwater mussel species. Even though Flat Creek has slightly smaller watershed than Fountain Creek, it was found to support more mollusk species than any of the other tributaries included in this examination.

The fish species occurring in these creeks, like the Duck River, have been the subject of relatively more collection effort and study. In addition to the results of the recent TVA sampling in Poplar, Greenlick, and Flat creeks, several collections have been made in various parts of the Fountain Creek watershed. Perhaps because of the more extensive sampling effort, Fountain Creek yielded the most fish species (50); however, the total for Flat Creek (38) was only slightly lower. Poplar and Greenlick creeks yielded 19 and 16 species, respectively (Appendix B, Table B-14), for a composite total of 25 species.

Tributary Summary

The total numbers of species (and other taxonomic levels) presented at the bottom of Table 12 indicate that the most types of aquatic life were encountered in the Fountain Creek watershed (182+); however, that total included information about several major groups that had not been sampled in the other watersheds. With regard to mollusks and fishes, both of which had been the subject of specific searches in each of these watersheds, the 46 species in these two groups found in the relatively small Flat Creek watershed probably represents the least disturbed of these streams. The 19 fish species found in Poplar Creek, draining a very small watershed, also seems to represent a relatively undisturbed stream. The 55 species of fishes and mollusks found in the Fountain Creek watershed and the 18 species in Greenlick Creek seem lower than expectations would predict. The site sampled on Greenlick Creek, in particular, seemed to have an excessive amount of fine sediment and many species were represented only by single individuals.

4.6 WETLANDS

Wetlands are areas that are wet or covered by shallow water for at least part of the year. Their soil conditions, and the plant and animal life they support, are determined mainly by the presence of water. Most wetlands are dominated by plants that can live in areas that are frequently flooded or have water present for long periods of time. These habitats are generally teeming with life because of the abundant water and nutrient supplies that are available to a wide variety of aquatic and terrestrial plant and animal species. Established wetlands also are important in controlling erosion, preventing flooding and storm damage, improving water quality, and helping to recharge ground water.

Wetlands are protected under both state and federal laws because of the benefits they provide. These "jurisdictional wetlands" (wetlands that meet specific criteria: having wetland plants, wetland soils, and wetland hydrology) are protected under Section 404 of the Clean Water Act. This law is administered by USACE. In addition, Executive Order 11990 (Protection of Wetlands) addresses wetlands located on federal property or affected by federal projects. In Tennessee, activities in wetlands also are regulated by TDEC under the authority of the Tennessee Water Quality Control Act of 1977.

The USFWS has produced a series of National Wetland Inventory (NWI) maps for much of the United States using a habitat-based classification system (Cowardin et al., 1979). This classification system starts out by identifying whether the wetland is basically part of a marsh (palustrine), part of a lake (lacustrine), or part of a stream (riverine). The classification system also identifies more detailed features of the habitat and the vegetation that is present.

Identification of wetlands in the project area was based on the NWI maps and existing color infrared photography of the Fountain Creek watershed. According to the available information, wetlands in the project area fall into three classification types: palustrine forested broad-leaved deciduous wetlands, palustrine scrub-shrub broad-leaved deciduous wetlands, and palustrine emergent, persistent [vegetation] wetlands. The following paragraphs indicate what is known at present about the wetlands that might be affected by each of the action alternatives.

Fountain Creek Reservoir Area

Wetland resources in the possible area of a Fountain Creek reservoir were identified based on an aerial inventory using color infrared photography, in addition to the information on the NWI maps. The results indicate that there are approximately 200 acres of palustrine forested wetlands, and approximately 25 acres of mixed palustrine forested and scrub/shrub wetlands in the project area. These wetland areas typically occur in narrow strips located along Goose Creek, Hurricane Creek, Silver Creek, and Greasy Branch.

Downstream Water Intake Area

The NWI map indicates palustrine forested wetlands associated with Gin Branch, Poplar Creek, and John Branch. There is also an extensive area of forested wetlands associated with the Duck River on the west side of Shelby

Bend and east of Greenfield Island. Several areas of palustrine emergent wetlands occur near the mouth of Poplar Creek. Palustrine scrub-shrub wetlands occur in a small area near the mouth of Poplar Creek and in the north section of Shelby Bend on the Duck River. All together, these areas amount to approximately 90 acres.

Normandy Reservoir Area

The NWI indicates the majority of wetlands are confined to the shallow heads of embayments around the reservoir. Many linear palustrine forested areas occur where tributary streams flow into the reservoir. The NWI indicates two small palustrine emergent wetlands in the Riley Creek embayment, one in the Barton Spring embayment, and another in the upper end of the lake northeast of Bullen Run. Two areas of palustrine scrub-shrub wetlands are located in an embayment just north of the dam. All together, these areas amount to approximately 220 acres.

Tims Ford Pipeline Area

The NWI indicates a number of palustrine forested wetlands in the most likely area where this alternative could be built. These are primarily linear wetlands associated with Flat Creek and its tributaries, and along the Long Creek and Hurricane Creek embayments on Tims Ford Reservoir. Three small palustrine emergent wetlands are indicated in embayments associated with Long Creek and Turkey Creek. Together, these areas amount to approximately 270 acres.

These initial descriptions of possible wetlands associated with the action alternatives were based on NWI map information compiled using high-altitude aerial photography (some of which is more than ten years old), accompanied by more recent data and limited field reconnaissance. While the existing information forms a good starting point, many wetland areas are small and/or hard to identify from high-altitude photographs. In addition, wetlands can change into other types of habitats over time, especially when landowners want to use the land for other purposes.

4.7 FLOODPLAINS/FLOOD CONTROL

Information exists about Duck River floods in the Columbia area from as early as 1814, but the first flood for which any elevation data are available occurred in 1874. The largest known flood in Columbia occurred in February 1948

when the Duck River exceeded bank-full stage by almost 20 feet. Other information about the flood history of the area is available in records maintained by the U.S. Geological Survey and TVA.

The Federal Emergency Management Agency coordinates the identification of floodplains and the preparation of Floodplain Maps in cooperation with local governments all across the country. Communities and other local agencies use the Floodplain Maps to establish the limits of floodplain areas in the community and to adopt specific floodplain regulations as the basis for their zoning or other flood protection planning measures.

Within this general project area, Maury, Marshall, and Moore counties, and Columbia and Shelbyville participate in the National Flood Insurance Program (NFIP) and have adopted the 100-year flood as the basis for their local floodplain regulations. Bedford and Coffee counties do not participate in the NFIP; however, some floodplain areas have been identified in parts of these counties.

With regard to the streams in this study area, floodplains have been identified and Floodplain Maps have been prepared for all of the included reach of the Duck River and for numerous other streams. This information has been made available to the counties and cities, and is being used in their floodplain management programs. The following paragraphs describe floodplain-related features specific to each of the action alternatives.

Fountain Creek Reservoir Area

The area most likely to be affected by the construction of this reservoir would be Fountain Creek between Creek Miles 0.2 and 14, Silver Creek between Creek Miles 0.0 and 5.0, Globe Creek between Creek Miles 0.0 and 2.5, and other minor tributaries in that part of the Fountain Creek watershed. The 100-year floodplain for Fountain Creek varies from elevation 604.1 feet mean-sea-level (msl) at the mouth (Creek Mile 0.0) to elevation 662.9 feet msl at Creek Mile 13.87. The 500-year (or "critical action" floodplain) on Fountain Creek varies from elevation 608.7 feet msl at the mouth to elevation 664.2 feet msl at Creek Mile 13.87.

With regard to the Fountain Creek tributaries, the 100-year floodplain on Silver Creek varies from elevation 604.1 feet msl at its mouth to elevation 660.6 feet msl at Silver Creek Mile 4.67. The 500-year floodplain on Silver Creek varies

from elevation 608.7 feet msl to elevation 661.1 feet msl at Creek Mile 4.67. The Globe Creek 100-year floodplain varies from elevation 648.9 feet msl at the mouth to elevation 657.1 feet msl at Creek Mile 2.24. The Globe Creek 500-year floodplain varies from 652.4 feet msl at the mouth to elevation 658.6 feet msl at mile 2.24. There is no flood information available for the other tributaries; however, the published Floodplain Maps for this area show the approximate 100-year floodplains for several streams.

Downstream Water Intake Area

Construction of a water intake downstream from the mouth of Catheys Creek and an associated pipeline would occur more or less along the Duck River from River Mile 104.4 to about River Mile 125 or 130. The approximate 100-year floodplain at Duck River Mile 104.4 is the land below elevation 538 feet msl and the approximate 500-year floodplain is the area below elevation 544 feet msl. The pipeline route would cross several streams, and the 100-year floodplains of these streams could be impacted by this construction. There is no flood information available for these tributary streams; however, the published Floodplain Maps for this area show the approximate 100-year floodplains for several of them. Detailed flood information is available for Greenlick Creek and Little Bigby Creek.

Normandy Reservoir Area

Under this alternative, the height of the existing Normandy Dam at Duck River Mile 248.6 would be raised to increase the volume of water that could be stored behind the dam. The 100- and 500-year floodplains on Normandy Reservoir are the areas below elevation 880.0 feet msl. The approximate floodplain area is shown on the published Coffee County, Tennessee, and Bedford County, Tennessee Floodplain Maps.

Tims Ford Pipeline Area

The area most likely to be affected by construction of an intake on Tims Ford Reservoir and an associated pipeline would extend from Tims Ford Reservoir to Shelbyville, Tennessee. The 100-year floodplain for Tims Ford Reservoir is the land below elevation 894.2 feet msl and the 500-year floodplain on the reservoir is the area below elevation 894.7 feet msl. The pipeline route would cross several small streams in the Flat Creek watershed and the 100-year floodplains of these streams could be impacted by this construction. No flood information is available for these streams; however, the published Floodplain Maps for this area show the approximate 100-year floodplains for some of them.

4.8 TERRESTRIAL LIFE

As indicated in Section 4.2, this project area occurs in the Central Basin Section of the Interior Low Plateau Province and adjacent parts of the Western and Eastern Highland Rim as described by Fenneman (1938). The Central Basin consists of areas with fertile soils, especially near the main rivers and less fertile areas with thin, rocky soils. Near its boundary with the Central Basin, the Highland Rim consists of rolling hills and incised valleys.

The terrestrial plant and animal communities that occur in this area all exist within the Western Mesophytic Forest Region (Braun, 1950). This forest region roughly coincides with the Interior Low Plateau but, in Tennessee, extends westward to the loess bluffs adjacent to the Mississippi River. This is a transitional region between the Mixed Mesophytic Region to the east, where numerous tree species share the canopy in mature forests, and the Oak-Hickory and Southeastern Evergreen Forest Regions to the west, both of which include few canopy tree species in mature forests. Forests of the Western Mesophytic Region have several dominant tree species in the canopy and a relatively large number of oak and hickory species. Many of the trees that help characterize the Mixed Mesophytic Region (such as yellow buckeye, basswood, hemlock, and white pine) are uncommon or absent in Western Mesophytic Region forests.

Many distinct terrestrial communities occurred in this area before European settlement of the region. During the past 200 years, human activities have greatly altered the previous vegetation and have produced a complex mixture of vegetation types. The most significant change from pre-settlement conditions has been the decrease in forest cover and the increase in pastures and croplands. Even in pre-settlement times, however, open areas existed in the form of limestone glades, barrens, and other areas kept open by fires, either started by lightning or set by Native Americans.

The terrestrial communities in this project area can be broadly categorized as bottomland hardwoods, mixed hardwoods, cedar-hardwoods, cedar forests, agricultural lands, brushy thickets (including fencerows), limestone glades, and barrens. In addition, communities associated with seepage areas, bluffs and cliffs, and caves are extremely uncommon but quite important to the regional biodiversity. These categories, although somewhat artificial and intergrading, cover the range of terrestrial communities which occur in the area. These

communities, arranged from wettest to driest, are described in the following paragraphs. The types of terrestrial communities that could be affected by each of the action alternatives are indicated in paragraphs near the end of this section.

Bottomland hardwood communities occur along the Duck River and its major tributaries. Such forests typically have various mixtures of box elder, red maple, sweet gum, river birch, sycamore, willow oak, water oak, and river cane. Depending on the extent and nature of the flooding, the herb and shrub layer may be extremely sparse or well-developed. Areas with a well developed herb/shrub layer may contain such species as chickweed, corn salad, bedstraw, field garlic, buttercups, violets, trillium, hen-bit, and coral-berry.

Bottomland hardwoods provide breeding sites and travel corridors for migrating neotropical birds, along with providing roosting and foraging habitat for a variety of semi-aquatic animals. Species of wildlife commonly found in these areas include belted kingfisher, blue-gray gnatcatcher, muskrat, beaver, mink, gray squirrel, white-tailed deer, and a variety of reptiles. Woodland depressions in bottomland hardwoods that are periodically inundated during winter months provide important breeding sites for numerous species of woodland salamanders including spotted and marbled salamanders. These woodland depressions are rare in middle Tennessee.

Seepage areas typically occupy less than one acre and normally occur on level or gently sloping sites. They may or may not be forested. These communities are vulnerable to habitat disturbances and changes in the hydrological regime. Seepages are often used extensively by large numbers of amphibians such as dusky and long-tailed salamanders.

Mixed hardwood stands are found most commonly on lower and mid-slope terrain and on sites where deeper soils have accumulated. Typical tree species in these stands include white oak, northern red oak, shumard oak, chinquapin oak, post oak, sugar maple, mockernut hickory, pignut hickory, shagbark hickory, black cherry, persimmon, hop-hornbean, and slippery elm. Shrub species characteristic of these areas include fragrant sumac, Carolina buckthorn, coral-berry, and leafy hypericum.

Mixed hardwood forests provide habitat for a variety of wildlife. Species such as white-tailed deer, gray squirrel, southern flying squirrel, and wild turkey are

typical of these areas. Many species of neotropical birds also nest and migrate in mixed hardwood forests.

Bluff or cliff areas occur along various parts of the Duck River in this project area. These habitats are typically very steep and may be partially or completely forested. Depending on where they occur, these habitats can vary from moist, dripping cliff faces to extremely dry bluff tops.

Bluffs can provide nesting and roosting habitat for black and turkey vultures and a variety of bat species. Crevices in bluff faces provide habitat for a variety of salamanders such as long-tailed, green, and slimy salamanders.

Agricultural lands include hayfields, pasture lands, and tracts in row crops such as cotton, soybeans, and corn. These lands typically have the featured agricultural crop and additional native or exotic weed species. Depending upon characteristics of the individual tract, these weeds may include sericea lespedeza, broom-sage, Japanese honeysuckle, buttercups, chickweed, smartweeds, numerous grasses, and dandelion.

Although heavily modified by man, agricultural lands provide habitat for many species of wildlife. Common species include eastern meadowlark, northern mockingbird, song sparrow, eastern cottontail rabbit, least shrew, and hispid cotton rat.

Brushy thicket communities are found in areas that have been severely disturbed and are revegetating. Disturbance in these areas is usually five to 20 years old, and woody plants are dominant in dense thickets of shrubs and tree saplings. Common species usually found in these areas include eastern red cedar, winged elm, persimmon, Carolina buckthorn, redbud, hackberry, osage-orange, sugar maple, Japanese honeysuckle, coral-berry, and sericea lespedeza. Because of the similarity of species which occur in these areas, fencerows are included in this cover type.

Common wildlife found in thickets include a variety of birds such as field sparrows, indigo bunting, eastern meadowlark, and prairie warbler. Common mammals include white-footed mice, skunk, opossum, woodchuck, least shrew, and hispid cotton rat. A variety of amphibians and reptiles including upland chorus frogs, American toad, and fence lizard can be found in these habitats.

Barrens are dynamic communities typically maintained by disturbance, such as fire. These areas are sparsely forested with oaks and have abundant grasses and herbs as a ground cover. Barrens communities usually occur on relatively level ground on the Highland Rim and have restricted water flow under the soil surface. On the eastern Highland Rim in Tennessee, the habitat types historically associated with barrens are oak woodland, oak savanna, shrub-grassland, and prairie-like openings.

Animals that favor early successional habitats, such as prairie warbler and indigo buntings, are often found in barrens habitats. Amphibians, such as upland chorus frogs, northern cricket frogs and American toads, often breed in temporary pools that form in these areas during frequent spring rains.

Cedar-hardwood forests have essentially the same tree and shrub species as the mixed hardwood forests of the region. They differ, however, in that eastern red cedar makes up one-third or more of the stand canopy. In addition, cedar-hardwood forests tend to have less white oak, scarlet oak, and black cherry, and more chinquapin oak, post oak, hop-hornbean, leafy hypericum, and fragrant sumac compared to the mixed hardwood forests. Cedar-hardwood is probably the most abundant forest type in the Central Basin portion of the project area.

Cedar forests occur on various sites in the area. Although any plant species encountered in cedar-hardwood forests could be found in small numbers in cedar forests, these stands are dominated by eastern red cedar. Cedar forests typically occur in areas where conditions are extremely favorable for their establishment and growth. Where dense stands are at least 40 years old, there is sparse undergrowth on the forest floor, partly due to dry conditions usually associated with such habitats and partly because of the dense shade created by a closed cedar canopy.

Dense stands of cedars are often used as nesting and roosting sites for birds such as common grackle. Cedar forests are used extensively as cover by white-tailed deer and eastern cottontail rabbit.

Cedar glade communities are open, rocky, treeless areas that are typically surrounded by eastern red cedar trees. Glades occur where particular types of limestone bedrock are covered with such shallow soil that trees cannot become established. Cedar glades are found only in limited areas of a few southeastern

states. In addition to the rarity of this habitat type, many of the plant species found within these glades have extremely limited ranges. Glades in the project area are important from a state and regional perspective. Large, undisturbed glades or those having rare species warrant special protection.

Wildlife commonly found in cedar glades include those species commonly found in early successional habitats such as yellow breasted chat, prairie warbler, indigo bunting, eastern cottontail rabbit, and fence lizards.

Caves are unique terrestrial habitats. Caves are very fragile ecosystems that often provide habitat for a variety of animal species. Wildlife commonly found in caves include a variety of bats, small mammals, and amphibians. Several caves are known from this general project area; however, few caves in the vicinity have been surveyed to determine which animals are present.

Fountain Creek Reservoir Area

As indicated in Section 4.9, much of the area that would be affected by construction of this reservoir is presently maintained as agricultural fields and pastures. Natural communities remaining on parts of this land include bottomland hardwoods, seepage areas, bluff or cliff areas, and cedar glades. Most of the bottomland hardwoods and seepage areas occur along Fountain and Silver creeks. Bluff and cliff habitats are not present in the Fountain Creek watershed but do occur along the Duck River downstream from the mouth of Fountain Creek and may exist along the pipeline corridor route. Cedar glades occur along the northwestern edge of the area that could be affected by this alternative.

Although much of Fountain Creek flows through agricultural lands, several well established forested riparian zones exist within the watershed. These areas are used as travel corridors and nesting sites for neotropical birds, bats, and a variety of other wildlife species.

Downstream Water Intake Area

Construction of a new water intake on the Duck River in the vicinity of Kettle Mills and an associated pipeline to connect to the water distribution system probably would affect existing road rights-of-way for most of its length. Much of this area, especially along the highways, is now managed as agricultural land. Native communities in this area include bottomland hardwoods, seepage areas, and bluff or cliff areas.

Bottomland hardwood communities occur along the part of the Duck River that could be affected by this alternative. Specific seepage areas have not been identified within this area but, if they are present, would most likely be found along the Duck River and its tributaries. Bluff or cliff habitats have not been encountered in this area; if these habitats are present, they would be found along the Duck River. Wildlife in this area consists of species that are locally and regionally abundant.

Normandy Reservoir Area

Lands immediately adjacent to Normandy Reservoir vary from forested slopes to open agricultural fields and residential developments. Forests adjacent to Normandy Reservoir are predominately upland hardwoods, cedar-hardwoods, pure stands of eastern red cedar, and bottomland hardwoods. Uncommon natural communities that may be associated with this alternative include bottomland hardwood forests, seepage areas, bluffs and cliffs, and barrens.

Bottomland hardwood communities and seepage areas are not presently known within the area likely to be affected by this alternative. If such habitats are present they would most likely be found along the Duck River below Normandy Dam, along the Normandy Reservoir shoreline, or along the tributaries flowing into Normandy Reservoir. No bluff, cliff areas, or barrens communities are presently known to occur within the footprint of this alternative and no likely locations for such communities have been identified (Call, 1998). Several caves are known to occur in the vicinity of Normandy Reservoir.

Tims Ford Pipeline Area

Forest lands around this reservoir include upland hardwoods, cedar-hardwoods, and bottomland hardwoods. The remaining forest lands are dominated by pure stands of eastern red cedar. Bottomland hardwoods and wetlands are both extremely rare on Tims Ford Reservoir. Bottomland hardwoods are dominated by box elder, sycamore, river birch, and hop-hornbeam. Upland hardwoods are dominated by oaks (white, black, scarlet, and chestnut), blackgum, sourwood, and hickory. Beech, sugar maple, basswood, and yellow poplar are common on more moist sites. Large mature deciduous forest are rare on Tims Ford and occur primarily in areas that were too steep to easily log or develop.

Most wildlife habitat associated with this alternative consists of agricultural fields and upland hardwood forests. Uncommon terrestrial communities

include bottomland forests, seepage areas, bluffs and cliffs, cedar glades, and barrens. Bottomland hardwood communities are uncommon and exist mostly along the Elk River downstream from Tims Ford Dam. One bottomland hardwood forest exists just upstream of Tims Ford Reservoir along the Elk River. This bottomland hardwood forest has been identified as a significant breeding site for woodland salamanders.

Rocky seepage areas are known to occur at several locations in the area likely to be affected by this alternative. These seepages, which occur in mid-age and mature woodlands, vary in slope, and continuously discharge water from fractured rock formations. The outcrops usually include both limestone and shale layers. A variety of mosses, liverworts, herbaceous plants, and woody plants occur at these sites. A variety of woodland salamanders also occur in these areas.

Bluff or cliff areas are known from along the shoreline of Tims Ford Reservoir, as well as along the Elk River where it enters the reservoir. These areas are often used as day roosts by bald eagles during winter months and are extensively used by a variety of small mammals and amphibians. No barrens communities are presently known to occur within the footprint of this alternative; however, barrens do occur on the Arnold Engineering Development Center, approximately four miles northeast from the possible intake locations (Call, 1998).

4.9 ENDANGERED AND THREATENED SPECIES

As discussed in Sections 4.5 and 4.8, the descriptions of aquatic and terrestrial life indicate that a wide diversity of plant and animal species occur in this part of Tennessee. Some of the species known from this region are protected under federal and state endangered species laws. In fact, available information suggests that 115 species now protected under federal and/or Tennessee endangered species laws have been reported from the five counties which could be affected by one or more of the action alternatives (Maury, Marshall, Bedford, Coffee, and Moore counties). The names and county occurrence information for all of these species are presented in Appendix C. Table 13 presents a brief summary of this information focused on their federal or state protection status.

Table 13. Summary of the numbers of federal and Tennessee endangered, threatened, and other categories of protected species known from the five counties included in this evaluation. Some of these species are protected at both the state and federal level and are counted in both summaries.

Categories	Animals	Plants	Totals
Federal Status			
Endangered	15	3	18
Threatened	1	1	2
Identified Candidates	1	0	1
Federal Totals	17	4	21
Tennessee Status			
Endangered	16	22	38
Threatened	8	26	34
Other Status	23	20	43
Tennessee Totals	47	68	115

The tables included in Appendix C also indicate the one or two types of habitats in which each protected species is typically found. This information, summarized in Table 14, indicates that most of the protected species occur only in a few of the habitats that exist in this project area. Of the identified habitats, wet meadows and creeksides contain the most protected species (26, all plants; 23 percent of the overall total), followed by rivers, where 20 species (17 percent of the total, all but one animals) are found. If similar habitats are grouped together, rivers and creeks support 35 species (30 percent of the protected species, all but one animals), followed closely by the 31 species which occur in wet meadows, creeksides, and seepage areas (27 percent of the total, all plants). Bottomland and mixed forests account for 18 percent of the total (half animals, half plants), cedar glades 11 percent (all plants), disturbed areas (agricultural areas, old fields, thickets, and barrens) eight percent (mostly plants), and bluffs and cliffs four percent (again mostly plants). Only one percent of the protected species occur on reservoirs (the bald eagle) and no protected species are reported as routinely occurring in cedar forests.

Table 14. Summary of the numbers of protected species known from the major habitat types present in the five counties included in this evaluation.

Habitat Associations	Animals	Plants	Totals
Aquatic			
Creeks	15		15
Rivers	19	1	20
Reservoirs	1		1
Underground Streams	1		1
Terrestrial			
Wet Meadows, Creeksides		26	26
Seepage Areas		5	5
Bottomland Forests	6	5	11
Mixed Hardwoods	3	7	10
Bluffs and Cliffs	1	4	5
Agricultural Areas	2	1	3
Old Fields, Thickets, Fencerows		1	1
Barrens		5	5
Cedar Forests			
Cedar Glades		13	13

Federal Protected Species

The information presented in Table 13 indicates that 21 species known from this 5-county area are protected under the federal Endangered Species Act. Some of these species, however, no longer occur in these counties and some of them occur only in parts of the counties that would not be affected by any of the action alternatives. Because of their federal protection status, these 21 species are individually identified in Table 15 and their potential to occur in the project area is described in the following paragraphs.

Plants

Chaffseed (*Schwalbea americana*) was listed as a federal endangered species in 1992 (USFWS, 1992). Primarily a coastal plain species, chaffseed was last observed in Tennessee in 1879. Although this species still survives in the coastal plains of New Jersey, North and South Carolina, Georgia, and Florida (USFWS, 1994), it is highly unlikely chaffseed persists within the project area.

Table 15. Federal endangered, threatened, and formal candidate species known from the five county area which could be affected by one or more of the action alternatives.

Common Name	Scientific Name	Federal Status	Likely in Project Area?
Plants			
chaffseed	*Schwalbea americana*	E	No
Eggert's sunflower	*Helianthus eggertii*	T	No
leafy prairie-clover	*Dalea foliosa*	E	Yes
yellow-eyed grass	*Xyris tennesseensis*	E	No
Mollusks			
birdwing pearlymussel	*Lemiox rimosus*	E	Yes
cracking pearlymussel	*Hemistena lata*	E	No
Cumberland combshell	*Epioblasma brevidens*	E	Yes
Cumberland monkeyface	*Quadrula intermedia*	E	Yes
Cumberland pigtoe	*Pleurobema giberum*	E	No
orange-footed pearlymussel	*Plethobasus cooperianus*	E	No
oyster mussel	*Epioblasma capsaeformis*	E	Yes
pale lilliput pearlymussel	*Toxolasma cylindrellus*	E	Yes
shiny pigtoe	*Fusconaia cor*	E	No
slabside pearlymussel	*Lexingtonia dolabelloides*	C	Yes
tan riffleshell	*Epioblasma walkeri*	E	Yes
tuberculed-blossom pearlymussel	*Epioblasma t. torulosa*	E	No
turgid-blossom pearlymussel	*Epioblasma turgidula*	E	No
yellow-blossom pearlymussel	*Epioblasma f. florentina*	E	No
Birds			
bald eagle	*Haliaeetus leucocephalus*	T	Yes
Mammals			
gray bat	*Myotis grisescens*	E	Yes
Indiana bat	*Myotis sodalis*	E	Yes

Eggert's sunflower (*Helianthus eggertii*) was listed as a federal threatened species in 1997 (USFWS, 1997b). This species is associated with dry, upland, acidic pH, barren habitats in the Highland Rim Province. It is known from twelve counties in Tennessee, four counties in Kentucky, and one county in Alabama (USFWS, 1996 and unpublished information). One of the Tennessee populations occurs in Maury County, approximately 12 miles southwest of Columbia. This sunflower was not found during extensive surveys of the Columbia Project lands and is not known to occur in the Central Basin Physiographic Province. The limestone barrens in the Central Basin produce a habitat with a basic pH, substantially different from the acid barrens on the Highland Rim where Eggert's sunflower sometimes occurs (USFWS, 1998a).

The **leafy prairie-clover** (*Dalea foliosa*), a member of the bean family that stands 12 to 24 inches in height, has bluish-purple flowers and blooms in July and August (USFWS, 1996). Leafy prairie-clover was listed as a federal endangered species in 1991 (USFWS, 1991b). This species occurs in seven middle Tennessee counties, two counties in north Alabama, and a single county in Illinois (USFWS, 1996). Four populations have been found on the Columbia Project lands, two of which are among the healthiest and largest known. The larger of these populations was discovered after the recovery plan was approved. The leafy prairie-clover is found along intermittent streams bordering limestone glades rather than on the bare rock of the glades themselves.

Yellow-eyed grass (*Xyris tennesseensis*), listed as a federal endangered species in 1991 (USFWS, 1991a), is a perennial typically found on seepage-slopes, springy meadows, or the banks of small, gravelly streams (USFWS, 1994b). This species is known from twelve locations within the Highland Rim physiographic province in Tennessee. The single record from the counties involved in this project occurs approximately eight miles from Normandy Reservoir, outside of the area which could be affected by any of the alternatives.

Mollusks

Seven of the 14 freshwater mussel species included in Table 14 have been found in the upper Duck River watershed within the last 25 years. Each of those species is described in one or more of the following paragraphs. The other seven mussel species fall into three groups. Three of these species (tuberculed-blossom, turgid-blossom, and yellow-blossom) have not been encountered in any part of their former habitats in the last thirty years and are presumed to be extinct (Williams, et al., 1993). Three others (cracking, orange-footed, and shiny pigtoe) survive in the lower Elk River and in other river reaches; however, none of them are known to persist in the parts of the Duck or Elk river watersheds which could be affected by one or more of the action alternatives. The remaining species (Cumberland pigtoe) is generally assumed to be restricted to the Collins River and, possibly, other nearby streams in the Cumberland River basin; however, an individual identified as this species was found in 1993 in the upper Elk River basin (Parmalee and Bogan, 1998).

The **birdwing pearlymussel** (*Lemiox rimosus* = *Conradilla caelata*), listed as a federal endangered species in 1976 (USFWS, 1976), is the most abundant of the endangered mussel species known from the Duck River. During detailed surveys conducted in both 1979 and 1988 (Ahlstedt, 1986; Jenkinson, 1988), the birdwing was found from Duck River Mile 147 upstream to River Mile 179 and was the fourth (in 1979) or sixth (in 1988) most abundant mussel species encountered in the quantitative samples that were taken (Jenkinson, 1988). More recent sampling indicates this species continues to occur throughout this river reach (Aquatic Resources Center, 1995b) and continues to be one of the more abundant species (Aquatic Resources Center, 1997). This species has not been found in the Duck River downstream from River Mile 147 or in any Duck River tributary. Outside of the Duck River basin, native populations of the birdwing pearlymussel occur (but are extremely rare) in a short reach of the Elk River and in longer reaches of the Powell and Clinch Rivers (Ahlstedt, 1984a).

In 1982, TVA staff transplanted members of this species from the Duck River to sites on the Buffalo, Nolichucky, and North Fork Holston Rivers, and to a site on the upper Duck River near Shelbyville (Jenkinson, 1983). Results of monitoring studies indicate that numbers at all four transplant sites have declined to very low levels; however, the recovery of a few young individuals suggests the introduced birdwings have successfully reproduced in both the North Fork Holston and Nolichucky Rivers (Aquatic Resources Center, 1994a; 1996a).

The **Cumberland combshell** (*Epioblasma brevidens*) was added to the federal endangered species list in 1997 (USFWS, 1997a). This species survives in the Clinch, Powell, and Duck Rivers in the Tennessee River basin and in Buck Creek and the Big South Fork in the Cumberland River basin. A few, old specimens of the Cumberland combshell also may persist in the main Cumberland River downstream from Cordell Hull Dam (USFWS, 1997a). This species was rare but routinely found in the middle reach of the Duck River through the mid-1970s (Ahlstedt, 1981); however, only two live animals have been encountered in this river in recent years (Ahlstedt, 1986; Jenkinson, 1988; Aquatic Resources Center, 1994b; 1996b; 1997; USFWS, 1998b).

The **Cumberland monkeyface** pearlymussel (*Quadrula intermedia*) was placed on the federal endangered species list in 1976 (USFWS, 1976). During various surveys and field activities in the Duck River starting in 1979, no more than 15

live individuals of this species (out of several thousand live mussels) have been found at sites between River Mile 162 and River Mile 179 (Ahlstedt, 1986; Jenkinson, 1988; Aquatic Resources Center, 1994b; 1996b; 1997). In addition to the Duck River, the species survives in very low numbers in a 40-mile reach of the Elk River and in a 30-mile reach of the Powell River (Ahlstedt, 1984b; Ahlstedt, 1986; TVA, unpublished data). This species typically occurs in medium and larger rivers; no individuals have been found in any Duck or Elk River tributaries.

The **oyster mussel** (*Epioblasma capsaeformis*), added to the federal endangered species list in 1997 (USFWS, 1997a), was found in the middle reach of the Duck River during the 1970s (Ahlstedt, 1981). For several years in the 1980s only a few specimens of the oyster mussel were collected in this area (USFWS, 1997a), but, more recently, Aquatic Resources Center staff have encountered this species routinely not far downstream from Lillard Mill Dam (Aquatic Resources Center, 1994b; 1996b; 1997; USFWS, 1998b). Outside of the Duck River watershed, the oyster mussel survives in the Clinch, Powell, and, possibly, Nolichucky River systems in the Tennessee River basin, and in Buck Creek and the Big South Fork in the Cumberland River basin (USFWS, 1997a).

The **pale lilliput pearlymussel** (*Toxolasma cylindrellus*) is known to occur in Rock Creek (a Duck River tributary); however, it has not been found anywhere in the main Duck River or in any other part of this project area within the last 25 years (Parmalee and Bogan, 1998). Outside of Big Rock Creek, the pale lilliput is only known from the Paint Rock River in north Alabama (Ahlstedt, 1984c). It was listed as a federal endangered species in 1976 (USFWS, 1976).

The **slabside pearlymussel** (*Lexingtonia dolabelloides*) is not presently protected under federal or Tennessee endangered species laws; however, it is an identified federal candidate for potential listing (USFWS, 1999). This species occurs in the middle and lower sections of the Duck River included in this evaluation and in the Elk River some distance downstream from Tims Ford Dam (Ahlstedt, 1986). The slabside pearlymussel has not been encountered in any Duck River tributaries in recent years (TVA unpublished data). Outside of the Duck and Elk River systems, the slabside pearlymussel still occurs in parts of the Clinch, Powell, Holston, Hiwassee, and Paint Rock rivers (Parmalee and Bogan, 1998).

The **tan riffleshell** (*Epioblasma walkeri*) was added to the federal endangered species list in 1977 (USFWS, 1977b) and, for several years, was thought to survive only in the Middle Fork Holston River (Neves, 1984). Now, the species is also known to be present in a short reach of the upper Clinch River (USFWS, unpublished data), in the Hiwassee River just downstream from Apalachia Dam (Parmalee and Hughes, 1994), and, may be present in part of the Big South Fork of the Cumberland River (S. A. Ahlstedt, personal communication). In 1988, TVA staff found a young, fresh-dead tan riffleshell in the Duck River at River Mile 151 (Jenkinson, 1988). No other members of this species have been found in more recent sampling on the Duck River (Aquatic Resources Center, 1994b; 1995b; 1997). This species apparently survives in the Duck, Clinch, Hiwassee, Big South Fork, and Middle Fork Holston Rivers but at extremely low numbers in each stream.

Bird

The **bald eagle** (*Haliaeetus leucocephalus*), presently listed as a federal threatened species, is known to occur in this area, at least on an occasional basis. Southern populations of bald eagles were listed as a federal endangered species in 1967 (USFWS, 1989) and, recently, have been proposed for de-listing (USFWS, 1999). Bald eagles typically nest along rivers or reservoirs. Both Tims Ford and Normandy Reservoirs are suitable nesting and foraging areas for bald eagles. Migrating bald eagles are regularly observed on both reservoirs during winter months, and a pair of bald eagles attempted to nest near Normandy Reservoir.

Mammals

The **gray bat** (*Myotis grisescens*), listed as a federal endangered species in 1976, is a colonial bat that roosts in caves year-round (Brady et al., 1982). Gray bats typically roost in caves along rivers and reservoirs within a range primarily restricted to the karst regions of the southeastern United States. Gray bats have been reported to roost in a cave on the Columbia Project lands as they migrate through the area in spring and autumn. Large ceiling stains found in several rooms within this cave suggest that large numbers of bats could be involved. Gray bats probably also use other caves along the Duck River as temporary roosting areas. Gray bats breed during the fall migration, making transition caves (such as those along the Duck River) important to the survival of the species. They also probably feed over the Duck River and its tributaries when they are in the area.

The **Indiana bat** (*Myotis sodalis*) also is likely to occur in this area. This bat was listed as a federal endangered species in 1967 (USFWS, 1967). These colonial bats hibernate in caves during winter months, and form small maternity colonies in hollow trees and beneath exfoliating bark during the summer (USFWS, 1983). Indiana bats are known only from the eastern half of the United States and, apparently, are more abundant in Indiana and Missouri than in Tennessee and Alabama. Recent discussions with Indiana Bat Recovery Team members indicate that population levels of Indiana bats are decreasing throughout their range. Indiana bats have been reported from a cave in Maury County approximately nine miles from part of the Columbia Project lands. Although no Indiana bats were encountered during recent cave surveys on the Columbia Project lands, members of this species may forage and roost in forested areas in this part of Maury County during summer months.

4. 10 LAND USE/PRIME FARMLAND/COMMUNITY NOISE

Land Use

As indicated in Section 1.6, this project area includes various parts of the upper Duck River watershed. Most of this watershed area presently is being used as forest land and agricultural land. The larger cities within the area are Columbia, in Maury County; Shelbyville, in Bedford County; and Tullahoma, in Coffee County. Several of the alternatives would affect land in the Columbia area, and the possible construction of a reservoir in the Fountain Creek watershed would affect the largest amount of land.

Information available from the Environmental Protection Agency's BASINS watershed database (USEPA, 1998) helps characterize how the land in this watershed is presently being used. As indicated in Table 16, 48.1 percent of the upper Duck River watershed is covered by various types of forests (also see Section 4.8), 45.1 percent of the land is used for agriculture, and 2.9 percent of the land is in residential use. All other uses of the land in the upper Duck River watershed affect only 3.9 percent of the area. The 1992 Census of Agriculture data for Maury County indicated that 245,681 acres of land was occupied by farms. This is 62.5 percent of the total area in the county. Similar figures compiled in 1982 indicated that 281,802 acres were in farmland, suggesting a 9.2 percent decrease in farm acreage within Maury County during that 10-year period.

When just the land in the Fountain Creek watershed is considered, forests occupy 39.8 percent of the land, agricultural use occurs on 51.6 percent, and 4.2 percent is in residential use (Table 16). Other uses of the land in the Fountain Creek watershed affect only 4.4 percent of the area.

Table 16. Land use in the Upper Duck River watershed, and in the Fountain Creek watershed.

Land Use *	Upper Duck River Watershed *		Fountain Creek Watershed **	
	Acres	Percent	Acres	Percent
Agriculture Use	2,251,774	45.1	33,913	51.6
Forestland	2,401,725	48.1	26,163	39.8
Residential	145,710	2.9	2,776	4.2
Transitional Areas/Shrub & Brush	83,085	1.7	1,330	2.0
Industrial/Commercial/ Other Built-Up Areas	42,666	0.9	946	1.4
Wetlands	20,709	0.4	459	0.7
Water Bodies/Streams	37,177	0.7	186	0.3
Strip Mines/Disturbed Areas	7,236	0.1	12	0.1
Total Area	4,990,080	100.0	65,785	100.0

* - Environmental Protection Agency, "Upper Duck, BASINS Core Data", 1998 (http://www.epa.gov/OST/BASINS/HUCS/06040002/)
** - TVA unpublished data

Prime Farmland

Prime farmland soils, as defined by the U.S. Department of Agriculture, have properties needed for the economic production of sustained high crop yields. These soils have the best combination of physical and chemical characteristics for producing food, feed, forage, fiber, and oilseed crops. Soils identified as prime farmland soils may presently be in use as cropland, pasture land, range land, forest land, or other uses, but cannot be in use as urban or built-up land. Of the total 392,960 acres of land in Maury County, approximately 112,000 acres (28 percent) is considered prime farmland soils.

The conversion of farmland and prime farmland soils to industrial and other nonagricultural uses essentially precludes producing crops on the land for the

foreseeable future. The 1981 Federal Farmland Protection Policy Act recognized the serious impacts of prime farmland loss on food and fiber production and established requirements for evaluating land prior to permanent conversion from farmland as a result of a federal action. The Act requires that a Farmland Conversion Impact Rating form be completed by federal agencies with assistance from the U.S. Department of Agriculture's Natural Resource Conservation Service. The evaluation rating is based on soil characteristics and site assessment criteria. Land with a rating of at least 160 (out of a possible score of 260) must be given consideration for protection. The Act only suggests that the land be protected and that other sites be considered; there is no legal requirement to do so.

Community Noise

As indicated above, most of the land in the upper Duck River watershed outside of the larger cities is predominantly light to moderate density rural residential and appears to be a broad mixture of old to new and low- to high-cost homes. Landowners primarily use their land for domestic, agricultural, and recreational purposes. These uses would include noise sources such as vehicles, lawn mowing equipment, agricultural equipment, chain saws, dogs, and recreational activities. Some parts of this area border major highways, such as Interstate 65, State Route 50, and State Route 41A. Vehicles are the dominant noise sources in these areas.

A few noteworthy departures from this typical pattern exist in the area. These departures represent the types of local variations that can occur in a rural, unzoned environment and can affect community noise impacts. Active quarrying of limestone is occurring in at least two areas: just north of Iron Bridge Road, across from the former Columbia dam site, and just off of Blue Springs Road near State Route 50. Typical quarrying and industrial noise is coming from both of these sites, along with vehicle noise produced by the heavy trucks which travel the adjacent roads to access these facilities.

A different type of departure from the typical noise pattern has occurred due to the completion of Tom Hitch Parkway between State Routes 412 (on the north) and 50 (on the south). Frontage land along this parkway is being developed for commercial uses, resulting in increased construction noise. As the area continues to develop, operational noises will increase from the new commercial and industrial facilities and vehicle noise will increase as the traffic count grows.

Fountain Creek Reservoir Area

Within the Fountain Creek watershed, 2,254 acres of land could be converted into a reservoir if the full pool elevation was at 629 feet. All of this area is presently zoned A-2, Rural Residential District. Of this acreage, 42.6 percent of the land use is presently in agricultural use and 34.4 percent is forest land (Table 17). Wetlands occupy 10.1 percent and shrub/brush land another 8.2 percent of the area. Two cemeteries (Harris Cemetery and Lancaster Cemetery) are located on the perimeter of the reservoir and three others are located within 500 feet of the full pool elevation (Atkinson Cemetery, Pleasant Mount Cemetery, and Bethany Cemetery). State Highways 50 and 373 intersect the reservoir at several places, and a variety of other roads traverse the reservoir area (including Moore Lane, Old Highway 50, Vaughn Road, Bryant Road, and Seavy Hight Road). A Southern Railroad line extends through a portion of the reservoir area at a point west of the Glendale Community. A transmission line connecting to a substation southeast of Columbia travels along the northeastern perimeter and intersects the northern part of the possible reservoir area.

Of the 2,254 acres which might be included in a Fountain Creek reservoir, 1,272 acres (56.4 percent) are prime farmland soils (Table 17). Of the 1,272 acres of prime farmland, 53.4 percent is presently in agricultural use, forest grows on 25 percent of the area, 11.2 percent is in wetlands, 6.1 percent in shrub and brush land, and 4.3 percent is in other land uses. In this area, the most prevalent prime farmland soils are Huntington silt loam, phosphatic phase (see Section 4.2). Other prime farmland soils in this potential reservoir area are Armour silt loam, eroded gently sloping terrace phase; Captina silt loam; Egam silty clay loam; Etowah silt loam; Hagerstown silt loam; Lindside silt loam; and Maury silt loam.

Other Alternatives

Each of the other alternatives would affect much smaller tracts of land, typically only in narrow corridors. The downstream water supply alternative would involve construction of a pipeline extending approximately 13 miles along State Highway 50 between Williamsport and Columbia. Approximately 70 percent of the area bordering that highway is agricultural land, 27 percent is forestland, and 3 percent is residential. The Tims Ford pipeline alternative would include construction of a pipeline (approximately 20 miles long) from Tims Ford Reservoir, in Moore County, to discharge into the Duck River near Shelbyville, in Bedford County. The pipeline would be constructed along

Table 17. Present total land use and present use of prime farmland soils within the possible impoundment area of a Fountain Creek reservoir (at elevation 629).

Land Use *	All Land *		Prime Farmland **	
	Acres	Percent	Acres	Percent
Agriculture	961	42.6	679	53.4
Forestland	776	34.4	318	25.0
Wetlands	227	10.1	142	11.2
Shrub/Brush	186	8.2	77	6.1
Water Bodies/Streams	79	3.5		
Residential	2	0.1		
Industrial/Commercial/ Other Built-Up Areas	23	1.0		
Other Use			55	4.3
Totals	2,254	100.0	1,272	100.0

* - TVA unpublished data
** - USDA, Soil Survey of Maury County, Tennessee, 1959

existing State Highway 82 and other road rights of way. State Highway 82 is bordered by about 75 percent agricultural land and about 25 percent residential land use. The majority of the land use bordering the other possible roads is forest land.

The raise Normandy pool alternative is somewhat different in that it would affect a band of land all around Normandy Reservoir located in Bedford and Coffee counties. This land is managed as a natural resource area and includes two camping areas (Cedar Point and Barton Springs) and several boat launching ramps (see Section 4.11). Two roads traverse the reservoir: Hiles Road and Mountview Road.

None of the potential pipeline corridors along state highways or other road rights of way would be classified as prime farmland. However, any non-highway pipeline easements, locations for water intakes, and locations for new water treatment plants could contain some prime farmland. The extent of prime farmland along these corridors has not been estimated because no specific sites or routes have been identified. About 25 percent of the soil on the perimeter of the Normandy Reservoir is classified as prime farmland (USDA,1999).

4.11 VISUAL CHARACTER, RECREATION, AND NATURAL AREAS

Visual Character

The physical, biological, and cultural features of an area combine to make the visual landscape character both identifiable and unique. Scenic integrity indicates the degree of unity or wholeness of the visual character. Where and how the landscape is viewed will affect the more subjective aspect of its aesthetic quality and sense of place. Views of a landscape are described in terms of what is seen in foreground, middleground, and background distances. In the foreground, an area within one half-mile of the observer, details of objects are easily distinguished in the landscape. In the middleground, normally between a mile and four miles from the observer, objects may be distinguishable but their details are weak and they tend to merge into larger patterns. Details and colors of objects in the background, the distant part of the landscape, are not normally discernible unless they are especially large and standing alone. The impressions of an area's visual character can have a significant influence on how it is appreciated, protected, and used.

The visual character of the upper Duck River watershed is typical of many central Tennessee river valleys. Much of the river corridor is bordered by tall bluffs and steep, rocky, forested banks. The land away from the river consists primarily of gently rolling topography and relatively shallow, gently flowing tributary streams. The countryside is a varied mix of woodland, open pastures, crop land, and mostly small communities, with little industry and relatively few major highways. Together, the natural and cultural elements in this area provide attractive scenic variety and form a relatively harmonious rural landscape.

The four action alternatives considered in this evaluation would each affect only part of the study area. The following paragraphs describe the present visual setting in which these alternatives would be placed.

Fountain Creek Reservoir Area

The possible 2200-acre reservoir would occupy part of a bottomland drainway averaging about 2000 feet wide, with a meandering stream, several smaller tributaries, and little elevation change. Within this area, open land originally bought for Columbia reservoir is mostly covered with recent-growth brush and trees. The remainder of the area is a mix of pasture and woodland. A few old roads remain, some of which are blocked to traffic and the bridges have been

removed. The reservoir area is surrounded by a gently rolling rural landscape consisting of woodlands, pastures, and sparse residential development. The elevation difference averages about 140 feet. Scenic integrity is moderately high. The natural and cultural elements together provide harmony, coherence, and scenic attractiveness in this area of rural countryside.

Homes are clustered on the higher elevations around the Scribners, Fountain Heights, and Crews Hill areas. The valley floor can be seen in the near foreground by these residents, as well as from a few farms. Motorists see the area in the foreground from local roads and Brush Creek Road bridge. They also see this area in both the foreground and middleground from the Highway 50 bridge. Traffic maps prepared by the Tennessee Department of Transportation show an average of 9,100 vehicles per day on this portion of Highway 50 and about 240 vehicles per day on Brush Creek Road. The potential reservoir area is also seen in the immediate foreground by those using the land for recreational activities.

Downstream Water Intake Area

The potential pipeline corridor generally follows Highway 50 and some local roads which run through a primarily rural countryside. The topography is gently rolling with an elevation difference along the route of about 220 feet. The corridor also runs through a small area of urban and industrial development on the northwest side of Columbia. The route crosses several streams and the Duck River near Williamsport. This area includes pasture lands, occasional woodlands, light residential development, churches, schools, and some revegetated strip mine areas. A variety of homes, farms, and several small subdivisions are located along the highway and adjoining local roads. Scenic integrity is moderate. The natural and cultural elements together provide variety, scenic attractiveness, and visual harmony with few contrasting elements in this corridor of rural landscape.

Residents and motorists view the potential pipeline corridor in the immediate foreground and beyond. Traffic maps show an average of 4,430 vehicles per day on Highway 50 from Columbia to the Sawdust community, and 2,800 vehicles per day from Sawdust north to Williamsport. A Duck River crossing would be seen in the immediate foreground of those using the adjacent river section for recreation activities and, possibly, by motorists on the highway bridge.

Normandy Reservoir Area

The potential project area includes Normandy Reservoir and a band of the surrounding property, all owned by TVA. Most of the surrounding land is steeply sloping, with five percent or less sloping gently enough for comfortable human use. The elevation difference from the full pool reservoir to the ridgetops averages about 230 feet. About 80 percent of the shoreline is wooded. The back-lying rural landscape has similar steep slopes with gently rolling ridgetops. The lands include pastures, woodlands, sparse residential development, and a few farms. Residential growth is occurring, especially on ridgetops that have views of the reservoir. Scenic integrity is moderately high. The natural and cultural elements together provide variety, scenic attractiveness, and visual harmony around this rural reservoir.

The reservoir is seen in the foreground by residents located on ridgetops and back-lying slopes near the shoreline. The visiting public views the areas from TVA facilities at the dam reservation and other recreation areas on the reservoir. Motorists see the reservoir in the foreground from Riley Creek Road, Wards Chapel Road, Powers Bridge Road, and other local roads. Traffic maps show an average of 1,790 vehicles per day on Riley Creek Road. The reservoir shoreline is also seen in the foreground by those using the lake for recreation activities.

Tims Ford Pipeline Area

The potential pipeline corridor generally follows local roads from Tims Ford Reservoir to the intersection of State Routes 55 and 82, then follows Route 82 to the Duck River near Shelbyville. The possible intake areas are located on embayments with mostly wooded shoreline and very few residences. The pipeline corridor runs through rather hilly rural countryside from Tims Ford Reservoir to about the Flat Creek community, and more gentle topography from there to the Duck River. Elevation difference along the route is about 400 feet. The study route crosses several streams, and includes pastures, woodlands, light residential development, several churches, and a school. A variety of homes and farms are located along the roadways. Scenic integrity is moderate. The natural and cultural elements together provide variety, scenic attractiveness, and visual harmony within this corridor of rural landscape.

Residents and motorists along the route view the corridor in the immediate foreground and beyond. Traffic maps show 850 vehicles per day along Chestnut Ridge Road near the embayments, 1,800 vehicles per day south to

Highway 55, and over 3,100 vehicles per day on Highway 82 from Flat Creek to Shelbyville. Potential areas for the intake can be seen by motorists on local roads crossing near the head of the reservoir embayments. The discharge area near Shelbyville is seen by residents on both sides of the river and from the highway bridge. These terminal points of the corridor are also seen in the foreground of those using adjacent sections of Tims Ford Reservoir and the Duck River for recreation activities.

Recreation Activities

Local residents and people from surrounding counties enjoy many types of recreational activities within the upper Duck River watershed. Water-based recreation activities include fishing in several habitats and boating on both the streams and reservoirs. Land-based recreation includes hunting, camping, and other individual activities, as well as group activities in a wide variety of parks and other facilities.

On a scale ranging from unattractive, uninspiring, pretty, beautiful, and spectacular, Sehlinger and Lantz (1983) described the middle section of the Duck River as "pretty." The same authors rated the Elk River "mostly pretty with some beautiful spots;" the Buffalo River "mostly beautiful with some pretty spots;" the Harpeth River "beautiful in spots;" and Richland Creek is rated "pretty." This part of the Duck River has few obstructions and is an easy canoeing stream. The American Whitewater Association (AWA) would consider this to be a Class I River, meaning there is moving water with a few riffles and small waves with few or no obstructions (AWA, 1977).

Several improved access points help people enjoy recreational time on the river. DRDA and TWRA have developed a concrete boat ramp and parking area on the river at Iron Bridge Road. A similar facility has been discussed for a site at Carpenters Bridge. The Iron Bridge ramp is used as a bass boat access to that section of the river and as a staging area for local weekly bass tournaments. Other access points at Williamsport, Chickasaw Trace, Columbia, Leftwich Bridge, Lillard Mill, Hardison Mill, Henry Horton State Park, Shelbyville, Three Forks Bridge, Dement Bridge, Cortners Mill, and Normandy Dam are used for canoeing and float fishing in those river sections. Carpenters Bridge has historically been used as a take out point for the eight miles of river downstream from Hardison Mill, the section which has been the most popular for canoeing.

TWRA maintains a year-round trout fishery in the Duck River just downstream from Normandy Dam by stocking trout from March through December. Stocking is concentrated near the dam, but the fishery extends to approximately Three Forks Bridge, eight miles downstream. A warmwater fishery for black bass (smallmouth bass, largemouth bass, spotted bass), sunfish (rock bass, bluegill, and crappie), and catfish develops several miles downstream from Normandy Dam, where the water temperatures return to normal, and continues throughout the remainder of the river. The warmwater sport fishery downstream from the Columbia City Dam also includes sauger and striped bass which migrate into that part of the river during their spawning season. Migrating redhorse and other sucker species also are caught throughout the Duck River by snag fishermen.

Normandy and Tims Ford reservoirs are popular water bodies for sport fishing. During 1996, an estimated 232,955 total hours were spent by fishermen at Normandy Reservoir (TWRA, 1997). Targeted species were primarily black bass, crappie, and catfish, although walleye/sauger and white bass were also sought. Tims Ford Reservoir supported over twice as much fishing pressure (509,571 hours) in 1996 as Normandy (TWRA 1997). In Tims Ford, the targeted species included black bass, striped or hybrid striped bass, and crappie, with lesser effort spent on walleye/sauger, sunfish, catfish, and white bass.

TVA's sport fishing index values indicate that Normandy Reservoir ranks among the best fishing lakes in the Tennessee and Cumberland River valleys. In 1998, Normandy ranked above average for largemouth bass, spotted bass, white bass, bluegill and channel catfish (TVA unpublished data). The index value for walleye/sauger fell to below average, and sample sizes for smallmouth bass and crappie were too small for a reliable calculation. Tims Ford Reservoir ranked above average for white bass and walleye/sauger and below average for largemouth and smallmouth bass, striped bass, bluegill and channel catfish. Small sample sizes for spotted bass and crappie precluded index calculations in those categories.

Hunting is the most identifiable form of land-based recreational activity in this project area. The public lands just east of Columbia and around Normandy Reservoir are fairly heavily used by people hunting for deer, turkey, rabbit, squirrel, and quail. Many private lands also are used during the hunting seasons. During 1998, over 8,800 deer and 1,000 turkeys were harvested in the 5-counties within this project area (TWRA unpublished data). Maury

County ranked eighth among Tennessee counties in total deer harvested during the 1998 season, and sixth during the 1997 season (TWRA unpublished data).

Several state and county recreational facilities exist within a 30-minute drive of the Columbia area, including five county parks west of Columbia. Maury County Park and Chickasaw Trace Park are the largest and most developed. Maury County Park is a 200-acre park serving both passive and active recreation needs. The park serves open space needs as well as picnicking, equestrian, various levels of league baseball, and Maury County Football Stadium. Chickasaw Trace Park is a large county park oriented toward family picnicking, open space, and river access.

Henry Horton State Park is located along the Duck River between Columbia and Shelbyville. This 1,140-acre park provides opportunities for camping, sport fishing, canoeing, and hiking. There is also a 72-room inn, a swimming pool, a championship golf course, and the only skeet and trap range in the Tennessee State Park system.

Near Shelbyville, TVA owns a small parcel of land where Highway 82 crosses Duck River that was acquired as a possible river access area. Although this site is presently undeveloped, TVA recently has received inquiries from Bedford County about proceeding to develop this access to the river.

Recreation facilities around Normandy Reservoir include two developed public campgrounds and a variety of other facilities. Barton Springs Campground includes 65 campsites with picnic tables and fire rings, three bathhouses with heated showers and flush toilets, a beach, a picnic pavilion and other picnic tables, and a boat ramp with a courtesy pier. Cedar Point Public Use Area has 50 campsites with picnic tables and fire rings, two bathhouses with heated showers and flush toilets, a picnic pavilion and 14 other picnic spaces, a beach, and a boat ramp. Four additional lake access areas, each with paved parking lots and boat ramps, exist on the dam reservation and at sites on Boyd's Branch, Ward's Chapel, and Powers Bridge. On the downstream side of the Normandy Dam Reservation is a public access area with paved parking and bank fishing facilities, as well as a canoe launch area. This access area is the upstream end of a 28-mile scenic floatway on the Duck River below the dam with public access areas at six locations.

Tims Ford State Park, located on the northern shore of Tims Ford Reservoir, contains approximately 1,680 acres, 20 cabins, 50 campsites with tables, grills, and electrical and water hookups. A lakeside picnic area has 50 individual tables and grills plus two picnic shelters with fireplaces, grills and numerous tables. The park, operated by TDEC, also includes a marina which provides equipment and supplies for boating and fishing, a boat launching ramp and dock, and rental boats. A double L-shaped swimming pool features a 12-foot diving pool, children's wading pool, bathhouse and concession stand. There are five miles of paved trails for hiking and cycling. An 18-hole golf course with pro-shop and driving range is expected to open soon.

Other public facilities located on Tims Ford Reservoir include two municipal parks (Winchester City Park and Estill Springs Park), Devils Step Campground, a swimming beach, and seven public boat launching facilities. Two commercial marinas on the reservoir provide boat storage, fuel, and boating supplies. There are several informal lake access areas and numerous informal recreation use areas.

Three wildlife management areas and two state scenic river segments are located within a one-hour drive of the Columbia area. Normandy State Wildlife Management Area is an approximately 750-acre area that is managed by TWRA for hunting and fishing. Located on Normandy Reservoir along Riley Creek, this wildlife management area provides a tract of relatively undeveloped shoreline that enhances the quality of the outdoor experience for lake users. Laurel Hill and Middle Tennessee State University Wildlife Management Areas are located somewhat further away in Lawrence and Hickman counties, respectively.

Natural Areas

Several identified natural areas occur in or near this part of the Duck River watershed. These areas have been recognized and, to various degrees, are being protected because they contain unique natural resources or scenic values. The following paragraphs describe each of these natural areas and their relationships to the possible action alternatives.

The **Duck River State Mollusk Sanctuary** includes all of the mainstem Duck River upstream to Normandy Dam and continuing into the headwaters. Mollusk sanctuaries are designated and protected by TWRA to aid in the conservation of native aquatic mollusks. Various sites and reaches along the Duck River could be affected by the action alternatives.

Jackson Falls Potential National Natural Landmark is located between Delk and Baker Bluffs along the Duck River near River Mile 102. The National Natural Landmark Program, administered by the National Park Service, was established in the 1970s and is intended to identify nationally significant examples of ecologically pristine or near-pristine landscapes. The program has been mostly inactive for several years, and many potentially qualifying sites such as Jackson Falls have not been formally designated as National Landmarks. Jackson Falls is formed where Jackson Branch flows through a small gorge-like valley. This waterfall is a classic example of stream piracy, a geologic phenomenon where the headwaters of one stream (Jackson Branch) capture a portion of another stream (unnamed stream) that is in close proximity. Jackson Falls is near the area that could be affected by the Downstream Water Intake Alternative.

The **Natchez Trace Parkway,** administered by the National Park Service, includes approximately 450 miles of historic and scenic highway. This parkway was established in 1938 to commemorate the original Natchez Trace, an old trail stretching 500 miles through the wilderness from Natchez, Mississippi, to Nashville, Tennessee. The original trace followed Native American trails and was used by boatmen, traders, and explorers returning to the eastern states after sailing down the Mississippi River. Later, the trace was used as a federal postal road and for troop movements during the War of 1812. Natural, cultural, and historic resources along the Trace are managed to provide quality recreation experiences for visitors. The Natchez Trace Parkway crosses the northwest portion of the area that could be affected by the Downstream Water Intake Alternative.

Columbia Glade Natural Area provides protection for several endemic plants, including at least one federally-listed endangered plant species. Columbia Glade, which at one time probably occupied more than 1,000 acres, presently covers approximately 327 acres. This property, part of the former Columbia Project lands, is now being managed jointly by TWRA, TDEC, and TVA. Columbia Glade lies along the northwestern edge of the area that could be affected by the Fountain Creek reservoir Alternative.

Normandy Fish Hatchery is a 205-acre facility managed by TWRA that is used primarily for the propagation of warmwater game fish. This facility produces fish that are stocked to support the increasingly-important sport fishing industry in Tennessee. The Normandy Fish Hatchery is located just

downstream from Normandy Dam, in an area that could be affected by the Raise Normandy Pool Level Alternative.

Short Springs State Natural Area is a 421-acre site that is managed jointly by the City of Tullahoma, Tullahoma Utilities Board, Friends of Short Springs, TDEC, and TVA. This natural area is significant from botanical, geological, and historical standpoints. An exceptional variety and abundance of wildflowers occurs on this site, including two Tennessee state-listed endangered plants. The geological features include a 60-foot high waterfall, several cascades, and numerous dripping springs and rock formations. Historically, the area has ties to many of the pioneering families of the region. Especially appreciated for its abundance of spring wildflowers, this natural area receives heavy year-round use by outdoor enthusiasts. Part of the Short Springs Natural Area lies along the existing shoreline on Normandy Reservoir, within the area that could be affected by the Raise Normandy Pool Level Alternative.

Old Stone Fort State Archaeological Area is a 2,000-year-old Native American site. The mounds and walls that were built on high ground where the Duck and Little Duck rivers flow together form an enclosure that measures 1.25 miles around. This site is believed to have been used as a ceremonial gathering place over a period of at least 500 years. The present State Archaeological Area, managed by TDEC, includes a 50-site campground, picnic area, visitor center, and a 9-hole golf course. The Old Stone Fork area harbors a diversity of topography, soils, plants, and animals and is a potential National Natural Landmark (see Jackson Falls area description, above). Old Stone Fort State Archaeological Area includes land just upstream from Normandy Reservoir and probably would not be affected by the Raise Normandy Pool Level Alternative.

Arnold Engineering and Development Center (AEDC) includes 39,000 acres of rich and diverse terrestrial and aquatic habitats. Approximately 88 percent of AEDC is largely undeveloped and provides habitat for at least 68 protected or rare plant and animal species. In addition, AEDC includes **Woods State Wildlife Management Area** which is managed by TWRA for large and small game and waterfowl hunting. Several federal, state, and private conservation organizations are working together to implement an ecosystem management plan for most of the AEDC lands. This area is located approximately four miles southeast of Normandy Reservoir, outside of the area that could be affected by either the Raise Normandy Pool Level or the Tims Ford Pipeline alternatives.

4.12 CULTURAL RESOURCES

The physical cultural resources of an area include archaeological sites, historic structures, and sites where historic events took place but where no remains of the event are still present. A great deal of cultural research has been conducted in this project area, in part associated with the completion of Normandy Reservoir and in preparation for the construction of Columbia Reservoir. Surveys and excavations in this region have identified a large number of cultural sites and have confirmed human existence in the area from the earliest known Native Americans through the present.

Archaeological Resources

Archaeological time periods are identified based on differences in the styles of the artifacts that remain and changes in housing and land use patterns that are thought to have taken place. In the Central Basin, cultural history is generally divided into four broad time periods: Paleo-Indian, Archaic, Woodland, and Mississippian. The Paleo-Indian period (12,000-8,000 B.C.) represents the first documented human occupation, a time when the area was dominated by highly mobile bands of hunter/gatherers. In the Archaic Period (8,000-1,000 B.C.), people lived at dispersed campsites in the uplands during the fall and winter but started to stay along streams during the spring and summer where they gathered food from the water and bottomlands, and began to take care of some types of useful plants. During the Woodland Period (1000 B.C.-A.D. 900), the people in this region lived in clusters of more permanent dwellings (typically located on the floodplains), made and used pottery, and began to rely on plants they grew. When Europeans first encountered Native Americans in this area, the end of the Mississippian Period (A.D. 900-1600), they saw organized societies that farmed corn and other crops while living in permanent settlements (typically located just above the floodplains).

The first Europeans started living in the Duck River Valley in the late 18th century and settled there in increasing numbers during the first half of the 19th century. Rather quickly, agriculture became an important part of the local economy, with cotton and tobacco the most important crops before the Civil War; however, grain and livestock replaced cotton in the late 19th century (Lightfoot, 1998). Mill sites located along the Duck River are associated with the increasing importance of grain crops.

During the Civil War, numerous skirmishes occurred in the upper Duck River watershed area but no major battles were fought there. Prior to and

immediately following the Civil War, African-Americans accounted for almost 50 percent of the population of Maury and surrounding counties (Jolley and Newman, 1982). In the late 19th and early 20th centuries, the African-American population in the area declined as people left for higher paying jobs in cities and to the north.

The Tennessee Division of Archaeology collects information from surveys and maintains files on archaeological sites all across Tennessee. These files indicate that 1,092 archaeological sites have been identified in the four counties involved in this project (Table 18). The relatively large number of sites reported from Maury and Coffee counties probably reflects the extensive amount of archaeological research conducted in those counties as parts of the Normandy and Columbia reservoir projects.

Table 18. Known prehistoric, historic, or multi-component sites in Tennessee counties that could be affected by one or more of the action alternatives. Entries in the table may not add up to the totals given for each county because of uncertainties about what exists at each site.

Time Periods	Maury County	Bedford County	Coffee County	Moore County
Paleo-Indian	30	2	19	5
Archaic	476	61	443	27
Woodland	294	44	239	22
Mississippian	27	2	4	2
Historic	61	34	29	1
Total Number of Sites	560	217	278	37

Historic Structures

Historic structures include standing buildings and other structures (such as bridges and dams) that are more than 50 years old and have significant historical associations. Systematic surveys of potential historic structures have been conducted in Maury, Bedford, and Moore counties (Steve Rogers, Tennessee Historical Commission, personal communication 1999). In 1987, a total of 3,133 historic structures was recorded in Maury County. A total of 690 historic structures has been recorded in Bedford County. Results of a 1979

survey in Moore County conducted by Middle Tennessee State University included 201 historic structures. No systematic survey of Coffee County has been undertaken; however, at least 15 historic structures are known to occur there.

Each of the four action alternatives would occur only in small parts of the general area covered by this evaluation. The following paragraphs focus on what is known about cultural resources in these specific areas.

Fountain Creek Reservoir Area

Most of the archaeological survey and testing work that was done as part of the Columbia Reservoir project in the 1970s and 1980s focused on the mainstem of the Duck River. In the Fountain Creek watershed, 68 prehistoric archaeological sites were found on 240 acres, approximately 15 percent of the total area (Dickson, 1976; Evans, 1972). Two historic structures on or eligible for listing on the National Register of Historic Places (the Giles Harris House and the lime kiln on Silver Creek) also are located in the part of the Fountain Creek watershed acquired to be part of Columbia Reservoir (Jolley and Newman, 1982). While this work might have identified the most important cultural sites in the watershed, the remainder of any area affected by this alternative would have to be surveyed to know the full extent of the archaeological and historical resources that are present.

Downstream Water Intake Area

No systematic survey of this potential project area has been conducted, in part because no specific intake site and no specific pipeline route have been identified. A large number of archaeological sites and historical structures are known to occur in Maury County, some of which are likely to occur along the Duck River and State Route 50. The specific area affected by this alternative would have to be surveyed to know the full extent of the archaeological and historical resources that are present.

Normandy Reservoir Area

Before Normandy Reservoir was completed, the University of Tennessee identified the archaeological and historical sites in the area (Faulkner and McCollough, 1973) and excavated sites that contained important archaeological resources (Faulkner and McCollough, 1977: 1978; and 1982). All of the structures that occurred on Normandy Project land were removed before the reservoir was filled. However, during a recent survey of 10 miles of Normandy Reservoir shoreline, 11 archaeological sites were found on relatively flat lands

in tributary hollows (John Cable, 1999, personal communication). The recent information suggests that some additional archaeological resources could occur in the area that would be affected by this alternative.

Tims Ford Pipeline Area

No systematic survey of this potential project area has been conducted, in part because no specific intake site and no specific pipeline route have been identified. Limited archaeological research was conducted in the area before Tims Ford Reservoir was completed (Faulkner, 1968). Additional archaeological surveys have been conducted as part of the TVA Shoreline Management Initiative and prior to development around the reservoir. In all, approximately 118 archaeological and historical sites have been recorded within the immediate Tims Ford Reservoir area. Twelve of these sites are located on the Hurricane Creek embayment and three are located on the Lost Creek embayment. A recent survey of approximately one-third of the TVA property on Lost Creek above the reservoir pool did not identify any additional prehistoric archaeological resources (DuVall, 1998). Away from Tims Ford Reservoir, the pipeline would likely have to cross several small streams and the Duck River floodplain. Flat areas along these streams are likely to have been suitable sites for prehistoric settlements. The specific area affected by this alternative would have to be surveyed to know the full extent of the archaeological and historical resources that are present.

4.13 SOCIOECONOMICS

The purpose of this project is to provide additional water to meet the future needs of the Maury/southern Williamson County Water Service Area. This Water Service Area includes virtually all of Maury County and the adjacent part of southern Williamson County (Figure 1). These two counties lie south of Davidson County (Nashville), and west to southwest of Rutherford County (Murfreesboro). Interstate 65 runs north and south through the eastern part of both Williamson and Maury counties. Interstate 840, now under construction, will pass through the southern part of Williamson County near the Maury County line and connect to Interstate 40 both east and west of Nashville. Interstate 840, which is now open from Interstate 40 east of Nashville to Interstate 24 near Murfreesboro, eventually will serve as a southern bypass for Nashville and provide much easier access east and west from the Columbia area. Given these various associations, an appropriate labor market area for this project would include both Maury and Williamson counties and all of the

counties adjacent to each of them. The nine counties in this Maury/southern Williamson County Labor Market Area are listed in Table 19.

According to the latest estimates prepared by the Bureau of the Census, the population of Maury County was 69,633 in 1998 (Table 19). If confirmed during the 2000 Census, this would amount to a 27 percent increase over the population counted in 1990. The 1998 population estimate for Williamson County (117,569) indicates that county grew even faster, experiencing a 45.1 percent increase since 1990. Rutherford County is the other county in the Maury/southern Williamson County Labor Market Area that added tremendously to its population, with an estimated increase of 40.0 percent since 1990. Overall, the state of Tennessee is estimated to have grown by 11.3 percent since 1990, while the national population increased by 8.7 percent. During the period from 1980 to 1990, the population in Maury County grew at a rate of 7.3 percent, while Williamson County grew at a rate of 39.4 percent. Growth in both counties was faster than Tennessee as a whole and the rate in Williamson County was much faster than the national average.

In 1997, the average income in Maury County ($19,304) was about 85 percent of the state average and 76 percent of the national average (Table 20). The average income in Williamson County was substantially higher ($33,760), at 149 percent of the state average and 134 percent of the national average. High average incomes in both Williamson and Davidson Counties raise the overall Maury/southern Williamson County Labor Market Area value above the state and national averages. During the period from 1979 to 1997, per capita income in Williamson County and the whole labor market area grew faster than in the state or the nation, while income in Maury County grew more slowly than both the state and national averages.

Table 19. Population statistics for counties in the Maury/southern Williamson County Labor Market Area . Data from U. S. Department of Commerce, Bureau of the Census

Counties in Labor Market Area:	1980	1990	1998	Percent Change 1980-90	Percent Change 1990-98
Davidson	477,811	510,786	533,967	6.9	4.5
Giles	24,625	25,741	28,925	4.5	12.4
Hickman	15,151	16,754	20,553	10.6	22.7
Lawrence	34,110	35,303	39,358	3.5	11.5
Lewis	9,700	9,247	10,868	- 4.7	17.5
Marshall	19,698	21,539	26,302	9.3	22.1
Maury	**51,095**	**54,812**	**69,633**	**7.3**	**27.0**
Rutherford	84,058	118,570	166,035	41.1	40.0
Williamson	**58,108**	**81,021**	**117,569**	**39.4**	**45.1**
Totals: Labor Market Areal	774,356	873,773	1,013,210	12.8	16.0
Tennessee	4,591,023	4,877,203	5,430,621	6.2	11.3
United States (X 1,000)	226,542	248,765	270,299	9.8	8.7

Table 20. Per Capita Personal Income (in 1997 dollars) for counties in the Maury/southern Williamson County Labor Market Area. Data from U. S. Department of Commerce, Bureau of Economic Analysis

Counties in Labor Market Area:	1979	1997	Percent Change 1979-1997
Davidson	19,870	30,723	54.6
Giles	15,849	19,526	23.2
Hickman	13,415	16,400	22.3
Lawrence	15,239	18,207	19.5
Lewis	10,366	14,627	41.1
Marshall	16,191	20,405	26.0
Maury	**16,399**	**19,304**	**17.7**
Rutherford	16,238	22,762	40.2
Williamson	**22,242**	**33,760**	**51.8**
Totals: Labor Market Area	18,753	27,472	46.5
Tennessee	16,508	22,699	37.5
United States (X 1,000)	20,158	25,288	25.4

The dominant sector of the economy in Maury County is manufacturing, primarily the automobile industry (Table 21). This dominance is particularly apparent with respect to income, where manufacturing accounts for 51.9 percent of the earnings total. The service, retail trade, and governmental sectors also account for important parts of the economy in Maury County.

In contrast, the economy of Williamson County is much more oriented toward the service sector, which accounts for 33.1 percent of employment and 36.6 percent of earnings in the county. Other important sectors in Williamson County include the financial and retail trade sectors.

Table 21. Employment and Earnings by Place of Work in Maury and Williamson counties, Tennessee in 1997. Data from U. S. Department of Commerce, Bureau of Economic Analysis

	Employment		**Earnings**	
Place of Work	Maury (Percent)	Williamson (Percent)	Maury (Percent)	Williamson (Percent)
Agriculture, Forestry, and Fishing	2,114 (5.0)	3,123 (4.6)	1,511 (0.1)	22,153 (1.1)
Mining	68 (0.2)	159 (0.2)	2,121 (0.1)	5,526 (0.3)
Construction	2,076 (4.9)	5,026 (7.3)	65,455 (4.6)	189,304 (9.3)
Manufacturing	11,733 (28.0)	5,645 (8.3)	735,529 (51.9)	186,912 (9.1)
Transportation and Public Utilities	1,595 (3.8)	1,873 (2.7)	65,064 (4.6)	95,543 (4.7)
Wholesale Trade	1,242 (3.0)	2,111 (3.1)	39,680 (2.8)	111,467 (5.4)
Retail Trade	5,897 (14.1)	11,625 (17.0)	91,935 (6.5)	220,223 (10.8)
Finance, Insurance, Real Estate	2,621 (6.2)	10,821 (15.8)	57,537 (4.1)	312,908 (15.3)
Services	9,457 (22.5)	22,648 (33.1)	209,959 (14.8)	748,205 (36.6)
Government	5,161 (12.3)	5,392 (7.9)	148,557 (10.5)	153,484 (7.5)
Total	41,964 (100.0)	68,423 (100.0)	1,417,348 (100.0)	2,045,725 (100.0)

Some of the action alternatives would involve construction and related activities in parts of counties outside of the Maury/southern Williamson County Labor Market Area. The counties that might be affected (Bedford, Coffee, Franklin, and Moore counties) are all located in the upstream part of the Duck River watershed or in the adjacent part of the Elk River watershed. Recent estimates about population, income, and employment statistics in these counties are presented in Table 22. Per capita personal income in each of these counties is below the average in the Maury/south Williamson County Labor Market Area. County population totals range from 5,196 in Moore County to 45,767 in Coffee County. Manufacturing accounts for almost 31 percent of jobs in Bedford County while employment in the other counties is predominantly service-oriented.

Table 22. Population, income, and employment information for other counties which might be affected by one or more of the action alternatives. Data from U.S. Department of Commerce, Bureau of the Census and Bureau of Economic Analysis

Measure (date of estimate)	Bedford County	Coffee County	Franklin County	Moore County
Population (1998)	34,533	45,767	37,465	5,196
Per Capita Personal Income (1997)	$19,130	$20,388	$18,420	$16,887
Employment (1997)	18,888	31,169	15,081	2,188
Manufacturing (%)	30.7	16.6	13.6	8.0
Trade (%)	15.7	20.3	18.3	n/a
Services (%)	17.8	36.1	31.6	n/a
Government (%)	11.9	10.8	11.6	32.8
Other (%)	24.0	16.2	24.9	n/a *

* - not available

4.14 ENVIRONMENTAL JUSTICE

Environmental justice refers primarily to ensuring that no segment of the population bears a disproportionate burden of health or environmental impacts of society's activities. Some studies suggest that poor, predominantly minority, populations are exposed disproportionately to adverse health and environmental impacts because of siting decisions for facilities with potential adverse effects. Other studies dispute these findings. Because of such

concerns, Executive Order No. 12898 directed certain federal agencies and requested others to consider environmental justice in environmental reviews.

The purpose of this project is to provide additional water to meet the future needs of the Maury/southern Williamson County Water Service Area. The part of Williamson County included in the study area is located in the southern parts of the Bethesda and Boston Census Divisions, as defined by the U. S. Bureau of the Census. The Bethesda Division includes the southeastern corner of the county. The Boston Division includes the remainder of southern Williamson County, including the part of the Town of Spring Hill that is located in Williamson County (most of the town is located in Maury County).

Information available from the 1990 Bureau of the Census indicates that both Maury and Williamson counties have smaller nonwhite populations and lower poverty rates than the state of Tennessee as a whole (Table 23). This is also true of the Bethesda and Boston Census divisions. Within Williamson County, the poverty rates in the Bethesda and Boston divisions are both higher than the county as a whole. The percent of nonwhite population in the Bethesda Division is higher than in the remainder of the county or in the Boston Division.

Table 23. Population in the Maury/southern Williamson County Water Service Area by race and poverty rates in 1990. Data from U.S. Department of Commerce, Bureau of the Census, Census of Population, 1990, File STF1A and File STF3A.

	Maury County Total	Williamson County			Tennessee Total (X 1,000)
		Total	Bethesda Division	Boston Division	
Population	54,812	81,021	4,252	3,945	4,877.2
White	45,868	74,903	3,792	3,784	4,048.3
Nonwhite	8,944	6,118	460	161	828.9
Percent Nonwhite	16.3	7.6	10.8	4.1	20.5
Percent below the poverty level	13.2	5.8	12.6	7.9	15.7

Some of the action alternatives would involve construction and related activities in parts of counties outside of the Maury/southern Williamson County Labor Market Area. The counties that might be affected (Bedford,

Coffee, Franklin, and Moore counties) are all located in the upstream part of the Duck River watershed or in the adjacent part of the Elk River watershed. Information about race and poverty rates in these counties from the 1990 Census is presented in Table 24. All four of these counties have smaller nonwhite populations than the state as a whole or in Maury County. Poverty rates are similar to those in the state as a whole, except for Moore County where the poverty rate is much lower than elsewhere in Tennessee.

Table 24. Population by race and poverty rates in 1990 for other counties which might be affected by one or more of the action alternatives. Data from U.S. Department of Commerce, Bureau of the Census, Census of Population, 1990, File STF1A and File STF3A.

	Bedford County	Coffee County	Franklin County	Moore County	Tennessee (X 1,000)
Population	30,411	40,339	34,725	4,721	4,877.2
White	27,117	38,233	32,501	4,536	4,048.3
Nonwhite	3,294	2,106	2,224	185	828.9
Percent Nonwhite	10.8	5.2	6.4	3.9	20.5
Percent below the poverty level	16.0	15.2	14.4	6.5	15.7

CHAPTER 5 - ENVIRONMENT CONSEQUENCES

5.1 INTRODUCTION

This chapter discusses the potential environmental consequences which could occur if each of the water supply alternatives was pursued. The components, possible locations, and likely construction measures involved in each of these alternatives are presented in Sections 3.3 through 3.8. The four action alternatives focus on different ways of making more water available to the Maury/southern Williamson County Water Service Area.

Each section in this chapter presents an evaluation of the potential impacts on a resource area that would be likely to occur during the construction and operation of the alternatives as presented in Chapter 3 given the existing state of that resource as presented in Chapter 4. The sections in this chapter address the same topics as those described in Chapter 4 and they are presented in the same order. Within each section, any general discussion is followed by an evaluation of each alternative. These evaluations assume that no changes would have occurred in present laws, regulations, and knowledge about the status of resources in the area. All of the evaluations presented in this chapter are summarized in Section 3.9.

5.2 CLIMATE, GEOLOGY, AND SOILS

The local climate, geology, and general characteristics of the soils in and around the upper Duck River basin would not be affected by construction and operation of any of the water supply alternatives. The presence of sinkholes and cracks in the rocks near the surface and the associated effects on ground water would have to be considered when specific sites and routes were being selected for any facilities that would be built (see Section 5.3) Similarly, soils that contributed to the quality of prime farmland would have to be considered as part of any proposed changes in land use (see Section 5.10).

5.3 GROUND WATER

Sections 4.2 and 4.3 indicate that much of the area which could be affected by the various water supply alternatives is underlain by limestones and dolomites that contain some ground water. Many of the surface rock layers

also contain sinkholes and cracks through which water can move into and out of the ground. Sinkholes and water-conducting channels in the bedrock could make it easy for surface water and a variety of pollutants to get into the ground water. Construction projects involving large areas (such as building or enlarging reservoirs) or extending for some distance (such as building pipelines) could increase the connections between the surface and ground water and could lead to various types of effects. Site-specific planning for any water supply project in this area would have to include a careful evaluation of the potential for leakage into the ground, adverse effects on ground water, and the use of appropriate measures to minimize both of these potential effects. More focused comments about each of the water supply alternatives are presented in the following paragraphs.

Alternative A - Continue to Use Present Sources (No Action)

In comparison with the other options, this alternative might result in the greatest long-term impact on existing groundwater resources. If the future water demand in the Columbia area does exceed what can be withdrawn from the Duck River and no other additional source of water is developed, attempts could be made to withdraw more water from the ground.

As of 1993, ground water supplied less than 10 percent of total public water use in the area (1.66 mgd). Information collected by the USGS (USGS, 1995) suggests that groundwater supplies in or near the project area are not available to meet that much of the future demand for water. Attempts to increase groundwater withdrawals could exceed the recharge capacity of the known water-bearing rock layers and could significantly reduce the amount of available ground water, causing adverse effects to the ground water and existing groundwater users in the area.

Alternative B - Fountain Creek Reservoir

Building a reservoir on Fountain Creek could result in both construction and operational effects on groundwater resources. During the construction period, appropriate erosion and pollution control measures would be required to prevent sediment, trash, and pollutants (e.g. spilled fuel) from flowing into the ground and the ground water. Available information (USACE, 1997b) also suggests that grouting of potential routes into the ground water would be required to slow water losses from the reservoir. All wells in the footprint of the new reservoir also would have to be properly abandoned before the area was flooded.

After the reservoir was filled, the level of water in the ground would be expected to rise. While this could improve the yield of wells in the immediate area, sediment and other materials from the reservoir could degrade the quality of the existing ground water. Grouting to hold more water in the reservoir could prevent or minimize much of this effect.

Alternative C - Downstream Water Intake

Construction of a new water intake and pumping station along the Duck River near the western edge of Maury County and a new approximate 13-mile pipeline and booster station would require that careful attention be given to the presence of potential groundwater access points. Once the proposed structures were properly located and designed, appropriate construction practices could be used to avoid or minimize effects to groundwater resources in the area.

Alternative D - Raise Normandy Pool Level

Raising the height of Normandy Dam by approximately five feet could lead to potential losses of reservoir water to the ground through caves, sinkholes, and cracks in the local bedrock. Losses to the ground water could be slowed or prevented by grouting the likely routes into the ground. Any wells in the expanded reservoir area also would need to be properly abandoned before the higher water level was reached. The use of these preventative measures would minimize or avoid any adverse effects of this alternative on groundwater resources.

Alternative E - Tims Ford Pipeline

The construction of a raw water intake and pumping station along the northern side of Tims Ford Reservoir and an approximate 20-mile pipeline and a booster station to discharge water into the Duck River near Shelbyville would require that careful attention be given to the presence of potential groundwater access points. Once the proposed structures were properly located and designed, appropriate construction practices could be used to avoid or minimize effects to groundwater resources in the area.

Comparison of Alternatives

All four of the action alternatives could be designed, constructed, and operated in ways that would avoid or substantially minimize adverse effects on ground water. Alternatives C and E are likely to have the fewest potential impacts on groundwater resources because both of these projects

could be built and operated in ways that would avoid or minimize any adverse effects on sinkholes or groundwater systems. Alternative B, which would include the construction of a new reservoir, has the potential for more groundwater effects than the modifications to an existing reservoir which would occur under Alternative D. While Alternative A would not have any immediate effects on ground water, it has the potential to impact this resource the most if attempts were made to meet future water needs by withdrawing more water from the limited underground supplies.

5.4 SURFACE WATER

The information presented in Chapter 2 and Section 4.4 describes how the water in the upper Duck River basin is controlled and affected by Normandy Reservoir and the several water supply and wastewater systems that exist all along the length of the river. With that information as a background, it should not be surprising to learn that each alternative which would provide more water for the Columbia area would have some effect on the water resources and water users throughout most of the rest of the basin.

Information presented in Section 4.4 also indicates that the upper Duck River watershed consistently has relatively high levels of nitrogen, phosphorus, iron, and manganese. While all four of these elements are relatively abundant in the rocks and soils in this watershed, nitrogen and phosphorus also are being added to the water from point source discharges, agricultural practices, and other non-point sources. In a few places throughout the upper Duck River watershed, these materials and other pollutants are making the water less than fully suitable for its classified uses (Table 10). The 1996 amendments to the federal Safe Drinking Water Act require water systems to identify source water protection areas, inventory potential sources of contaminants, determine the susceptibility of the water supply to potential contamination, and develop plans to protect their sources from potential contamination. The amendments to that law also require water systems to pay more attention to the chemicals formed when chlorine reacts with natural carbon-containing compounds. These amendments to the Safe Drinking Water Act require water systems to take an active role in making sure the water they distribute is free of watershed-related contaminants that have potential to affect human health.

Three of the action alternatives would involve the construction of some length of pipeline to transfer water from one location to another. The construction of any pipeline could result in temporary adverse effects on the water quality in each stream along its route. As the pipeline is constructed adjacent to or across a stream, the work could cause temporary increases in the amount of suspended solids, sediment, and other materials in the stream. Under each of these alternatives, the location, design, and construction of the pipelines and any other related structures would include measures to avoid or minimize adverse effects on streams and water quality (see Section 3.5). Where the construction of a pipeline and other structures would have to occur in or immediately adjacent to a stream, the work would be planned to minimize the duration of the impact and, when possible, to be conducted during a typically low-flow season of the year.

The following paragraphs present specific reviews of the potential effects of each alternative on surface water resources.

Alternative A - Continue to use Present Sources (No Action)

Under this alternative, no additional source would be developed to meet the projected future water demands of the Maury/southern Williamson County Water Service Area. When required, the existing intake and treatment facilities in Columbia would be expanded or supplemented to withdraw and treat more of the water available in the river. The potential construction-related effects of these activities on surface water probably would be minor, especially if the work was done in compliance with appropriate NPDES permits. If the demand for water did exceed the amount presently allowed to be withdrawn from the Duck River, some action would have to be taken to curtail use or find additional water to meet at least critical needs. One possible way to meet future critical needs would be to request approval from TDEC to reduce the flow in the Duck River below 100 cfs during drought periods. Additional withdrawals from the river would reduce the amount of natural flow in the 6-mile reach between the Columbia Power and Water intake and the wastewater plant discharge (Figure 3). This reduction in flow would allow the water temperature to rise more than normal and the dissolved oxygen level probably would decline. If the reduced flows continued for very long and water quality did decline, impacts could occur to designated uses such as aquatic life and recreation. Over time, if the required volume of additional withdrawals from the river increased as the

need for water continued to grow in the Columbia area, adverse effects on designated uses would occur more often and would be more severe.

Alternative B - Fountain Creek Reservoir

Building a reservoir on the downstream part of Fountain Creek would meet the additional need for water in the Maury/southern Williamson County Water Service Area. The construction and operation of this reservoir also would have a variety of effects on water supply and water quality both in the reservoir area and downstream into the Duck River.

Construction of this reservoir would involve soil disturbance activities on up to 3,600 acres of land and heavy equipment activity adjacent to the streams in the affected part of the Fountain Creek watershed. During the construction period, particular attention would have to be given to the timing of clearing activities, the way earthmoving work was conducted, and how erosion control measures should be used to minimize potentially adverse impacts on water quality in Fountain Creek and the adjacent reach of the Duck River. Careful planning of the various construction stages of the project could minimize water quality impacts by isolating areas before extensive earthmoving work would be done and by rerouting the streamflow into stabilized channels instead of having equipment operate in the flowing water. If this alternative was proposed to be built, the planning leading up to the construction of a reservoir in the Fountain Creek watershed would include a detailed evaluation of ways to minimize adverse effects on the water in the streams passing through the area and the adjacent reach of the Duck River. The results of that planning effort would be reviewed by TDEC, USACE, and other agencies and, if approved, would be addressed in the NPDES permit for the construction work.

Once the reservoir was constructed and filled, the decay of vegetation left in the pool area and the oxygen demand of the flooded soil would reduce the amount of dissolved oxygen in the water during much of the first two or three years. This potential adverse effect could be minimized by removing much of the woody vegetation from the area before the reservoir was filled. That potential water quality benefit might have to be balanced against the potential benefits to aquatic life of leaving some trees in the reservoir (see Section 5.5).

In the summer, the surface water of the reservoir would be warmer and the water on the bottom would be cooler than nearby flowing streams. A water supply reservoir on Fountain Creek would experience strong thermal layering (stratification) similar to that observed in Normandy Reservoir. Reservoirs with low flows and high volumes have low flushing rates, that is the average number of times the reservoir volume is replaced each year. The estimated flushing rate for a Fountain Creek reservoir would be 2.6 times per year while the flushing rate for Normandy is 2.8 times per year. Thus, water quality conditions associated with thermal stratification would be similar for both reservoirs, with conditions in a Fountain Creek reservoir possibly being more severe because of the slower flushing rate. The amount of oxygen in the lower layers of the reservoir probably would begin to drop in early May and there would likely be no oxygen present below a depth of about 15 feet from June to some time in October, when all of the water in the reservoir would mix once again.

Chemical changes associated with the absence of dissolved oxygen on the bottom would cause iron and manganese to become dissolved in the deeper water of the reservoir. There is sufficient iron and manganese in the inflow to the reservoir (0.2 mg/L and 0.095 mg/L, respectively - See Appendix A) to produce high levels in the deeper water during thermal stratification. High levels of dissolved iron and manganese in finished (tap) water can stain laundry and plumbing fixtures. If the water system had to withdraw water from the lower depths of a Fountain Creek reservoir, additional treatment processes would be required to remove iron and manganese from the finished water.

Throughout the life of a reservoir, the amounts of nitrogen, phosphorus, and other nutrients in the water serve to control how much algae are present. Excessive algal growth can cause wide daily variations in pH and dissolved oxygen levels in the upper layers of a reservoir, contribute to oxygen depletion in the deeper water, produce taste and odor in water supplies, and lead to the use of alternative disinfection methods to avoid undesirable reactions of natural carbon-containing substances with chlorine (commonly used in water treatment processes). Information presented in Section 4.4 indicates that the Fountain Creek watershed contains relatively high levels of nitrogen and phosphorus from natural sources, as well as non-point sources. These nutrient levels would be quite likely to support excessive algal growth in the upper layers of the reservoir.

The combination of excessive algal growth in the upper layers of the water and high concentrations of dissolved iron and manganese in the water near the bottom would make it important for the water system to be able to withdraw water from a variety of depths. The construction and use of a multi-level intake structure in the deepest part of the reservoir would make it possible for the water system to withdraw the best quality water that was available and minimize this potential adverse effect. The multiple levels in the intake structure also would have to be used as the reservoir was drawn down during the drier months of normal years and, especially, during drought conditions.

A Fountain Creek reservoir would be relatively small in comparison to most reservoirs in the Tennessee River system. For example, it would hold about 1/3 the volume of water as Normandy Reservoir, also one of the smaller reservoirs in the system. Because of its relatively small volume, the water would be very susceptible to contamination from pollution sources. Recent amendments to the Safe Drinking Water Act would require a water system withdrawing from a Fountain Creek reservoir to prepare a source water assessment and to protect the water source from potential contaminants. On a reservoir the size of Fountain Creek, source water protection actions might need to include reducing agricultural and other types of non-point source pollution in the watershed, restricting recreational uses which could cause contamination of the water, and controlling activities on the land around the reservoir to prevent the introduction of more contaminants such as nutrients and bacteria. The potential for contaminant effects on the water supply and the ramifications of various ways to avoid those effects would have to be important parts of a more detailed evaluation of this alternative if it was proposed to be built.

The dam probably would have to provide a continuous release of at least five cfs of water to maintain water quality and support aquatic life in the downstream reach of Fountain Creek. That amount of minimum release, which would be approximately three times the natural 7-day, 10-year minimum flow in Fountain Creek, could improve water quality in the downstream part of the creek. Careful planning about the amount and quality of this water would be important to avoid adverse effects on aquatic life in the tailwater of this dam and in the adjacent reach of the Duck River.

If this alternative resulted in a net increase in the amount of water in the Duck River at Columbia, it would have a positive effect on water quality in the river. If, for example, all of the future water demand of the Columbia area were to be met from the Fountain Creek reservoir, there could be at least 43 cfs of additional flow in the river as it passed through town (Figure 5). The additional flow would help maintain acceptable water quality conditions for fish and aquatic life and recreational uses downstream from the existing water intake, as well as provide more initial dilution for the discharge from the Columbia wastewater treatment plant. This increase in initial dilution also would help maintain reasonable wastewater treatment costs for Columbia.

In summary, construction and use of a Fountain Creek water supply reservoir would create a relatively small, nutrient-rich reservoir which probably would have to be carefully monitored and the watershed strictly managed to protect the quality of the source water. Water suitable for domestic use could be withdrawn from this reservoir if a multi-level intake structure was built and used to select the best water available from the various layers in the reservoir. This reservoir would not have any adverse construction or operational effects on water quality in the downstream reach of Fountain Creek or the adjacent reach of the Duck River if appropriate erosion and pollution measures were taken while the project was being built and if water for the minimum release was drawn from appropriate layers in the reservoir pool.

Alternative C - Downstream Water Intake

Construction of a new water intake and pumping station on the Duck River downstream from the mouths of Big Bigby and Catheys creeks and an approximate 13-mile pipeline and booster station to transport water to a new treatment plant and the existing distribution system could affect surface water quality in the Duck River adjacent to the intake site and in the various other streams that would be crossed by the pipeline. If these structures were built as described in Section 3.4, the construction effects on surface water would be only minor and temporary.

If this downstream intake was built, future water demands above the likely maximum capacity of the existing water treatment plant (30.8 cfs) would be met using water withdrawn at the downstream site. At that site, Big Bigby Creek, Catheys Creek, and other tributaries would have added at least 11

cfs of additional flow to the river, in addition to the water that would be returned to the system from the Columbia and Spring Hill wastewater treatment plants (Figure 7). The likely location of this intake is more than 25 river miles downstream from the Columbia wastewater treatment plant discharge (Duck River Mile 127.2) and at least 20 miles downstream from the industrial wastewater discharge on Big Bigby Creek (Creek Mile 15). At present, these well-treated effluents make up about 6 percent of the minimum flow near River Mile 100. The percentage from the Columbia wastewater treatment plant is projected to increase to 15 percent of the minimum flow by the year 2050. The Duck River near River Mile 100 presently meets all applicable water quality criteria and is classified for domestic water supply use. Previous water quality studies on the Duck River indicate that, even during low flow conditions, the wastewater from Columbia is completely assimilated in the 2.5 days it takes to reach Duck River Mile 116.0 (TVA, 1986).

Leaving additional water in the Duck River between the existing Columbia intake and the wastewater discharge would improve water quality conditions in that part of the river. Water quality in the river reach downstream from the wastewater discharge would be especially benefited by having more water available for initial dilution of the treated effluent.

Alternative D - Raise Normandy Pool Level

Increasing the amount of water that could be stored in Normandy Reservoir would require the dam and a variety of other structures on the reservoir to be raised by that same height. Construction activities associated with, or required by, raising the dam include adding a large volume of earth fill and riprap on the dam, rebuilding the roadway at the dam, raising the Riley Creek Road bridge and approaches, and raising or replacing a variety of roads, structures, and other facilities at existing recreation areas. The use of best management practices would be required at each of these construction sites to control runoff and prevent soil erosion which could adversely affect water quality in the reservoir or the tailwater.

Raising the level of the Normandy pool also would affect the immediate shoreline of the reservoir which, now, is typically covered with trees and woody vegetation. Virtually all of the vegetation would be cleared within the band of present shoreline that would become part of the higher reservoir pool. If the clearing of this area was conducted in ways that would

minimize erosion and sedimentation effects on the reservoir, it would minimize the potential for impacts on surface water quality. This would include making appropriate decisions about what to do with the cleared debris, taking into account its potential to increase nutrients and oxygen demand if some or all of that material was placed in the reservoir.

If the Normandy pool level was raised and an additional 16 cfs of water was discharged from the dam during the summer months, water quality conditions in the reservoir and the tailwater would change but, perhaps, only slightly. The larger discharge from the dam would tend to increase the flushing rate and reduce the volume of the cooler water in the lower layers of the reservoir. In the tailwater, the additional flow would not change water quality conditions near the dam; however, the cooler water from the dam discharge would affect a slightly longer reach of the river. Under extremely dry conditions, all of the cooler, low dissolved oxygen water in the bottom layer of the reservoir might be discharged, which would result in higher temperatures and other water quality changes in the tailwater. Further downstream from Normandy Dam, the additional 16 cfs of minimum summer flow in the river would provide some water quality benefit to the Shelbyville wastewater discharge (at River Mile 221.3) by providing more initial dilution for the treated wastewater. If this alternative is proposed to be built, detailed modeling studies of the proposed operating conditions might be required to determine how much water quality in the reservoir and the dam tailwater could change during typical and extremely wet or dry years.

At present, Normandy Reservoir is the most important water supply source in the upper Duck River watershed. If this alternative is proposed to be built and Normandy Reservoir is to provide more of the water used in this region, the protection of water quality in the reservoir would have to become a priority for each of the water systems it serves. Under the 1996 amendments to the Safe Drinking Water Act, each of the downstream water systems should take an active role in a source water assessment program for Normandy Reservoir. Such a program could help prevent impacts caused by agricultural non-point sources, residential shoreline development, other forms of urban or industrial development, and any other potential threats to water quality. In addition, the downstream water systems should exert leadership to improve and protect water quality in the Duck River from bacterial contamination, agricultural non-point sources, or

other potential impacts that exist in Bedford County, Marshall County, and the upstream part of Maury County.

Alternative E - Tims Ford Pipeline

This alternative could affect surface water quality during the construction of the intake, pump stations, and discharge structure; during the construction of the pipeline; and when this facility was moving water from Tims Ford Reservoir to the Duck River. The use of appropriate erosion and pollution prevention measures described in Section 3.4 would reduce the potential construction impacts to short-term and minor effects on water quality.

Water quality in both the Lost Creek and Hurricane Creek embayments would be suitable for water supply use. Neither Hurricane Creek or Lost Creek is presently classified for domestic water supply use; however, the Tennessee Water Quality Control Board could be petitioned to add that use to the classification for both of these streams. Operators of the Jack Daniel Distillery/Lynchburg joint water intake on the Lost Creek embayment report mostly favorable water quality conditions except during short time periods in the spring and late fall as a result of thermal stratification. Like Normandy Reservoir, Tims Ford Reservoir experiences strong thermal stratification, and the two embayments would become thermally stratified from May into October each year. To avoid potential problems associated with thermal stratification, the new intake would have to be able to withdraw water from various depths in the water column. No quality characteristics of the water in Tims Ford Reservoir would be incompatible with water quality in the Duck River.

If this transfer system was built, water probably would be withdrawn from Tims Ford Reservoir only during extreme dry periods which, in the upper Duck River watershed, typically occur in July through part of October. The results of initial modeling studies conducted by TVA indicate that if a water intake had been withdrawing 22 cfs from Tims Ford Reservoir during the severe drought which occurred in the region in 1987-1988, the water elevation in Tims Ford Reservoir would have been lowered 7 to 8 inches by the end of October each year. In future years, part of this estimated reduction in the Tims Ford elevation could be offset by an increase in the volume of water now discharged into the reservoir from the Tullahoma wastewater treatment plant. Tullahoma purchases water from the Duck River Utility Commission which withdraws water from Normandy Reservoir.

Tullahoma discharges treated wastewater into Rock Creek, a tributary to the Elk River which drains into Tims Ford Reservoir (at Elk River Mile 161.8). If Tullahoma grows and expands its wastewater collection system as anticipated, the additional wastewater discharged into Rock Creek could offset some of the reduction in the Tims Ford Reservoir elevation associated with this proposed withdrawal. If this alternative was proposed to be built, updated modeling studies should be conducted to confirm the possible effects on the elevation in Tims Ford Reservoir.

In the Duck River, the water from Tims Ford Reservoir would augment the existing flow only during extreme drought conditions (Figure 11). If this water was discharged upstream from Shelbyville, it would provide some water quality benefit to the Shelbyville wastewater discharge (at River Mile 221.3) by providing more initial dilution for the treated wastewater.

As indicated under Alternative D, the protection of water supply sources would have to become a priority for each of the water systems in this part of the basin. Under the 1996 amendments to the Safe Drinking Water Act, each of the downstream water systems would need to assure that each of its sources (in this case including Tims Ford Reservoir) was protected from agricultural non-point sources, residential shoreline development, other forms of urban or industrial development, and any other potential threats to water quality. In addition, the downstream water systems should exert leadership to improve and protect water quality in the Duck River from bacterial contamination, agricultural non-point sources, or other potential impacts that exist in Coffee, Bedford, Marshall, and Maury counties.

Comparison of Alternatives

The information about the potential effects that could occur if each alternative was proposed to be built also can be used to compare them. The construction of either Alternative C (Downstream Water Intake) or Alternative E (Tims Ford Pipeline) would have less potential for adverse impacts because both of these alternatives would result in only short-term and localized effects on surface water quality. Raising the Normandy Pool Level (Alternative D) would have more potential for construction impacts on surface water quality because of the larger scope of disturbance activities at the dam, along roadways, at a variety of recreation areas, and associated with clearing and inundating part of the existing shoreline. The construction of a new reservoir on Fountain Creek (Alternative B) would

involve the most disturbance of the land; would convert a free-flowing stream into a shallow, nutrient-rich reservoir; and would result in the most impacts on surface water quality of any of the action alternatives.

Even at the end of the planning period (around 2050), operation of all of the action alternatives would increase the minimum flow and, probably, improve water quality conditions in various lengths of the Duck River beyond what it would be under the No Action Alternative (Alternative A). Releasing more water from Normandy Dam (Alternative D) or moving water into the Duck River from Tims Ford Reservoir (Alternative E) would increase the flow by between 16 and 22 cfs along at least 85 miles of the river upstream from the Columbia water intake. Alternative E would maintain at least 100 cfs of flow in the river downstream from the water intake. Meeting all of the water needs of the Columbia area from a new reservoir in the Fountain Creek watershed (Alternative B) would result in a minimum flow of 137 cfs in the river from the existing Columbia water intake downstream to the wastewater discharge. Alternative B also would provide sufficient flows to meet water quality needs at both the Columbia water intake and wastewater discharge sites. Withdrawing some water at a downstream location (Alternative C) would involve the least modification in river flows but would allow at least 110 cfs of water to be left in the river downstream from the Columbia water intake.

Deciding to follow Alternative A (No Action) would not result in any construction-related impacts on surface water quality because no facilities would be built to provide an additional water source for the Columbia area. If the demand for water did exceed the amount presently allowed to be withdrawn from the Duck River, whatever action was taken to meet the future needs could result in some adverse effects on surface water quality.

5.5 AQUATIC LIFE

The information presented in Section 4.5 indicates that the streams and reservoirs in this project area support many types of aquatic life, as many as 436 species in the middle reach of the Duck River. Section 4.5 also indicates that the habitats and numbers of species vary quite a bit, ranging from small creeks and the reservoirs where relatively few species occur to the downstream and middle reaches of the Duck River where many species exist in a variety of flowing-water habitats. The different types of aquatic

habitats and diversity of aquatic life that occurs throughout this area would be affected in a variety of ways by the five water supply alternatives.

Three of the four action alternatives include the construction of some length of a pipeline to transfer water from where it was available to where it would be used. As indicated in Section 3.4, specific techniques would be used during the construction of these pipelines that would avoid or minimize potential adverse impacts on streams. If the route of the pipeline was carefully located, designed, and constructed, adverse impacts to streams and aquatic life would be minimal and would occur only during short periods of time. The subsequent review of more detailed plans for any of these alternatives proposed to be built would confirm or address the anticipated low level of construction effects.

Once it was built, each action alternative would be operated to hold water somewhere or move water from one location to another so it could be used to meet a water supply need. Each of these proposed changes in water flow also would have some effect on aquatic habitats and aquatic life, both at the source and in any receiving stream. The level of effect these changes could have on aquatic life would depend on when the transfer would occur during the year, how much the flow would be changed, and whether the change would modify the temperature and other water quality conditions. Most of the time, the volume of water that would be removed or introduced would be very small in comparison with what was left or was there initially. However, when the flow in a stream was extremely low (for example, during drought conditions), the amount being withdrawn or added could have important effects on the resident aquatic life.

The following paragraphs describe the potential effects of each alternative on aquatic life. The concluding paragraph in this section presents a summary and comparison of these potential effects.

Alternative A - Continue to use Present Sources (No Action)

If this alternative was followed, no additional source of water would be developed to meet the projected future needs of the Columbia area. Initially, this alternative would not have any effect on aquatic life because no structures would be built. Existing water quality and habitat conditions in the streams within this project area would not be changed from the way they are now. However, if the projected increased demand for water in the

Columbia area did occur at some time in the future, action would have to be taken to meet at least the critical needs for water. The most accessible way to meet a critical water need probably would be to withdraw more water from the Duck River than is presently allowed to be removed. As described in Section 5.4, the additional withdrawals from the Duck River could reduce the rate of flow in the six-mile reach between the intake and wastewater discharge (Figure 3), probably allow the water temperature to rise more than normal in that reach, and cause the dissolved oxygen level to drop. These water quality effects would stress aquatic life in the area and, under very low flow conditions, could result in fish kills and other losses in the aquatic life. These impacts could be minimized or avoided by finding other water sources to meet the future needs of the Columbia area.

Alternative B - Fountain Creek Reservoir

Construction of a reservoir in the Fountain Creek watershed would involve considerable modification of the aquatic habitat in the project area. Actual construction of the reservoir would require extensive modification of the land adjacent to the streams. These construction effects would allow more sunlight to raise the temperature of the water, increase the amount of sediment and nutrients in the streams, and result in the modification or destruction of the stream habitats. To minimize adverse effects on aquatic life in the reach of Fountain Creek downstream from the project area and in the adjacent reach of the Duck River, careful attention would have to be given to the timing of clearing activities, the way earthmoving work was conducted, and how erosion control measures should be used. These measures probably would become requirements included in the NPDES or other permits for the construction work.

After the reservoir was filled, the stream-dwelling aquatic life in the project area would be replaced by species capable of living in the standing-water habitats of a reservoir. More than likely, the 182+ species now living in the downstream part of the Fountain Creek watershed would be replaced with an aquatic community similar to the 44+ to 48+ species known to occur in Normandy and Tims Ford reservoirs. A reservoir on Fountain Creek would probably have an abundant plankton community, a bottom community composed of just a few types of insects and other tolerant species, and a fish community composed of a few plankton feeders and a few predatory species. Some of these species could become relatively abundant,

depending upon the nutrients available in the water and how the reservoir was managed.

If the reservoir was required to provide some minimum flow into the short reach of Fountain Creek downstream from the dam site, aquatic life in that area and in the adjacent reach of the Duck River would be affected by the temperature and quality of the water being released. If the dam release was consistently colder or warmer than it is now, if it had low dissolved oxygen levels, or if it contained large amounts of dissolved iron, manganese, or other materials not typically found now in Fountain Creek, the aquatic community would likely be different from what occurs there now. If all of the water needs of the Columbia area were met by withdrawing water from a Fountain Creek reservoir, the minimum flow in the Duck River, especially in the 6-mile reach between the present water intake and the wastewater discharge point, would be substantially higher than it would be under Alternative A (Figure 5). Aquatic life in that part of the river and in the river reach downstream from the wastewater discharge would benefit from the higher flow, increased water quality conditions, and increased dilution of the wastewater discharge (see Section 5.4). If this alternative was proposed to be built, careful planning would have to be given to the location, design, and operation of the discharge to minimize the potential for adverse effects on aquatic life in the downstream part of Fountain Creek and the adjacent reach of the Duck River. The results of this effort also probably would become a requirement included in the TDEC Aquatic Resource Alteration Permit for this project.

Alternative C - Downstream Water Intake

Construction of an intake and pumping station on the Duck River somewhere near River Mile 100 and a 13-mile pipeline and booster station from the intake site to somewhere in the Columbia area could have adverse impacts on aquatic life in the river and in each of the tributary streams that would be affected. However, if the intake facilities and pipeline route were located appropriately and the construction techniques described in Section 3.4 were followed, this alternative could be built with only minor and short-term effects on aquatic life. The subsequent review of detailed plans for this project would confirm or address the minimal construction effects on aquatic life that are likely to occur.

The withdrawal of as much as 31 cfs of water from the Duck River downstream from the mouths of Big Bigby and Catheys creeks would not have an adverse impact on aquatic life in that part of the river. As indicated in Section 3.4, the minimum flow in that reach of the river is approximately 147 cfs and, even during drought conditions, the withdrawal would amount to 21 percent of the flow. This modest reduction in the minimum flow (down to 116 cfs), would not be likely to change the characteristics of any habitats in the river or cause adverse effects on aquatic life.

Aquatic life living in the 30-mile reach of the Duck River between the Columbia water intake and the mouth of Catheys Creek could benefit if this intake and other area water-related facilities were used appropriately. Water withdrawn near Duck River Mile 100 would make it possible for at least 100 cfs of flow to be left in the river between the existing intake at River Mile 133 and the wastewater treatment plant at River Mile 127 (Figure 7). This amount of flow would help aquatic life process the nutrients in the wastewater discharge more quickly than would occur under Alternative A (No Action).

Alternative D - Raise Normandy Pool Level

Modifying the height of Normandy Dam, raising the pool level in Normandy Reservoir, and increasing the minimum flow in the tailwater could have a variety of effects on aquatic life, both in the reservoir and downstream in the river. The general nature of most of these effects can be predicted based on the description of this alternative presented in Section 3.5; however, these generalities should be confirmed or amended as part of the subsequent evaluation of a more detailed plan if this alternative is proposed to be built.

Construction effects on aquatic life likely to be associated with this alternative include temporary habitat disruptions and sedimentation effects that could occur during almost any project. In this case, the construction impacts could occur when the dam was modified, when roads and bridges were being raised, when recreation facilities were being modified or relocated, and when the shoreline vegetation was being removed in preparation to be flooded. Adverse impacts to aquatic life in the tailwater and the reservoir could be avoided or minimized with the use of appropriate measures to control erosion and sedimentation.

Raising the elevation of Normandy Reservoir could have a variety of effects on the aquatic life living in the reservoir pool. Some of the potential effects on aquatic life would be caused by changes in the operational plan dictating how water would be held and discharged. The range of possible changes in the flushing rate and the amount of cooler, low dissolved oxygen water in the lower layers of the reservoir are discussed in Section 5.4. Any substantial change in water quality conditions in the reservoir would affect the amount of habitat available to support fish and other aquatic life. Similarly, the suitability of the band of new shoreline habitat around the reservoir would be affected by the kinds and amount of trees and other material that would be left there when it was flooded. Raising the maximum pool level also could change the amount of shallow water habitat that would be available when different fish and other species were spawning. If this alternative was proposed to be built, the subsequent review would include a careful evaluation of changes in the operational plan for the reservoir and the effects those changes would have on water quality, aquatic habitats, and aquatic life in the reservoir pool.

Increasing the minimum flow in the discharge from Normandy Dam would benefit aquatic life in the Duck River downstream from this dam. In the first few miles downstream from the dam, the minimum flow determines how much bottom habitat is always available for use by aquatic life. Further downstream, the minimum flow from the dam continues to provide some stability in the amount of bottom habitat, especially during drought conditions. If the minimum flow was increased, more habitat would be available and more aquatic life could live there. One possible negative effect of maintaining a higher minimum flow from Normandy Dam (described in Section 5.4) would be the possibility that all of the cooler water in the bottom layer of the reservoir could be discharged before the end of a particularly dry summer. If that occurred, coldwater conditions in the first few miles of the dam tailwater would not be maintained and aquatic life adapted to those conditions (such as rainbow trout) might not be able to survive there. If this alternative was proposed to be built, modeling studies might be required to determine how often water quality conditions in the tailwater could change enough to adversely affect resident aquatic life adapted to coldwater conditions.

Alternative E - Tims Ford Pipeline

The construction of an intake and pumping station on a northern embayment of Tims Ford Reservoir and an approximate 20-mile pipeline (with a booster station) to discharge water into the Duck River somewhere near Shelbyville could affect aquatic life adjacent to the intake site in the reservoir, in the streams along the pipeline route, and in the Duck River at the discharge location. If the pipeline route essentially followed State Highway 82 towards Shelbyville, the effects of pipeline construction could occur in part of the East Fork Mulberry Creek watershed and at several sites all along the length of the Flat Creek watershed. If the intake facilities and pipeline route were located appropriately and the construction techniques described in Section 3.4 were followed, this alternative could be built with only minor and short-term effects on aquatic life. The subsequent review of detailed plans for this project would confirm or address the minimal construction effects on aquatic life that are likely to occur. Avoiding or effectively minimizing adverse impacts on aquatic life at each potential impact site would be much more important in the Flat Creek basin because the pipeline could affect several sites in that small watershed.

An intake structure could be built in either of the two northern embayments of Tims Ford Reservoir (Hurricane Creek and Lost Creek embayments) with little or no adverse effect on aquatic life. Much of the work could be scheduled to occur when the reservoir was at winter pool, and lower elevation work probably would occur during a short-term drawdown. Aquatic life in Tims Ford Reservoir is adapted to periodic fluctuations in the water level and would not be adversely affected by this construction activity.

Construction of the discharge structure on the Duck River also could be completed without significant or long-term effects on aquatic life. The location and design of the discharge structure would have to include some consideration of river bank stability in the area where it would be built. Actual construction of the discharge structure also would have to be planned to occur during low flow conditions and to include ways to prevent erosion and sedimentation effects on aquatic life.

As indicated in Section 3.7, this water transfer system would likely be used only during severe drought conditions in the Duck River watershed and, as described in Section 5.4, would be likely to reduce the elevation in Tims

Ford Reservoir by no more than seven or eight inches. That amount of water level reduction would not have any adverse effect on aquatic life in Tims Ford Reservoir.

When this transfer system was operating, it would add approximately 22 cfs of flow to the Duck River somewhere near Shelbyville (Figure 11). This additional flow would supplement the 165 cfs of minimum flow being discharged from Normandy Dam. This new level of minimum flow during drought conditions would benefit aquatic life in the river. If this additional flow was added upstream from the Shelbyville wastewater discharge (River Mile 221), it would help aquatic life process the nutrients in the discharge more quickly. The increased minimum flow also would mean that more of the river bed would always be under water, making slightly more habitat available for aquatic life.

Comparison of Alternatives

Based on the available information about the intent and general concepts of each alternative, Alternatives C, D, or E probably could be constructed with only minimal and short-term adverse effects on aquatic life in local areas. For each of these alternatives, however, a careful review of the location, design, and proposed construction techniques associated with each component would be required to confirm that no avoidable or long-term effects on aquatic life would occur. Alternative A would not have any adverse construction effects on aquatic life because no water supply facilities would be built. The construction of a reservoir in the Fountain Creek watershed (Alternative B) would adversely affect the resident aquatic life in the project area; however, the use of appropriate erosion and pollution control measures could prevent or minimize adverse effects in the downstream reach of Fountain Creek and the adjacent reach of the Duck River.

The most significant operational adverse effects on aquatic life associated with any of these alternatives would occur under Alternative B (Fountain Creek Reservoir). The relatively large number of aquatic species now living in flowing-water habitats in part of the Fountain Creek watershed would be replaced by considerably fewer species adapted to life in the standing-water conditions in the reservoir. Species capable of living in the reservoir would become more abundant in the area because up to 2,200 acres of terrestrial habitats would be converted into standing water. Alternatives D and E

would both have the potential to affect aquatic life in an existing reservoir; however, the effect of Alternative E on aquatic life in Tims Ford Reservoir probably would be substantially less than the effect of Alternative D on aquatic life in Normandy Reservoir.

Away from the reservoirs, operational effects of the action alternatives on aquatic life probably would be beneficial because each alternative would tend to increase minimum flows in various reaches of the Duck River. Alternative B could result in substantially increased flows in the part of the river which passes through Columbia and could benefit aquatic life in that area. Alternatives D and E would result in smaller increases in flows and benefits to aquatic life in the Duck River from Normandy or the discharge point near Shelbyville downstream to the Columbia water intake. Alternative C would result in increased flows and benefits to aquatic life from the Columbia water intake downstream to near River Mile 100 and, more than likely, only insignificant decreases in the flow and no detectable adverse effects on aquatic life downstream from there.

5.6 WETLANDS

Preliminary information about the types and locations of wetlands present in areas that could be affected by the action alternatives is presented in Section 4.6. That section also describes the federal and state laws and regulations which protect wetlands: Section 404 of the Clean Water Act, Executive Order 11990 (Protection of Wetlands), and the Tennessee Water Quality Control Act of 1977.

Three of the action alternatives include the potential to affect wetlands during the construction of pipelines. The types of impacts that could occur include vegetation removal, temporary removal of soils, sedimentation, soil compaction, and alteration of drainage patterns. If a pipeline is properly sited, designed, and constructed, it should have few or no adverse impacts on wetlands. The impacts that might occur would be greatest during and immediately following construction of the pipeline. In emergent wetlands, the construction impacts would be relatively brief because the non-woody vegetation would regenerate quickly. In forested and scrub-shrub wetlands, the impacts would last longer because woody vegetation takes longer to re-establish.

All proposed wetland impacts would be subject to the requirements of state water quality regulations; a Section 404 permit issued by the USACE; and, if federal funds are involved, compliance with the wetlands Executive Order. Mitigation to offset wetland impacts might be required, depending on the amount and types of wetlands that would be affected. That mitigation would have to be completed in accordance with permit requirements after consultation with the USACE. The functions of disturbed or modified wetlands would be expected to return over time, as wetland hydrology is restored and natural revegetation and succession occur.

Alternative A - Continue to Use Present Sources (No Action)

This alternative would not have any effect on wetlands because no facilities would be built to provide additional water for the Columbia area. If the demand for water increases as expected in future years, additional withdrawals from the Duck River or whatever other alternatives are developed might eventually have some effect on wetlands.

Alternative B - Fountain Creek Reservoir

The construction of an impoundment in the Fountain Creek watershed as described in Section 3.4 would inundate approximately 200 acres of palustrine forested wetlands and approximately 25 acres of mixed palustrine forested and scrub/shrub wetlands. Once the reservoir was filled, some new wetland areas would likely develop in the area, particularly along the shorelines of embayments and in tributary bottomlands. While it is difficult to predict the types and extent of the new wetlands which would develop, it is likely they would not perform the same level of ecological function as the wetlands which would be lost. If that is true, construction and operation of this alternative would result in a net loss of wetland functions in the project area and would require mitigation as directed by the USACE and state water quality regulations administered by TDEC.

Alternative C - Downstream Water Intake

Construction of a new intake and pumping station on the Duck River and an approximately 13-mile pipeline and booster station has the potential to affect some known wetlands in the area. Proper siting, design, and construction of the facilities would substantially reduce or eliminate the potential for adverse impacts on wetlands. A review of the potential for wetlands impacts would be part of the subsequent evaluation of detailed plans for this project if this alternative is proposed to be built.

Alternative D - Raise Normandy Pool

Raising the water level in Normandy Reservoir by approximately five feet would inundate several forested wetlands that now occur at the upstream ends of some reservoir embayments. In the short term, although some of these areas could be flooded more than many wetland species can tolerate, the effect in these embayments might not result in the loss of the present communities. Small increases in water levels could expand the zone of soil saturation in some riparian and shoreline areas, particularly along embayment shorelines and tributary bottomlands. Over the long term, if these areas were wet long enough during the growing season, the wetland boundary could expand in these areas. If this alternative was proposed to be built, confirmation of this likely result on wetlands would have to be conducted as part of the subsequent evaluation of the detailed plans for the project.

Alternative E - Tims Ford Pipeline

Construction of a new intake and pumping station on Tims Ford Reservoir and an approximately 20-mile pipeline to the Duck River near Shelbyville have the potential to affect some known wetlands in the area, especially along Flat Creek. Building this alternative could have few or no adverse impacts on wetlands if the facilities are properly sited, designed, and constructed.

This alternative also would result in a slightly lower pool level within Tims Ford Reservoir during a severe drought event; however, the change would be within the normal annual and seasonal variability in lake level and is no different from the range of conditions under which the wetlands have developed in these areas. Therefore, this alternative would have little or no adverse effect on the wetlands around the margins of Tims Ford Reservoir.

Comparison of Alternatives

Four of the five alternatives (Alternatives A, C, D, and E) are likely to result in few or no adverse impacts to wetlands. Most impacts associated with these alternatives would be temporary and associated with the various aspects of pipeline construction. Construction of a reservoir on Fountain Creek (Alternative B) would displace approximately 225 acres of forested and scrub/shrub wetlands. Even assuming that new wetlands would develop around the edge of the reservoir and mitigation requirements would be met, building Alternative B is likely to result in a net loss of wetland

acreage and wetland functions. That loss would have to be mitigated as part of the project.

5.7 FLOODPLAINS/FLOOD CONTROL

As indicated in Section 4.7, Maury, Marshall, and Moore counties, and Columbia and Shelbyville participate in the National Flood Insurance Program (NFIP) and have adopted the 100-year flood as the basis for their local floodplain regulations. Bedford and Coffee counties do not participate in the NFIP. The construction of any project in the floodplain would have to comply with applicable local floodplain regulations. Under these regulations, development in the floodplain that would be subject to flood damage must be elevated so that it would be a minimum of one foot above the 100-year flood elevation at that location. Under the NFIP, any activities that would include construction in a floodplain or floodway would have to be approval by the local floodplain administrator before construction started.

As indicated in Section 1.8, any project involving federal funds also would be subject to the requirements of Executive Order 11988 (Floodplain Management). This Executive Order states that all proposed facilities must be located outside the limits of the 100-year floodplain unless an evaluation supports a determination of "no practicable alternative" to siting within the floodplain. If this determination can be made, adverse floodplain impacts would have to be minimized during design of the project.

Because water supply is the purpose of this project, each of the action alternatives is likely to involve the construction of an intake, a pipeline, or some other types of structures in the floodplain of one or more streams. There would be no practicable alternative to the construction of these types of structures in floodplains. To comply with the Executive Order, water intakes and discharges in floodplains would have to be designed and built so they would not be damaged during a flood. The pipelines also would be constructed using best management practices, revegetated where natural vegetation is removed, and the corridor would be returned to pre-construction conditions after completion of the project.

Pumping stations, water treatment plants, and other structures that might not have to be located in a floodplain would either be built outside of the

100-year floodplain or alternatives would be evaluated and documented to support a determination of "no practicable alternative" to siting them in the floodplain. If a floodplain location was selected for any part of a proposed project, items and/or equipment subject to flood damage would have to be either located above the 100-year flood elevation or floodproofed consistent with local floodplain regulations. The intent of these commitments is to make sure that any project which is constructed complies with all of the requirements of Executive Order 11988 and the National Flood Insurance Act.

The following paragraphs describe floodplain and flood control aspects of each of the water supply alternatives.

Alternative A - Continue to Use Present Sources (No Action)
This alternative would not have any effect on floodplains or flood elevations in the study area because no new water supply facilities would be constructed. Floodplains in the area would continue to be protected from, or impacted by, ongoing activities and development projects not related to water supply activities described in this EIS.

Alternative B - Fountain Creek Reservoir
Under this alternative, the construction of a new reservoir, a water intake, and most of a five-mile pipeline probably would take place within the limits of the 100-year floodplain. These structures would be constructed in ways that would minimize adverse impacts to floodplains and, specifically, would comply with requirements of the National Flood Insurance Act and, if appropriate, Executive Order 11988. Construction of the dam would increase flood elevations upstream along Fountain Creek and several of its tributaries. These new flood elevations would be determined and mapped. Land that would be located below the top of the dam or within a selected floodplain would be purchased or flood easements would be obtained to prevent flood damages on non-project lands.

Downstream from the dam, flood elevations along the short reach of Fountain Creek and part of the Duck River downstream from the mouth of Fountain Creek could be reduced because a large volume of water could be held in the reservoir. If necessary, revised 100-year flood elevations for these areas would be developed and provided to Maury County and Columbia for their use. Studies also probably would be performed to

determine the potential impacts of a failure of the new dam and to document that the project would comply with all state and local dam safety requirements.

Alternative C - Downstream Water Intake

Construction of the intake and at least parts of the 13-mile pipeline would occur in floodplains of the Duck River and other streams. If this alternative was proposed to be built, all of the project components would be located, designed, and constructed in ways that would minimize adverse impacts to floodplains and, specifically, would comply with requirements of the National Flood Insurance Act and, if appropriate, Executive Order 11988.

Alternative D - Raise Normandy Pool Level

Under this alternative, the height of Normandy Dam would be raised and additional water would be stored in the reservoir which could be released to increase the summer season minimum flow in the Duck River. If the dam was raised by five feet, the normal maximum reservoir elevation could be increased from 875 feet to 880 feet.

If this alternative was proposed to be built, studies would be performed to determine the new full-pool elevation of the reservoir and the anticipated flood elevations upstream from the dam. The results of these studies would indicate if any additional land rights would have to be obtained to control development and prevent an increase in upstream flood damages as a result of this project. These results also would indicate if existing structures around the reservoir would have to be relocated or floodproofed to remain in compliance with local regulations.

Downstream from the dam, present flood elevations might be reduced because of the larger storage volume that could be held in the reservoir. If necessary, revised 100-year flood elevations for these areas would be developed and provided to Bedford County and Shelbyville for their use. Studies also would be performed to determine the potential impacts of a failure of the modified dam and to document that the project would be consistent with all state and local dam safety requirements.

Alternative E - Tims Ford Pipeline

Under this alternative, a raw water intake and pumping station would be constructed on either of two northern arms of Tims Ford Reservoir and an

approximate 20-mile pipeline would be built to discharge water into the Duck River near Shelbyville. If this alternative was proposed to be built, all of the project components would be located, designed, and constructed in ways that would minimize adverse impacts to floodplains and, specifically, would comply with requirements of the National Flood Insurance Act and, if appropriate, Executive Order 11988.

Federal funds could not be used in constructing the pipeline and the discharge structure on the Duck River unless Bedford County decides to participate in the NFIP. The National Flood Insurance Act provides that "[n]o Federal officer or agency shall approve any financial assistance for acquisition or construction purposes" for use in a floodplain unless the community is participating in the NFIP (42 U.S.C. § 4106).

Comparison of Alternatives

Among the alternatives, Alternative A (No Action) would not have any impact on floodplains and flood control because no additional water source would be developed, at least initially. Alternatives C (Downstream Water Intake) and E (Tims Ford Pipeline) are likely to have negligible impacts on flood elevations and floodplain values. The pipelines that would be built under those alternatives would not result in adverse floodplain impacts because disturbed areas would be returned to pre-construction conditions after completion of the project. Proposing to build Alternative D (Raise Normandy Pool Level) would cause minor changes in flood elevations upstream and downstream from Normandy Dam. Alternative B (Fountain Creek Reservoir) would involve construction and operation of a new dam. Upstream flood elevations would be increased substantially and impacts on downstream flood elevations would have to be determined once the specific design of the project was available. Natural and beneficial floodplain values would be destroyed in the area covered by the reservoir pool and new floodplain areas would be created upstream of the dam.

5.8 TERRESTRIAL LIFE

Information presented in Section 4.8 indicates that a wide variety of terrestrial habitats and species occur in the areas where the water supply alternatives could be built. The most common terrestrial habitats in these areas are associated with agricultural development and other human modifications of the natural communities that once occupied these parts of

the Central Basin and Highland Rim. Remnant areas of natural habitats, including cedar glades and other unusual communities, still occur throughout this area. Under most of the alternatives, construction activities would occur on small sites and in narrow corridors and would result in only short-term and local effects on widespread and common terrestrial species. If one or more of the action alternatives was proposed to be built, the subsequent review of the detailed plans would confirm that only widespread communities would be affected or would address any potential effects to unusual natural communities.

The following paragraphs focus on the potential effects of each of the water supply alternatives.

Alternative A - Continue to use Present Sources (No Action)
This alternative would not have any effect on terrestrial life because no facilities would be built to provide additional water for the Columbia area. If the demand for water increases as expected in future years, additional withdrawals from the Duck River or whatever other alternatives are developed to meet the additional needs of the human population might eventually have some effect on terrestrial plant and animal communities.

Alternative B - Fountain Creek Reservoir
Construction of a reservoir on the downstream part of the Fountain Creek watershed would displace all of the existing terrestrial communities in the area that would be flooded. Available information suggests that the plants and animals which occur in this area are common and widespread species in middle Tennessee and would not be adversely affected by the loss of these populations. If this alternative was proposed to be built, field surveys would be conducted to confirm this determination; however, if unique communities or unusual species were found, appropriate measures would be included in the project to address any potential adverse effects to those communities or populations. In addition, planning for the project should include activities to protect and enhance natural communities and species populations on the land surrounding the reservoir. Invasive plant species management, plantings to enhance wildlife species, and long term planning to reverse forest fragmentation also should be considered as important parts of the ancillary activities associated with this project.

Alternative C - Downstream Water Intake

The construction of a water intake and pumping station along the Duck River west of Columbia and the construction of a pipeline and a booster station largely along existing highway rights-of-way are unlikely to have more than local and short-term adverse effects on terrestrial life. The plant and animal species known to occur in these areas are widespread and common throughout middle Tennessee. If this alternative was proposed to be built, field surveys would be conducted to locate any uncommon terrestrial communities or species in the impact area and, if any are found, appropriate avoidance or minimization measures would be included in the project plans.

Alternative D - Raise Normandy Dam

The vegetation and animal communities which occur around Normandy Reservoir are thought to be common and representative of that portion of Tennessee. If this alternative was proposed to be built, it is unlikely to cause more than local adverse effects on these species or their populations in the area. To confirm and support this initial determination, the actual areas that would be affected by the modification of the dam and higher pool level in the reservoir would be surveyed for the presence of caves and uncommon terrestrial plant and animal species before any construction activity begins. If important surface or cave communities or unusual populations were found, appropriate measures to avoid or minimize any adverse effects to them would be included in the project.

Alternative E - Tims Ford Pipeline

Construction of a water intake and pumping station on Tims Ford Reservoir and an associated pipeline largely along existing highway rights-of-way to discharge into the Duck River near Shelbyville are unlikely to have more than local and short-term adverse effects on terrestrial life. The plant and animal species known to occur in these areas are widespread and common throughout middle Tennessee. If this alternative was proposed to be built, field surveys would be conducted to locate any uncommon terrestrial communities or species in the impact area and, if any were found, appropriate avoidance or minimization measures would be included in the project plans. Along the southern part of this area, particular care would be given to surveying seepages and possible caves which might support unique communities or uncommon species.

Comparison of Alternatives

The available information suggests that, even though none of the five alternatives would have significant long-term effects on terrestrial plant and animal communities, some alternatives would have less effects than others. Alternative A (No Action) would not involve any effects on terrestrial life because no facilities would be built. Alternatives C (Downstream Water Intake) and E (Tims Ford Pipeline) would have only localized and short-term effects on terrestrial plant and animal populations during the construction of the pipelines and associated facilities. Alternatives D (Raise Normandy Pool Level) and B (Fountain Creek Reservoir) would involve construction activities and long-term modifications in areas around an existing reservoir or to create a new reservoir; however, less habitat modification would occur around Normandy Reservoir under Alternative D than would occur where a Fountain Creek reservoir would be built under Alternative B.

5.9 ENDANGERED AND THREATENED SPECIES

The information presented in Section 4.9 indicates that 115 species (68 plants and 47 animals) reported from the five counties in this general project area are now protected under federal and state endangered species laws. Of these 115 species, 21 (4 plants and 17 animals) are protected under the federal Endangered Species Act. A number of the protected species reported from these counties either have not been seen in this area in over 50 years or are unlikely to occur where the action alternatives could affect them. For example, among the 21 federal protected species, only 11 species (one plant, and 10 animals) are likely to occur in the possible project areas (Table 15).

Although some of the protected species reported from these counties (such as the bald eagle and the Indiana bat) can occur in a wide variety of habitats, most protected species are typically associated with specific habitat types. Information presented in Appendix C and summarized in Section 4.9 indicates that 35 of the protected species (30 percent) occur in rivers and creeks, 31 (27 percent) occur in wet meadows, creeksides, and seepage areas, 21 (18 percent) occur in bottomland and mixed hardwood forests, and 13 (11 percent) occur in cedar glades. The fact that these four broad habitat types are the most likely places to find 89 percent of the protected species reported from this five-county area is useful in evaluating the potential effects of each alternative.

The likely effects of the alternatives on all of the aquatic and terrestrial life in the project area are presented in Sections 5.5 and 5.8. The initial evaluations of possible impacts on protected species described in the following paragraphs assume that the projects would be built before any changes would have occurred in present laws, regulations, or knowledge about the status of these plants and animals. While this assumption applies to all of the sections in this chapter (see Section 5.1), its limited value is particularly important with regard to protected species. New information about the distribution and habitat requirements of protected species is continually being discovered and several species which occur in this area could be either added to or removed from the federal and state protected lists before any of the action alternatives would have to be built. Whenever one or more of the action alternatives was designed and proposed to be constructed, an up-to-date evaluation of the potential for impacts on protected species would have to be part of the more detailed environmental review of the project. If federal agencies or federal endangered or threatened species could be involved, the more-detailed, up-to-date, evaluation also would have to be reviewed by the USFWS in accordance with the Endangered Species Act.

Alternative A - Continue to use Present Sources (No Action)

If no new water source was developed for the Columbia area, there would be no effects on endangered, threatened, or other protected species. If the need for water in the Columbia area increases beyond what could be withdrawn from the adjacent part of the Duck River without degrading its other uses, the approach used to meet area needs during drought conditions could have adverse effects on any protected species living in the affected area. The potential effects that action might have on protected species would have to be evaluated and, if appropriate, reviewed by the USFWS when it was being proposed.

Alternative B - Fountain Creek Reservoir

The construction of a reservoir in part of the Fountain Creek watershed would substantially modify the existing aquatic and terrestrial habitats in the proposed reservoir pool area and on the surrounding land. At present, no endangered or threatened aquatic species are known from the stream habitats in the likely reservoir area; however, at least one federal endangered plant (leafy prairie-clover, *Dalea foliosa*) and a variety of state protected terrestrial plants and animals are known to occur in cedar glades

and other habitats on land surrounding the possible reservoir. If this alternative was proposed to be built, appropriate measures would be included in the construction plans to avoid and protect cedar glade habitats where endangered and other protected plants occur. In addition, field surveys would be conducted during appropriate seasons of the year to search for previously unknown populations of federal- or state-listed species which could be adversely affected by construction of the project.

Once the project was built, management of the reservoir and the surrounding land probably would be required to include activities to protect and enhance any federal- or state-listed endangered or threatened species in the area. Depending on water levels and land use in the area, some protected species (presently including bald eagles, gray bats, and Indiana bats) could have additional forage and roosting habitats. Habitats around the reservoir in which protected species occurred (such as cedar glades) would be protected as part of the management plan for the land. Similarly, the quality and quantify of water released from the reservoir would be controlled to avoid adverse effects on any protected species living in Fountain Creek downstream from the dam or in the adjacent reach of the Duck River. Withdrawing enough water to meet all of the water needs of the Maury/southern Williamson County Water Service Area from a Fountain Creek reservoir would result in substantially increased flows in the part of the Duck River in the Columbia area. If other aquatic habitat characteristics were suitable, protected aquatic species might become established in this area.

If this alternative was to be built, known populations of the leafy prairie-clover in the area would have to be protected and enhanced. In addition, site-specific surveys might have to be conducted to update whether other suitable habitats in the affected area support populations of endangered or threatened species. If any potential adverse effects to endangered or threatened species could occur, those potential effects would be addressed during the subsequent review of the project once it was described in more detail.

Alternative C - Downstream Water Intake

Construction of a water intake and pumping station near Duck River Mile 100 and an approximate 13-mile pipeline and booster station to connect the intake to a treatment plant and the existing water distribution system

would not be likely to have adverse effects on federal endangered or threatened species because no federal protected species are known to exist within the habitats through which this project might be built. Several state-listed species and an identified candidate for federal protection (the slabside pearlymussel, *Lexingtonia dolabelloides*) are known to exist in Maury County (see Appendix C) and could be impacted by the project if it affected habitats in which they occur.

The operation of this possible additional water intake near Duck River Mile 100 is not expected to have adverse effects on protected terrestrial plants and animals and could lead to beneficial effects on protected aquatic species. As indicated in Section 5.5, the projected withdrawal of as much as 31 cfs of water from that part of the river is unlikely to have adverse effects on aquatic life, including resident endangered or threatened species, because it would constitute no more than a 21 percent reduction in the minimum flow in the river at that location. In addition, the use of this intake could raise the minimum flow level and improve conditions for protected species in the first few miles of the river downstream from the Columbia water intake.

These initial determinations about the potential effects of this alternative on endangered and threatened species would have to be reviewed as part of the subsequent evaluation when details of the proposed project were known. Site-specific surveys might be required to determine if suitable habitats along the project route did support populations of federal- or state-listed endangered or threatened species.

Alternative D - Raise Normandy Pool Level

Construction activities associated with raising the height of Normandy Dam, raising or relocating facilities around the reservoir, and preparing part of the present reservoir shoreline to be flooded would be unlikely to have adverse effects on endangered, threatened, or other protected species. Most of the habitats that would be disturbed are unlikely to support populations of protected species. Some unusual habitats or populations of protected species might occur within or adjacent to the shoreline area that would be flooded. When specific changes were proposed for the Normandy Reservoir pool level, field surveys would be conducted during the appropriate seasons of the year to document whether any federal- or state-listed species actually could be impacted.

Operation of Normandy Reservoir at a higher maximum pool level would be unlikely to affect any protected species populations around the reservoir that were not affected by the construction work. As indicated in Section 5.5, the increased minimum flow in the Duck River downstream from the dam could result in beneficial effects on aquatic life, potentially including any protected species that were present. The potential effects of this alternative on endangered, threatened, and other protected species would have to be confirmed during the subsequent environmental evaluation of the specific plans for this project.

Alternative E - Tims Ford Pipeline

Construction of a water intake and pumping station in one of the northern embayments of Tims Ford Reservoir and an approximate 20-mile pipeline and booster station to pump water to a discharge point on the Duck River near Shelbyville would be unlikely to have adverse effects on endangered, threatened, and other protected species because no federal protected species are known to exist within the habitats through which this project might be built. Any construction-related impacts on state-listed endangered or threatened species known or likely to occur in the specific impact areas would be temporary and avoidable.

The operation of this pipeline during drought conditions is unlikely to affect protected species in and around Tims Ford Reservoir because the withdrawal is projected to have only a minimal effect on the reservoir level. As indicated in Section 5.5, the additional amount of flow in the Duck River could help prevent drought-related adverse impacts to aquatic life, including any resident protected species. If this additional flow was added upstream from the Shelbyville wastewater discharge (River Mile 221), it could make the adjacent reach of the river more suitable habitat for endangered and other protected species. These determinations about the potential effects of this alternative on protected species would have to be verified as part of the more detailed environmental review of the specific project components.

Comparison of Alternatives

Information presented in the preceding parts of this section suggests that adverse biological effects associated with building the pipelines and associated structures probably can be avoided or minimized. Effects associated with the operation of the water withdrawal or transfer systems

appear to be either minor or, in places, could be beneficial to protected aquatic species. At present, the potential for adverse effects of the alternatives seems to be related to the amount of natural habitat that would be destroyed or permanently modified.

These generalizations suggest that Alternatives C (Downstream Water Intake) and E (Tims Ford Pipeline) would be the least likely to have adverse effects on protected species because they would involve the fewest long-term changes in the terrestrial and aquatic habitats. Alternative D (Raise Normandy Pool Level) appears to have somewhat more potential for adverse effects, mostly because it would involve the flooding of additional land around Normandy Reservoir. Among the action alternatives, Alternative B (Fountain Creek Reservoir) seems to have the most potential for adverse effects on protected aquatic species because it would involve the conversion of natural terrestrial and flowing-water aquatic habitats into standing-water conditions of a reservoir. Depending on water levels and land use around this reservoir, bald eagles and endangered bats might gain some additional forage and roosting habitats.

The potential effect of Alternative A (No Action) on endangered and threatened species is difficult to compare with the action alternatives because, if the projected need for water in the Columbia area does develop, some source would have to be developed. There is no way to predict how that need would be met and what the effects of that action would be on protected species.

On September 19, 2000, TVA submitted a copy of the draft EIS to the USFWS and requested their concurrence with a determination that this programmatic evaluation of possible impacts of future water supply projects would not have any effects on federal endangered and threatened species. On December 20, 2000, the USFWS sent a letter to TVA concurring with that determination, in part because detailed, site-specific endangered and threatened species studies would have to be conducted if any of the alternatives were proposed to be built (see Appendix E).

5.10 LAND USE/PRIME FARMLAND/COMMUNITY NOISE

The present uses of the land, the occurrence of prime farmlands, and the typical community noise patterns in this project area are all described in

Section 4.10. For most of the action alternatives, a majority of the potential impacts to existing land use and noise patterns would occur during the construction of the intakes, pumping stations, and pipelines that would be involved in harvesting water and moving it to where it would be treated and used. Generally, these construction effects would be temporary disruptions in the land use and noise patterns, and these patterns would return to pre-construction conditions within a few days or weeks after the construction work was completed. Where new buildings or other surface facilities such as intakes or pumping stations would be built, small areas would be affected by long-term changes in land use and operating noise levels. In many cases, the location and design of these facilities could include ways to avoid or minimize impacts on adjacent uses.

Alternative A - Continue to use Present Sources (No Action)

If this alternative was followed, there would be no immediate impact on land use, prime farmland, or noise levels in the project area. If no additional water source was developed and the demand for water in the Columbia area did increase beyond the amount that could be withdrawn from the Duck River, industrial, commercial, and residential development would be unlikely to alter the present use patterns in the area.

Alternative B - Fountain Creek Reservoir

The construction and operation of this alternative would have the greatest impact on land use, prime farmland, and community noise patterns among the four action alternatives. As described in Section 3.4, the reservoir property (including necessary flood storage capacity) would occupy approximately 3,600 acres of land. Approximately 2,800 acres of this land already is in public ownership; however, approximately 800 acres of land now in private ownership would have to be acquired. All cemeteries within the project area would have to be relocated, and all of the homes, affected roads, and other developed structures would have to be moved or prepared for flooding. Existing uses of the land in the affected area would be converted to water supply use, including land which is now occupied by prime farmland soils. The final amount of land that would be included would be determined during the detailed planning process and would depend on the specific purposes of the project. Detailed planning toward the construction of this alternative would have to include the completion of Form AD 1006 with assistance from the U.S. Department of Agriculture's

Natural Resource Conservation Service to determine the rating associated with the prime farmland conversion that would be involved.

Construction activities associated with clearing the reservoir land and building the dam and other components of this project would generate noise that would be heard in the affected areas. This noise would be generated primarily by heavy equipment such as trucks, bulldozers, and earthmovers. It would be similar to the noise presently produced by the rock quarry and crushed stone operation along Blue Springs Road. The noise level probably would peak during the period when the reservoir was being cleared and when earth and rock were being hauled to the dam site. Along the pipeline route, noise levels would peak during the excavation and refilling of the construction trench. The noise level could be lessened by restricting construction to daylight hours and by requiring proper maintenance of engines and muffler systems. The construction noise might be annoying to some neighboring residents, but would not be hazardous to their hearing.

Once the reservoir was built, the purposes of the project would have a substantial effect on the use of adjacent land, including any prime farmland that was present, and on the noise levels that could occur. Development of the land surrounding the reservoir for residential, recreational, or commercial use could encourage the conversion of adjacent land to similar uses. Restrictions on the use of land within the project area (for example, intended to protect the quality of the water supply -- see Section 5.4), might minimize any change in the present uses of the surrounding land. Wide-ranging restrictions or zoning changes on the reservoir property (for example, to further protect the quality of the water supply) might lead to more controlled uses of the land adjacent to this project area. Each of the possible uses of the reservoir land would result in different noise levels, most likely related to the types and amount of recreational use that would occur. Substantial recreational activity could result in engine noise from boats and personal watercraft that would be heard in the areas immediately around the reservoir. If this alternative was proposed to be built, the potential land use and noise aspects of the project would be addressed during the more detailed evaluation of the specific proposal.

Alternative C - Downstream Water Intake

The construction of an intake, pumping stations, and a pipeline that would transport water from the western part of Maury County more or less along

State Highway 50 to a treatment plant near Columbia could have short-term adverse effects on land use, prime farmland, and community noise levels. Construction of these facilities would involve clearing areas, excavating a trench, laying the pipeline, and restoring the work site (see Section 3.4); however, the location, design, and construction of these facilities should be adaptable enough to avoid or minimize those effects on existing land uses. If the permanent use of more than 10 acres of land would be required for this alternative, then Form AD 1006 would have to be completed to determine the rating associated with the conversion of prime farmland. During construction of the pipeline, heavy equipment use, blasting, and increased truck traffic would raise local noise levels. These effects could be lessened by restricting construction to daylight hours and by requiring proper maintenance of engines and muffler systems.

Operation of the pumping station would involve some noise associated with the use of electric motors and pumps. Noise emissions from the facility could be reduced to insignificant levels if low-noise equipment was specified and if the buildings were designed and constructed to absorb and block escaping noise. Properly located, designed, and constructed, this alternative would have insignificant effects on land use, prime farmland, and noise.

Alternative D - Raise Normandy Pool Level

Raising the pool level on Normandy Reservoir would involve increasing the height of the dam structure and modifying or replacing existing roads and recreation facilities around the reservoir. Existing trees and other vegetation also would have to be removed from the band of land around the reservoir that would become part of the enlarged pool. The affected area is all part of the Normandy reservation and there would not be any change in the use of most of the land (however, see Section 5.11 concerning changes that would occur at recreation sites and a natural area).

Construction activities related to raising the dam and modifying the roads, bridges, and recreation facilities around the reservoir would generate noise impacts in the immediate areas of the work sites. This construction noise would come from the trucks and other heavy equipment involved in these activities. The overall impact of the noise could be reduced by minimizing the length of the construction period and having the heavy equipment operate only during daylight hours. Noise emissions also could be reduced

by requiring the engines and mufflers to meet manufacturers original specifications and appropriate maintenance programs. The operation of this alternative would not include any additional noise effects.

Alternative E - Tims Ford Pipeline

The construction of an intake, the pumping stations, and a pipeline that would transport water from Tims Ford Reservoir more or less along State Highway 82 to empty into the Duck River near Shelbyville could have short-term adverse effects on land use, prime farmland, or community noise levels. Construction of these facilities would involve clearing areas, excavating a trench, laying the pipeline, and restoring the work site (see Section 3.4); however, the location, design, and construction of these facilities should be adaptable enough to avoid or minimize those effects on existing land uses. If the permanent use of more than 10 acres of land would be required for this alternative, then Form AD 1006 would have to be completed to determine the rating associated with the conversion of prime farmland. Local noise levels would increase during the construction of the pipeline. These noise effects, generated by heavy equipment, blasting, and additional truck traffic, could be lessened by restricting construction to daylight hours and by requiring proper maintenance of engines and muffler systems.

Operation of the pumping stations would involve some noise associated with the use of electric motors and pumps. Noise emissions from the facility could be reduced to insignificant levels if low-noise equipment was specified and if the buildings are designed and constructed to absorb and block escaping noise. Properly located, designed, and constructed, this alternative would have insignificant effects on land use, prime farmland, and noise.

Comparison of Alternatives

Alternative A (No-Action) would not have any adverse impact on land use, prime farmland, or community noise. The construction of Alternatives C (Downstream Water Intake), D (Raise Normandy Pool Level), or Alternative E (Tims Ford Pipeline) would have short-term adverse effects on these resource areas during the construction period. These alternatives would have little or no long-term adverse impacts on these resources if appropriate measures were taken to avoid or minimize effects on local land uses, areas of prime farmland, and noise emissions.

Construction and operation of Alternative B (Fountain Creek Reservoir) would have the most effect on land use, prime farmland, and community noise. Construction of a reservoir on part of the Fountain Creek watershed would involve buying approximately 800 acres of land, converting approximately 2,200 acres of land from the existing uses to a water supply reservoir, and could affect the use of land surrounding that reservoir. Noise levels in the area would increase during the construction period and, depending upon the specific uses of the area, after the reservoir was completed.

5.11 VISUAL CHARACTER, RECREATION, AND NATURAL AREAS

Information presented in Section 4.11 indicates the visual setting, recreational background, and descriptions of the natural areas which exist in the parts of the Duck and Elk River watersheds that could be affected by one or more of the water supply alternatives. Most of the area has an attractive, harmonious, rural character that supports a wide variety of recreational uses and a diverse group of natural areas. Each of the water supply alternatives could result in some level of impact on these aesthetic, recreational, and natural resources.

Three of the action alternatives would include the construction of various types of intakes, pumping stations, and some length of a pipeline. The types of activities which could occur during the construction of these structures include increased traffic, heavy equipment use, vegetation removal, excavation work, and reclamation of the area. These disruptions would be most likely seen in the foreground by local residents and by motorists using the adjacent highways. The construction work would add temporary visual discord, while reducing coherence and harmony in the rural landscape. Local scenic integrity would be low during the construction period. If these project components were located, designed, and built as described in Section 3.4, the construction activity would only result in short-term effects on visual and recreation resources. Under each of the alternatives involving a pipeline, the detailed planning for the project would include measures to avoid natural areas and minimize adverse construction effects on visual and recreational resources. The overall effects of the proposed measures on these resource areas would be evaluated as part of the subsequent environmental review of the projects.

The operation of the intakes and pumping stations also could result in long-term changes in the character and use of small areas along the streams and in the landscapes where these structures would be built. Visual harmony and scenic integrity might be reduced in the foreground views of local residents, motorists, and others who encounter these structures. These impacts could be minimized with proper attention to the relationship of these facilities to their proposed settings and preexisting uses of the land.

Alternative A - Continue to use Present Sources (No Action)

Initially, at least, following this alternative would not result in any adverse effects on visual character, public recreation, or natural areas. If the anticipated additional needs for water in later years were met by withdrawing more water from the reach of the Duck River at Columbia, temporary adverse effects on water-oriented recreational opportunities could occur in the area. Scenic integrity along the river would be reduced if larger amounts of the bank are exposed for long time periods. The additional withdrawal also could adversely affect the portion of the Duck River Mollusk Sanctuary in the Columbia area (see Section 5.5).

Alternative B - Fountain Creek Reservoir

Construction of a reservoir in part of the Fountain Creek watershed would substantially impact the visual character and recreational use of the project area; however, the Columbia Glade Natural Area would be protected from adverse effects associated with the construction and operation of this reservoir. Removing the existing vegetation, altering the surface water flow, and building the dams and other structures would be highly discordant with the existing rural countryside and would substantially reduce recreational use of the affected area throughout the construction period. The large-scale earthwork, related construction activities, and increased traffic congestion would provide adverse visual contrast, while reducing coherence, harmony, scenic integrity, and tranquillity in the landscape. These visual changes would impact the foreground and middleground views of area residents and motorists using local roads, highways, and bridges.

The completed reservoir would be a major change in the visual landscape character, replacing views of pastures and woodland with a large expanse of water surface. In general, water bodies are highly desired visual assets which enhance scenic attractiveness and the value of properties from which they are viewed. The reservoir would add some uniqueness, variety, and

compatible contrast to the landscape without substantially reducing visual harmony. This reservoir also would provide some negative visual impacts during the summer, fall, and winter seasons including a wide band of bare earth exposed during water supply drawdowns, shoreline erosion, and, possibly, disruption of visual tranquillity by motorized water sports. Homes with foreground views would receive the greatest impact. For those with middleground views, negative impacts would be lessened and positive impacts would be enhanced by the greater viewing distance.

With regard to recreation, the reservoir could provide a variety of lake-oriented opportunities not otherwise available this close to Columbia. The extent of new boating, fishing, and other recreational opportunities on this reservoir would depend on several factors including water level fluctuations, water quality, lake access, and the results of any actions required to protect the water source from potential contamination (see Section 5.4). If this alternative was proposed to be built, all of the potential construction and operational effects on visual resources, recreation, and natural areas would be addressed as part of the environmental review of the specific project that was being proposed.

Alternative C - Downstream Water Intake

Building an intake, pumping stations and a pipeline from somewhere near Duck River Mile 100 to a new treatment plant and the existing water distribution system would likely have only short-term and minor effects on visual character, recreational resources, and natural areas. The possible adverse effects associated with pipeline construction and ways to avoid or minimize them are discussed in the introduction to this section. The construction work would be seen in the foreground by residents and motorists using Highway 50 between Williamsport and Columbia. Scenic integrity would return to a moderate level once construction and reclamation were completed.

Operation of this alternative could have a local impact on visual quality because the intake structure would be a feature essentially out of character with the rural countryside. Recreational uses and natural areas would not be affected by the operation of this intake and pipeline.

Alternative D - Raise Normandy Pool Level

Both the construction and subsequent operation of Normandy Reservoir at a higher maximum pool level could have significant effects on the visual character, existing recreational resources, and adjacent natural areas. During the construction period, the existing landscape character would be disrupted by the work being done on the dam, recreation areas, and bridges, in addition to the vegetation being removed from a band of land all around the reservoir. This visual discord would be seen in foreground views from area homes, local motorists, and boat traffic on the reservoir. Once the modifications were complete, the visual changes might only be discernible to frequent visitors and recreational users who were familiar with water levels and facilities as they had been in the past. Scenic integrity probably would return to a moderately high level after reclamation.

Recreational users on Normandy Reservoir would notice substantial changes associated with raising the maximum pool level because most of the recreational activity around this reservoir is focused on where the water meets the land. As indicated in Section 3.6, raising the maximum pool level would require the modification or relocation of some roads, bridges, boat ramps, and existing facilities in the Barton Springs and Cedar Point recreation areas. Changes in the way water was managed in the reservoir also could lead to changes in the abundance of various fish populations and where they could be found at different times of the year (Section 5.5). During the construction period, many recreation facilities probably would be closed for various lengths of time while modifications were being made. When the construction work was completed, recreational users would have to become familiar with the modified or replaced facilities and new habitat conditions in the reservoir.

Downstream from the dam, the additional flow would improve recreational use of the tailwater, probably including recreational fishing. The additional flow also could provide some habitat improvement benefits to parts of the Duck River Mollusk Sanctuary.

With regard to natural areas, Short Springs State Natural Area extends down to the present summer pool level on Normandy Reservoir. Raising the reservoir level would result in significant flooding and erosion effects on three acres within the floodplain area that supports large populations of many wildflower species which contribute to the importance of this site.

The higher pool level also would adversely affect water levels in the creeks on this natural area and the present foot trail adjacent to the impounded creek shoreline. If this alternative was proposed to be built, these potential adverse effects would be evaluated and addressed during the subsequent review of the detailed project that was being proposed.

Alternative E - Tims Ford Pipeline

Building an intake, pumping station, and a pipeline from one of the northern embayments on Tims Ford Reservoir to the Duck River near Shelbyville would be likely to have only short-term and minor effects on visual character, recreational resources, and natural areas. The potential adverse effects associated with pipeline construction and ways to avoid or minimize them are discussed in the introduction to this section. The construction work would be seen in the foreground by residents, nearby boat traffic in the affected embayment, and motorists using Highway 82 between Flat Creek and Shelbyville. Scenic integrity could return to a moderate level after reclamation of the construction sites.

Operation of this alternative is likely to have few or no adverse effects on visual character, recreational uses, or natural areas. A new intake and pumping facility on a Tims Ford embayment and a new discharge structure on the Duck River could have local impacts on visual quality because one or both structures would be out of character with the existing setting. Operation of this pipeline would not have any adverse effects on recreation or natural areas around Tims Ford Reservoir because little or no change in water levels would occur. The additional flow in the Duck River during drought conditions, however, could provide some benefits to recreational use and the part of the Duck River Mollusk Sanctuary downstream from the discharge point.

Comparison of Alternatives

The information presented in this section suggests that both Alternative C (Downstream Water Intake) and Alternative E (Tims Ford Pipeline) are not likely to have any adverse effects on natural areas and would result in only short-term and minimal adverse effects on visual character and recreational resources.

With regard to the two other action alternatives, both Alternatives B (Fountain Creek Reservoir) and D (Raise Normandy Pool Level) would

involve construction activity over fairly wide areas and would produce a variety of changes in the visual character and recreational potential of the affected areas. The changes which could result from building a new reservoir in the Fountain Creek watershed (Alternative B) appear to have more potential for effects on these resources than would occur during the modifications to the existing Normandy Reservoir (Alternative D). With regard to Natural Areas, Alternative B probably could be built and operated with no adverse effects on the Columbia Glade; however, construction and operation of Alternative D probably would have significant adverse effects on an important part of Short Springs.

Initially, at least, Alternative A (No Action) would have no adverse effect on these resources; however, that situation might not last into the future. If additional water is needed for the Columbia area, some source would have to be developed. The potential long-term effects of whatever that alternative might be cannot be evaluated at this time.

5.12 CULTURAL RESOURCES

The information presented in Section 4.12 indicates that a large number of cultural resource sites occur throughout this 5-county area. In Maury County alone, the available information suggests there are more than 4,000 identified archaeological sites and historic structures. Section 106 of the National Historic Preservation Act requires that any federal project sponsor or permitting agency consider the potential impacts of projects on important cultural resources and take steps to avoid or minimize adverse effects.

While a large number of cultural sites do exist in this project area, nearly all of these sites occupy relatively small plots of ground and could be avoided during the planning phase of many types of projects. Using the results of appropriate preliminary surveys, the locations of intakes, pumping stations, and pipelines could be adjusted to prevent or minimize the disturbance of important cultural sites. Operating under the requirements of the National Historic Preservation Act, federal agency sponsors or permitting staffs would have to consult with the Tennessee State Historic Preservation Office about the plans for any project that could affect cultural resources. Federal agency sponsors also would be required to consult with the state preservation office on mitigation measures that would eliminate or reduce the potential for adverse effects. These requirements would apply to each of

the action alternatives included in this EIS which involved a federal agency, either as a participant or as a permitting agency.

Even though archaeological and other historic resources are known to exist in many parts of this general project area, none of the action alternatives has been developed in enough detail for field crews to know where to survey for cultural resources which could be affected by specific construction activities. Given this lack of site-specific information, it is premature to attempt to describe any adverse effects that might be caused by proposing to build one or more of the action alternatives.

At this stage in the evaluation, however, an initial comparison of the potential for adverse impacts among the four alternatives can be based on the acreage that would have to be disturbed to construct each project. Information provided in Sections 3.4 through 3.7 and summarized in Table 6 indicates that Alternative C (Downstream Water Intake) and Alternative E (Tims Ford Pipeline) would disturb small amounts of land during the construction of intakes, pumping stations, and a discharge point (approximately two acres, each) and more land along the routes of the related pipelines. If the density of cultural sites in these project corridors was relatively consistent, the 13-mile length of pipeline (and approximately 130 acres of land disturbance) associated with the downstream water intake would suggest that Alternative C could have somewhat less potential for impacts on cultural resources than could occur under Alternative E along the 20-mile pipeline (and approximately 200 acres of land disturbance) from Tims Ford Reservoir to the Shelbyville area.

Construction of a reservoir in the Fountain Creek watershed (Alternative B) is estimated to affect approximately 3,600 acres of land. Approximately 230 acres of land would be affected by raising the pool level on Normandy Reservoir (Alternative D). Again, assuming that cultural resource sites are evenly distributed, Alternative B (Fountain Creek Reservoir) appears to have more potential for adverse impacts on cultural resources than Alternative D (Raise Normandy Pool Level).

Alternative A (No Action) would not involve any construction activity and, initially at least, would not have any adverse effects on cultural resources. However, Alternative A also would not meet the projected need for

additional water in the Columbia area and, if that need developed, some action alternative would have to be implemented.

While this perspective might be useful in comparing the potential impacts of these conceptual alternatives, a more detailed evaluation of effects would have to be conducted for any alternative proposed to be constructed. That evaluation would have to include a description of the specific cultural sites which could be impacted, results of the consultations with the State Historic Preservation Office, and any measures which would be taken to avoid or minimize potential adverse effects.

On October 11, 2000, TVA sent a letter to the Tennessee State Historic Preservation Office requesting their concurrence with our determination that completion of this programmatic EIS would have no effect on historic properties and that TVA has met present obligations under Section 106 of the National Historic Preservation Act. In a letter dated October 19, 2000, the State Preservation Office concurred with this determination, in part because the "review is limited to the drafting of the Programmatic EIS for future project implementation. Upon selection, the chosen alternative from the EIS must undergo independent Section 106 review" (see Appendix E).

5.13 SOCIOECONOMICS

Existing population, income, and employment information for the counties included in this project area is presented in Section 4.13. Each of the alternatives could have some effect on population and local economic conditions both during whatever construction period was involved and based on the change in available water supply.

Alternative A (No Action) would not have any immediate effect on population or economic conditions because the water supply in the Columbia area should be adequate until severe drought conditions some time after 2015. However, if the demand for water continues to increase, population growth and economic activity in the area eventually would be impacted, with important negative effects on the local economy. If enough water was not available to meet the increasing needs of the area, population, employment, and income would grow much more slowly than they have in recent years or would not grow at all. New businesses and industries, as well as some existing ones, might choose to locate in other areas where sufficient water

was available. Although some change might be made toward less water-intensive economic activities, the net result could be lower than projected population, income, and employment levels, especially if reliable water supplies were available elsewhere.

Each of the action alternatives would involve some level of construction activity. In general, construction activity would generate short-term positive impacts on employment and income in the area, as well as a range of impacts on community services, local government revenues, and expenses. The duration and extent of the construction benefits would vary with the complexity of the project, more or less matching the projected cost of each alternative. On that basis, proposing to build Alternative B (Fountain Creek Reservoir) would have the most construction benefit, followed in order by Alternative D (Raise Normandy Reservoir Pool), Alternative E (Tims Ford Pipeline), and Alternative C (Downstream Water Intake). A more detailed analysis of the socioeconomic impacts of each action alternative could be conducted when more project-specific details were available.

Proposing to build Alternative D (Raise Normandy Pool Level) is likely to meet the projected need for water through 2035, while Alternatives B, C, or E would meet the needs in the Columbia area at least through 2050, the end of the present planning period. As with Alternative A, whenever enough water was not available to meet the increased needs of the service area, population, employment, and income could grow much more slowly than in earlier years or, perhaps, not grow at all. Near the end of this planning period or 2035 (if Alternative D was completed), water supply agencies would have to conduct a new analysis of future water needs in light of economic conditions and growth projections at that time. The results of that evaluation would indicate how well the existing sources would meet future needs and, if appropriate, how much additional water would be required in the future to avoid adverse effects on the local economy.

5.14 ENVIRONMENTAL JUSTICE

Available information about the percentages of nonwhite and low income residents in this project area is presented in Section 4.14. Construction activities associated with the action alternatives could result in disproportionate impacts on disadvantaged populations depending on how decisions would be made concerning the locations of structures and the

routing of pipelines. The analysis of whether particular segments of the population might be adversely affected would require more information about the locations of structures and proposed pipeline routes than is available at present. That analysis would be conducted as part of the subsequent environmental review of any action alternative proposed to be constructed and depending on the extent of federal agency participation in the project. At this time and based on the data shown in Tables 23 and 24, we do not anticipate disproportionate impacts on any segment of the population.

The lack of an adequate water supply in the area would have negative effects on all segments of the population in the water service area. At this time, there is no reason to believe that future additions to the water supply would be more available to some segments of the population than to others.

5.15 INDIRECT AND CUMULATIVE EFFECTS

This EIS evaluation is the most recent in a long series of studies and projects related to using the Duck River as a water supply source for communities in the upper Duck River watershed. As indicated in Section 2.2, many of the historic low flow problems that once occurred in the Duck River were addressed in 1976 when Normandy Dam started to be used to maintain a higher than natural minimum flow level in the river. Results of the Needs Analysis conducted as part of this project (summarized in Section 2.10) indicate the present amount of minimum flow from Normandy Dam would be enough to meet projected water demands in the Bedford County and Marshall County Water Service Areas through the end of the study period (to 2050). Construction of any one of Alternatives B, C, E, or D (with the inclusion of some water conservation measures) would meet the projected water demands of the Maury/southern Williamson County Water Service Area through 2050. Meeting the projected demands for water in all three service areas for most or all of the next 50 years would eliminate the worry that many local residents have had about an adequate water supply. The cumulative effect of resolving local concerns about the quantity of the water supply probably would make people feel better about their communities and would allow economic growth to proceed at or near the Additional Development rate included in Table 2.

This evaluation also indicates that people living in and around the upper Duck River watershed have no other choice but to depend on the river and area reservoirs as their water supply sources, both now and into the future. The amount of water available for use in the Columbia area is, and will be, dependent on how much water is released from Normandy Dam (and any other dams feeding into the watershed), and how much water is withdrawn from and not returned to the river between Normandy Dam and the Columbia area. The quality of the water in the Columbia area also is and will be dependent on the types and amounts of nutrients and other materials that are allowed to flow into the river from point sources and from the land all along the creeks and the river upstream from the water intakes. Especially as more and more people move into the area, everyone in the watershed will have to realize that protection of the quantity and quality of the water supply will be critical to their health and the local economy. People living in different parts of the watershed also will have to work together to make sure each community has enough good quality water to meet their needs. The cumulative effect of this part of the evaluation will depend on how well individuals, communities, and agencies in the area understand this relationship and act on it to encourage or require cooperation among the water use organizations.

As indicated in Section 3.8, water conservation is just beginning to emerge as an issue (and an opportunity) in Tennessee and other eastern states. In the future, the realization that water resources really are limited may force conservation to become an important component in water resource planning. Present water conservation measures probably could produce at least a ten percent reduction in water use in the Duck River region, especially if people would accept and implement the measures that are already available. The identification of alternatives in this EIS which could meet the projected water demands in the upper Duck River watershed through 2050 might allow people and agencies in the area to virtually ignore water conservation until many years from now. Alternatively, the integrated nature of the reservoirs, river, and the water systems discussed in this document could help local agencies and the public realize they can protect and extend the use of their water sources far beyond 2050 by careful planning and adopting reasonable conservation measures. Only time will tell the cumulative effects of that aspect of this water supply project.

5.16 UNAVOIDABLE ADVERSE IMPACTS

Selection of Alternative A would not involve any additional unavoidable adverse impacts, at least not until severe drought conditions some time after 2015. When water demands in the Columbia area exceed the amount of water that can be withdrawn from the river without affecting other uses, adverse impacts could occur in the Duck River or whatever other source would be affected. If additional withdrawals were made from the Duck River, the potential adverse impacts could affect water quality, aquatic life, and recreational use of the river.

Unavoidable adverse impacts associated with Alternatives B, C, and E would each include the construction of some length of pipeline. Construction of one or more of these pipelines could result in localized, short-term impacts on aquatic, terrestrial, and cultural resources; however, many of those impacts could be avoided or minimized as the detailed plans for the projects were developed. Alternatives B and D would involve the construction or enlargement of a reservoir. In each case, these alternatives could include adverse impacts on water quality, aquatic life, archaeological sites, and historical structures in the areas, some of which could be avoided or minimized with careful planning. Alternative B also would require the acquisition of approximately 800 acres of land presently in private ownership.

5.17 SHORT-TERM USES AND LONG-TERM PRODUCTIVITY

All of the action alternatives included in this EIS are intended to address the long-term needs for water in the upper Duck River basin, especially the Maury/southern Williamson County Water Service Area where additional water is projected to be needed in future years. The evaluation of these alternatives is focused on identifying the full range of potential short-term construction effects and long-term operational impacts that could occur on the environmental and cultural resources in the affected areas. The intent of this analysis and programmatic EIS is to help the DRDA, local water systems, and the public understand the water needs that are projected to occur in this area through the year 2050, the various ways that are available to meet those needs, and the types of environmental effects that could occur if some of the most likely alternatives were proposed to be built. Proposing to build any of the action alternatives would meet the water supply needs of this area through at least 2035; proposing to build Alternatives B, C, or E would meet the needs through 2050.

5.18 IRREVERSIBLE AND IRRETRIEVABLE RESOURCE COMMITMENTS

By itself, this programmatic EIS does not involve any irreversible or irretrievable commitment of resources because it is strictly an evaluation and early planning exercise. Proposing to build Alternatives B (Fountain Creek Reservoir) as described in Section 3.4 could be viewed as involving the irreversible and irretrievable commitment of approximately 2,200 acres of land to become a water supply reservoir. Approximately 56 percent of this land contains prime farmland soils and approximately 10 percent is wetlands (Section 4.10). This area also is likely to contain a large number of archaeological sites (Section 4.12). If a Fountain Creek reservoir was constructed as described in Section 3.4, all of the land would be converted to water supply use and all of the existing archaeological sites and wetlands in the pool area would be inundated (however, some new wetland areas probably would develop around the reservoir – see Section 5.6). Protection of the water supply source also might include restrictions on the use of the land surrounding the reservoir and elsewhere in the Fountain Creek watershed (see Section 5.4). An undetermined amount of rock, earth, other building materials, and fuel would be used in the construction of the reservoir.

Proposing to build Alternative D (Raise Normandy Pool Level) would involve the irreversible and irretrievable commitment of 230 acres of land, some existing wetlands, and archaeological sites during the enlargement of Normandy Reservoir. All of the land potentially affected by that project already is part of the Normandy Dam Reservation. The quantities of rock, earth, other building materials, and fuel that would be used in the modifications to Normandy Reservoir also have not yet been determined.

Both of the two other action alternatives (Alternatives C and E) would require much smaller irreversible and irretrievable commitments of resources to build the intakes, pumping stations, and pipelines they would include. Both of these alternatives also would require long-term commitments of around two acres of land for the intake and pumping facilities and only short-term use of the land surface along the route of the pipelines. Fuel, building materials, and other resources would be used during these projects; however, the quantities that would be involved have not yet been estimated

CHAPTER 6 - SUPPORTING INFORMATION

6.1 LIST OF PREPARERS

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Position:	Civil Engineer, TVA River Operations
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Contribution:	Floodplains material

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6.2 GLOSSARY OF TERMS

action alternative - one of the alternatives that would involve doing something to meet the purpose(s) of the project. Opposite: No Action Alternative

algae - small (generally microscopic) plants which live either floating in the water or attached to submerged objects.

best management practices - construction or maintenance practices which have been shown to be the most effective and practical ways of preventing impacts to environmental resources.

cfs - cubic feet per second. Typically used as a measure of flow in a stream.

CMCP - Cumberlandian Mollusk Conservation Program - a TVA program (active in 1980 through 1984) originally intended to mitigate the likely impacts of building Columbia Reservoir on the endangered and other mussel and snail species living in the Duck River.

Columbia Dam Project - the part of the Duck River Project which, originally, was intended to be the construction of a dam and reservoir at Duck River Mile 137.

Columbia Project lands - land acquired by TVA to be part of Columbia Dam and Reservoir.

designated uses - categories of beneficial uses of water in a stream that have been specifically identified by the Tennessee Department of Environment and Conservation (TDEC).

DRDA - the Duck River Development Agency.

Duck River Project - originally, a TVA project to construct two dams (Normandy and Columbia) on the Duck River. Funded by federal appropriations starting in 1969.

EIS - environmental impact statement. This is the most detailed type of environmental assessment document identified in the National Environmental Policy Act (NEPA).

endangered species - an animal or plant which is in danger of extinction throughout all or a significant part of its range.

Endangered Species Act - a federal law, first passed in 1973, establishing federal lists of endangered and threatened wildlife and plants, and which requires federal agencies to insure that any action they authorize, fund, or carry out is not likely to jeopardize the continued existence of listed species.

Executive Order 11988 - an order to federal agencies signed by the president requiring them to avoid or mitigate any actions which could result in impacts to the floodplains of streams.

Executive Order 11990 - an order to federal agencies signed by the president requiring them to avoid or mitigate any actions which could harm wetlands.

Executive Order 12372 - intergovernmental review of federal programs, provides for federal agencies to consult with state and local elected officials regarding federal development activities and programs that may affect community and area development planning and to accommodate their comments in the form of recommendation to the greatest extent possible. TVA and most states have a "Single Point of Contact" (SPO) for Executive Order 12372. TVA's SPO is the NEPA staff representative involved in the project.

Executive Order 12898 - federal actions to address environmental justice in minority populations and low-income populations, signed by President Clinton on February 11, 1994.

floodplain - the part of a stream valley which is covered with water during a flood situation. Typically used associated with a flood which could occur at a given frequency (for example, the edges of a 100-year floodplain would be covered with water only during floods expected to occur less frequently than once in 100 years).

genus (plural: genera) - the next larger grouping of animal or plant species which are assumed to be closely related to each other.

glade - a terrestrial habitat where extremely shallow soils and, usually, little moisture hinder the growth of trees and shrubs but favor the growth of smaller plants which can survive there.

gpm - gallons per minute. Typically used as a measure of water use or availability.

invertebrates - animals which do not have backbones. Used to refer to all animals except fish, amphibians, reptiles, birds, and mammals.

karst - an irregular limestone region with sinks, underground streams, and caverns.

Land Use EIS - the abbreviated title for the 1999 TVA EIS "Use of Lands Acquired for the Columbia Dam Component of the Duck River Project."

mgd - million gallons per day. Typically used as a measure of water treated or handled in some facility.

minimum flow - the amount of water that would be expected or, in the case of a controlled stream, would be released to flow in a stream during dry conditions.

Needs Analysis - an evaluation of the present water use in an area accompanied by the estimation of future water demand based on anticipated population and economic growth in the area.

NEPA (National Environmental Policy Act) - a 1970 federal law which requires agencies to determine the environmental impacts of proposed actions, to consider alternatives to those actions, and to include a consideration of the environmental impacts when deciding which actions to conduct.

NHPA (National Historic Preservation Act) - A federal law which requires agencies to avoid or mitigate impacts to significant archaeological or historic resources.

OMB (Office of Management and Budget) - an Executive Branch office which authorizes the use of funds provided by the Congress.

order of magnitude cost estimate- a cost estimate based the cost of previous projects adjusted up or down for the size or capacity of new project. When comparable data are not available for one or more project components, a separate cost estimate is developed. This type of cost estimate, with an likely accuracy of $\pm$ 30 percent, is less accurate than any of the three other recognized cost estimate levels (conceptual, preliminary, and definitive).

periphyton - aquatic life which lives attached to material submerged in the water.

plankton - small (generally microscopic) animals and plants which live floating in the water.

PMF - probable maximum flood.

programmatic review - a type of environmental review that looks at a broad class of possible projects, typically in more general terms, instead of evaluating specific ways of meeting a particular need.

pumping station - a structure housing two or more pumps used to move water through a pipeline from one location to another over some higher elevation.

scoping - an early part of the NEPA process when agencies and members of the public are encouraged to help focus the planned evaluation on important subject areas.

sinkhole (sink) - a place on the earth where surface water is able to flow down into the ground and has created an obvious depression.

taxon (plural: taxa) - a general term used to refer to an unknown or unspecified level of animal or plant classification. Typically used as a plural when a total includes a mixture of species, genera, and higher taxonomic categories ("28 insect taxa were found").

TDEC - the Tennessee Department of Environment and Conservation.

threatened species - animal or plant which is likely to become an endangered species within the foreseeable future throughout all or a significant portion of its range.

TVA - the Tennessee Valley Authority.

TWRA - the Tennessee Wildlife Resources Agency.

USACE - the U.S. Army Corps of Engineers.

USFWS - the U.S. Fish and Wildlife Service.

USGS - the U.S. Geological Survey.

wastewater discharge - water released into a stream or reservoir after being processed through a wastewater (sewage) treatment plant.

water intake - a pipe or more complex structure designed and used to withdraw water from a stream or reservoir.

water quality - the physical, chemical, and biological characteristics of water compared to recognized standards of quality necessary to maintain certain uses.

Water Service Area - typically, the area served by a public water supply utility. In this document, modified slightly to include more than one utility located in essentially the same area. The three water service areas discussed extensively in this document have boundaries closely associated with the county lines.

water supply - water removed from a stream or reservoir for municipal or industrial use.

wetlands - land areas adjacent to, or away from flowing streams which support plants and animals that have high water requirements.

zooplankton - small (usually microscopic) animals which live floating in the water.

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APPENDIX A

Results of water quality sampling conducted by TVA in the Fountain Creek watershed from August through November 1998

Table A-1. Results of water quality sampling conducted by TVA in the Fountain Creek watershed in August through November 1998

Stream	Sample (Stream Mile)	Date	Time Central	Discharge (cfs)	Depth (meters)	Temp. (°C)	Dissolved Oxygen (mg/1)	pH
Fountain Creek	FC-1 (17.1)	08/26	8:00	2.74	0.2	21.0	7.1	8.0
		09/29	9:25	1.25	0.2	21.5	7.1	7.9
		10/20	9:22	1.76	0.2	13.9	8.7	8.0
		11/17	14:00	1.35	0.2	13.6	10.4	8.1
Fountain Creek	FC-2 (14.5)	08/26	9:15	5.94	0.2	21.6	6.9	7.8
		09/29	10:15	3.70	0.2	21.6	6.2	7.7
		10/20	9:50	2.74	0.2	14.6	8	7.8
		11/17	14:40	2.29	0.1	13.3	9	7.9
Fountain Creek	FC-3 (8.95)	08/26	9:06	15.90	0.2	22.8	6.8	7.9
		09/30	10:30	4.56	0.1	22.3	6.1	7.9
		10/21	12:10	1.26	0.1	15.1	9.1	8.0
		11/17	12:45	7.81	0.1	10.9	10.1	8.2
Fountain Creek	FC-4 (0.5)	08/27	12:30	13.50				
		09/30	9:15	4.21	0.1	22.4	7.2	8.1
		10/20	10:36	8.71	0.2	14.7	9.4	8.1
		11/17	11:40	7.53	0.1	11.1	10.2	7.9
South Fork	SF-1	08/26	8:40	3.71	0.1	22.5	6.5	7.8
		09/30	10:45	3.90	0.1	23.0	6.8	7.8
		10/20	10:15	2.12	0.1	15.7	8.1	7.8
		11/17	11:10	2.08	0.1	11.3	9.2	7.9
East Fork	EF-1	08/27	10:50	1.64	0.1	25.0	9.1	8.2
		09/30	12:15	0.35	0.1	23.8	6.1	7.9
		10/21	11;09	0.68	0.1	14:0	8.8	8.0
		11/17	10:00	0.63	0.2	8.1	9.6	8.1
Globe Creek	GC-1	08/26	10:00	4.98	0.2	23.1	6.8	8.1
		09/30	11:35	0.87	0.3	22.4	5.7	7.8
		10/20	10:40	2.04	0.2	13.7	8.1	8.0
		11/17	10:40	2.42	0.2	8.2	9.6	8.0
Brush Creek	BC-1	08/26	10:05	0.22	0.1	21.4	6.6	7.4
		09/30	11:40	0.00	0.1	22.0	5.6	7.6
		10/20	12:40	0.05	0.1	15.2	6.7	7.2
		11/17	12:10	<0.02	0.1	10.2	9	7.8
Hurricane Creek	HC-1	08/26	11:36	3.15	0.1	24.5	11.3	8.5
		09/30	9:55	0.75	0.1	22.2	9.2	8.4
		10/20	11:30	0.47	0.1	16.0	10.6	8.4
		11/17	12:45	0.87	0.1	16.0	10	8.2
Silver Creek	SC-1	08/26	10:40	0.14	0.1	23.9	5.1	7.7
		9/90		0.00				Dry
		10/20	9:40	0.03	0.1	14.3	4.25	7.6
		11/17	13:15	0.27	0.1	14.0	7.8	8.0

Table A-1. (Continued)

Stream	Sample (Stream Mile)	Date	Alkalinity mg/l as CaCo3	Conductivity umhos/cm	ORP (mv)	Fecal Coliform no/100ml	BOD-5 (mg/l)	BOD-10 (mg/l)
Fountain Creek	FC-1 (17.1)	08/26	200	387	264	1220	<2.0	NA
		09/29	180	366	340	1750	<2.0	NA
		10/20	160	365	348	5260	<2.0	<2.0
		11/17	190	283	351	<1	<2.0	<2.0
Fountain Creek	FC-2 (14.5)	08/26	200	419	256	1490		
		09/29	200	404	351	1690	<2.0	NA
		10/20	190	403	345	<1	<2.0	<2.0
		11/17	190	383	286	>3210	<2.0	2.1
Fountain Creek	FC-3 (8.95)	08/26	200	410	213	390	<2.0	NA
		09/30	200	396	349	240	<2.0	NA
		10/21	190	405	349	130	<2.0	<2.0
		11/17	190	383	324	120	<2.0	<2.0
Fountain Creek	FC-4 (0.5)	08/27						
		09/30	190	388	345	270	<2.0	NA
		10/20	180	401	346	270	<2.0	<2.0
		11/17	190	422	NA	120	<2.0	<2.0
South Fork	SF-1	08/26	160	362	261	1220	<2.0	NA
		09/30	170	359	340	1040	<2.0	NA
		10/20	170	357	342	200	<2.0	<2.0
		11/17	170	338	269	110	7	<2.0
East Fork	EF-1	08/27	210	442	247	740	<2.0	NA
		09/30	230	481	353	250	<2	NA
		10/21	200	478	354	140	<2.0	<2.0
		11/17	230	462	265	140	<2.0	<2.0
Globe Creek	GC-1	08/26	190	429	253	350	<2.0	NA
		09/30	190	402	347	590	<2.0	NA
		10/20	190	426	349	190	<2.0	<2.0
		11/17	220	401	260	160	<2.0	<2.0
Brush Creek	BC-1	08/26	200	429	236	110	<2.0	NA
		09/30	230	445	363	210	<2.0	NA
		10/20	220	458	361	30	<2.0	<2.0
		11/17	210	415	270	20	<2.0	<2.0
Hurricane Creek	HC-1	08/26	230	441	212	530	<2.0	NA
		09/30	220	464	344	180	<2.0	NA
		10/20	210	443	348	50	<2.0	<2.0
		11/17	230	505		70	<2.0	<2.0
Silver Creek	SC-1	08/26	220	446	228	280	<2.0	NA
		9/90	No	Flow				
		10/20	170	429	344	410	5	5.7
		11/17	230	444	384	410	<2.0	2.2

Table A-1. (Continued)

Stream	Sample (Stream Mile)	Date	BOD-20 (mg/l)	BOD-30 (mg/l)	BOD-50 (mg/l)	TOC (mg/l)	DOC (mg/l)	Suspended Solids (mg/l)
Fountain Creek	FC-1 (17.1)	08/26	NA	NA	NA	1.4	1.4	4
		09/29	NA	NA	NA	2.3	2.2	<1.0
		10/20	2.2	2.6	3.1	2.2	2.2	3
		11/17	<2.0	2.3	2.7	2.3	2.1	<1.0
Fountain Creek	FC-2 (14.5)	08/26				2	1.8	5
		09/29	NA	NA	NA	2.8	2.8	2
		10/20	2.5	2.9	3.6	2.6	2.6	3
		11/17	2.7	3.4	4	3.1	2.9	1
Fountain Creek	FC-3 (8.95)	08/26	NA	NA	NA	1.9	1.8	3
		09/30	NA	NA	NA	2.9	2.8	2
		10/21	<2.0	<2.0	<2.0	2.6	2.6	2
		11/17	2.1	2.6	3.2	3.2	3.2	<1.0
Fountain Creek	FC-4 (0.5)	08/27						
		09/30	NA	NA	NA	3	2.9	<1.0
		10/20	<2.0	<2.0	<2.0	2.5	2.5	<1.0
		11/17	<2.0	2.2	2.9	3.5	3.5	<1.0
South Fork	SF-1	08/26	NA	NA	NA	1.7	1.8	2
		09/30	NA	NA	NA	2.2	2.2	<1.0
		10/20	<2.0	<2.0	2.4	2.1	2.1	<1.0
		11/17	<2.0	<2.0	2.3	2.3	2.3	<1.0
East Fork	EF-1	08/27	NA	NA	NA	2.9	2.6	18
		09/30	NA	NA	NA	3.7	3.7	5
		10/21	2.3	2.9	3.6	3.3	3.3	3
		11/17	<2.0	2.3	2.8	2.9	2.9	2
Globe Creek	GC-1	08/26	NA	NA	NA	2.4	2.3	2
		09/30	NA	NA	NA	4	3.9	<1.0
		10/20	2.3	2.8	3.5	3.6	3.6	2
		11/17	<2.0	2.3	3.1	3.4	3.4	<1.0
Brush Creek	BC-1	08/26	NA	NA	NA	2.3	2.2	10
		09/30	NA	NA	NA	3.6	3.5	2
		10/20	2.4	2.8	3.6	3.7	3.7	1
		11/17	<2.0	<2.0	2.3	3.5	3.2	<1.0
Hurricane Creek	HC-1	08/26	NA	NA	NA	2	2	<1.0
		09/30	NA	NA	NA	3.7	3.6	<1.0
		10/20	<2.0	2.3	3	3.7	3.7	3
		11/17	2.2	2.8	3.4	3.3	3.3	3
Silver Creek	SC-1	08/26	NA	NA	NA	3.1	2.9	2
		9/90		Dry	No	Flow		
		10/20	8.5	9.8	11.7	9.4	9.4	3
		11/17	2.9	3.6	4.7	6	6	<1.0

Table A-1. (Continued)

Stream	Sample (Stream Mile)	Date	TKN (mg/l)	Nitrate + Nitrate (mg/l)	Total Phosphorus (mg/l)	Ortho Phosphorus (mg/l)	Total Iron (ug/l)	Dissolved Iron (ug/l)
Fountain Creek	FC-1 (17.1)	08/26	0.26	0.74	0.35	0.30	220	<10
		09/29	0.21	0.64	0.33	0.30	110	<10
		10/20	0.12	0.33	0.35	0.31	220	10
		11/17	0.11	0.32	0.34	0.29	140	10
Fountain Creek	FC-2 (14.5)	08/26	0.37	0.80	0.39	0.33	250	<10
		09/29	0.27	0.41	0.45	0.37	230	20
		10/20	0.14	0.35	0.39	0.35	260	10
		11/17	0.11	0.30	0.42	0.38	170	30
Fountain Creek	FC-3 (8.95)	08/26	0.29	0.50	0.38	0.33	180	<10
		09/30	0.19	0.12	0.38	0.37	120	410
		10/21	0.11	0.12	0.39	0.34	70	<10
		11/17	0.11	0.04	0.37	0.35	70	10
Fountain Creek	FC-4 (0.5)	08/27						
		09/30	0.19	0.08	0.37	0.34	70	<10
		10/20	0.12	0.04	0.34	0.32	50	<10
		11/17	0.13	0.01	0.39	0.37	60	10
South Fork	SF-1	08/26	0.30	0.77	0.32	0.28	120	<10
		09/30	0.16	0.48	0.35	0.32	60	<10
		10/20	0.30	0.43	0.31	0.30	70	10
		11/17	0.09	0.02	0.28	0.26	50	10
East Fork	EF-1	08/27	0.42	0.12	0.37	0.34	110	<10
		09/30	0.39	<0.01	0.47	0.43	170	<10
		10/21	0.21	<0.01	0.36	0.35	150	10
		11/17	0.13	<0.01	0.36	0.32	120	10
Globe Creek	GC-1	08/26	0.36	0.39	0.37	0.34	140	<10
		09/30	0.29	0.05	0.42	0.41	70	<10
		10/20	0.20	0.02	0.35	0.34	100	<10
		11/17	0.11	0.02	0.40	0.38	70	10
Brush Creek	BC-1	08/26	0.39	0.10	0.29	0.22	620	<10
		09/30	0.29	<0.01	0.27	0.19	150	<10
		10/20	0.14	<0.01	0.30	0.23	80	10
		11/17	0.11	<0.01	0.30	0.26	50	<10
Hurricane Creek	HC-1	08/26	0.29	0.58	0.32	0.30	80	<10
		09/30	0.27	0.02	0.37	0.36	40	<10
		10/20	0.33	<0.01	0.36	0.32	100	<10
		11/17	0.13	<0.01	0.40	0.37	190	<10
Silver Creek	SC-1	08/26	0.52	0.08	0.25	0.23	260	<10
		9/90						
		10/20	1.20	<0.01	0.33	0.31	150	40
		11/17	0.29	<0.01	0.40	0.36	100	10

Table A-1. (Continued)

Stream	Sample (Stream Mile)	Date	Total Manganese (ug/l)	Dissolved Manganese (ug/l)
Fountain Creek	FC-1 (17.1)	08/26	49	22
		09/29	30	20
		10/20	51	20
		11/17	63	23
Fountain Creek	FC-2 (14.5)	08/26	96	68
		09/29	90	80
		10/20	100	55
		11/17	92	48
Fountain Creek	FC-3 (8.95)	08/26	26	<5
		09/30	30	1500
		10/21	16	<5
		11/17	15	<5
Fountain Creek	FC-4 (0.5)	08/27		
		09/30	<5	<5
		10/20	10	<5
		11/17	11	<5
South Fork	SF-1	08/26	50	23
		09/30	30	20
		10/20	34	11
		11/17	28	<5
East Fork	EF-1	08/27	33	5
		09/30	60	20
		10/21	34	<5
		11/17	20	<5
Globe Creek	GC-1	08/26	27	5
		09/30	30	20
		10/20	23	<5
		11/17	13	<5
Brush Creek	BC-1	08/26	95	6
		09/30	140	100
		10/20	51	33
		11/17	12	<5
Hurricane Creek	HC-1	08/26	5	<5
		09/30	5	<5
		10/20	10	<5
		11/17	22	<5
Silver Creek	SC-1	08/26	62	20
		9/90		
		10/20	120	80
		11/17	28	<5

APPENDIX B

Aquatic Life Known From Three Reaches of the Duck River and Other Streams Which Could be Affected by One or More of the Action Alternatives

Table B-1. Genera of algae identified from plankton and periphyton samples collected during the early 1980s in three reaches of the Duck River. Data from Wade and Webb (1986).

Scientific Name	RM 100 - 135	RM 136 - 179	RM 180 - 249
Chlorophyta (46)	**NS**	**(40)**	**(30)**
Actinastrum		X	X
Ankistrodesmus		X	X
Arthrodesmus		X	
Bracteacoccus		X	
Carteria		X	X
Characium		X	
Chlamydomonas		X	X
Chlorella		X	X
Chlorogonium		X	X
Chodatella			X
Cladophora			X
Closteriopsis		X	X
Closterium		X	X
Coelastrum		X	X
Cosmarium		X	X
Crucigenia			X
Dactylococcus			X
Dictyosphaerium		X	X
Eudorina		X	
Franceia		X	X
Golenkinia		X	X
Gongrosira		X	
Gonium		X	
Hyalotheca		X	
Kirchneriella		X	X
Mougeotia		X	X
Oedogonium		X	
Oocystis		X	X
Pandorina		X	X
Pediastrum		X	X
Protococcus		X	
Pteromonas		X	
Pyramimonas		X	X
Rhizoclonium		X	

Table B-1 (Continued)

Scientific Name	RM 100 - 135	RM 136 - 179	RM 180 - 249
Scenedesmus		X	X
Schroederia		X	X
Selenastrum		X	
Spermatozoopsis		X	X
Spirogyra		X	
Spondylosium		X	
Staurastrum			X
Stigeoclonium		X	
Tetraedron			X
Tetrastrum		X	X
Truebaria		X	X
Ulothrix		X	
Chrysophyta (24)	**NS**	**(22)**	**(20)**
Achnanthes		X	X
Chaetoceros			X
Cocconeis		X	X
Cyclotella		X	X
Cymatopleura			X
Cymbella		X	X
Diatoma		X	X
Dichotomococcus		X	X
Dinobryon		X	
Epithemia		X	X
Gomphonema		X	X
Gyrosigma		X	X
Mallomonas		X	
Melosira		X	X
Meridion		X	
Navicula		X	X
Nitzchia		X	X
Pleurosigma		X	
Rhizosolenia		X	X
Rhoicosphenia		X	X
Stephanodiscus		X	X
Surirella		X	X
Synedra		X	X
Synura		X	X

Table B-1 (Continued)

Scientific Name	RM 100 - 135	RM 136 - 179	RM 180 - 249
Cryptophyta (1)	**NS**	**(1)**	**(1)**
Cryptomonas		X	X
Cyanophyta	**NS**	**(10)**	**(8)**
Anabaena		X	X
Anabaenopsis			X
Anacystis		X	X
Aphanizomenon		X	X
Calothrix		X	
Dactylococcopsis		X	X
Leptochaete		X	
Lyngbya		X	X
Merismopedia		X	X
Oscillatoria		X	X
Spirulina		X	
Euglenophyta (4)	**NS**	**(4)**	**(4)**
Cryptoglena		X	X
Euglena		X	X
Phacus		X	X
Trachelomonas		X	X
Pyrrophyta (3)	**NS**	**(3)**	**(2)**
Ceratium		X	
Glenodinium		X	X
Gymnodinium		X	X
Totals (89)	**NS**	**79**	**65**

NS - Reach not sampled for these species

Table B-2. Zooplankton taxa identified from plankton and periphyton samples collected during the early 1980s in three reaches of the Duck River. Data from Wade and Webb (1986).

Scientific Name	RM 100 - 135	RM 136 - 179	RM 180 - 249
Cladocera (18)	**NS**	**(11)**	**(12)**
Bosmina longirostrus		X	X
Bosminopsis sp.			X
Ceriodaphnia lacustris		X	X
Chydorus sp.		X	X
Daphnia ambigua			X
Daphnia parvula			X
Daphnia retrocurva			X
Diaphanosoma leuchtenbergianum		X	
Ilyocryptus imm.		X	
Leptodora kindtii			X
Leydigia acanthocercoides			X
Moina imm.		X	X
Moina minuta		X	
Pleuroxus denticulatus		X	X
Pleuroxus hamulatus		X	
Capholebris kingi		X	
Scapholebris kingi			X
Sida crystallina		X	
Copepoda (12)	**NS**	**(8)**	**(10)**
Callanoida imm.		X	
Cyclopoida imm.		X	X
Cyclops bicuspidatus thomasi			X
Cyclops varicans rubellus			X
Cyclops vernalis		X	X
Diaptomus reighardi			X
Elaphoidella bidens coronata		X	X
Ergasilus imm.		X	X
Eucyclops agilis		X	
Macrocyclops albidus			X
Mesocyclops edax		X	X
Tropoclops prasinus		X	X
Rotifera (35)	**NS**	**(25)**	**(31)**
Asplanchna amphora			X
Asplanchna herricki		X	X
Bdelloidea			X

Table B-2 (Continued)

Scientific Name	RM 100 - 135	RM 136 - 179	RM 180 - 249
Brachionus angularis		X	X
Brachionus budapestinensis		X	X
Brachionus calyciflorus		X	X
Brachionus caudatus		X	X
Brachionus havanaensis			X
Brachionus quadridentatus		X	X
Cephalodella sp.			X
Conochilcides sp.		X	X
Conochilus hippocrepis			
Epiphanes macrourus		X	X
Euchlanis sp.		X	X
Hexarthra mira		X	
Kellicottia bostoniensis			X
Keratella cochlearis			X
Keratella earlinea			X
Lecane sp.		X	X
Machrochaetus subquadratus		X	X
Monommata grandis			X
Monostyla quadridentata		X	X
Monostyla sp.		X	X
Mytilina sp.			
Notommata sp.		X	
Platyias patulus		X	X
Platyias quadricornis		X	X
Ploesoma truncata		X	X
Polyarthra sp.		X	X
Rotaria neptunia			X
Rotaria sp.			X
Synchaeta sp.		X	X
Testudinella sp.		X	X
Trichocerca sp.			X
Trichotria			X
Totals (65)	**NS**	**44**	**53**

NS - Reach not sampled for these species

Table B-3. Names of the larger aquatic plants observed in the Duck River near Sowell Ford (River Mile 159) and Lillard Mill (River Mile 179) in 1980 and 1981. Information from Wade and Webb (1986).

Common Name	Scientific Name	RM 100 - 135	RM 136 - 179	RM 180 - 249
Mosses and liverworts	**Bryophyta (3)**			
	Fissidens fontanus		X	X
	Porella pinnata		X	X
	Leptodictyum riparium			X
Flowering plants	**Angiospermae (11)**			
	Decodon verticillata			X
Canadian waterweed	*Elodea canadensis*		X	X
Mud-plantain	*Heteranthera dubia*		X	
Waterwillow	*Justicia americana*	X	X	X
Rice-cutgrass	*Leersia oryzoides*		X	X
	Nasturtium officinale			X
Threadfoot riverweed	*Podostemum ceratophyllum*		X	X
Leafy pondweed	*Potamogeton foliosus*		X	
Knotty pondweed	*Potamogeton nodosus*		X	X
Lizard's-tail	*Saururus cernuus*		X	X
	Scirpus americanus			X
Totals	**14**	**1+**	**10**	**12**

Table B-4. Larger aquatic invertebrates (except mollusks) encountered within the last 25 years in the middle reach of the Duck River. Data from Barr, et al. (1986), Scott, et al. (1996), and TVA (1975).

Categories and Taxa	RM 100 - 135	RM 136 - 179	RM 180 - 249	Normandy	Tims Ford
Hydrozoa (1)	**NS**		**(1)**		
Hydridae			X		
Platyhelminthes (2)		**(2)**	**(1)**		
Dugesia tigrina		X			
Planariidae		X	X		
Nematoda (1)	**NS**	X **(1)**		X **(1)**	X **(1)**
Oligochaeta (9)	**NS**	X **(9)**	X **(4)**	X **(4)**	X **(4)**
Branchiura sowerbyi		X	X	X	
Dero					X
Limnodrilius				X	X
Lumbricidae		X			
Lumbriculus		X			
Lumbriculidae		X	X		
Nais bretscheri		X			
Oligochaeta		X			
Pristinella		X			
Tubificidae		X	X	X	X
Hirudinea (6)	**NS**	**(6)**	**(1)**		
Erpobdellidae		X	X		
Eropbella		X			
Glossiphoniidae		X			
Helobdella		X			
Placobdella multilineata		X			
Placobdella		X			
Crustacea (12)	**NS**	**(9)**	**(9)**		
Asellus			X		
Caecidotea		X	X		
Cambarus		X	X		
Crangonyx		X	X		
Cyclopidae			X		
Gammarus			X		
Gammarus fasciatus		X			

Table B-4 (Continued)

Categories and Taxa	RM 100 - 135	RM 136 - 179	RM 180 - 249	Normandy	Tims Ford
Hyalella azteca		X	X		
Lirceus		X	X		
Lirceus fontinalis		X			
Orconectes		X	X		
Orconectes placidus		X			
Arachnoidea (1)	**NS**		**(1)**		
Hydracarina			X		
Plecoptera (21)	**NS**	**(17)**	**(12)**		
Acroneuria abnormis		X			
Acroneuria evoluta		X	X		
Agnetina capitata		X			
Brachyptera			X		
Capniidae		X			
Isoperla			X		
Leuctra			X		
Nemoura		X	X		
Neoperla		X	X		
Neoperla clymene		X			
Neophasganophora		X			
Perlidae		X	X		
Perlesta		X	X		
Perlesta placida		X	X		
Perlinella ephyre		X			
Perlinella		X			
Phasgnophora		X	X		
Phasgnophora capitata			X		
Pteronarcys		X			
Pteronarcys dorsata		X			
Taeniopteryx		X	X		
Odonata (24)	**NS**	**(21)**	**(12)**		
Argia		X	X		
Basiaeshna janata			X		
Boyeria		X	X		
Boyeria vinosa		X			

Table B-4 (Continued)

Categories and Taxa	RM 100 - 135	RM 136 - 179	RM 180 - 249	Normandy	Tims Ford
Calopteryx		X	X		
Coenagrionidae		X	X		
Dromogomphus		X			
Dromogomphus armatus		X			
Enallagma		X			
Gomphus		X			
Hagenius brevistylus		X	X		
Hetaerina		X	X		
Hetaerina americana		X			
Ischnura		X	X		
Ladona		X			
Lathus		X			
Macromia		X	X		
Macromia alleghaniensis		X			
Neurocordylia yamaskanensis			X		
Ophiogomphus		X			
Ophiogomphus rupinsulensis		X	X		
Progomphus		X			
Somatochlora		X			
Stylogomphus albistylus			X		
Ephemeroptera (27)	**NS**	**(25)**	**(13)**		**(1)**
Baetis		X	X		
Baetisca			X		
Caenis		X	X		
Ephemerella		X	X		
Ephemeron		X			
Ephoron leukon		X			
Ephoron		X			
Eurylophella		X			
Heptagenia		X			
Hexagenia		X			X
Isonychia		X	X		
Leptophlebia		X	X		

Table B-4 (Continued)

Categories and Taxa	RM 100 - 135	RM 136 - 179	RM 180 - 249	Normandy	Tims Ford
Leucrocuta		X			
Paraleptophlebia		X	X		
Potamanthus		X	X		
Potamanthus distinctus		X			
Pseudocloeon			X		
Rhithrogena		X	X		
Stenacron		X	X		
Stenacron interpunctatum		X			
Stenonema		X	X		
Stenonema femoratum		X			
Stenonema ithaca		X			
Stenonema mediopunctatum		X			
Stenonema modestum		X			
Stenonema terminatum		X			
Tricorythodes		X	X		
Hemiptera (5)	**NS**	**(5)**	**(2)**		
Corixidae		X			
Belostoma		X	X		
Ranatra		X			
Rhagovelia		X	X		
Trepobates		X			
Trichoptera (33)	**NS**	**(28)**	**(13)**		
Agapetus		X			
Brachycentrus		X			
Cheumatopsyche		X	X		
Cheumatopsyche btrona		X	X		
Chimarra			X		
Glossosoma		X	X		
Hydropsychidae		X	X		
Hydropsyche		X	X		
Hydropsyche demora		X			
Hydropsyche patera		X			
Hydropsyche simulans		X			
Hydroptila		X			

Table B-4 (Continued)

Categories and Taxa	RM 100 - 135	RM 136 - 179	RM 180 - 249	Normandy	Tims Ford
Ironoquia		X			
Lepidostomata		X			
Limoephilus		X			
Lype			X		
Micrasema		X			
Nectopsyche candida		X			
Nectopsyche esquisita		X			
Neureclipsis		X			
Oecetis		X			
Philopotamidae			X		
Polycentropus			X		
Protoptila		X			
Psychomyia		X	X		
Pycnopsyche		X	X		
Rhyacophila			X		
Steodes incerta		X			
Seodes		X			
Symphitopsyche		X	X		
Symphitopsyche morosa		X			
Triaenodes injustus		X			
Traenodes tardus		X			
Megaloptera (4)	**NS**	**(4)**	**(3)**		
Corydalus cornutus		X	X		
Nigronia		X	X		
Sialis		X	X		
Sialis aequalis		X			
Diptera (40)	**NS**	**(29)**	**(16)**	**(3)**	**(6)**
Ablabesmyia		X			
Ablabesmyia mallochi		X			
Antocha			X		
Atherix variegata			X		
Bezzia				X	
Ceratipogonidae		X	X		
Chaborous			X		
Chironomidae		X	X		

Table B-4 (Continued)

Categories and Taxa	RM 100 - 135	RM 136 - 179	RM 180 - 249	Normandy	Tims Ford
Chironomus		X	X	X	X
Clinotanypus		X			
Coelotanypus		X			
Conchapelopsis		X			
Cricotopus		X			
Cricotopus bicinctus		X			
Cricotopus tremulus		X			
Cryptochironomus		X	X		X
Dicrotendipes		X			
Empididae			X		
Endochironomus		X			
Eriocera		X			
Eukinefferiella		X			
Hexatoma		X			
Hydrobaenus					X
Microtendipes			X		
Nanocladius		X			
Orthocladius		X			
Parametriocnemus		X			
Polypedilum		X	X		X
Procladius				X	X
Rheotanytarsus		X			
Simulidae		X	X		
Simulium		X	X		
Stenochironomus		X			
Tabanus			X		
Tanytarsus		X			X
Tendipedidae		X			
Tipulidae		X	X		
Tipula			X		
Tipula acdominalis			X		
Tribelos		X			
Coleoptera (19)	**NS**	**(13)**	**(10)**		
Dubiraphia		X			
Dinetus		X	X		

Table B-4 (Continued)

Categories and Taxa	RM 100 - 135	RM 136 - 179	RM 180 - 249	Normandy	Tims Ford
Dinetus discolor		X			
Elmidae			X		
Ectoparia			X		
Helichus			X		
Macronychus			X		
Macronychus glabratus		X			
Microcylleopus pusillus		X			
Optioservus			X		
Oulimnius		X	X		
Pletodytes		X			
Promoresia elegans		X			
Psephenus		X	X		
Psephenus herricki		X			
Stenelmis		X	X		
Stenelmis crenata		X			
Stenelmis humerosa		X			
Tropisternus lateralis			X		
Total Taxa (207)	**NS**	**169**	**98**	**8**	**12**

Table B-5. Freshwater mollusks (snails, mussels, and other bivalves) found in reaches of the Duck River between the Hickman County line (near Duck River Mile 100) upstream to Normandy Dam (Duck River Mile 249) within the last 30 years (since 1970). Information from Ahlstedt (1981); Ahlstedt (1986); Aquatic Resources Center (1995); Barr, et al. (1986); Jenkinson (1988); TVA (1975); and TVA unpublished data. Nomenclature follows Turgeon, et al. (1988).

Scientific Name	Common Name	RM 100 - 135	RM 136 - 179	RM 180 - 249	Normandy	Tims Ford
Gastropoda	**Aquatic Snails (14)**	**NS**	**(13)**	**(8)**	**NS**	**NS**
Campeloma sp.	Campeloma		X	X		
Elimia edgariana	Cumberland elimia		X	X		
Elimia laqueata	Panel elimia		X	X		
Ferrissia sp.	Ancylid		X	X		
Gyraulus sp.	Gyro		X			
Leptoxis praerosa	Onyx rocksnail		X	X		
Lithasia duttoniana	Helmet rocksnail		X			
Lithasia geniculata	Ornate rocksnail		X	X		
Lithasia jayana	Rugose rocksnail		X			
Lymnaea sp.	Lymnaea		X	X		
Physa sp.	Physa		X			
Planorbella sp.	Rams-horn			X		
Pleurocera canaliculata	Silty hornsnail		X			
Somatogyrus sp.	Pebblesnail		X			
Bivalvia: Unionidae	**Native Mussels (44)**	**(21)**	**(40)**	**(13)**	**NS**	**NS**
Actinonaias carinata	Mucket		X			
Actinonaias pectorosa	Pheasantshell		X	X		
Amblema plicata	Threeridge		X	X		
Anodonta grandis	Giant floater	X	X			
Anodonta imbecillis	Paper pondshell	X	X			
Arcidens confragosus	Rock pocketbook	X				
Cyclonaias tuberculata	Purple wartyback	X	X	X		
Elliptio dilatata	Spike		X	X		
Epioblasma brevidens	Cumberland combshell		X			
Epioblasma capsaeformis	Oyster mussel		X			
Epioblasma triquetra	Snuffbox		X	X		
Epioblasma walkeri	Tan riffleshell		X			
Fusconaia barnesiana	Tennessee pigtoe		X	X		
Fusconaia ebena	Ebonyshell	X	X			
Lampsilis fasciola	Wavy-rayed lampmussel	X	X	X		
Lampsilis ovata	Pocketbook	X	X	X		
Lampsilis teres	Yellow sand shell	X				
Lasmigona complanata	White heelsplitter		X			
Lasmigona costata	Fluted-shell	X	X	X		
Lemiox rimosus	Birdwing pearlymussel		X			
Leptodea fragilis	Fragile papershell	X	X			

Scientific Name	Common Name	RM 100 - 135	RM 136 - 179	RM 180 - 249	Normandy	Tims Ford
Lexingtonia dolabelloides	Slabside pearlymussel	X	X	X		
Ligumia recta	Black sand shell	X				
Medionidus conradicus	Cumberland moccasinshell		X			
Megalonaias nervosa	Washboard		X			
Obliquaria reflexa	Threehorn wartyback	X	X			
Obovaria subrotunda	Round hickorynut		X	X		
Pleurobema cordatum	Ohio pigtoe		X			
Pleurobema oviforme	Tennessee clubshell		X			
Pleurobema pyramidatum	Pyramid pigtoe		X			
Potamilus alatus	Pink heelsplitter	X	X			
Ptychobranchus fasciolaris	Kidneyshell	X	X			
Quadrula c. cylindrica	Rabbitsfoot		X			
Quadrula intermedia	Cumberland monkeyface		X			
Quadrula p. pustulosa	Pimpleback	X	X			
Quadrula quadrula	Mapleleaf	X	X			
Strophitus undulatus	Squawfoot	X	X			
Toxolasma lividus	Purple lilliput		X			
Tritogonia verrucosa	Pistolgrip	X	X			
Truncilla donaciformis	Fawnsfoot		X			
Truncilla truncata	Deertoe	X	X			
Villosa iris	Rainbow		X	X		
Villosa taeniata	Painted creekshell		X			
Villosa v. vanuxemensis	Mountain creekshell	X	X	X		
Bivalvia: Others	**Clams (2)**	**(1)**	**(1)**	**(2)**		
Sphaeriidae	Fingernail Clams	NS	NS	X		
Corbicula manilensis	Asiatic clam	X	X	X	X	
Mollusk Totals	**61 taxa**	**22 +**	**54**	**23**	**1+**	**NS**

NS - Reach not sampled for these species

Table B-6. Freshwater fishes encountered in reaches of the Duck River, Normandy and Tims Ford Reservoirs within the last 30 years (since 1970). Data from ARC (1995); Barr et al. (1986); Burr et al. (1993); Nieland (1982); Saylor and Ahlstedt (1993); and Scott and Gardner (1995), Scott, et al. (1996), and TVA unpublished data.

Scientific Name	Common Name	RM 100-135	RM 136-179	RM 180-249	Normandy	Tims Ford
Petromyzontidae	**Lampreys (1)**		(1)	(1)		
Ichthyomyzon bdellium	Ohio lamprey		X	X		
Lepisosteidae	**Gars (2)**	(1)	(1)	(1)	(1)	(1)
Lepisosteus oculatus	Spotted gar		X			
Lepisosteus osseus	Longnose gar	X	X	X	X	X
Hiodontidae	**Mooneyes (1)**		(1)			
Hiodon tergisus	Mooneye		X			
Clupeidae	**Herrings (2)**	(1)	(1)	(1)	(2)	(2)
Dorosoma cepedianum	Gizzard shad	X	X	X	X	X
Dorsoma petenense	Threadfin shad				X	X
Cyprinidae	**Minnows (26)**	(16)	(21)	(22)	(4)	(3)
Campostoma oligolepis	Largescale stoneroller	X	X	X		
Clinstomus funduloides	Rosyside dace			X		
Cyprinella galactura	Whitetail shiner	X	X	X		
Cyprinella spiloptera	Spotfin shiner	X	X	X	X	X
Cyprinella whipplei	Steelcolor shiner	X	X			
Cyprinus carpio	Common carp		X	X	X	X
Erimystax dissimilis	Streamline chub	X	X	X		
Erimystax insignis	Blotched chub	X	X	X		
Hybopsis amblops	Bigeye chub	X	X	X		
Luxilus chrysocephalus	Striped shiner	X	X	X	X	
Lythrurus ardens	Rosefin shiner		X	X		
Lythrurus lirus	Mountain shiner		X	X		
Notropis ariommus	Popeye shiner		X	X		
Notropis atherinoides	Emerald shiner	X				X
Notropis boops	Bigeye shiner		X	X		
Notropis photogenis	Silver shiner	X	X	X		
Notropis rubellus	Rosyface shiner	X	X	X		
Notropis sp.	"Sawfin" shiner	X	X	X		
Notropis telescopus	Telescope shiner	X	X	X		
Notropis volucellus	Mimic shiner	X	X	X		
Phenacobius uranops	Stargazing minnow		X	X		
Pimephales notatus	Bluntnose minnow		X	X	X	
Pimaphales promelas	Fathead minnow			X		
Pimephales vigilax	Bullhead minnow	X	X			
Rhinichthys atratulus	Blacknose dace			X		
Semotilus atromaculatus	Creek chub	X				

Table B-6 (Continued)

Scientific Name	Common Name	RM 100-135	RM 136-179	RM 180-249	Normandy	Tims Ford
Catostomidae	**Suckers (14)**	**(9)**	**(11)**	**(9)**	**(7)**	**(9)**
Carpiodes carpio	River carpsucker					X
Carpiodes cyprinus	Quillback carpsucker		X			X
Carpiodes velifer	Highfin carpsucker		X			
Catostomus commersoni	White sucker			X		
Hypentelium nigricans	Northern hog sucker	X	X	X	X	
Ictiobus bubalus	Smallmouth buffalo	X	X			X
Ictiobus cyprinellus	Bigmouth buffalo			X		
Ictiobus niger	Black buffalo	X	X			X
Minytrema melanops	Spotted sucker	X	X	X	X	X
Mosostoma anisurum	Silver redhorse	X	X	X	X	X
Moxostoma carinatum	River redhorse	X	X	X	X	
Moxostoma duquesnei	Black redhorse	X	X	X	X	X
Moxostoma erythrurum	Golden redhorse	X	X	X	X	X
Moxostoma macrolepidotum	Shorthead redhorse	X	X	X	X	X
Ictaluridae	**Catfishes (9)**	**(4)**	**(8)**	**(5)**	**(3)**	**(3)**
Ameiurus melas	Black bullhead		X			
Ameiurus natalis	Yellow bullhead		X	X		
Ictalurus furcatus	Blue catfish			X	X	X
Ictalurus punctatus	Channel catfish	X	X	X	X	X
Noturus eleutherus	Mountain madtom	X	X			
Noturus exilis	Slender madtom		X	X		
Noturus flavus	Stonecat		X			
Noturus miurus	Brindled madtom	X	X			
Pylodictis olivaris	Flathead catfish	X	X	X	X	X
Salmonidae	**Trout (1)**			**(1)**		
Oncorhynchus mykiss	Rainbow trout			X		
Cyprinodontidae	**Topminnows (3)**	**(2)**	**(3)**	**(1)**		
Fundulus catenatus	Northern studfish	X	X	X		
Fundulus notatus	Blackstripe topminnow	X	X			
Fundulus olivaceus	Blackspotted topminnow		X			
Poecilidae	**Livebearers (1)**	**(1)**	**(1)**	**(1)**		
Gambusia affinis	Western mosquitofish	X	X	X		
Athernidae	**Silversides (1)**	**(1)**	**(1)**			**(1)**
Labidesthes sicculus	Brook silverside	X	X			X
Cottidae	**Sculpins (1)**	**(1)**	**(1)**	**(1)**		
Cottus carolinae	Banded sculpin	X	X	X		

Table B-6 (Continued)

Scientific Name	Common Name	RM 100-135	RM 136-279	RM 180-249	Normandy	Tims Ford
Moronidae	**Temperate Basses (3)**	**(2)**			**(1)**	**(3)**
Morone chrysops	White bass	X			X	X
Morone mississippiensis	Yellow bass					X
Morone saxatilis	Striped bass	X				X
Centrarchidae	**Sunfishes (12)**	**(7)**	**(11)**	**(11)**	**(12)**	**(11)**
Ambloplites rupestris	Rock bass	X	X	X	X	X
Lepomis auritus	Redbreast sunfish			X	X	X
Lepomis cyanellus	Green sunfish	X	X	X	X	X
Lepomis gulosus	Warmouth		X	X	X	X
[*Lepomis (hybrid)*]	[Hybrid sunfish]		[X]	[X]		
Lepomis macrochirus	Bluegill	X	X	X	X	X
Lepomis megalotis	Longear sunfish	X	X	X	X	X
Lepomis microlophus	Redear sunfish		X	X	X	
Micropterus dolomieu	Smallmouth bass	X	X	X	X	X
Micropterus punctulatus	Spotted bass	X	X	X	X	X
Micropterus salmoides	Largemouth bass	X	X	X	X	X
Pomoxis annularis	White crappie		X		X	X
Pomoxis nigromaculatus	Black Crappie		X	X	X	X
Percidae	**Perches (24)**	**(12)**	**(19)**	**(18)**	**(4)**	**(2)**
Etheostoma aquali	Coppercheek darter	X	X	X		
Etheostoma blennius	Blenny darter			X		
Etheostoma blennioides	Greenside darter	X	X	X		
Etheostoma caeruleum	Rainbow darter	X	X	X		
Etheostoma camurum	Bluebreast darter		X	X		
Etheostoma cinereum	Ashy darter		X	X		
Etheostoma crossopterum	Fringed darter		X			
Etheostoma flabellare	Fantail darter	X	X	X		
Etheostoma flavum	Saffron darter		X	X		
Etheostoma luteovinctum	Redband darter		X	X		
Etheostoma nigripinne	Blackfin darter		X	X		

Table B-6 (Continued)

Scientific Name	Common Name	RM 100-135	RM 136-179	RM 180-249	Normandy	Tims Ford
Etheostoma rufilineatum	Redline darter	X	X	X		
Etheostoma simoterum	Snubnose darter	X	X	X		
Etheostoma stigmaeum	Speckled darter	X	X	X		
Etheostoma striatulum	Striated darter		X			
Etheostoma tippecanoe	Tippecanoe darter		X	X		
Etheostoma zonale	Banded darter	X	X	X		
Perca flavescens	Yellow perch				X	
Percina caprodes	Logperch	X	X	X	X	X
Percina evides	Gilt darter	X				
Percina phoxocephala	Slenderhead darter	X	X			
Percina sciera	Dusky darter		X	X		
Stizostedion canadense	Sauger	X			X	
Stizostedion vitreum	Walleye			X	X	X
Sciaenidae	**Drums (1)**	**(1)**	**(1)**	**(1)**	**(1)**	**(1)**
Aplodinotus grunniens	Freshwater drum	X	X		X	X
Totals	(excluding hybrids) **102 Species**	**56**	**80**	**72**	**35**	**36**

Table B-7. Genera of algae identified from plankton and periphyton samples collected during the early 1980s in Fountain Creek at Tennessee Route 50A (Creek Mile 13.3). Data from Etnier, et al. (1983).

Scientific Name
Chlorophyta (4)
Ankistrodesmus
Closterium
Pachycladon
Rhizoclonium
Chrysophyta (20)
Achnanthes
Amphipleura
Cocconeis
Cyclotella
Cymatopleura
Cymbella
Diatoma
Fragilaria
Frustulia
Gomphonema
Gyrosigma
Melosira
Meridion
Navicula
Nitzchia
Pinnularia
Rhoicosphenia
Stauroneis
Surirella
Synedra
Cyanophyta (3)
Lyngbya
Merismopedia
Oscillatoria
Total 27 Genera

Table B-8. Larger aquatic invertebrates (except mollusks) encountered in the early 1980s at Fountain Creek at Tennessee Route 50A (Creek Mile 13.3). Data from Etnier, et al. (1983).

Platyhelminthes (1)
Planariidae
Nematoda (1)
Oligochaeta (4)
Lumbriculus
Oligochaeta
Pelescolex
Tubificidae
Hirudinea (1)
Glossiphoniidae
Crustacea (4)
Decapoda
Gammarus
Orconectes mirus
Orconectes placidus
Arachnoidea (1)
Hydracarina
Plecoptera (3)
Neoperla clymene
Neophasganophora
Perlesta placida
Odonata (18)
Argia
Basiaeshna janata
Boyeria vinosa
Calopteryx maculata
Chromagrion
Didymops transversa
Dromogomphus spinosus
Enallagma
Gomphurus vastas
Gomphus lividus
Gomphus quadricolor
Hagenius brevistylus
Ischnura
Lathus
Macromia
Macromia georgiana
Macromia illinoiensis
Neurocordylia yamaskanensis
Ephemeroptera (14)
Baetis
Caenis
Choroterpes hubbeli
Coroterpes
Heptagenia
Hexagenia
Isonychia
Leptophlebia
Neocloeon
Paraleptophlebia
Stenacron
Stenonema femoratum
Stenonema mediopunctatum
Tricorythodes
Hemiptera (6)
Gerris
Rhagovelia
Rheumatobates rileyi
Rheumatobates tenuipes
Rheumatobates trulliger
Trepobates pictus
Trichoptera (12)
Brachycentrus
Cheumatopsyche
Cheumatopsyche petiiti
Chimarra
Helicopsyche
Helicopsyche borealis
Hydropsyche
Hyroptila gunda
Hydroptila waubesiana
Mystacides septulchralis
Oecetis
Polycentropus

Table B-8 (Continued)

Megaloptera (2)
Corydalus cornutus
Sialis
Lepidoptera (1)
Petrophila
Diptera (25)
Antocha
Chironomidae
Cladotanytarsus
Conchapelopsis
Cricotopus
Cricotopus bicinctus
Cryptochironomus fulvus
Empididae
Eriocera
Hexatoma
Limnophora
Micropsectra
Microtendipes
Nioltanypus
Parametriocnemus lundbecki
Phaenopsectra obediens
Polypedilum convictum
Polypedilum halteralis
Polypedilum illinoense
Simulidae
Stenochironomus
Tabanus
Tanytarsus
Tendipedidae
Thienemanniella

Coleoptera (17)
Cyphon
Dubiraphia
Dinetus
Dinetus discolor
Estopria nervosa
Helichus
Hydroporus
Macronychus glabratus
Microcylleopus pusillus
Optioservus
Pletodytes
Psephenus
Psephenus herricki
Sperchopsis tessellatus
Stenelmis
Stenelmis sexlineata
Tropisternus lateralis

Total Taxa 110

Table B-9. Freshwater mussels found alive or as fresh shells in Poplar Creek, Greenlick Creek, and two sites in the Duck River, Maury County, TN, June 23 and 24, 1999.

Scientific Name	Common Name	Poplar Creek	Greenlick Creek	Duck River	
		Foster Chapel Road	TN 50 Bridge	Kettle Mills DRM 104	Williamsport DRM 116
Gastropoda	**Aquatic Snails (4)**		**(1)**	**(3)**	**NS**
Anculosa praerosa	Onyx rocksnail			X	
Elimia sp.	Elimia		X		
Lithasia sp.	Rocksnails			X	
Pleurocera canaliculata	Silty hornsnail			X	
Bivalvia	**Mussels and Clams**			**(10)**	**(21)**
Anodonta grandis	Giant floater				X
Anodonta imbecillis	Paper pondshell				X
Arcidens confargosus	Rock pocketbook				X
Cyclonaias tuberculata	Purple watryback				X
Fusconaia ebena	Ebonyshell				X
Lampsilis fasciola	Wavy-rayed lampmussel			X	X
Lampsilis ovata	Pocketbook			X	X
Lampsilis teres	Yellow sandshell			X	X
Lasmigona costata	White heelsplitter				X
Leptodea fragilis	Fragile papershell			X	X
Lexingtonia dolabelloides	Slabside pearlymussel				X
Ligumia recta	Black sandshell			X	X
Megalonaias nervosa	Washboard			X	
Obliquaria reflexa	Threehorn wartyback			X	X
Potamilus alatlus	Pink heelsplitter			X	X
Ptychobranchusfasciolaris	Kidneyshell				X
Quadrula pustulosa	Pimpleback				X
Quadrula quadrula	Mapleleaf				X
Strophitus undulatus	Squawfoot				X
Tritogonia verrucosa	Pistolgrip			X	X
Truncilla truncata	Deertoe				X
Villosa vanuxemensis	Mountain creekshell			X	X
Corbicula manilensis	Asiatic clam		X	X	X
Mollusk Taxa Total		**0**	**2**	**14**	**22+**

NS - Not sampled

Table B-10. List of fish species found in Greenlick Creek, Poplar Creek, and two sites in the Duck River, Maury County, TN, June 23-24, 1999.

Scientific name	Common Name	Poplar Creek	Greenlick Creek	Duck River	
		Foster Chapel Road	TN 50 Bridge	Kettle Mills DRM 104	Williamsport DRM 116
Lepisosteidae	**Gars (1)**			**(1)**	**(1)**
Lepisosteus osseus	Longnose Gar			X	X
Clupeidae	**Herrings (1)**			**(1)**	**(1)**
Dorosoma cepedianum	Gizzard shad			X	X
Cyprinidae	**Minnows (21)**	**(5)**	**(8)**	**(13)**	**(15)**
Campostoma oligolepis	Largescale stoneroller	X	X	X	X
Clinostomus funduloides	Rosyside dace	X	X		
Cyprinella galactura	Whitetail shiner	X		X	X
Cyprinella spiloptera	Spotfin shiner			X	X
Cyprinella whipplei	Steelcolor shiner			X	X
Erimystax dissimilis	Streamlined chub			X	X
Erimystax insignis	Blotched chub			X	X
Hybopsis amblops	Bigeye chub			X	X
Luxilus chrysocephalus	Striped shiner	X	X	X	X
Lythrurus ardens	Rosefin shiner		X		
Notropis atherinoides	Emerald shiner				X
Notropis photogenis	Silver shiner			X	
Notropis rubellus	Rosyface shiner			X	X
Notropis telescopus	Telescope shiner			X	X
Notropis volucellus	Mimic shiner			X	X
Notropis sp.	Sawfin shiner				X
Phoxinus erythrogaster	Southern redbelly dace	X			
Pimephales notatus	Bluntnose minnow	X			
Pimephales vigilax	Bullhead minnow			X	X
Rhinichthys atratulus	Blacknose dace	X			
Semotilis atromaculatus	Creek chub	X	X		X
Catostomidae	**Suckers (9)**	**(2)**	**(1)**	**(8)**	**(9)**
Hypentelium nigricans	Northern hog sucker	X	X	X	X
Ictiobus bubalus	Smallmouth buffalo			X	X
Ictiobus niger	Black buffalo			X	X
Minytrema melanops	Spotted sucker				X
Moxostoma anisurum	Silver redhorse			X	X
Moxostoma carinatum	River redhorse			X	X
Moxostoma duquesnei	Black redhorse			X	X
Moxostoma erythrurum	Golden redhorse		X	X	X
Moxostoma macrolepidotum	Shorthead redhorse			X	X
Ictaluridae	**Catfishes (5)**	**(1)**	**(1)**	**(2)**	**(3)**
Ameiurus natalis	Yellow bullhead	X			
Ictalurus furcatus	Blue catfish				

Table B-10 (Continued)

Scientific Name	Common Name	Poplar Creek	Greenlick Creek	Duck River	
		Foster Chapel Road	TN 50 Bridge	Kettle Mills DRM 104	Williamsport DRM 116
Ictalurus punctatus	Channel catfish		X	X	X
Noturus eleutherus	Mountain madtom			X	X
Pylodictis olivaris	Flathead catfish				X
Fundulidae	**Topminnows (2)**	**(1)**		**(2)**	
Fundulus catenatus	Northern studfish	X		X	
Fundulus olivaceus	Blackspot topminnow			X	
Poeciliidae	**Livebearers (1)**				**(1)**
Gambusia affinis	Western mosquitofish				X
Atherinidae	**Silversides (1)**				**(1)**
Labidesthes sicculus	Brook silverside				X
Cottidae	**Sculpins (1)**	**(1)**	**(1)**	**(1)**	**(1)**
Cottus carolinae	Banded sculpin	X	X	X	X
Moronidae	**Temperate basses (2)**				**(2)**
Morone chrysops	White bass				X
Morone saxatilis	Striped bass				X
Centrarchidae	**Sunfishes (7)**	**(2)**	**(4)**		
Ambloplites rupestris	Rock bass		X	X	X
Lepomis cyanellus	Green sunfish	X	X	X	X
Lepomis macrochirus	Bluegill	X	X	X	X
Lepomis megalotis	Longear sunfish		X	X	X
Micropterus dolomieu	Smallmouth bass			X	X
Micropterus punctulatus	Spotted bass			X	X
Micropterus salmoides	Largemouth bass			X	
Percidae	**Perches (15)**	**(5)**	**(3)**	**(10)**	**(9)**
Etheostoma aquale	Coppercheek darter			X	
Etheostoma blennioides	Greenside darter			X	X
Etheostoma caeruleum	Rainbow darter	X		X	
Etheostoma flabellare	Fantail darter	X	X		
Etheostoma flavum	Saffron darter	X	X		
Etheostoma luteovinctum	Redband darter	X			
Etheostoma nigripinne	Blackfin darter	X			
Etheostoma rufilineatum	Redline darter			X	X
Etheostoma simoterum	Snubnose darter			X	X
Etheostoma stigmaeum	Speckled darter				X
Etheostoma zonale	Banded darter			X	X
Percina caprodes	Logperch		X	X	X
Percina evides	Gilt darter			X	X
Percina phoxocephala	Slenderhead darter			X	X
Stizostedion canadense	Sauger			X	X
Sciaenidae	**Drums (1)**			**(1)**	**(1)**
Aplodinotus grunniens	Freshwater drum			X	X
Totals	**65 Species**	**19**	**16**	**46**	**50**

Table B-11. Freshwater mollusks (snails, mussels, and other bivalves) found in the Fountain Creek watershed within the last 30 years (since 1970). Information from Etnier, et al. (1983); and TVA unpublished data. Nomenclature follows Turgeon, et al. (1988).

Scientific Name	**Common Name**	**Fountain Creek Mi. 0.3**	**Fountain Creek Mi. 13.3**
Gastropoda	**Aquatic Snails**		**(4)**
Elimia laqueata	Panel elimia		X
Ferrissia sp.	Ancylid		X
Physella sp.	Physa		X
Planorbella sp.	Rams-horn		X
Bivalvia: Unionidae	**Native Mussels**	**(1)**	**(1)**
Lampsilis ovata	Pocketbook	X	
Corbicula manilensis	Asiatic clam		X
Sphaeriidae	Fingernail Clams	NS	
Mollusk Totals	**5**	**1**	**5**

Table B-12. Freshwater fishes encountered in the Fountain Creek watershed within the last 30 years (since 1970). Data from ARC (1995); Burr et al. (1993); Nieland (1982); Saylor and Ahlstedt (1993); and Scott and Gardner (1995); and TVA unpublished data.

Scientific Name	Common Name	FC #1	FC #2	Silver Creek	Hurricane Creek	S. Fk F C	Brush Creek
Clupeidae	**Herrings (1)**						
Dorosoma cepedianum	Gizzard shad		X				
Cyprinidae	**Minnows (15)**						
Campostoma oligolepis	Largescale stoneroller	X	X	X	X	X	X
Cyprinella galactura	Whitetail shiner		X		X		
Cyprinella spiloptera	Spotfin shiner	X	X		X		
Erimystax insignis	Blotched chub	X	X				
Hybopsis amblops	Bigeye chub		X				
Luxilus chrysocephalus	Striped shiner	X	X	X	X	X	X
Lythrurus ardens	Rosefin shiner		X	X	X	X	X
Lythrurus lirus	Mountain shiner	X	X				
Notropis ariommus	Popeye shiner						
Notropis boops	Bigeye shiner			X			
Notropis rubellus	Rosyface shiner						
Notropis telescopus	Telescope shiner	X	X			X	X
Notropis volucellus	Mimic shiner						
Pimephales notatus	Bluntnose minnow	X	X	X	X	X	X
Semotilus atromaculatus	Creek chub			X			
Catostomidae	**Suckers (6)**						
Catostomus commersoni	White sucker						
Hypentelium nigricans	Northern hog sucker	X	X			X	
Minytrema melanops	Spotted sucker						
Moxostoma duquesnei	Black redhorse	X	X			X	
Moxostoma erythrurum	Golden redhorse	X		X		X	
Moxostoma macrolepidotum	Shorthead redhorse						
Ictaluridae	**Catfishes (4)**						
Ameiurus melas	Black bullhead						
Ameiurus natalis	Yellow bullhead	X	X	X			
Noturus exilis	Slender madtom		X				
Noturus miurus	Brindled madtom						
Cyprinodontidae	**Topminnows (3)**						
Fundulus catenatus	Northern studfish	X	X	X	X	X	
Fundulus notatus	Blackstripe topminnow	X	X	X	X	X	X
Fundulus olivaceus	Blackspotted topminnow						

Table B-12 (Continued)

Scientific Name	Common Name	FC #1	FC #2	Silver Creek	Hurricane Creek	S. Fk. F C	Brush Creek
Poecilidae	**Livebearers (1)**						
Gambusia affinis	Western mosquitofish	X		X			
Athernidae	**Silversides (1)**						
Labidesthes sicculus	Brook silverside	X	X				
Cottidae	**Sculpins (1)**						
Cottus carolinae	Banded sculpin	X	X	X		X	
Centrarchidae	**Sunfishes (8)**						
Ambloplites rupestris	Rock bass		X				
Lepomis cyanellus	Green sunfish	X	X	X	X		
Lepomis gulosus	Warmouth						
Lepomis macrochirus	Bluegill	X	X			X	
Lepomis megalotis	Longear sunfish	X	X			X	
Micropterus dolomieu	Smallmouth bass		X				
Micropterus punctulatus	Spotted bass	X	X				X
Micropterus salmoides	Largemouth bass						
Percidae	**Perches (11)**						
Etheostoma aquali	Coppercheek darter	X	X				
Etheostoma blennioides	Greenside darter	X	X			X	
Etheostoma caeruleum	Rainbow darter	X	X				
Etheostoma crossopterum	Fringed darter	X	X	X	X	X	X
Etheostoma flabellare	Fantail darter	X	X	X	X	X	X
Etheostoma flavum	Saffron darter	X	X	X	X	X	X
Etheostoma luteovinctum	Redband darter			X			
Etheostoma rufilineatum	Redline darter	X	X				
Etheostoma simoterum	Snubnose darter	X	X				
Percina caprodes	Logperch		X				
Percina phoxocephala	Slenderhead darter						
Totals	**50**	**28**	**34**	**17**	**12**	**17**	**10**

Table B-13. Freshwater mussels found alive or as fresh shells in Flat Creek (three sites), Bedford County, TN, and East Fork Mulberry Creek, Moore County, TN, June 21 and 22, 1999.

Scientific name	Common Name	Flat Creek			East Fk. Mulberry Creek
		US 231	Old Center Church Road	New Center Church Road	TN 55 and TN 82 Bridges
Gastropoda	**Aquatic Snails**	**(2)**	**(2)**	**(1)**	
Elimia sp.	Elimia	X	X	X	
Lithasia sp.	Rocksnails	X			
Pleurocera canaliculata	Silty hornsnail		X		
Bivalvia	**Mussels and Clams**	**(3)**	**(1)**	**(4)**	
Fusconaia barnesiana	Tennessee pigtoe	X		X	
Medionidus conradicus	Cumberland moccasinshell	X	X	X	
Villosa iris spp.	Rainbows	X		X	
Villosa vanuxemensis	Mountain creekshell			X	
Corbicula manilensis	Asiatic clam	X			
Mollusks	**8 Species**	**6**	**3**	**5**	**0**

Table B-14. List of fish species found in Flat Creek (three sites), Bedford County, TN, and East Fork Mulberry Creek, Moore County, TN, June 21-22, 1999.

Scientific name	Common Name	Flat Creek			East Fk. Mulberry Creek
		US 231	Old Center Church Road	New Center Church Road	TN 55 and TN 82 Bridges
Cyprinidae	**Minnows (14)**	**(10)**	**(7)**	**(8)**	**(11)**
Campostoma oligolepis	Largescale stoneroller	X	X	X	X
Clinostomus funduloides	Rosyside dace				X
Cyprinella galactura	Whitetail shiner	X	X	X	X
Cyprinella spiloptera	Spotfin shiner	X		X	X
Cyprinus carpio	Common carp			X	
Hybopsis amblops	Bigeye chub	X	X	X	X
Luxilus chrysocephalus	Striped shiner	X	X	X	X
Lythrurus ardens	Rosefin shiner	X	X	X	X
Notropis boops	Bigeye shiner	X	X		
Notropis telescopus	Telescope shiner	X		X	X
Notropis volucellus	Mimic shiner				X
Phenacobius uranops	Stargazing minnow	X			
Pimephales notatus	Bluntnose minnow	X			X
Semotilis atromaculatus	Creek chub		X		X
Catostomidae	**Suckers (4)**	**(4)**	**(2)**	**(3)**	**(2)**
Hypentelium nigricans	Northern hog sucker	X	X	X	X
Moxostoma anisurum	Silver redhorse	X			
Moxostoma duquesnei	Black redhorse	X		X	
Moxostoma erythrurum	Golden redhorse	X	X	X	X
Ictaluridae	**Freshwater Catfishes(2)**	**(1)**	**(1)**		**(1)**
Ameiurus natalis	Yellow bullhead	X	X		
Noturus exilis	Slender madtom				X
Fundulidae	**Topminnows (1)**		**(1)**	**(1)**	**(1)**
Fundulus catenatus	Northern studfish		X	X	X
Poeciliidae	**Livebearers (1)**	**(1)**	**(1)**		
Gambusia affinis	Western mosquitofish	X	X		
Atherinidae	**Silversides (1)**		**(1)**		
Labidesthes sicculus	Brook silverside		X		
Cottidae	**Sculpins (1)**	**(1)**	**(1)**	**(1)**	**(1)**
Cottus carolinae	Banded sculpin	X	X	X	X
Centrarchidae	**Sunfishes (6)**	**(6)**	**(5)**	**(5)**	**(5)**
Ambloplites rupestris	Rock bass	X	X	X	X
Lepomis cyanellus	Green sunfish	X	X	X	X
Lepomis macrochirus	Bluegill	X	X	X	X
Lepomis megalotis	Longear sunfish	X	X	X	X
Micropterus dolomieu	Smallmouth bass	X			X
Micropterus punctulatus	Spotted bass	X	X	X	

Table B-14 (Continued)

Scientific name	Common Name	Flat Creek			East Fk Mulberry Creek
		US 231	Old Center Church Road	New Center Church Road	TN 55 and TN 82 Bridges
Percidae	**Perches (12)**	**(10)**	**(6)**	**(5)**	**(4)**
Etheostoma aquale	Coppercheek darter	X			
Etheostoma blennioides	Greenside darter	X	X	X	X
Etheostoma caeruleum	Rainbow darter	X	X	X	
Etheostoma cinereum	Ashy darter	X			
Etheostoma duryi	Black darter				X
Etheostoma flabellare	Fantail darter	X	X	X	X
Etheostoma flavum	Saffron darter	X	X	X	
Etheostoma nigripinne	Blackfin darter	X			X
Etheostoma rufilineatum	Redline darter	X			
Etheostoma simoterum	Snubnose darter	X	X	X	
Etheostoma stigmaeum	Speckled darter		X		
Etheostoma zonale	Banded darter	X			
Total	**42 Species**	**32**	**25**	**23**	**25**

APPENDIX C

Habitat and county occurrence information for the protected plant and animal species which could occur in areas affected by one or more of the action alternatives

Table C-1. Habitat and county occurrence information for the protected plant species which could occur in areas affected by one or more of the action alternatives. Occurrence data derived from TVA Regional Heritage database; habitat data provided by TVA staff specialists.

Scientific Name	Common Name	Typical Habitat	Federal Status	State Status	Maury County	Marshall County	Bedford County	Moore County	Coffee County
Agalinis pseudophylla	Purple gerardia *	Z		E					X
Amsonia tabernaemontana var. *gattingeri*	Blue star *	G, Z		S	X				
Anemone caroliniana	Carolina anemone	G, N		E			X		
Arenaria fontinalis	Sandwort	W		E-PT		X			
Asclepias hirtella	Green milkweed	G, N		S					X
Astragalus tennesseensis	Tennessee milk-vetch	G		S	X	X	X		
Aureolaria patula	False foxglove	F, M		T					X
Carex barrattii	Sedge *	W, Z		E					X
Carex buxbaumii	Sedge *	W, Z		S					X
Cerastium velutinum	Starry cerastium	G		PE	X				
Croton alabamensis	Alabama croton	F		E-P					X
Dalea foliosa	Leafy prairie-clover	G	E	E	X	X	X		
Drosera brevifolia	Sundew *	Z		T					X
Drosera capillaris	Sundew *	Z		T					X
Echinacea pallida	Pale purple coneflower	G, N		T					X
Eupatorium leucolepis	Justice weed	Z		E					X
Festuca paradoxa	Fescue *	W, Z		S					X
Fimbristylis puberula	Hairy fimbristylis	Z		T					X
Gaylussacia dumosa	Dwarf huckleberry	M, N		T					X
Gentiana puberulenta	Downy gentian	N		PE					X
Gymnopogon brevifolius	Beardgrass	N		S					X

Table C-1 (Continued)

Scientific Name	Common Name	Typical Habitat	Federal Status	State Status	Maury County	Marshall County	Bedford County	Moore County	Coffee County
Helianthus eggertii	Eggert's sunflower	H	T	T	X				X
Hieracium scabrum	Hawkweed *	M, N		T					X
Hydrastis canadensis	Goldenseal	M, G		S-C	X				X
Hypericum adpressum	Creeping St. John-wort	Z		T					X
Iris prismatica	Narrow blue flag	Z		T					X
Juncus brachycephalus	short-head rush	W, Z		S	X				
Lachnanthes caroliana	Red root	Z		E					X
Leavenworthia exigua var. *exigua*	Glade Cress *	G		E-P	X				
Leavenworthia exigua var. *lutea*	Pasture glade Cress	G		T	X	X	X		
Lespedeza angustifolia	Narrowleaf bush clover	N		T					
Lesquerella densipila	Duck River bladderpod	A		T	X	X	X		
Lesquerella globosa	Shorts bladderpod	F		PE	X				
Lilium michiganense	Michigan lily	M, H		T					X
Listera australis	Southern twayblade	B		E					X
Lobelia canbyi	Canby lobelia	B		T					X
Ludwigia sphaerocarpa	Globe-fruit ludwigia	B, Z		T					X
Lycopodiella alopecuroides	Foxtail clubmoss	Z		T					X
Lysimachia terrestris	Swamp loosestrife	B, Z		E					X
Mirabilis albida	Pale umbrella-wort	G, N		T	X				
Muhlenbergia torreyana	Torrey muhly	Z		E					X
Myriophyllum pinnatum	Water-millfoil *	R		T					X
Nestronia umbellula	Nestronia	M		E					X

Table C-1 (Continued)

Scientific Name	Common Name	Typical Habitat	Federal Status	State Status	Maury County	Marshall County	Bedford County	Moore County	Coffee County
Neviusia alabamensis	Snow-wreath	F		T				X	
Panax quinquefolius	Ginseng	M		S-C				X	X
Panicum acuminatum var. *leucothrix*	Panic-grass *	I		S					X
Panicum hemitomon	Maidencane	Z		S					X
Pedicularis lanceolata	Swamp lousewort	Z		T					X
Phlox pilosa ssp. *ozarkana*	Downy phlox	G		S	X				
Platanthera flava var. *flava*	Southern rein orchid	Z, B		S					X
Platanthera integra	Yellow fringeless orchid	Z		E					X
Platanthera nivea	Snowy orchid	Z		E					X
Pogonia ophioglossoides	Rose pogonia	Z		T					X
Polygala nuttallii	Nuttall milkwort	N		E					X
Prunus pumila	Dwarf cherry	Z		E-PT					X
Rhynchospora perplexa	Beakrush	Z		T					X
Sagittaria graminea	Grass-leaf arrowhead	B, Z		T					X
Schoenolirion croceum	Sunnybell *	G		T	X	X			
Schwalbea americana	Chaffseed *	Z	E	E-P					X
Scleria verticillata	Low nut-rush	Z		S					X
Silphium brachiatum	Rosinweed *	M		E		X			
Talinum calcaricum	Limestone fame-flower	G		S	X	X			X
Tofieldia racemosa	False asphodel	Z		E					X
Woodwardia virginica	Virginia chain-fern	Z		S					X
Xyris fimbriata	Fringed yellow-eyed-grass	Z		E					X

Table C-1 (Continued)

Scientific Name	Common Name	Typical Habitat	Federal Status	State Status	Maury County	Marshall County	Bedford County	Moore County	Coffee County
Xyris laxifolia var. *iridifolia*	Yellow-eyed-grass *	Z		S					X
Xyris tennesseensis	Yellow-eyed-grass *	Z, W	E	E					X
Zigadenus leimanthoides	Black snakeroot *	Z		T					X

Habitat Abbreviations:

A - Agricultural Areas, B - Bottomland Forests, C - Creeks, F - Bluffs and Cliffs, G - Cedar Glades, H - Thickets and Fencerows, J - Cedar Forests, M - Mixed Hardwoods, N - Barrens, R - Rivers, U - Caves, V - Reservoirs, W - Seepage Areas, and Z - Wet Meadows and Sandy Creeksides.

Status Abbreviations:

E - Endangered, E-P - Endangered but possibly extirpated, E-PT - Endangered but proposed for Threatened status, PE - proposed Endangered, S - Special Concern, S-C - Special Concern-commercially exploited, T - Threatened

Occurrence Abbreviations:

X - Known to occur in this county within the last 30 years,
X> - Not known from the parts of this county that could be affected by any of the action alternatives.

* = denotes common name for the genus; no common name is used of the individual species.

Table C-2. Habitat and county occurrence information for the protected animal species which could occur in areas affected by one or more of the action alternatives. Occurrence data derived from TVA Regional Heritage database; habitat data provided by TVA staff specialists.

Scientific Name	Common Name	Typical Habitat	Federal Status	State Status	Maury County	Marshall County	Bedford County	Moore County	Coffee County
Insects									
Gomphus sandrius	Tennessee clubtail dragonfly	C			X		X		
Pseudanophthalmus bendermani	Benderman's cave beetle	U			X				
Pseudanophthalmus tullahoma	Duck River cave beetle	U							X
Snails									
Leptoxis praerosa	Onyx rocksnail	CR			X	X	X		X
Leptoxis subglobosa umbilicata	Umbilicate rocksnail	CR							X
Lithasia duttoniana	Helmet rocksnail	CR			X	X	X		X
Lithasia geniculata	Ornate rocksnail	R			X	X	X		X
Lithasia geniculata fuliginosa	Geniculate riversnail	R			X		X		X
Lithasia geniculata pinguis	Small geniculate riversnail	C							X
Lithasia jayana	Rugose rocksnail	R			X		X		X
Lithasia lima	Warty rocksnail	CR						X	X
Lithasia salebrosa	Rustic rocksnail	R			X				
Lithasia verrucosa	Varicose rocksnail	R					X		
Polygyra auriformis	Rockpile liptooth								X>

Table C-2 (Continued)

Scientific Name	Common Name	Typical Habitat	Federal Status	State Status	Maury County	Marshall County	Bedford County	Moore County	Coffee County
Native Mussels									
Epioblasma brevidens	Cumberland combshell	R	E	E	X	X			
Epioblasma capsaeformis	Oyster mussel	R	E	E		X			
Epioblasma florentina florentina	Yellow-blossom pearlymussel	R	E	E	X		X		
Epioblasma torulosa torulosa	Tuberculed-blossom pearlymussel	R	E	E		X			
Epioblasma triquetra	Snuffbox	R			X	X			
Epioblasma turgidula	Turgid-blossom pearly mussel	R	E	E	X		X	X	X
Epioblasma walkeri	Tan riffleshell	R	E	E	X	X			
Fusconaia cor	Shiny pigtoe	R	E	E				X	
Hemistena lata	Cracking pearlymussel	R	E	E	X				
Lemiox rimosus	Birdwing pearlymussel	R	E	E	X	X			
Lexingtonia dolabelloides	Slabside pearlymussel	R			X	X	X	X	X
Medionidus conradicus	Cumberland moccasinshell	CR			X	X	X		
Obovaria subrotunda	Round hickorynut	R			X	X	X		
Plethobasus cooperianus	Orange-footed pearlymussel	R	E	E	X	X			
Pleurobema gibberum	Cumberland pigtoe	CR	E	E					X>
Pleurobema oviforme	Tennessee clubshell	R			X	X		X	X
Quadrula cylindrica cylindrica	Rabbitsfoot	R			X	X			
Quadrula intermedia	Cumberland monkeyface	R	E	E	X	X			
Toxolasma cylindrellus	Pale lilliput pearlymussel	C	E	E	X	X			X
Toxolasma lividum	Purple lilliput	CR			X				

Table C-2 (Continued)

Scientific Name	Common Name	Typical Habitat	Federal Status	State Status	Maury County	Marshall County	Bedford County	Moore County	Coffee County
Fishes									
Cycleptus elongatus	Blue sucker	R		T	X>				
Etheostom aquali	Coppercheek darter	R		T	X	X	X		X>
Etheostoma cincereum	Ashy darter	CR		D		X	X		
Etheostoma forbesi	Barrens darter	C		E					X>
Etheostoma luteovinctum	Redband darter	C		D	X	X	X		X
Etheostoma microlepidum	Finescale darter	R		D			X>		
Etheostoma striatulum	Striated darter	CR		D	X	X	X		X
Etheostoma denoncourti	Golden darter	R		D	X	X	X		
Fundulus julisia	Barrens topminnow	C		T					X>
Hemitrema flammea	Flame chub	C		D	X	X	X		X
Notropis rupestris	Bedrock shiner	C		D			X		
Noturus sp.	Duck River saddled madtom	CR		T	X	X	X		
Percina burtoni	Blotchside logperch	CR		D			X		X>
Percina macrocephala	Longhead darter	CR		T			X		X>
Percina phoxocephala	Slenderhead darter	R		D	X	X	X		
Typhilchthys subterraneus	Southern cavefish	U		D					X>
Amphibians									
Ambystoma talpoideum	Mole salamander	B		D					X
Cryptobranchus alleganiensis	Hellbender	CR		D	X		X		X
Hemidactylium scutatum	Four-toed salamander	BW		D					X
Hyla gratiosa	Barking treefrog	BC		D					X
Rana capito sevosa	Dusky gopher frog								X>
Gyrinophilus palleucus	Tennessee cave salamander	U>		T					

Table C-2 (Continued)

Scientific Name	Common Name	Typical Habitat	Federal Status	State Status	Maury County	Marshall County	Bedford County	Moore County	Coffee County
Reptile									
Pituophis melanoleucus melanoleucus	Northern pine snake	M		T					X
Birds									
Ammodramus henslowii	Henslow's sparrow	H							X>
Ammodramus savannarum	Grasshopper sparrow	AH		D	X		X		X
Haliaeetus leucocephalus	Bald eagle	RV	T	T					X
Ixobrychus exilis	Least bittern	RV		D	X>				
Tyto alba	Barn owl	AF		D					
Mammals									
Corynorhinus rafinesquii	Eastern big-eared bat	BF		D					
Lutra canadensis	River otter	RC		T		X			
Myotis grisescens	Gray bat	VR	E	E	X		X	X	
Myotis sodalis	Indiana bat	BM	E	E	X		X		
Neotoma magister	Eastern woodrat	FU		D	X		X		
Sorex cinereus	Common shrew	MC		D	X>				X>
Sorex fumeus	Smoky shrew	MC		D					X>
Sorex longirostris	Southeastern shrew	BH		D					X
Zapus hudsonius	Meadow jumping mouse	CH		D					X

Habitat Abbreviations:

A - Agricultural Areas, B - Bottomland Forests, C - Creeks and Springs, F - Bluffs and Cliffs, G - Cedar Glades, H - Thickets and Fencerows, J - Cedar Forests, M - Mixed Hardwoods, N - Barrens, R - Rivers, U - Caves, V - Reservoirs, and W - Seepage Areas.

Status Abbreviations:

D - Deemed in Need of Management, E - Endangered, T - Threatened

Occurrence Abbreviations:

X - Known to occur in this county within the last 30 years,

X> - Not known from the parts of this county that could be affected by any of the action alternatives.

APPENDIX D

Comments on the Columbia Area Water Supply EIS

Annotated Table of Contents

Section **Page**

Introduction **D-7**

Extensive Sets of Comments **D-8**
Sets of comments including ten or more specific and, often, different issues. The specific comments in these sets [identified in brackets] are addressed in the following sections with all of the other comments.

A - General and EIS Process **D-31**
Very general comments about the EIS process, how well the draft EIS accomplished its purposes, and other, largely, procedural comments.

B - Other General Topics **D-40**
Comments focused on issues which are not directly related to the specific purposes of this EIS.

C - Water Needs **D-45**
Comments focused on the need for additional water supply for the area, ways to meet that need, and who should address it.

D - Alternative A - No Action **D-52**
Comments related to taking no action to meet future water needs in the upper Duck River basin.

E - Alternative B - Fountain Creek Reservoir **D-53**
Comments focused on building a reservoir in the Fountain Creek watershed and issues associated with this possible project.

F - Alternative C - Downstream Water Intake **D-61**
Comments on the pros and cons of building a water supply intake downstream from Columbia.

G - Alternative D - Raise Normandy Pool Level **D-65**
Comments about raising the pool level on Normandy Reservoir and releasing more water from that dam to meet future needs near Columbia.

H - Alternative E - Tims Ford Pipeline **D-70**
Comments related to building an intake and pipeline on Tims Ford Reservoir to meet drought-related needs in the Columbia area.

I - Climate, Geology, and Soils **D-76**
A comment concerning the lack of geologic and soils work associated with the proposed reservoir in the Fountain Creek watershed.

J - Ground Water **D-77**
Comment related to the impacts of various alternatives on ground water in the affected areas.

K - Surface Water **D-78**
Comments related to water quality protection and specific water quality concepts which were or were not discussed in the draft EIS.

L - Aquatic Life **D-85**
Comments specific to aquatic life issues and the aquatic life content or evaluations in the draft EIS.

M - Wetlands **D-88**
Comments obviously focused on wetland issues and the content of the draft EIS on this subject.

N - Floodplains **D-90**
A comment concerning the effects of the alternatives on floodplains which would be affected.

P - Terrestrial Life **D-91**
A comment related to the effects of pipeline construction on wildlife, wildlife habitat, and their protection.

Q - Endangered and Threatened Species **D-92**
Comments about federal- and state-protected species, and the presentation of this information in the document.

R - Land Use **D-96**
Comments focused on the land which would be affected by one or more of the alternatives and the way that information is, or should be, presented in the EIS.

S - Visual, Recreation, & Natural Areas **D-99**
Mostly specific comments about the effects of raising the Normandy pool level on the Short Spring Natural Area.

T - Cultural Resources **D-101**
Comments associated with the identification and protection or archaeological and historical resources as presented in the draft EIS.

U - Socioeconomics **D-102**
Comments related to the economic growth projections used in the Needs Analysis and other economic issues.

V - Environmental Justice **D-105**
Comments clearly associated with equality toward all members of the local and regional communities.

Commenter Index **D-106**

Introduction

The draft Environmental Impact Statement (EIS) on Future Water Supply Needs in the Upper Duck River Basin was distributed in August 2000. Members of the public and interested agencies provided comments on the draft EIS at a public meeting held on September 28, 2000, or by surface or electronic mail. Most comments on the draft EIS were received by October 30; however, some comments continued to arrive into early November 2000.

TVA received a total of 80 sets of comments on this draft EIS, including individual letters, letters from organizations and agencies, and verbal comments delivered either at the main session of the public meeting or in an individual comment room. These sets of comments include input from 57 individuals, one federal agency, seven state agencies, three identified county and local government agencies, and eight other organizations. Most of these sets of comments focused on only one or just a few issues; however, a few sets included many issues. The six sets of comments addressing ten or more separate issues have been reprinted here (starting on page D-4) to help clarify the full scope of those reviews of the draft EIS.

TVA has reviewed all of these sets of comments, has identified specific comments about the EIS contained in each of them, and has associated similar comments to produce the following list of 301 separate comments, each of which still identifies its original source(s). These comments are arranged in 21 sections, generally matching the major subject areas discussed in the EIS. Within each section, the comments are arranged with general issues first, then those for the subject action, then those opposed to it, followed by any alternative concepts. Usually simple comments are presented before longer ones, and basic comments are presented before complex ones. TVA staff have provided a response related to every comment, either individually or by clusters of clearly-related comments.

TVA and the cooperating agencies sincerely appreciate the time and thought a number of people have applied to the review of the draft EIS. Several concepts presented in these comments have been used to improve the content of the final EIS. These comments also will help the Duck River Agency and other local interests as they begin to make detailed decisions about how to meet future water needs of the upper Duck River basin.

Columbia Water Supply EIS Log Number 33
Environmental Science Graduate Students, University of Tennessee at Chattanooga

October 19, 2000

Linda B Oxendine
Tennessee Valley Authority
400 W Summit Hill Drive
Mailstop: WT 8C-K
Knoxville, Tennessee 37902

RE; DEIS - Future Water Supply Needs in the Upper Duck River Basin

Dear Ms. Oxendine,

Several Graduate Students of Environmental Science have reviewed the reference Draft Environmental Impact Statement (DEIS) and offer the following comments.

This letter is in opposition to all the alternatives proposed in your Draft Environmental Impact Statement on the Future Water Supply Needs in the Upper Duck River Basin We regard the proposed alternatives as a highly undesirable course of action for several reasons. However, if any of the proposed alternatives must be chosen we support Alternative C: Downstream Water Intake. **[F14]** Included below are our comments in addition to our criticisms in reference to Alternative C. Lastly. we recommend our own Alternative which was not considered in the DEIS

Section 5.2 Climate, Geology, and Soils

Adoption of Alternative C entails the development of a 13-mile pipeline and the subsequent construction of its downstream Duck River booster station. The sinkholes and caves at this venue often form delicate conduits or natural water pipes. There are concerns that during construction the sinkholes and caves may be impacted. Such impacts during construction might involve irreversible collapsing of the fragile karst topography quite possibly increasing the likelihood of ground water contamination. **[J2]**

The soils that are present in the Duck River area range from well to moderately well drained silty/loamy soils to highly acidic and low nutrient content soils. The silty/loamy soils are productive for a variety of different crops and considered prime farmland. Grazing cattle frequently use such soils. The economic cost of changing the land use of these yew productive agricultural areas merits further investigations before implementing Alternative C. **[R2]**

Section 5.3 - 5.4 Ground and Surface Water

From a water-quality point of view, we believe Alternative C will have the Least Minimal Impact (LMI) on water quality from both the natural reservoir and the reservoir Construction area is minimal and does not run the risk of contaminating water from exposed soil runoff or wiping out entire communities of organisms. The amount of water transferred is sufficiently small enough, greatly reducing the risk of affecting nutrient cycling and thermal stratification or the lowered dissolved oxygen levels within certain population parameters. **[K15]**

On the other hand, Alternative B will have the greatest effects on the quality of surface and ground water. The large area necessary for construction will have adverse effects on a complex array of aquatic ecosystems For example, by destroying undetermined species within the large non-surveyed areas, we cannot be certain of the impacts that one or perhaps three or four species disappearance would have on the system as a whole. **[L2]**

The extraction of soils necessary for construction would subject the nearby waters to high amounts of dissolved metals, petroleum and organic acids that have been long since trapped within the soils. This contamination could effectively lower the pH, possibly affecting nearby ground water tables. In addition, increased amounts of freshly killed plant matter and the introduction of carbon rich humus into the heterogeneous waters may cause many species of heterotrophic bacteria to bloom. Collectively, potential effects of lowering the dissolved oxygen content in the reservoir as well as increasing the chance for an outbreak of dangerous bacteria such as *Cryptosporidium* sp., *E coli* and other fecal coliform merits further rejection of Alternative B. **[K11]**

The modification of introducing cold oxygen depleted bottom water into the system will possibly further deplete the dissolved oxygen - possibly disrupting the complex thermal stratification layers in the water. Such a disruption could also interfere with nutrient cycling - a necessity for all life in aquatic systems. Accurate impact assessments dealing with such intricately complex cycles and oxygen depletion effects (often exponential) in Alternative B should be approached with caution. **[K9]**

Additionally, many bivalent metal ions tend to dissolve out of solution and into the soils over time However. a lowered pH and depleted dissolved oxygen will cause many metals (calcium, manganese, etc) to dissolve back into the water. This alone can have a hazardous effect upon humans via primary ingestion, secondary, ingestion or prolonged contact. **[K10]**

These reasons alone brand Alternative B unacceptable because of its effects on water quality. The issue is not just the previously elucidated factors that present danger or caution, but the infinite unforeseeable factors that may cause the greatest damage.

Section 5.5 Aquatic Life

There appear to be few impacts on the aquatic fauna associated with the adoption of Alternative C. Of the alternatives suggested by TVA, Alternatives C and E appear to be the most reasonable alternatives concerning aquatic life. Due to the relatively low amount of water that is being withdrawn from the proposed site in Alternative C, few negative effects would be likely. Sedimentation from construction could present localized problems in terms of disturbing habitats of benthic and lithophilic species, especially certain percid and cyprind fishes which utilize these habitats for spawning (12 darter species and 16 shiner/chub species). **[L4]**

Additionally, there is concern that the project may pose some localized threats to the mollusk fauna, as they too are sensitive to sedimentation from construction activities Fortunately, the mollusk fauna at the potential withdrawal site (RM 104) does not contain some of the more sensitive mussel species *(Epioblasma* sp., *Lemiox* sp.). However, little or no survey data concerning the gastropod fauna from this rcach is available. Given the presence of an endemic gastropod in the Duck River system *(Lithasia genticulata),* and the rich species diversity present in the Duck, it is incumbent on TVA to conduct a gastropod inventory in this proposed withdrawal area. TVA needs to be aware of what aquatic fauna is to be reasonably affected by a withdrawal station. **[L5]**

Section 5.6 Wetlands

As previously stated in the DE1S, the implementation of Alternative C would have short-term minor effects on some known wetlands. The minor effects are further defined as probable minimal construction effects in the DEIS. The severity of the minor short-term effects is apparently dependent on the proper siting, design, and construction of the contiguous facilities. Long-term effects and net loss or total displacement assessments for those wetlands are not adequately addressed in the DEIS. The issues below merit investigations before selection of Alternative C, albeit it is the nominee. The wetlands in peril need proper denotations as either forested and scrub-shrub type or emergent type wetlands. **[M1]** Furthermore, a vascular and non-vascular inventory for endangered or threatened species is appropriate if not imperative. **[Q2]**

Section 5.7 Flood Plains

Since the purpose of this project is to supply water, the pipeline and the intake will have to be constructed in the flood plain because there is no other feasible alternative. This will cause some disruption to the areas around the construction of the pipeline, but if the disturbed areas are reverted back to their natural state there should not be any long term effects. The route chosen for the pipeline would take it across numerous streams. It is at these points that it will be crucial for the construction of the pipeline to follow best management practices to minimize the impacts of the crossings. The pipelines will also have to be constructed in a way to make them able to withstand flood like conditions and to comply with the National Flood Insurance Act.

Alternative C would effect only small areas during construction, but without any major impacts. There would be no change in the climate or the general characteristics of the geology of the Duck River area. The effects upon the soils and the flood plain will be negligible. **[N1]**

Section 5.8 Terrestrial Life

Given the length of the proposed pipeline (13 miles), certain species could be affected either by directly disturbing habitat or through disturbance of foraging ability, nesting, etc. Attention to sensitive species (such as the Indiana Gray Bat) should be considered. **[Q1]** Most importantly to consider are habitat fragmentation effects associated with a pipeline right-of-way. This would have the potential to destroy underground nests/burrows of terrestrial species and potentially impact a species metapopulation. TVA should address potential impact areas for whatever terrestrial species are located there, and provide some attempt to relocate species that most likely affected by pipeline construction. Additionally, TVA should investigate the possibility of co-locating the proposed pipeline in existing right-of-ways. **[P1]**

Section 5.9 Endangered and Threatened Species

Considering endangered or otherwise protected vascular plant species of Tennessee, the DEIS methodology of determining the potential for a protected species to occur in any of the Upper Duck River Basin alternative project areas is unacceptable. Furthermore, simply stating the likelihood of a protected species occurring in an affected area as either 'yes' or 'no' is also unacceptable. For example, *Helianthus eggertii* occurs in nine (not eight) Tennessee counties (Chester, E W, Wofford, B E., and Robert Kral, 1997. *Atlas of Tennessee Vascular Plants'.* Volume 2 Angiosperms: Dicets Miscellaneous Publication Number 13. The Center for Field Biology, Austin Peay University. Clarksville, Tennessee. 238 pp.). This composite, as noted in the DEIS, occurs approximately twelve miles SW of Columbia in Maury County. As stated in the DEIS, *H. eggertii* is not known to occur in the Central Basin Physiographic Province of Tennessee. However, significant portions of Maury, Bedford, and Davidson Counties each with a site record of the composite subsequently occur in the Central Basin Physiographic Province (Chester), including the station at Maury County. This alone establishes that the protected plant is not associated exclusively with the Highland Rim Provinces (East and West). Six counties in the Eastern and Western Highland Rim Provinces support *H. eggertii* (Chester *et al.*, 1997), not including the station at Coffee County as stated in the DEIS. Three of the nine known and documented Tennessee stations of the composite are supported in the Central Basin Province contradictory to statements issued in the DEIS. **[Q11]**

Considering that three of the populations occur in the Highland Rim Province and more importantly three in the Central Basin Province, should not a complete vascular plant inventory be conducted before any alternative is implemented? Although surveys were conducted on Columbia Project Lands. their methodologies are poorly if at all delineated in the DEIS - merely stated as extensive surveys were conducted. Did the surveys intend to find only *H. eggertii* or *all* the states listed and federal species? How is an extensive survey defined? Complete vascular inventories should entail a systematic collection within all affected areas, not merely probable habitats. Sampling should run through two growing

seasons depending on the area and number of habitats and documentation of specimens (voucher specimens if applicable for protected species or even pictures) and their respective locations should all be obtainable by the public. Furthermore, extensive surveys are not tantamount to baseline inventories. Surely, a single voucher specimen for every vascular plant encountered was collected and identified in the Columbia Project Lands area. If not, how can the species probability or likelihood of occurrence be stated with any confidence? **[Q12]**

Lastly, *Schwalbea americana* and *Xyris tennesseensis* found in Coffee and Lewis Counties respectively are both considered not potentially affected or likely to occur in any of the alternative project areas These assumptions are based on an 1879 site record and an eight-mile separation from a proposed alternative project area. The issue here does not concern itself with tangible distances and uncommonly intermittent records, or even distributions amongst physiographic provinces of protected plants near probable affected areas. But simply how can statements in the DEIS be made concerning the potential or likelihood *of at least* sixty-eight protected species occurring in alternative areas without a complete baseline vascular plant inventories. **[Q7]**

Section 5.10 Land Use

Alternative C would only have short-term adverse effects on land use, primarily because the location and construction of the pipeline, intake, and booster station can be adjusted so as to minimize their effects on prime farmland and other uses of the land in the area. Due to its minimum requirements for land (estimated to be 2 acres plus 130 acres of easement for the pipeline), this alternative is preferred over Alternative B which would require the disturbance of 3,600 acres of land. **[R1]**

Section 5.11 Recreation

Alternative C would have only a minimum impact upon the recreational use of the Duck River - and for only a brief period of time Only a very small (< 1 acre) would be required for the intake structure Also, neither the presence nor operation of the underground pipeline would negatively impact the recreational use of this river. **[S1]**

Section 5.12 Cultural Resources

When compared with Alternative E (requiring a 20-mile-long pipeline), and Alternative B (requiring the disturbance of 3,600 acres), Alternative C would only disturb a small amount of Land Therefore, assuming that the potential cultural resources are evenly distributed, the Alternative C would have the least impact on any existing cultural resources. In addition, after the site/route is reviewed by the Tennessee State Historic Preservation Office, the pipeline construction could be adjusted to minimize further disturbance to cultural resources under this alternative. **[T1]**

Section 5.13 - 5.18

Alternative C has some unavoidable adverse impacts which include the construction of 13 miles of pipeline and localized short-term impacts on aquatic, terrestrial, and cultural resources. It also has some irreversible and irretrievable resource commitments to build the intakes, pumping stations, and pipelines. There will be long-term commitments of around 10 acres of land for the intake and pumping facilities, and short-term use of the land surface along the routes of the pipelines.

However, an alternative that we feel would best fit this project was not considered. This alternative is as follows:

Alternative Not Considered

Given the potential serious impacts on aquatic fauna in several proposed alternatives, TVA is strongly urged to completely disregard Alternative B and D, and consider the possibility of constructing an offshore reservoir Page 58 of the DEIS stated that

this alternative was "adequately represented by the Fountain Creek Reservoir alternative" . However, our proposed alternative represents an entirely different scope than a tributary reservoir. TVA should not consider these alternatives to be the same.

Given the number of federally listed aquatic species in the Duck River system, and the relatively common nature of many of the terrestrial plants and animals, it makes much more sense to limit impacts to an offshore site. Impacts with this sort of alternative would likely only affect plant communities in the area. Since TVA has purchased the rights to 3,800 acres of land within the Fountain Creek watershed, surely a parcel of land exists where few sensitive plant or animal communities exist, or where these effects would be minimal. This alternative would preserve the biotic integrity of the aquatic fauna of the Fountain Creek system (182 spp.).

Additionally, this alternative could adequately meet water supply needs if the containment reservoir was built to accommodate a large volume of water (ca. I billion gallons). Such a reservoir allowed to fill slowly would minimize cubic feet per second (cfs) removal effects if the water withdrawal area were around Duck River Mile 140-200. Furthermore, this alternative could allow construction of the reservoir near the river (within a few miles), therefore eliminating the need for a 10-20 mile pipeline.

TVA should strongly consider including this alternative in their potential revisions or attachments to the DEIS. **[A25]** Besides Alternative C and E, this alternative would pose the least threat to the aquatic fauna

Sincerely,

Graduate Students - Environmental Science
University of Tennessee at Chattanooga

Columbia Water Supply EIS Log Number 43
Justin P. Wilson, Deputy to the Governor of Tennessee

October 20, 2000

Ms. Linda Oxendine
Draft EIS-Upper Duck River Basin
400 West Summit Hill Drive, WT 8C
Knoxville, Tennessee 37902

Dear Ms. Oxendine:

As the Governor's Lead Contact for State of Tennessee, National Environmental Policy Act (NEPA) reviews, I am providing comments in response to the Draft Environmental Impact Statement (DEIS), Future Water Supply Needs in the Upper Duck River Basin, August 2000. The attached comments from state agencies represent the complete and official response of the State of Tennessee. Please give these comments your full consideration.

A variety of unresolved issues and unmet obligations remained after the closure of the Columbia Dam project. First and foremost of these is the need to resolve the long-term water supply needs of the Upper Duck River Basin. In **Governor Don Sundquist's view, clean and dependable water for the Columbia region is as fundamental to the economic growth of the region as is dependable, low-cost electricity. This is the State's overriding concern. [C1]**

As we stated in our letter dated March 7, 1997 concerning the closure of the Columbia project, "The TVA should verify existing public water supply sources or finance new supplies at levels that meet local long-range water supply needs as defined by the Regional Water Supply Analysis for Southern Williamson, Marshall and Maury Counties or by the State." We also stated, "Although local interests have shared responsibility to support water supplies, the larger burden to verify or produce dependable water supplies is TVA's alone." These assertions remain true.

TVA's water analysis seriously examines regional water supply needs. It is a responsible effort to meet your obligations to the people of the Upper Duck River region. **[A10]**

The draft identifies a variety of alternatives ranging from a traditional impoundment, pipeline options and a dam improvement alternative. A single alternative or combination of options can provide water well into the future.

One or more of the alternatives addressed by the EIS may provide a long-term and reliable source of water. **[A19]** The following summarizes our view of the alternatives evaluated.

- The Fountain Creek Dam Alternative is fraught with both opportunity and limitations. This alternative appears to provide an adequate water supply. The Columbia Dam land use EIS, associated deed restrictions and agency agreements provide for environmental mitigation. Other permit issues must be resolved before project approval. Moreover, reservoir's shallow nature creates challenges for water quality. In no event, however, should the Fountain Creek Dam alternative be abandoned until provisions have been made for an adequate water supply through 2050. **[E29]**

- Based on information provided by the EIS, the Tennessee Department of Environment and Conservation's Division of Water Supply states that the Tim's Ford pipeline alternative provides the highest quantity and quality water. This alternative may also provide benefits to other communities along its route who face increasing water needs. **[H2]**

- Raising Normandy Dam has additional benefits independent of the water needs identified in this study. **[G22]**

The assumptions and conclusions in this document would be more complete if they included additional information and assessment. State agencies have identified a variety of concerns that may add greater clarity to future decisions, The following should be incorporated into the final draft:

- We do not accept the premise in the Draft EIS that there will be no growth in "new large, water consuming industries." The Tennessee Department of Economic and Community Development believes that industrial growth will be critical to the future growth of the region. **[U1]**

- Additional consideration of low-flow impacts from implementation of Alternative C, the pipeline to downstream reaches of the Duck River, should be further evaluated and discussed. All impacts should be weighed and assessed to contrast each alternative fully. **[F15]**

- Broader benefits provided by the Normandy reservoir option to increase flow in the Duck River and the potential for mitigation measures to protect Short Springs Natural Area should be documented in the EIS. **[S2]**

- The Summary Comparison Table 6 on page 60 should also document a brief summary of natural and environmental impacts since environmental permit issues will be a major consideration in balancing benefits with impacts. **[A18]**

Although it is not a specific part of this analysis, we commended TVA for meeting another state criteria to resolve its obligations for water. The setting aside of locally derived trust funds for regional water supply projects represents sound judgment and necessary fairness. These funds can play a significant role in the funding of an alternative addressed in the EIS. **[B14]**

Ultimately, the decision to make a proposal to replace the water that would have been provided by the Columbia dam and to offer it for federal and state permits resides with the community. The TVA has acted responsibly and prudently to aid the community to make the necessary decisions. We commend your leadership and offer our assistance for a final resolution. **[B9]**

Sincerely,

Justin P. Wilson
Deputy to the Governor

Attachments

Columbia Water Supply EIS Log Number 51
U. S. Environmental Protection Agency

October 26, 2000

Dr. Linda Oxendine
Tennessee Valley Authority
400 West Summit Hill Drive, WT 8C
Knoxville, TN 37902

EPA NEPA Comments on TVA DEIS for the "Future Water Supply Needs in the Upper Duck River Basin;" Bedford, Marshall, Maury and Williamson Counties, Tennessee; CEQ No. 000315

Dear Dr. Oxendine:

Consistent with Section 102(2)(C) of the National Environmental Policy Act (NEPA) and Section 309(a) of the Clean Air Act, the U.S. Environmental Protection Agency (EPA) has reviewed thc referenced Tennessee Valley Authority (TVA) Draft Environmental Impact Statement (DEIS) on various future water supply alternatives for the area.

The purpose of the DEIS is to: 1) determine the need for additional water supply in the Duck River watershed over the next 50 years for Bedford, Marshall, Maury and southern Williamson County, 2) identification of ways to meet any determined water needs, and 3) environmental and societal impacts associated with those ways of meeting any water needs.

We offer the following comments for TVA's consideration in the development of the Final ElS (FEIS):

NEPA Process - As suggested on page 1, the EIS is written much like a programmatic EIS since it generically explores a need for additional water supplies and leaves site-specific plans for the future. For example, the reservoir management plan for the Fountain Creek Reservoir alternative (B) was not developed, the environmental impacts of the new water treatment plant for the downstream intake alternative (C) were not included in the impact analysis, and the pipeline impacts for Alternatives C, E and B were also not disclosed. Page 39 also states that "TVA is not proposing to design or construct any of these facilities" and "[i]n this EIS, these action alternatives have been generally described in light of their conceptual nature at this early stage." Page 1 further states that "..., several of the alternatives would not have to be built for a number of years." While EPA agrees with the concept and need for programmatic EISs that are followed by site-specific NEPA documents, our concern is that this EIS was not titled as a programmatic EIS. This should be discussed. **[A13]**

It should also be noted that if the present EIS is not a programmatic EIS but rather is an action EIS, construction of the preferred alternative would need to be initiated within five years or a re-evaluation of impacts would be needed, If impacts were determined at that time to be significantly different, a supplemental EIS would be needed if the project was pursued. **[A14]**

Consistent with the *Federal Register,* public comments are due to TVA by 10/30/00 as opposed to the 10/20/00 date stated on the DEIS cover page. Accordingly, we recommend that TVA receive comments postmarked by the 10/30/00 date. **[A17]**

Purpose & Need - Although there seems to be a perceived need by some of the locals (pg. 10) for additional water supplies in the watershed, the actual need seems unjustified at this time for the Bedford and Marshall County service area through 2050, based on the needs analysis in the *DEIS.* However, for the Maury and southern Williamson County service area, water supply is expected to become a growing issue after 2015. The DEIS indicates (pg. 31) that by 2025 the unmet need would be 6 cfs (4 mgd), by 2035 it would be 14 cfs (9 mgd), and by 2050 it would be 22 cfs (14 mgd) beyond the 40 cfs available from the Normandy Reservoir. However, page 35 notes that "[t]hese amounts of water would be needed only during extended drought conditions, when demand was at its maximum and nearly all of the flow in the river was supplied by the minimum discharge from Normandy Dam." **[C9]**

The DEIS analyses assume that no new water-consuming industries were to site in the watershed and increase the water demands. In addition, it is somewhat unclear *if agricultural* needs were adequately included. Page 24 of the DEIS states that "[t]he amount of water withdrawn for agricultural irrigation is not known, but given the intensive agricultural land use in the three county area, significant amounts could be drawn during an extended drought." Similarly, page 25 states that the USGS, in their 1996 needs evaluation estimates, "...did not include any water for new, self-supplied industries or major expansions of agricultural water use in any of the three water service areas." The FEIS should further discuss agricultural needs and the potential for agricultural expansion and additional water-consuming industries siting in the area. **[V3]**

Given the apparent minimal immediate need for additional source water, the intended purpose of the reservoir may be more to enhance real estate and recreational value in the area more so (or rather than) creation of additional source water. If so, the focus of the EIS should be environmental impacts on actions associated with increased urbanization and residential sprawl into rural areas. **[A12]**

• **Alternatives -** In addition to the No (federal) Action Alternative (A), four action alternatives were considered: Fountain Creek Reservoir (B), Downstream Water Intake (C), Raise Normandy Reservoir Pool (D), and the Tims Ford Reservoir Pipeline (E). Alternative A would involve no new water supply although improvements of existing systems would proceed; Alternative B would involve construction of a new multipurpose reservoir on Fountain Creek near the confluence with Duck River; Alternative C would involve construction of a new water intake on the Duck River downstream of the confluence with Catheys Creek and include an associated 13-mile long pipeline (with a booster station) to a new water treatment plant; Alternative D would raise the pool of the existing Normandy Reservoir to augment flows in Duck River; and Alternative E would involve construction of a water intake in nearby Tims Ford Reservoir and include an associated 20-mile long pipeline to the Duck River (with a booster station) to augment river flows when needed. Overall, these alternatives would increase additional water volumes from none (A), to 16 cfs (D), to 22 cfs (E), to 46 cfs (C), to 74 cfs (B) and would meet perceived water needs until 2015 (A), 2035 (D), 2050 (E), or beyond 2050 (B and C). The most significant land use changes would be via construction of the Fountain Creek Reservoir (B) involving the clearcutting of some 225 acres of forested wetlands and flooding 2,200 acres of land at normal full pool as well as the construction of a short 5-mile long pipeline. The next most disruptive alternative would be raising the pool of Normandy Reservoir (D) some five feet involving loss of shoreline vegetation (including forested wetlands) and existing shoreline recreational amenities. Finally, the significant pipeline constructions associated with the water intakes for Alternatives C (13-mile pipeline) and E (20-mile pipeline) could be disruptive if environmental features within the ROW corridor are unavoidable. The No Action Alternative would involve only minor construction unless the existing water treatment plant were expanded to capacity (30.8 mgd), which seems likely. All action alternatives would increase Duck River flows at some point along the river and therefore increase downstream

wetted areas and benefit associated aquatic species. These alternatives would also allow maintenance of the minimum 100 cfs flows (at RM 132.8) required for the river system according to the TDEC.

From a practical perspective, implementation of the Fountain Creek Reservoir would utilize some 2,800 acres of the available Columbia lands previously acquired for the discontinued Columbia Dam and Reservoir. Such use would keep these lands in public ownership and under the direct purview of TVA. However, an additional 800 acres of land currently not in public ownership would need to be acquired for the reservoir. **[A16]**

· **Preferred Alternative** - No preferred alternative was selected by TVA in the DEIS, although TVA has indicated a non-preference for the No Action Alternative (A). While acceptable from a NEPA perspective and understandable in the sense that TVA and its cooperators might want additional public input before selecting a preferred alternative, we note that delaying the identification of TVA's selection until the FEIS stage is *late* in the NEPA process. At that stage, the public and resource agencies would not be able to comment on the preferred alternative until the FEIS comment period, which may or may not truly influence any modification of the preferred alternative and would reduce the probability of a different alternative being selected if the public so-requested. **[A24]**

EPA is not convinced that a water supply alternative is needed at this time for the area of concern, particularly the Bedford and Marshall County service areas. In regard to Maury and southern Williamson County, we believe the determined unmet need during droughts starting in 2015 through 2025 (4 mgd or 6 cfs) could and should be met through water conservation. The 2035 unmet need (9 mgd or 14 cfs) could arguably also be met through conservation. The unreel need for 2050 (14 mgd or 22 cfs), however, is approximately 50% above the 40 csf baseline Normandy flows, and therefore would likely require additional water supply. However, that need is many years away and would only apply during drought situations. As such, based on the DEIS, EPA believes the need for additional water supply is unfounded for the Bedford and Marshall Counties and can be met by conservation methods for some time (through approximately 2025 or 2035) for the Maury and southern Williamson Counties during droughts. At this time, therefore, EPA favors the No Action Alternative (A) for the near term. We recognize, however, the value of early planning for future needs in order to determine an adequate and environmental approach to additional source water. **[C10]**

If this approach is unacceptable to local water authorities or if additional agricultural or water-consuming interests can be expected to withdraw significant additional volumes from the Duck River, EPA recommends that the most environmental alternative be implemented by approximately 2025. Voluntary conservation methods should be encouraged and employed regardless of which alternative is selected, with incentives and disincentives should be provided by local authorities for complying customers. Conservation should target those activities that consume water (e.g., lawn watering) as opposed to those that return a large portion of the water to its source (e.g., wastewater). **[A31]**

Of the four presented action alternatives (B-E), EPA does not environmentally favor the construction of Fountain Creek Reservoir. This is due to the projected substantial loss of forested wetlands and uplands, potential ground-water effects due to local karstic geology, the potential for shoreline development and its associated impacts on water quality, the expectation for a small nutrient-rich reservoir with a slow flushing rate which may result in noncompliance with water quality standards associated with eutrophication, the potential for aquatic ecology effects downstream of the proposed dam due to reduced flows, the need to acquire an additional 800 acres of land, the uncertainty of the undocumented impacts of the new water treatment plant and associated five-mile long pipeline, and the existence of two nearby reservoirs (Normandy and Tims Ford) which might be utilized. **[E24]**

Conversely, however, we recognize that the Fountain Creek Reservoir would apparently become part of the TVA system and would therefore be managed by TVA, which has demonstrated significant expertise and success in reservoir management. **[E32]**

To help further assess the potential success or problems associated with the reservoir alternative, we suggest that water quality monitoring data for the nearby Normandy Reservoir (which by now has aged or equilibrated as a reservoir) be provided in the FEIS for comparison, to the extent the two reservoirs are similar. We have also enclosed an EPA Region 4 checklist *(EPA Section 404 Reservoir Review)* prepared by our wetlands section that should provide additional guidance in assessing potential reservoir projects. **[K9]**

The impacts of the remaining action alternatives (C, D & E) are uncertain since impacts of pipeline routes C & E) and specifics on treatment plants common to all action alternatives are not disclosed. **[A29]** Alternative E also proposed interbasin transfer of water from Tims Ford Reservoir to Duck Creek, with which there also could be some associated environmental issues. **[H23]** We recommend that a modification of Alternative E (which we name here as *Modified E)* be considered to the extent that it might be feasible. Modified E relates to the Tullahoma Wastewater Treatment Plant (Tullahoma) discussed on pages 152-153. Tullahoma purchases water from the Duck River Utility Commission which withdraws from the Normandy Reservoir. Tullahoma then discharges its treated wastewater into Rock Creek which is a tributary of the Elk River, which is connected to and drains into the Tims Ford Reservoir. As such, water is being removed from the Duck River system and discharged into Tims Ford and, with Alternative E, Tims Ford water is being withdrawn and discharged into the Duck River. We suggest that the potential for Tullahoma returning its Duck River water to Duck River as Modified E be explored. This would avoid interbasin transfer and the Tims Ford 20-mile pipeline (albeit, the logistics and volumes of Modified E are unclear and the need for a pipeline of uncertain length from Tullahoma to the Duck River exists). **[K26]** Given these considerations, our alternatives "preference" from most preferred to least is as follows: *A, Modified E (if feasible), C, E, D and B.* **[A30]**

· **Water Conservation** - The document fails to discuss water conservation as an alternative or supplement to the action or no action alternatives. Efficient use of existing supplies can save money, obviate the need for additional water storage capacity, and prolong the use of existing supplies during shortages. Successful implementation of water conservation measures depends on regulatory action by state and local governments and management decisions by the local utility. Typical measures are codes and ordinances that mandate water conservation through the use of plumbing fixtures, use of reclaimed water, installation of meters, leak detection programs, rate structure changes, and public education programs. As previously indicated, voluntary conservation methods should be encouraged and employed regardless of the alternative selected, with incentives and disincentives provided by local authorities for complying customers. Conservation should target those activities that consume water (e.g., lawn watering) as opposed to those that return a large portion of the water to its source (e.g., wastewater). **[C22]**

· Water Quality

* *Surface Water* - Page 147 indicates that the Fountain Creek watershed that would contain the reservoir proposed under Alternative B "...contains relatively high levels of nitrogen and phosphorus from natural sources as well as non-point sources." This page further states that "[t]hese levels of nutrients would be quite likely to support excessive algal growth in the upper layers of the reservoir." Page 149 similarly states that "...construction and use of the Fountain Creek water supply reservoir would create a relatively small, nutrient-rich reservoir which probably would have to be carefully monitored and the watershed strictly managed to protect the quality of the source water." Accordingly, EPA is concerned that the Fountain Creek Reservoir proposed under B could become eutrophic and not comply with the Clean Water Act. **[E23]**

As further discussed below under *Water Supply,* sediments and disinfection-by-products (THMs) have been a significant issue for the public water supply system currently using the Duck River as its source water. The source, effects and control of THMs should be discussed in the FEIS. **[K3]**

* *Ground Water* - The project area is generally karstic and as such has sinkholes and other natural conduits to the water table. Construction of a reservoir in these areas could promote contamination of ground water if the reservoir water quality and sediment quality becomes degraded and migrate into the water table. The DEIS mentions (pg. 142) the potential for grouting the bottom of the reservoir area during construction to prevent such interconnection. Special engineering methods would be needed in these karstic areas, particularly those involving excavation, low elevations, caves, and similar geologic features. The greatest potential for ground water impacts among the alternatives appears to be the construction of the reservoir. **[J1]**

· **Wetlands** - The greatest wetland losses are associated with B (reservoir) and D (raising Normandy pool). As previously indicated, B would result in the loss of some 225 acres of forested wetlands as well as the loss of the reach of Fountain Creek that would be inundated. It is unclear if perhaps other non-forested wetlands may also be lost within the 2,200 acres to be inundated for the reservoir (the FEIS should therefore total all the estimated jurisdictional wetlands that would be inundated by the reservoir). It should be noted that EPA considers both vegetated wetlands and creek water as wetlands, and water inundation of the reservoir wetlands and creek water is considered the same as filling wetlands with soil. **[M2]**

The 225 acres of wetlands were not precisely determined in the field but were estimated by aerial false-color infra-red photography. A jurisdictional determination of these wetland habitats needs to be made pursuant to Section 404/U.S. Army Corps of Engineer regulations. Following this determination, an avoidance or mitigation strategy should be provided. The mitigation strategies (pg. 163) indicated in the DEIS were general in nature and should be refined to indicate a more specific mitigation plan. Although not required, a draft mitigation plan should be included in the FEIS as well as a commitment to provide wetland compensation to the satisfaction of the resource agencies. **[M3]**

Implementation of Alternative D, which would raise the elevation of Normandy Reservoir by five feet, would result in the inundation of riparian vegetation including "...several forested wetlands that now occur at the upstream ends of some reservoir embayments" (pg. 164) as well as herbaceous fringe wetlands along the current Normandy shoreline. It is unclear what wetland losses or conversions may be associated with the pipeline alternatives C and E). The FEIS should be more specific as to the kind, quality and function of the wetlands that would be lost for each alternative. **[M4]**

Consistent with 404 (b)(l) guidelines, the loss of wetlands associated with B and D would need to be considered in the alternatives analysis, especially since other practicable alternatives with less wetland impacts exist. **[M5]**

· **Geotechnical and Soils** - EPA is concerned over the apparent lack of geotechnical studies in the document to determine the suitability of the site soils to hold water relative to the reservoir alternative (B). Local soils should ideally be relatively impermeable in order to retain desired water levels without creating zones of saturated soils adjacent to the project. Leakage and erosion of the proposed earthen dam are also a concern. The FEIS should contain estimates of impacts of water loss through the permeable parent soil materials that will make up the basin of the proposed reservoir. **[I1]**

· **Water Supply** - We offer the following comments and general questions regarding water supply:

* *Classified Uses:* We note from page 82 that: "The domestic water supply use classification is excluded in these areas because the State of Tennessee (TDEC) considers stream reaches immediately downstream from municipal wastewater discharges to be unsuitable for domestic water supply withdrawal." The state's criteria and scientific basis for this decision is unclear. How does TDEC determine where such an exclusion zone should no longer exist? Although not a TVA decision, we would appreciate some discussion on this matter in the FEIS. **[K2]**

* *Water Supply Designated Use* - Similarly, it is also unclear what criteria TDEC uses to determine that one stream segment is suitable for an industrial water supply designated use, and not for a municipal water supply designated use. **[K1]**

* *Source Water Protection* - As suggested above, sediments and disinfection-by-products (THMs) have been a significant issue for the public water supply system currently using the Duck River as its source water. THM precursors include algae and high Total Organic Carbon (TOC) levels, which are in turn related to elevated nutrients. We strongly recommend a TVA commitment for source water protection as part of the preferred alternative in the FEIS. We believe such protection should be part and parcel of any potential approval of a water supply project **[K4]** (also see below discussion under *Basin Management Plan* which includes the referenced *Randleman Watershed Management Rules,* as well as item #6.k. under the enclosed *EPA Section 404 Reservoir Review).*

* *Minimum Flows* - All minimum flows downstream of the proposed dam for Alternative B *should be consistent with the U.S. Fish and Wildlife (FWS) and EPA guidelines that include* minimum flow rates and variable flows consistent with sustainability requirements for fish and other aquatic inhabitants. **[L2]**

· **Basin Management** -The disposition, ownership, and management of the environs surrounding the reservoir proposal (B) are a major shortcoming of the DEIS. As other reservoir projects in the nation have experienced, control of nutrients in the reservoirs and lakes in the southern U.S. are a continuing challenge. Shallow, warm water bodies enriched with nutrients from farmland and agricultural runoff and natural sources quickly become colonized with mats of aquatic plants and algae. To control nutrient enrichment and Eutrophication, the drainage basin containing the reservoir will likely require management measures and land use controls including but not limited to: creation of buffer zones in perennial and intermittent streams in the watershed; timber cutting and agricultural use restrictions in buffer zones; lot size and housing density restrictions; policies on septic tank placement and maintenance, and other strategies to prevent pollutants and nutrients from entering the proposed reservoir. If Alternative B is selected by TVA as its preferred alternative, the FEIS should provide at least a draft basin management plan that includes TVA policies and procedures on shoreline management, water quality, monitoring, aquatic weed control, fisheries, etc. as they relate to the proposed Fountain Creek Reservoir.

As an example of reservoir management techniques that may be useful in addition to TVA's management EISs such as the recent *Shoreline Management EIS,* we have enclosed the watershed management rules that the State of North Carolina required for the Lake Randleman watershed *(Randleman Watershed Management Rules)* in 1998. **[R4]**

· **Fisheries** - As is typical for a reservoir project that impounds a stream reach, the biodiversity of the inundated stream would decrease as the system changes from a lotic to a lentic system, although the numbers of the remaining species would likely increase. For the reservoir alternative (B), the DEIS (pg. 156) indicates that the182+ species in Cane Creek are expected to be reduced to the 44+ to 48+ species living in nearby Normandy Reservoir.

· **Endangered Species** - Given the fact that endangered mussels caused the Columbia Dam to be discontinued, TVA should ensure that no such endangered species or other unresolvable "show-stoppers" exist in the nearby Fountain Creek watershed if the reservoir alternative (B) is pursued. **[Q6]**

· **Environmental Justice (E J)** - We note that the EJ Executive Order (EO 12898) was not listed on pages 16-17 under *Other Review and Permit Processes.* The FEIS should list it and, more importantly, consider potential EJ impacts relative to the alternatives. **[V1]**

Page 137 discusses demographics of the project area. It appears that minority and low-income percentages are similar among project counties and lower than the state average. One exception is the Bethesda Division of Williamson County for low-income groups, which is noticeable greater (12.6%) than that of the total county (5.8%). This should be considered during infrastructure construction of the alternative. However, since the overall effect of the project would be to increase water supply in these counties, this may or may not be a great EJ concern. **[V2]**

· **Cumulative/Secondary Impacts** -The relocation of Highway 50, any secondary roads, power transmission lines, water treatment plants and other related facilities of the presented alternatives, as well as other present, proposed and foreseeable future projects over a 10- to 20-year horizon in the region, should be considered and discussed in the FEIS. **[A28]**

· **Summary** - In summary, until a true water need can be demonstrated beyond what existing sources (Normandy flows and wastewater returns) and conservation methods can provide, EPA favors the No Action (A) for the near future. If this is considered unacceptable to local water authorities and implementation of one of the remaining alternatives (B-E) is pursued, we would not prefer implementation of the Fountain Creek Reservoir (B) or raising the pool of the Normandy Reservoir (D) due to their impacts. We also have environmental concerns about the alternatives with long pipelines (C and E) with unclear routes and undisclosed impacts. If the pipeline impacts could be minimized through alignment shifts and the impacts of new water treatment plants common to all action alternatives could also be minimized, we would favor C over E since it has a shorter pipeline than E, and E also involves interbasin transfer. However, we strongly suggest that the feasibility of a modification of E (Modified E) be considered, which returns additional wastewater to the Duck River as opposed to transferring it to the Tims Ford Reservoir. **[A32]**

· **EPA DEIS Rating** - Since no preferred alternative was selected, EPA has rated all alternatives individually. As previously indicated, our alternatives "preference" from most preferred to least is as follows: *A, Modified E (if feasible), C, E, D and B.*

We rate A as "LO" *(Lack of Objections)* due to the minimal environmental disruption and the acceptability of the water supply volumes for the near term, especially if water conservation methods are implemented in Maury and southern Williamson Counties during droughts. We rate Modified E, C and E as "EC-2" *(Environmental Concerns,* with additional information requested) due to the uncertain feasibility and impacts of Modified E, and the long pipelines of C and E plus the additional interbasin transfer aspect associated with E. We rate D and B as "EO-2" *(Environmental Objections,* with additional information requested) due to land use impacts such as loss of forested wetlands for B and loss of shoreline vegetation (including forested wetlands) and shoreline amenities for D. Overall, we also rate the DEIS as "EO-2" since two of the alternatives are rated "EO-2".

We were pleased to provide these comments. Should you have questions, feel free to contact Chris Hoberg of my staff at 404/562-9619.

Sincerely,

Heinz J. Mueller, Chief
Office of Environmental Assessment Environmental Accountability Division

Enclosures

Columbia Water Supply EIS Log Number 64
Andrew N. Barrass, Natural Heritage, Tennessee Department of Environment and Conservation

October 20, 2000

Ms. Linda B. Oxendine
Tennessee Valley Authority
400 West Summit Hill Drive
WT 8C
Knoxville TN 37902

Subject: Project review information for rare, threatened, or endangered species and critical or sensitive habitat; Draft Environmental Impact Statement, Future Water Supply Needs Upper Duck River Basin, Tennessee Valley Authority

Dear Ms. Oxendine:

As a part of our review of the subject **Draft Environmental Impact Statement** *(Draft ELS),* please be advised that we have reviewed our Departmental data bases and find recorded State and/or Federally listed species, within a one mile radius of the proposed Tennessee Valley Authority (TVA) project boundaries and within a one mile radius of the proposed managed lands (project alternatives). These species have very specific or rare habitat. Our records also indicate additional species occurrence records, sensitive ecological sites, and management areas, within an approximate four mile radius of the proposed project site(s). Your agency is aware of these records and we suggest that these records be further evaluated in cooperation with your Heritage Program in Norris, TN. **[Q3]**

Our Division reviewed the subject document and we offer these general comments as part of our review:

General comments;

In order to comply with the National Environmental Policy Act consideration should be given to the comprehensive and *cumulative* impacts associated with the project actions. Considering the information provided, it is probable that any proposed pipeline development will increase stream crossings, will affect instream, aquatic, and riparian habitat, and thereby significantly degrading habitat as part of proposed construction implementation. The TVA has not identified restoration nor reclamation actions to lessen any construction-related impacts, e.g., best management practices or bioengineering techniques. **[A27]**

We strongly support a *no-net-loss* (similar to our Tennessee Wetland Conservation Strategy and the wetland protection initiative) approach to the management of public lands and our State natural resources. Although TVA outlines some protection of natural resources as part of the description of the proposed Alternatives, these are not specific and do not address long term protection of natural resources, specific sensitive *habitat* and species *throughout* the planning corridor. **[A26]**

We also offer these specific comments related to the *Draft ElS* document and proposed Alternatives or management strategy of Federal lands and water supply.

Specific comments;

Alternative B proposes the construction of a reservoir on Fountain Creek. The Fountain Creek reservoir does not appear to be a viable alternative in light of the estimated cost and potential for eutrophication caused by the nutrient rich Fountain Creek basin. Both TVA and the Tennessee Department of Agriculture have identified many nonpoint source water pollution issues throughout the watershed. These water pollution issues could have long-term impacts on the biodiversity of the area, particularly aquatic species. Correction of these problems is not a documented cost nor included in the discussion of impacts of this proposed alternative. **[K13]**

Although not documented in the *Draft ElS,* there are numerous rare, threatened or endangered aquatic species records at the mouth of Fountain Creek and immediately downstream in the Duck River. Assuming suitable habitat exists within Fountain Creek, these species could be present in the watershed e.g., Coppercheek Darter *(Etheostoma aqua#)* and Slabside Pearlymussel *(Lexingtonia dolabelloides).* **[Q17]**

Also, this alternative would inundate known populations of a number of rare plant species and could impact several registered State Natural Areas. The Glade cress *(Leavenworthia exigua var. exigua),* Tennessee milk-vetch *(Astragalus tennesseensis),* and Limestone fame-flower *(Talinum calcaricum) are* Tennessee special concern plants, which occur in the area of proposed inundation by a reservoir on Fountain Creek. These limestone cedar glade plants, that are globally rare and the plant communities (habitat), would be destroyed by inundation. **[Q13]**

The Water stitchwort *(Arenaria fontinalis)* is a Tennessee threatened and obligate wetland plant *(OBI.). The Water stitchwort occurs in* seepages *and other wet* areas a/ong *creeks. The OBL* plant would not survive prolonged inundation. The Duck river bladderpod *(Lesquerella densipila)* is a Tennessee threatened and globally rare plant, which also occurs in the area ora proposed reservoir on Fountain Creek. Field surveys conducted in the spring of this year by the Division of Natural Heritage staff have documented serious declines in populations of this plant in the majority of its range. Several bottomland areas adjoining Silver Creek continue to support populations of this plant. *These populations would be inundated under the Drafi ElS,* Alternative B. **[Q8]**

It is important to note that the Division of Natural Heritage staff did not survey the area south of State Route 50 on Fountain Creek in the spring of this year for the *Duck* River *bladderpod. This* area could also support populations of the protected plant species (potentially inundated by the proposed Fountain Creek reservoir). **[Q9]**

A population of the Tennessee and Federally listed (endangered) Leafy prairie-clover *(Dalea foliosa)* occurs between 620 feet and 630 feet elevation in the Moore Lane Glade Registered State Natural Area. This area is outside of the Fountain Creek watershed, but would require protection from inundation (629-foot elevation) by the two proposed extension (saddle) dam structures west of the proposed Fountain Creek reservoir. **[Q14]**

The information presented indicates that the Moore Lane Glade Registered State Natural Area (west of State Route 50) will be directly affected by the proposed location of the dam and construction area. A raised water table resulting from the impoundment could effect stream flow throughout the proposed project area. Due to the karst features of the area, a small, unnamed tributary to the Duck River (within the Natural Area) could have increased flow from ground water *inflow. It is not clear how this change in hydrology would affect the Leafy* prairie clover populations, which occur within the Natural Area. **[Q15]**

The proposed Alternative C would construct a water supply intake at a point downstream from Columbia in the Duck River and downstream from Cathy's Creek. The *Draft EIS* outlines suggested short-term impacts to ground water, surface water, aquatic life, terrestrial life, endangered species, etc. The document fails to identify the probable impacts of the proposed construction and water withdrawal. Although the document discusses the withdrawal of approximately a fifth of the maximum flow, the document does not acknowledge the potential impacts to reduced flow as seen during the most recent drought and low flow conditions (summer flow gauge records for 1998-2000). **[L5]**

Under Alternative D, the suggested maximum pool of Normandy Lake would be raised from 875 feet to 880 feet. Alternative D would flood portions of Short Springs Designated State Natural Area along Bobo Creek at contours below 880 feet during the normal maximum pool elevation of the reservoir. The bottom-land habitat receives seasonal inundation. By raising the lake level there would be prolonged periods of occasional inundation as well as longer periods of more permanent flooding of the habitat. We would expect this habitat and associated biological diversity to change community type and floristic composition along with the associated forest habitat. The forest type is a high quality mesic area with rich displays of spring wildflowers along Normandy Lake between the 875 and 880-foot contours. These areas could be impacted by inundation under Alternative D and could significantly impact the natural area through the destruction of the flora and fauna depending upon the timing and duration of inundation. This impact is cited in table 7 on page 63; however, it is not mentioned in the impacts described under Alternative D pages 48 - 56. The environmental impact of flooding the bottomland riparian forest could be a violation of Natural Resources Areas Rules, {TCA Section, 0400-2-8-.08 Intrusions, 0400-2-8-.22 Water Level Control} and may require additional Departmental permits for wetland impacts. **[G21]**

In addition, there are a number of Tennessee endangered, threatened and special concern plants which occur on lands above the 900 foot contour, around Normandy Lake at sites known as Rutledge Falls, Copperas Branch, and Short Springs Designated State Natural Area. The Division of Natural Heritage has no records of Tennessee endangered, threatened or special concern plants below the 900-foot contour of Normandy Lake. **[Q16]**

A change in water flow rates (downstream) or significant water withdrawals from the reservoir could affect two rare plants that occur in the Duck River. These are Water stitchwort *(Arenaria fontinalis)* a Tennessee threatened and obligate wetland plant (OBL), and Limestone blue star *(Amsonia tabernaemontana var. gattingeri),* a Tennessee special concern listed species and a facultative wetland plant. Comparing these two rare species, the Water stitchwort is more dependent on water (an obligate wetland plant) and would be sensitive to changes in hydrology (reduced seepage and flow rates). Occurrences of both species are found in the Duck River watershed, both above and below the confluence of Fountain Creek. It is unclear how the rare plant populations in the Duck River would be affected under the different alternatives, however the increased minimum flow under Alternative D could be beneficial to these rare species. **[Q10]**

An increase in shoreline erosion associated with additional access to Federal lands, encouraged by the proposed raising of water levels, could result directly in an increase in water pollution (especially sedimentation). The *Draft EIS* does not provide documentation for adequate protection of natural resources that could result in net losses of the State's biological and natural resources as well as increases in shoreline erosion. Perhaps TVA could suggest shoreline management strategies that would be implemented to protect natural resources and biodiversity if this alternative were selected. **[G23]**

Additionally, the proposed Alternative D could increase shoreline erosion, decrease water quality, reduce aquatic habitat, manipulate and significantly reduce forested and riparian

habitat, and reduce contiguous forested tracts (communities) simply as a result of prolonged inundation by sustained higher lake levels. We suggest that TVA fully document these losses and compare them to anticipated habitat improvements associated with increasing the lake shoreline area by raising the lake levels.

Managed shorelines, with increased efforts toward restoring habitat (particularly by erosion control through bioengineering techniques), are paramount to long term water quality improvements and protection of the State's rare, threatened or endangered species. By utilizing specific reservoir-wide management strategies throughout Normandy Lake TVA could demonstrate habitat improvements associated by raising the lake levels with increasing the lake shoreline area. Additional documentation is needed to outline steps that will be taken by TVA to protect the current *recreational* uses and diverse habitat along the shoreline. **[G24]**

Alternative E proposes to transfer water from Tims Ford reservoir to a downstream site through a 20-mile pipeline and booster pumping station to the lower Duck River. The transfer of large volumes of water between watersheds (inter-basin) could result in artificial range extensions for aquatic species or increase the likelihood that exotic species could invade these watersheds e.g., zebra mussels. The *Draft EIS* does not consider these potential impacts. The long-term impact by minor but continued drawdowns is not fully addressed considering the reduction of water from Tims Ford reservoir as part of this proposal. The *Draft EIS* does not consider aquatic biodiversity impacts in the reservoir resultant from sustained water withdrawals during drought conditions. **[L7]**

Our Department has worked with TVA staff for many years to develop policy and procedures in order to protect large undeveloped tracts of Federal lands. The purpose of this protection is to prolong significant habitat and biodiversity, especially for those species that utilize shorelines.

In conclusion, the document clearly illustrates many *significant* environmental impacts associated with the proposed Alternative B. Alternatives that lessen environmental impacts have been defined and documented in Alternatives C and E. The TVA acknowledges potential environmental impacts should Alternative D be implemented, including flooding portions of the Short Springs Designated State Natural Area.

In summary, considering the Alternatives presented, we find Alternatives C and E least objectionable and these alternatives clearly present minimal environmental impacts when compared to other alternatives presented. We have concerns about the management of shoreline tracts (Alternative D) and decreased stream flows that could result from Alternative C. We suggest that these impacts be further addressed and documented in the Final *EIS* as well as the methods for avoiding impacts associated with implementing these Alternatives. **[A33]**

We appreciate the opportunity to assist you with your pre-project planning. Please contact me if we can be of further assistance with this project or provide additional information. Our office is in Nashville, telephone 615/532-0431.

Respectfully

Andrew N. Barrass, Ph.D.
Environmental Review Coordinator,
Division of Natural Heritage
Department of Environment and Conservation

Columbia Water Supply EIS Log Number 58
Marty Marina, Tennessee Conservation League

Ms. Linda B. Oxendine, Project Manager
Draft EIS - Upper Duck River Basin
Tennessee Valley Authority
400 West Summit Hill Drive, WT 8C
Knoxville, TN 37902

Reference: Water Supply Duck River Basin

Dear Linda:

Thank you for the opportunity to comment on alternatives for addressing future water supply needs of the Upper Duck River Basin. The League has investigated the choices and believes raising Normandy Dam to be the optimal choice. **[G2, part]** Let me explain by first addressing our global concerns, then speaking to each solution.

We recognize that this EIS -- like the TERDA EIS -- is burdened with years (and generations) of expectations, disappointment, and frustration. In this case it was created by the anticipated completion of the Columbia Dam and its subsequent abandonment. Fortunately, the final EIS can benefit from improvements in conservation science and the science of water (supply and quality) management gained through the intervening decades. It is imperative that decisions in the final EIS also anticipate ethical considerations in preventing and managing present and future social conflicts over natural resources on the Duck. **[A40]** For instance,

The draft EIS is geared to providing enough water for Columbia to grow at the present rate for the next 50 years. We believe the present rate was not anticipated when the dam was originally projected and cannot be sustained for so long a period. Further, planning for it (or failing to recognize this) will eventually negatively impact Colombians' quality of life and the economic viability of other counties in the watershed. Atlanta could serve as a poster child for unbridled development. **[H4]**

The draft EIS addresses anticipated water demand without considering the impacts of low flow scenarios - similar to those presently being experienced - on maintaining river function. TVA's experience this summer in managing the water supply for Chattanooga and northeast Tennessee speaks to what happens when God does not provide enough rain to create adequate runoff. **[C15]**

The draft EIS does not address cumulative impacts of projected development on water quality or the water supply needed to clean the anticipated Total Maximum Daily Load (TMDL) created by development. Failures to address this issue can be found among the many streams listed on the Tennessee Department of Environment and Conservation's 303D list. **[K5]**

A. Using the present resources is an untenable solution because the system is presently functioning near its limits. **[D5]**

B. Building Fountain Creek Reservoir is an expensive alternative, reminiscent of choices made in the '60s and '70s. TVA and its stakeholders will do well to learn from previous experience and save itself and the taxpayer's dollars by choosing another scenario. This area of Fountain Creek is not suited to a reservoir because of the shallow water depth. As noted in the draft EIS, the Fountain Creek Reservoir will be a shallow, nutrient rich reservoir. By definition, we believe it will provide a poor water supply and poor aquatic

habitat. It also has a potential for creating more public expectation and suffering the same sociological conflicts over resources presently experienced on TVA's Nickajack, Chickamauga and Guntersville reservoirs. These were unintended consequences in those areas. Neither TVA, the state or county governments can afford the cost of managing the natural resource conflicts and it would be inexcusable to knowingly create them. Further, building the reservoir will cause biological loss and maintaining it under low dissolved oxygen and low flow circumstances will likely to continue this trend. **[E27]** (See TWRA and TDEC statements).

C. Taking water from downstream of the Columbia discharge needs more information before it can be a viable choice. This EIS does not consider construction or low-flow impacts to ground water, surface water, aquatic life, terrestrial life, or endangered species. Further it does not address consequences to the supply or biological life from continuously recycling water so close to the outflow pipe. What will be the attendant cost of wastewater and freshwater treatment or biological loss? **[F17]**

D. Raising the Normandy pool level has a moderate cost and the best chance of answering short and mid-term supply, with minimal biological or sociological impacts. While there will be some short-term loss, this alternative seems to accommodate management of the State Natural Area for its intended purpose and other habitat concerns at the reservoir. It will also improve present habitat conditions on the Duck. **[G3]**

E. Building a pipeline from the Tims Ford Reservoir to the Duck River will unnaturally favor a county outside the Tims Ford Reservoir and handicap counties within they reservoir as they struggle to meet their existing and current demands for clean and plentiful water. There will also be negative impacts to flora and fauna as the pipeline is constructed and maintained over the years. **[H18]**

Again, thank you for soliciting and considering the League's comments. Please know that we also wholeheartedly endorse comments made by TWRA and TDEC's Natural Heritage Division. As usual, we look forward to supporting TVA in creating a well-balanced solution to this issue. **[G2, part]**

Sincerely,

Marty Marina
Executive Director
Tennessee Conservation League

Columbia Water Supply EIS Log Number 72
Wayne Romesberg
(from Transcript of Public Meeting)

First thing I would like to say this is a local issue and it should be solved by the local people. We don't need environmental groups from California (western states) and we don't need environmental organizations in the southeast to help solve our problems and we definitely don't need another attorney from Murphreesboro to try to solve our problem. We know what happened last time there besides him getting rich. I think anyone here tonight needs to speak, state who they are, where they live, and if they represent any organizations. **[B10]** I am Wayne Romesberg; I am with the Murray County Commission. I am basically a life-long resident of Columbia.

Going to the alternatives, on Alternative A, the alternative of doing nothing, to me that is not an answer, so we should not even consider that. **[D3]** Going to Alternative C, Alternative C is Cathy's Creek Pumping Station, I don't believe this is an acceptable alternative because I don't know about you all but I don't think the idea of drinking my own sewer water is acceptable and I understand the people in California have been doing that for years and we see some of the problems they have. **[F19]**

The Alternative D, raising Normandy, this may be semi-acceptable but it is definitely better for the upper reaches of the Duck River Agency and for the lower regions like Marshall, Murray, Hickman, Humphreys, that in the long run probably will not help solve us as well as they just said. We still have to do water conservation in 2035 so basically that means our children will have to be back in 2035 to try to find another answer that we didn't solve. **[C12]**

[T]he pumping station from Tims Ford, I don't believe that's good. I do not like the idea of taking water from one river valley, pumping it to another river valley. It sets a precedent. What could happen in the future there, if someone wants to come into the Duck River valley, take water out of the Duck River valley, say pump it into the Harpeth River valley, or maybe even go back to the Elk. That's entirely possible. If we take this action, then we are setting a precedent. I don't believe this is good, **[H27]** which leaves only one alternative, which is B.

I would like to say one thing here before I get to B. We do need to consider something for the long range. I don't want to say nothing about people in the past; but if in the 60's, if we'd had leadership (and I don't mean local leadership), our local leadership wanted the Columbia Dam, but if we had leadership up higher, especially in Washington, who had some backbone to stand up to some environmentalists, we wouldn't be here discussing this today. The option I am looking for is for our children and the next generation not to have to come back to this auditorium or one similar to it where they are going to have to discuss thing - what are going to have to do about water. We have our chance now to solve the water for a long range and we need to have the backbone to do it **[A39]**

So the solution I see is B, is Fountain Creek Dam. Granted it is more expensive but sometimes you do have to bite the bullet to solve a problem and this is the bullet. **[E7, part]** Some notes I was also taking as we were discussing these, the average depth would only be 19 feet. I don't know about you but I see a few sportsmen out here, 19 feet would be some pretty good fishing, especially for some Crappie and Brim and that's what I enjoy fishing for. We didn't talk about the recreational uses. There will be recreational uses for Fountain Creek. **[E37]**

Also, one thing I notice that was said, the $50M, the approximate $50M cost, it was also put in that could be plus or minus 30%. Well that means if we watch our construction cost, this dam could be completed for as little as $35M if we pinch pennies. If we don't pinch pennies, it could $65M, and I also noticed when we talked about the pipelines, we never did say if that was going to be plus or minus 30%, Being that it was not said, I am going to assume that it wasn't so when we are looking at possibly a $35M versus some of these $11M and $18M alternatives, hey we are in the neighborhood. **[E39]**

One thing I would like to say is to finish up, and Dan it is not your fault. but people in Murray County still have a sour taste about TVA. I know you had the project dumped in your lap and it's not your fault but there are a lot of people that still have a sour taste about the Columbia Dam fiasco, and that's what it was - a fiasco. It should have never happened, but it did. **[B2]**

But in the long haul, I do feel like Alternative B, the Fountain Creek, is our best alternative for us, our children, and generations to come. **[E7, part]** If we do decide to go with Alternative B, what we need to do is make a solid commitment behind it, no bailing out from pressures of any group; and if, I don't know if TVA will even have anything to do with it, but if they do I would like to make sure that TVA does fight for Fountain Creek like they did fight for Tellico years ago because when they fought for Tellico, they won all the way to the Supreme Court. **[E40]** I would like to thank you for your time.

Wayne Romesberg

A. General and EIS Process

A1. [W]*e want to express appreciation to TVA and cooperating agencies for the opportunity to participate in this review and input process.* **John R. Collier, Jr., Chairman, Board of Public Utilities of Columbia, Tennessee, 53c**

A2. *We concur with the TVA's assessment and forward-thinking approach to the water supply in middle Tennessee.* **Frank M. Tamberrino. President, Maury Alliance, 66b**

A3. *Thank you for a good report unaffected by political restraints. We continue to need your advise and experience as we do our planning.* **Charles Sanders, 15b**

A4. *I would like to commend the authors of this draft project report on their thoroughness in developing the data that outlines the project options.* **Richard E. Lockwood, 31a**

A5. *I have followed this through from the beginning since they got rid of the Columbia Dam issue. I first want to thank Dan Ferry and TVA. They have done a great job; they've done the best they could; I know they've taken a lot of hard hits but I appreciate all the work they've done and all the effort that's gone into it.* **Sharon Vaughn, 79a**

A6. *We appreciate your willingness to accept comments and to travel to Columbia. TVA has been a good utility and good corporate citizen for many years, and we look forward to our continued partnership for the betterment of this community, the middle Tennessee region and the State of Tennessee.* **Frank M. Tamberrino. President, Maury Alliance, 66c**

A7. *The . . . . Draft EIS captures the biological data that exists for the Duck River region, while effectively outlining the scope of the potential impacts of each action alternative. The Nature Conservancy believes this is a thorough preliminary review that can be utilized to evaluate the important environmental and socioeconomic issues that must be addressed.* **Leslie Colley, The Nature Conservancy of Tennessee, 44a**

Response to Comments A1 - A7: Comments noted. TVA appreciates your willingness to participate in reviews such as this and your openness to new ideas.

A8. *On behalf of the* [Tennessee Duck River Development] *Agency, I want to express my appreciation to TVA and the other cooperating agencies for their leadership and contributions to this draft of the future water supply needs in the Upper Duck River Basin (or water supply EIS) and for the opportunity to participate in the process. This document is an important milestone on our path towards developing additional water supply to meet the anticipated needs of the region. Our Board believes TVA has accomplished the stated goals of the EIS. It has evaluated the need for water in the Upper Duck River watershed, identified potential ways to meet the identified need, and evaluated the environmental and socioeconomic impacts of several possible ways to meet those needs.* **Linda Nannie, Chairman Duck River Agency, 20a and 71a**

A9. *The EIS document has accomplished the stated goals. It has evaluated the need for water in the Upper Duck River watershed, identified potential ways to meet*

and identify needs, and evaluated the environmental and socioeconomic impacts of several possible ways to meet those needs. It its very important to us, as a water utility serving customers in Lewisburg and Marshall County, that this document has established an outline of the environmental issues and concerns that must be addressed in the development of the alternatives and the ultimate selection and completion of a project solution without prematurely limiting alternatives. **Larry E. Jones, 1a**

A10. *As we stated in our letter dated March 7, 1997 concerning the closure of the Columbia project, "The TVA should verify existing public water supply sources or finance new supplies at levels that meet local long-range water supply needs as defined by the Regional Water Supply Analysis for Southern Williamson, Marshall and Maury Counties or by the State." We also stated, "Although local interests have shared responsibility to support water supplies, the larger burden to verify or produce dependable water supplies is TVA's alone." These assertions remain true. TVA's water analysis seriously examines regional water supply needs. It is a responsible effort to meet your obligations to the people of the Upper Duck River region.* **Justin P. Wilson, Deputy to the Governor,43b**

A11. *Tennessee Citizens for Wilderness Planning commends TVA and its four cooperating agencies for their professional and thorough effort in producing the DEIS. The document has three related purposes:*

(a) Evaluation of water-supply needs through the year 2050. Demands above 40 cfs (which can be supplied by the existing Normandy Reservoir plus return flows from wastewater plants) are increasingly likely to occur after the year 2015. The alternatives that have been developed in the DE1S are based on supplying an additional 22 cfs.

(b) Identification of potential ways to meet the water needs; no preferred alternative has been selected in the DEIS.

(c) Evaluation of the environmental and socio-economic impacts of the identified alternative.

Liane B. Russell, for the Tennessee Citizens for Wilderness Planning Board of Directors, 30a

Response to Comments A8 - A11: Comments noted. TVA appreciates comments indicating that we have defined and met the specific purposes of this EIS.

A12. *Given the apparent minimal immediate need for additional source water, the intended purpose of the reservoir may be more to enhance real estate and recreational value in the area more so (or rather than) creation of additional source water. If so, the focus of the EIS should be environmental impacts on actions associated with increased urbanization and residential sprawl into rural areas.* **EPA, 51f**

Response to Comment A12: As indicated in several sections of the draft EIS (in particular Sections 1.1, 3.1, and 3.9), the third purpose of this evaluation is to "evaluate the environmental and socioeconomic impacts of several possible ways to meet the future water needs for communities within this river basin." As indicated in Sections 5.4, 5.10, and 5.11, real estate and recreational development may occur associated with one or more of the action alternatives; however, those activities are acknowledged to generate potential conflicts with the purposes of this project.

A13. *As suggested on page 1, the EIS is written much like a programmatic EIS since it generically explores a need for additional water supplies and leaves site-specific plans for the future. For example, the reservoir management plan for the Fountain Creek Reservoir alternative (B) was not developed, the environmental impacts of the new water treatment plant for the downstream intake alternative (C) were not included in the impact analysis, and the pipeline impacts for Alternatives C, E and B were also not disclosed. Page 39 also states that "TVA is not proposing to design or construct any of these facilities" and "[i]n this EIS, these action alternatives have been generally described in light of their conceptual nature at this early stage." Page 1 further states that ".., several of the alternatives would not have to be built for a number of years." While EPA agrees with the concept and need for programmatic EISs that are followed by site-specific NEPA documents, our concern is that this EIS was not titled as a programmatic EIS. This should be discussed.* **EPA, 51a**

Response to Comment A13: This document is intended to be a programmatic EIS; however, that term conveys rather little meaning to members of the general public. Appropriate parts of the document (especially Sections 1.1 and 3.2) have been modified to clarify the intended programmatic intent of this EIS.

A14. *It should also be noted that if the present EIS is not a programmatic EIS but rather is an action EIS, construction of the preferred alternative would need to be initiated within five years or a re-evaluation of impacts would be needed, If impacts were determined at that time to be significantly different, a supplemental EIS would be needed if the project was pursued.* **EPA, 51b**

Response to Comment A14: Comment noted.

A15. *Your report also covers (albeit briefly) wetlands, archeological resources, aquatic life land recreational considerations. These are all well and good to consider, but if you need water to sustain the basics of life, then someone needs to get the priorities right.* **Jerry C. Lashlee, 26d**

Response to Comment A15: As indicated in Sections 1.3 and 3.2, the TVA role in this evaluation is to assist local agencies in determining their future need for water and evaluating possible ways to meet the identified needs. Under the National Environmental Policy Act (NEPA), documents such as this EIS are required to evaluate the effects of proposed projects on "the natural and physical environment and the relationship of people with that environment." The intent is "to create and maintain conditions under which man and nature can exist in productive harmony, and fulfill the social, economic, and other requirements of present and future generations of Americans."

A16. *From a practical perspective, implementation of the Fountain Creek Reservoir would utilize some 2,800 acres of the available Columbia lands previously acquired for the discontinued Columbia Dam and Reservoir. Such use would keep these lands in public ownership and under the direct purview of TVA. However, an additional 800 acres of land currently not in public ownership would need to be acquired for the reservoir.* **EPA, 51g**

Response to Comment A16: As indicated in Sections 1.3 and 3.2, the TVA role in this evaluation is to assist local agencies in determining the future

need for water and identifying ways to meet those future needs. Even if local interests decide a reservoir in the Fountain Creek watershed should be constructed, TVA has no plans to own, build, or operate that reservoir.

A17. *Consistent with the Federal Register, public comments are due to TVA by 10/30/00 as opposed to the 10/20/00 date stated on the DEIS cover page. Accordingly, we recommend that TVA receive comments postmarked by the 10/30/00 date.* **EPA, 51c**

Response to Comment A17: Comments were accepted into early November.

A18. *The Summary Comparison Table 6 on page 60 should also document a brief summary of natural and environmental impacts since environmental permit issues will be a major consideration in balancing benefits with impacts.* **Justin P. Wilson, Deputy to the Governor,43j**

Response to Comment A18: A summary of the environmental effects is included in Table 7, which is the companion to Table 6 and follows it in Section 3.9.

A19. *The draft identifies a variety of alternatives ranging from a traditional impoundment, pipeline options and a dam improvement alternative. A single alternative or combination of options can provide water well into the future. One or more of the alternatives addressed by the EIS may provide a long-term and reliable source of water.* **Justin P. Wilson, Deputy to the Governor,43c**

Response to Comment A19: TVA concurs with this assessment.

A20. *I know the people that has to make these decisions have a hard job. . . . You people that are inside have got to make a decision some way, and I'm for you if you can do something right but, if you can't, let's just don't go too far until we can get something else done.* **Jack Craig, 77d**

A21. *Mr. Craig was so correct in saying they need to definitely count the cost and don't start doing something that the environmentalists are going to come in and discount.* **Sharon Vaughn, 79d**

A22. *Does it say that the downstream water intake, is that a sure thing, can it be done, there's nothing to uphold it, the environmentalists or anything can't step in and say you can't take water out or is this a sure thing or is this just a guess? And then on Normandy, raising of that pool, is that a sure thing, can it be done, or are you going to have trouble raising that pool? And on the Tims Ford pipeline, is that a sure thing, or can they say, well, you don't get any more water. Are we going to the expense to do some of these and not have any assurance or get any water? And on Normandy, if they raise that pool or if it stays like it is, in a push and shove situation when we run out of water, is there any kind of guarantee that we are going to get water out of that dam? There's a lot of unanswered questions and until we know whether they are sure things or not, I don't see how anybody can make a projection on that they want.* **William Derryberry, 73a**

A23. *These four alternatives that you are suggesting were present at the time the other dam was built and, if they were present then, they ought to have been thought about and it should have been checked out and knew you could put water behind Columbia before*

it was ever built. If you are thinking about building a dam on Fountain Creek, we need to know for sure that the thing can be built. No need in building one and then tearing it down. $84M is a lot of tax money thrown away, not to think about the homes and lives of the people that live there. Fish and mussels and everything mean a lot but people's lives and their homes mean nothing to anybody. They need to be taken into consideration. **William Derryberry, 73g**

Response to Comments A20 - A23: Comments noted. The chief purpose of this evaluation has been to help everyone understand the variety of issues that ought to be considered when deciding how to meet the future needs for water in the watershed.

A24. *No preferred alternative was selected by TVA in the DEIS, although TVA has indicated a non-preference for the No Action Alternative (A). While acceptable from a NEPA perspective and understandable in the sense that TVA and its cooperators might want additional public input before selecting a preferred alternative, we note that delaying the identification of TVA's selection until the FEIS stage is late in the NEPA process. At that stage, the public and resource agencies would not be able to comment on the preferred alternative until the FEIS comment period, which may or may not truly influence any modification of the preferred alternative and would reduce the probability of a different alternative being selected if the public so-requested.* **EPA, 51h**

Response to Comment A24: As with the related Land Use EIS, TVA determined that members of the public and the affected agencies would benefit most from a wide-ranging discussion concerning several viable water supply alternatives. Especially when local agencies will have to build and defend the eventual project(s), we believe this approach results in better-informed decisions.

A25. *Given the potential serious impacts on aquatic fauna in several proposed alternatives, TVA is strongly urged to completely disregard Alternative B and D, and consider the possibility of constructing an offshore* [off-stream ?] *reservoir. Page 58 of the DEIS stated that this alternative was "adequately represented by the Fountain Creek Reservoir alternative." However, our proposed alternative represents an entirely different scope than a tributary reservoir. TVA should not consider these alternatives to be the same. Given the number of federally listed aquatic species in the Duck River system, and the relatively common nature of many of the terrestrial plants and animals, it makes much more sense to limit impacts to an offshore site. Impacts with this sort of alternative would likely only affect plant communities in the area. Since TVA has purchased the rights to 3,800 acres of land within the Fountain Creek watershed, surely a parcel of land exists where few sensitive plant or animal communities exist, or where these effects would be minimal. This alternative would preserve the biotic integrity of the aquatic fauna of the Fountain Creek system (182 spp.). Additionally, this alternative could adequately meet water supply needs if the containment reservoir was built to accommodate a large volume of water (ca. 1 billion gallons). Such a reservoir allowed to fill slowly would minimize cubic feet per second (cfs) removal effects if the water withdrawal area were around Duck River Mile 140-200. Furthermore, this alternative could allow construction of the reservoir near the river (within a few miles), therefore eliminating the need for a 10-20 mile pipeline. TVA should strongly consider including this alternative in their potential revisions or attachments to the DEIS.* **Environmental Science Graduate Students, University of Tennessee at Chattanooga, 33v**

Response to Comment A25: In order to meet the projected need for water in 2050, any potential source would have to be able to supply 14 mgd (22 cfs of flow) during all of a July-October drought period (123 days). The total volume of water used during this period would be approximately 1.72 billion gallons (14 mgd x 123 days), which equals 5,285 acre-feet of water. If the depth of the off-stream reservoir averaged seven feet, the usable volume of the reservoir would need to be 755 acres; however, to compensate for evaporative losses (at about three inches per surface acre per summer month) the reservoir would need to include 755 more acre-feet of water (5,285 + 755 = 6,040 acre-feet), or a total of 863 acres (6040 acre-feet/7 feet). At that size, the construction and operation of an off-stream reservoir would involve most of the same problems described for the Fountain Creek reservoir (land acquisition, landowner rights, controlling leakage, nutrient enrichment, long retention time, etc.). In addition, the water stored in the off-stream reservoir probably would be pumped from the Duck River during winter and early spring (the high flow period) when the river would contain large amounts of organic matter and nutrients resulting from non-point source runoff. The quality of the water in an off-stream storage reservoir might be too poor to release back to the Duck River without treatment and might be expensive to treat due to its high organic content and the likely presence of taste- and odor-producing algae. These are some of the factors which led TVA to conclude that an off-stream storage reservoir was not a reasonable and separate water supply alternative which needed to be evaluated in this EIS.

A26. *We strongly support a no-net-loss (similar to our Tennessee Wetland Conservation Strategy and the wetland protection initiative) approach to the management of public lands and our State natural resources. Although TVA outlines some protection of natural resources as part of the description of the proposed Alternatives, these are not specific and do not address long term protection of natural resources, specific sensitive habitat and species throughout the planning corridor.* **Andrew N. Barrass, Environmental Review Coordinator, Division of Natural Heritage, 64c**

A27. *In order to comply with the National Environmental Policy Act, consideration should be given to the comprehensive and cumulative impacts associated with the project actions. Considering the information provided, it is probable that any proposed pipeline development will increase stream crossings, will affect instream aquatic and riparian habitat, and thereby significantly degrading habitat as part of proposed construction implementation. The TVA has not identified restoration nor reclamation actions to lessen any construction-related impacts, e.g., best management practices or bioengineering techniques.* **Andrew N. Barrass, Environmental Review Coordinator, Division of Natural Heritage, 64b**

A28. *The relocation of Highway 50, any secondary roads, power transmission lines, water treatment plants and other related facilities of the presented alternatives, as well as other present, proposed and foreseeable future projects over a 10- to 20-year horizon in the region, should be considered and discussed in the FEIS.* **EPA, 51ai**

A29. *The impacts of the remaining action alternatives (C, D & E) are uncertain since impacts of pipeline routes (C & E) and specifics on treatment plants common to all action alternatives are not disclosed.* **EPA, 51n**

Response to Comments A26 - A29: The general nature of these issues are identified in the appropriate sections of the EIS; however, specific measures to protect them will have to be addressed in the subsequent NEPA and NPDES permit evaluation(s) for whatever projects are proposed to be built.

A30. *Given these considerations, our alternatives "preference" from most preferred to least is as follows: A, Modified E (if feasible), C, E, D and B.* **EPA, 51q**

A31. *If . .* [adoption of the No Action Alternative for the near term] *is unacceptable to local water authorities or if additional agricultural or water-consuming interests can be expected to withdraw significant additional volumes from the Duck River, EPA recommends that the most environmental alternative be implemented by approximately 2025. Voluntary conservation methods should be encouraged and employed regardless of which alternative is selected, with incentives and disincentives should be provided by local authorities for complying customers. Conservation should target those activities that consume water (e.g., lawn watering) as opposed to those that return a large portion of the water to its source (e.g., wastewater).* **EPA, 51j**

A32. *In summary, until a true water need can be demonstrated beyond what existing sources (Normandy flows and wastewater returns) and conservation methods can provide, EPA favors the No Action (A) for the near future. If this is considered unacceptable to local water authorities and implementation of one of the remaining alternatives (B-E) is pursued, we would not prefer implementation of the Fountain Creek Reservoir (B) or raising the pool of the Normandy Reservoir (D) due to their impacts. We also have environmental concerns about the alternatives with long pipelines (C and E) with unclear routes and undisclosed impacts. If the pipeline impacts could be minimized through alignment shifts and the impacts of new water treatment plants common to all action alternatives could also be minimized, we would favor C over E since it has a shorter pipeline than E, and E also involves interbasin transfer. However, we strongly suggest that the feasibility of a modification of E (Modified E) be considered, which returns additional wastewater to the Duck River as opposed to transferring it to the Tims Ford Reservoir.* **EPA, 51aj**

A33. *In summary, considering the Alternatives presented, we find Alternatives C and E least objectionable and these alternatives clearly present minimal environmental impacts when compared to other alternatives presented. We have concerns about the management of shoreline tracts (Alternative D) and decreased stream flows that could result from Alternative C. We suggest that these impacts be further addressed and documented in the Final EIS as well as the methods for avoiding impacts associated with implementing these Alternatives.* **Andrew N. Barrass, Environmental Review Coordinator, Division of Natural Heritage, 64r**

Response to Comments A30 - A33: Comments noted.

A34. *I still have faith in TVA doing the right thing, and I hope that this matter will be settled this time. I hope it will be sooner rather than later and we don't wait until we have a problem to handle it.* **Sharon Vaughn, 79e**

A35. *A review of the work and efforts put into the EIS reminds us that with each of the possible alternatives there remains many unanswered questions. A good foundation of knowledge has been established, but a great deal of work remains. . . . For us, this document is only the first step of a renewal effort to meet the anticipated need for WATER in the Duck River Basin.* **Larry E. Jones, 1b**

A36. *Work on the EIS has reminded all of us that with each of the possible alternatives there are still many unanswered questions. A good foundation of knowledge has been established but a great deal of work remains to be done. Those of us with a direct*

responsibility for water supply feel an increasing urgency to move forward with the process. For us, this document is but the first step of a renewed effort to meet the anticipated need for water in the Duck River Region. **Linda Nannie, Chairman, Duck River Agency, 20c and 71c**

A37. *I was born about 2000 feet south of Fountain Creek. I moved across it about 2000 feet when I was two, three, or four years old, and lived there until I was grown. After I come back out of service, I bought a farm on Fountain Creek and I've seen that stream real low. Everybody else that's been in that area has seen the same thing I have. I'm not smart; I'm not inside on this thing. If I was, it would probably be in worse shape than it is but I think we've got a problem and I think it's the most environmental thing that we are looking at of all the choices that we have.* **Jack Craig, 77a**

Response to Comments A34 - A37: Comments noted.

A38. *The support for <u>any</u> action is mixed and limited. Local trust of TVA has reached bottom. Any plan selected will incur undue opposition even though TVA has stated they would not participate in design or construction. The low attendance at your meeting of 9/28/2000 indicates poor local interest and support. When Columbia actually realizes that they are, or will be, short on their water supply, the deadheads will come alive and the politicians will climb aboard.* **Douglas K. Mitchener, 59b**

A39. *We do need to consider something for the long range. I don't want to say nothing about people in the past but if, in the 60's, we'd had leadership (and I don't mean local leadership; our local leadership wanted the Columbia Dam), but if we had leadership up higher, especially in Washington, who had some backbone to stand up to some environmentalists, we wouldn't be here discussing this today. The option I am looking for is for our children and the next generation not to have to come back to this auditorium or one similar to it where they are going to have to discuss the same thing - what are going to have to do about water. We have our chance now to solve the water for a long range and we need to have the backbone to do it.* **Wayne Romesberg, 72f**

Response to Comments A38 and A39: Comments noted. These comments reflect some of the negative perspectives which will have to be addressed when one or more water supply projects are proposed.

A40. *We recognize that this EIS -- like the TERDA EIS -- is burdened with years (and generations) of expectations, disappointment, and frustration. In this case, it was created by the anticipated completion of the Columbia Dam and its subsequent abandonment. Fortunately, the final EIS can benefit from improvements in conservation science and the science of water (supply and quality) management gained through the intervening decades. It is imperative that decisions in the final EIS also anticipate ethical considerations in preventing and managing present and future social conflicts over natural resources on the Duck.* **Marty Marina, Executive Director, Tennessee Conservation League, 58b**

A41. *As stated in the EIS, people living in the upper Duck watershed "will have to realize that protection of the quantity and quality of the water supply will be critical to their health and local economy," and "will have to work together to make sure each community has enough good quality water to meet their needs." As a member of this watershed community, The Nature Conservancy strongly urges that all residents, organizations, and utility districts assist the Duck River Agency in finding a long-term,*

regional solution that balances environmental concerns and economic development needs. **Leslie Colley, The Nature Conservancy of Tennessee, 44h**

A42. *It is extremely important to the local water systems and the Duck River Agency, which are jointly responsible for the water supply in the region, that this document has established an outline of the environmental issues and concerns that must be considered in the future development of the alternatives and the ultimate selection and completion of project and program solutions without prematurely limiting the alternatives. Over 30 years ago our predecessors anticipated the region's need for water and conceived of the Duck River project. They did not solve the problem indefinitely, but they did create Normandy Reservoir which sustains all of us and the main Duck River environment today. None of the current alternatives will sustain us indefinitely either. This EIS looks out to the year 2050 but there is nothing magical about that year. We owe it to the next generation to preserve alternatives and options that may be needed well beyond our lifetime.* **Linda Nannie, Chairman Duck River Agency, 20b and 71b**

A43. *The Duck River will be unable to supply Columbia's and Maury County's water supply needs by the year 2015. Maury County will have to find additional water supply sources to meet the water supply and water quality control needs of its citizens and industries. Since the halting of construction work on the Columbia Dam in 1983, no significant progress has been made toward meeting the future water needs of the lower Duck River area. An enormous amount of time and financial resources have been expended studying and documenting the obvious issues, needs, and solutions. It is imperative that no more time be lost. TVA, working with local water systems and Duck River Agency, has prepared an Environmental Impact Statement (EIS) on ways to meet projected water supply needs of the area. The draft EIS identifies water needs of the Duck River Basin and evaluates the environmental and socioeconomic impact of possible ways to meet future water needs without pre-selection of one alternative. The information contained in the discussion of general concepts presented can be beneficial to water planners and community leaders as they pursue a timely regional water resource. Obviously, important factors such as costs, consumer rate impacts, and site-specific details can and should be made by local and regional project sponsors.* **John R. Collier, Jr., Chairman, Board of Public Utilities of Columbia, Tennessee, 53a**

A44. *By addressing the environmental and socioeconomic issues of the alternatives early in the project's concept and design phase, we can create an opportunity for a successful project that balances community water resource needs, economics, and environmental impact. On behalf of CPWS water customers in Columbia, Maury County, and parts of southern Williamson County, we urge every responsible agency and community leader involved to show renewed determination and effort to complete the task of securing additional water supplies.* **John R. Collier, Jr., Chairman, Board of Public Utilities of Columbia, Tennessee, 53b**

Response to Comments A40 - A44: Even though they are stated in slightly different ways, all of these comments seem to imply that this EIS represents an opportunity to address the long-term water needs in the upper Duck River area without causing adverse environmental effects. If that happens, the document will have achieved all of its purposes.

B. Other General Topics

B1. *Complete the Columbia Dam; it should never have been stopped!* **Don F. Lee, 6c**

B2. *Dan* [Ferry] *it is not your fault, but people in Murray County still have a sour taste about TVA. I know you had the project dumped in your lap and it's not your fault but there are a lot of people that still have a sour taste about the Columbia Dam fiasco, and that's what it was - a fiasco. It should have never happened, but it did.* **Wayne Romesberg, 72j**

B3. *I know we all feel like that there has been a terrible mistake made and I think we are justified in doing this, us people that lived here. I had to move; my parents had to move, and a pretty good percentage of neighbors in our area had to move from where we were because of this thing and then it didn't work out besides all the tax dollars we put into it. I feel like if our friend Joe L. Evans had lived, the environmentals wouldn't had the problem we've had we would have had in here. I think we would have had a dam in Columbia today and been using it, but that's my opinion. It's not somebody else's, but I think when we lost our politics in Washington is the reason we don't have a dam in Columbia today. I hope, just like Buddy said and Mr. Jacobs, that we don't make this same mistake again.* **Jack Craig, 77c**

B4. *There were five options to accept or discuss, there really should have been six, number six being, the completion of the Columbia dam project. . . . The land is already acquired, the engineering of the dam is already complete and the preliminary work is already done. . . . The project will allow Maury County a growth of many years with water readily available, water sports and recreation would bring both increased populace as well as increased revenue to the county, due to the availability of water sports. . . . The disadvantages are few, one really, the possibility of one lost refuge for a mussel, mind you <u>not the last refuge.</u> No matter how you look at the entire scenario there is no logic for not completing the Columbia project. The benefits are not only to Maury county but all the surrounding counties as well, industry and manufacturing would find a greater attraction to the entire area. Mankind and the continuation of mankind as we know it should and must remain the top priority. There were five options mentioned in the article, none of which will meet the long-term needs of Maury County. The construction of another new dam on Fountain Creek would almost certainly meet the same resistance as the Columbia Project did, plus all the land is not acquired. It's time we looked at the needs of the majority not the desires of the special interest groups and met those needs. It's time to do what's "best for the business" and complete the Columbia Project.* **Jim Hillman, 16**

Response to Comments B1 - B4: TVA understands and appreciates the heart-felt nature of these comments; however as indicated in the Columbia Project Land Use EIS and in Section 1.2 of this EIS, in 1995 TVA determined that the Columbia Dam Project could not be completed as a dam and reservoir on the Duck River. Since then, TVA has been working with a variety of agencies to meet the purposes of that project in other ways. One of those purposes was water supply, which this EIS addresses.

B5. *I was born and raised here in Murray County, been here all my life practically, and I know you all have been through a tremendous amount with all this last 20-25 years. It has affected our county more than anything I've ever seen happen in this county. It's very disturbing to a lot of people to see things like this happen when we're suppose to*

have what I call common sense. We might not have a degree from some college but when you get into things like this, I think you need to use a little common sense. **Ed Jacobs, 76a**

B6. *I was nine years old when my grandparents sold their land to TVA and, of course, nothing came through as far as the dam. There's a lot of the older generation, my generation, that's all we remember is people selling their land and nothing has come of it. A lot of people have lost trust and they really need to keep this in the community versus bringing water from outside. We need to have our trust back and we don't want to be dependent upon anyone else for our resources. We want to be an independent county of everyone else.* **Cindy Short, 81**

Response to Comments B5 and B6: One of the potential benefits of this EIS is to help everyone in the upper Duck River watershed realize that good planning now can make a long-term difference in the availability of water for everyone.

B7. *Retain public land for public use.* ***No*** *new development on public land. Permanently turn over Duck River Dam property to TWRA.* **Nancy L. Penrod, 69b**

Response to Comment B7: Comment noted. Uses of the Columbia Project lands were evaluated in the Land Use EIS.

B8. *I feel that the options presented are viable; however, I believe that the gentlemen from the County Commission that talked about we need to take care of this locally was very correct and that we need to handle our own water issues and not be as dependent on other counties and other areas to provide our water. This is a local issue.* **Sharon Vaughn, 79b**

B9. *Ultimately, the decision to make a proposal to replace the water that would have been provided by the Columbia dam and to offer it for federal and state permits resides with the community. The TVA has acted responsibly and prudently to aid the community to make the necessary decisions. We commend your leadership and offer our assistance for a final resolution.* **Justin P. Wilson, Deputy to the Governor,43l**

B10. *I would like to say this is a local issue and it should be solved by the local people. We don't need environmental groups from California (western states), we don't need environmental organizations in the southeast to help solve our problems, and we definitely don't need another attorney from Murfreesboro to try to solve our problem. We know what happened last time there . .* [words lost on tape] *. . besides him getting rich. I think anyone here tonight needs to speak, state who they are, where they live, and if they represent any organizations.* **Wayne Romesberg, 72a**

Response to Comments B8 - B10: TVA concurs that addressing the future water needs of the Columbia area is a local issue. As stated in the EIS, TVA has prepared this evaluation of the need for water and the comparison of several possible ways to meet the identified need to help local agencies and the public understand the choices that are available.

B11. *Local governments, within the assistance of the Duck River Agency need to set up a commission of affected counties to plan and formulate a set of action steps to address the water supply issue for this region.* **Charles Sanders, 15a**

Response to Comment B11: This is one of several ways decisions could be made with regard to meeting the future water needs of the area.

B12. *Now, if a major wastewater treatment plant and associated infrastructure is built for our State Park and areas around the lake, as a trade off, the issue of water quality on Tims Ford Reservoir can change. Most importantly, we need to change the way we do business around here. Yesterday, we worked on Tims Ford Reservoir planning, today it's the Upper Duck River Basin planning. Wouldn't it be advisable to do comprehensive regional planning? TVA is doing most of this at our expense. It appears we are takers of whatever we are told we can do. Franklin and Moore Counties can only develop small parcels in a small way--yet, our neighbors in Maury, Bedford, Marshall, and Williamson counties get whatever they need at someone else's expense, including our water. I take issue with this approach and request that TVA either leave us alone, or help us help others by giving us some tools to protect our precious resources and thus have them available for all to use not just 50 years from now, but for all time beyond 2050.* **F. Montgomery Adams, Jr., Franklin County Executive, 29f**

Response to Comment B12: While everyone might not think so at any given time, TVA always attempts to act responsibly with regard to the wise use and conservation of the natural resources in the entire Tennessee River watershed. Acting responsibly also does not always mean that TVA can or should assist everyone in doing what they want, just because they want it.

B13. *While unrelated to the environmental impact issue, the financing of a future water supply is a major consideration. The 5¢ per thousand gallons TVA has collected from the Columbia area should be forfeited since they failed to complete their contract as scheduled when appropriations by Congress were approved.* **Douglas K. Mitchener, 59h**

B14. *Although it is not a specific part of this analysis, we commended TVA for meeting another state criteria to resolve its obligations for water. The setting aside of locally derived trust funds for regional water supply projects represents sound judgment and necessary fairness. These funds can play a significant role in the funding of an alternative addressed in the EIS.* **Justin P. Wilson, Deputy to the Governor,43k**

B15. *The 5¢ per thousand should continue to be collected from all users of Duck River water. Revenue collected from Shelbyville and upstream would be used for the maintenance of the Normandy Lake and river system water quality down to the Lewisburg intake. Revenue from Columbia, Lewisburg and Spring Hill (if they build their own water intake) would be added to funds already collected. Thus an account for future construction of the Williamsport Water intake would be established, funds would be controlled (and audited) by a representative(s) of each contributing system.* **Douglas K. Mitchener, 59i**

Response to Comments B13 - 15: As indicated in the Land Use EIS, the 5¢ per thousand gallons surcharge was collected by the Duck River Agency, not TVA, and placed in a trust fund to meet the local financial contribution to completion of Normandy and Columbia reservoirs, components of the Duck River Project. Subject to certain conditions, TVA has agreed to transfer the money in the trust fund to help respond to the water supply needs in the Columbia area. Future collection and use of this type of surcharge should be determined by people in the affected area.

B16. *We in Tennessee deserve better and demand more judicious treatment of our life-giving rivers. There is far more value to a river than simply its supply of water for human consumption. It seems that TVA should have learned this lesson from its loss of prestige due to the highly unpopular Tellico Dam, which destroyed one of the most beautiful rivers in the Nation, and from its experience in the abandoned Columbia Dam fiasco.* **Floyd and Linda Ayers, 32d**

Response to Comment B16: TVA agrees that the waters of the Tennessee Valley have many beneficial uses. Domestic water supply, recreation, and fish and aquatic life uses are all very important. One of the purposes of this EIS is to examine the potential impacts of each of the four action alternatives on existing and potential uses of the streams and reservoirs.

B17. *Let me say a few words about the Duck River Development Agency. You have changed your name so many times; you have changed your mission statement. I don't even think you recognize yourself when you look in the mirror. I don't. What have you done for Maury County. Name one thing. I don't think you can. Maury County has contributed over half of that nickel on a thousand gallons. What have you done for Maury County? Went to Hickman County and built them a water park or something like that for about $45K. You didn't even do that for Maury County. Why Maury County would even give you our support is beyond me. The Duck River Development Agency was created for one reason, maybe two. They gave one man a job for the rest of his life that nobody else could hold as long as he was alive, and you have been sopping up that nickel on a thousand gallons since 1972 and you still are. Thirty five years down the road, have you accomplished anything? Do you think in another 35 years you will have accomplished anything? You haven't done a thing, not a thing. Mr. Murdock, I told you once, I will tell you again. You got a lousy job. You're going to try to straighten up something somebody has made so crooked, bless your heart. Go back to Florida.* **Carolyn Derryberry, 74b**

Response to comment B17: Comment noted. TVA and DRDA recognize the strong feelings some have about the Columbia Reservoir Project and the agencies involved in it.

B18. *The only thing we are guaranteed by the Duck River Development Agency is that we pay a nickel on the thousand gallon but, in the DRA's legal response to TVA contractual audit March 26, 1998, page 54, the nickel per thousand gallon has not paid for water taken from the reservoir but from the Duck River. Again, it is not payment for water, it is a payment for a promise but undelivered - a two-dam reservoir project. That was stated in that audit. In the contract between TVA and the Upper Duck River Development Agency dated July 1, 1971, page 13-14, in the contract between the Upper Duck River Development Agency and the five public water utilities, including the City of Columbia, page 3 and 4, it first states they guarantee so many million gallons to all of them, and on the next page it says neither the TVA nor Agency guarantees the availability of the foregoing amounts of water. The only thing that was guaranteed was that nickel on the thousand gallon and these contracts. Everybody in Maury County and Marshall and all of them need to ask for these contracts and read them. You'd be surprised what you learn.* **William Derryberry, 73f**

Response to Comment B18: Comments noted.

B19. *Now I have a ruling on a U.S. Supreme Court case. Some ranchers in northern California and southern Oregon asked the EPA for water from reservoirs in that area* [but] *they turned them down, so they carried it to the United States Supreme Court. The ruling was in favor of the ranchers and against the environmentalists. This ruling is number 95813 Supreme Court of the United States Argued November 13, 1996, Decided March of 1997. I wish you would get a copy of that, look at it, and see if we file a lawsuit to get rid of the Pearly Mussel. . . . . We need to send the EPA a lawsuit about the Pearly Mussel or any other thing in the way and get the Corps of Engineers to build a dam for us or help get us one built because it looks like TVA don't want to at all.* **Glenn Stevenson, 78d**

Response to Comment B19: Comment noted.

C. Water Needs

C1. *A variety of unresolved issues and unmet obligations remained after the closure of the Columbia Dam project. First and foremost of these is the need to resolve the long-term water supply needs of the Upper Duck River Basin. In* ***Governor Don Sundquist's view, clean and dependable water for the Columbia region is as fundamental to the economic growth of the region as is dependable, low-cost electricity. This is the State's overriding concern.*** **Justin P. Wilson, Deputy to the Governor,43a**

Response to Comment C1: TVA agrees that clean, dependable water supplies are needed in the upper Duck River region. Each of the action alternatives discussed in the EIS is capable of meeting the projected water supply need through the year 2035 or 2050. The residents of the area can be confident that their long-term water needs would be met by one or more of these alternatives.

C2. *The solution to the projected problem(s) in the Duck River watershed should be solved in the Duck River watershed. Only as a last resort should the other watersheds adjacent to it be asked to share their dwindling resources. This is not a selfish comment, but a matter of possible future survival. The mighty Colorado River was once thought inexhaustible. There have been so many diversions for so many reasons, that it is only a small part of what it once was. We can't let that happen here.* **Jerry C. Lashlee, 26f**

Response to Comment C2: Comment noted.

C3. *Now air is our number one most valuable thing and water is next, second. We can't do without either one of them too long, so for the benefit of the future, TVA paid me for a 100 acres just above the dam not too far. I'd rather see it covered with water than to give it back to me or sell it back to me. Water is going to be a problem all over the world at a certain time. Atlanta is hunting water; Dallas is hunting water; . . . we don't know what year it is coming. It may be two years or twenty years but it's coming.* **Glenn Stevenson, 78e**

Response to Comment C3: Comment noted. TVA, in cooperation with local water systems, has been able to estimate when additional water would be needed in the Duck River at Columbia. As indicated in Section 2.8, during drought conditions between the years 2015 and 2025, the water demand at Columbia would exceed the amount of water available in the Duck River.

C4. *One of the biggest concerns that we have in Marshall County is water. When we apply for community development block grants, one of the criteria for getting the grant is to test the wells of the potential customers. In almost all cases these reports come back with a positive contamination report. It is in the best interest of Marshall County to find a new source of water other than the Duck River.* **Terry Wallace, Marshall County Executive, 65c**

Response to Comment C4: Microbial contamination of groundwater is very common in many parts of the upper Duck River watershed. The shallow soil underlain by limestone rock provides many opportunities for contamination from animal and human waste to percolate down into the groundwater. This also is the reason why public water systems with effective water treatment capabilities are so important to the region. Section 2.8 indicates that the future water demand in the Marshall County Water Service Area can be met by the Duck River.

C5. *More emphasis must be placed on future water needs throughout the basin. Normandy Reservoir is already not meeting the stated objectives. The release from the dam is already curtailed each year through the winter to allow the reservoir to be filled by the limited rainfall that occurs in the basin. Even at this reduced release, the reservoir has not reached full pool by the target date in some years. Fortunately, timely summer rainfall events have allowed the reservoir to be filled to full pool or higher. To date, the area has just plain been lucky.* **Randal J. Braker, 70a**

Response to Comment C5: TVA agrees that more emphasis is needed on water issues in the upper Duck River watershed. TVA also believes that Normandy Reservoir has met, and is continuing to meet, its project objectives. When Normandy reservoir was planned, TVA recognized that the recreation pool elevation of between 870 feet to 875 feet could be maintained only 90 percent of the time. TVA implemented water conservation operation measures during the drought of 1980-1981 and during the drought of 1987-1988 to keep the reservoir pool elevation as near normal as possible while meeting the intent of the downstream water quality and water supply minimum flow objectives. These operations to conserve water have been continued to date to benefit the water supply of the Duck River Utility Commission. TVA has effectively used the water from summer rainfall events to help maintain lake levels as high as practical during recent dry summer months.

C6. [I]*f you use A, B, or C or whatever down here, Lewisburg and Shelbyville hasn't got any guarantee that they're going to have sufficient water in the future. If you put the pipeline in, Shelbyville gets the benefit of the water; Lewisburg gets the benefit of the water; we get the benefit of the water. It comes downstream and our cost and environmental impact on the pipeline is negligible . . . as it has already been told here tonight. So I don't really see why it is really such a complicated matter to solve our water problems, and we are talking about 2050, that's 50 years off. So I believe the figure on that was $13M and I'm sure a fellow could run a 30-inch pipeline for $13M and put a couple of pumping stations on it. You're amount of people to operate it and see after it and whatnot.* **Ed Jacobs, 76c**

Response to Comment C6: Comment noted.

C7. *It is clear to the DRA Board of Directors and to the managers of the regions water systems, who serve on our Technical Advisory Committee and work each day to remove the pollutants from our drinking water, that we are not separable from our environment. If we are to continue to enjoy the quality of life that is Middle Tennessee, we must take steps to ensure that there is abundant clean water for all elements of the environment. With each day that we delay, additional stress is placed on the environment and solutions become more costly.* **Linda Nannie, Chairman, Duck River Agency, 20d and 71d**

Response to Comment C7: TVA appreciates the efforts of the water supply systems in the upper Duck River watershed to produce safe drinking water. The purpose of the EIS is to help guide future coordinated efforts of these systems to ensure that there will be safe, dependable water supplies for the region's growing population and economy.

C8. *This situation was calculated years ago by the TVA when the Columbia Dam was proposed and mostly built. Now that the dam project has been canceled, the chickens have come home to roost. Water, plentiful and clean, is the most compelling issue we will all face in our lifetime. We have watched as the Upper Duck River Basin has*

evolved into a major growth area complete with all the problems that come from lack of sufficient planning and unbridled growth. **F. Montgomery Adams, Jr., Franklin County Executive, 29a**

Response to Comment C8: Comment noted.

C9. *Although there seems to be a perceived need by some of the locals (pg. 10) for additional water supplies in the watershed, the actual need seems unjustified at this time for the Bedford and Marshall County service area through 2050, based on the needs analysis in the DEIS. However, for the Maury and southern Williamson County service area, water supply is expected to become a growing issue after 2015. The DEIS indicates (pg. 31) that by 2025 the unmet need would be 6 cfs (4 mgd), by 2035 it would be 14 cfs (9 mgd), and by 2050 it would be 22 cfs (14 mgd) beyond the 40 cfs available from the Normandy Reservoir. However, page 35 notes that "[t]hese amounts of water would be needed only during extended drought conditions, when demand was at its maximum and nearly all of the flow in the river was supplied by the minimum discharge from Normandy Dam."* **EPA, 51d**

Response to Comment C9: The purpose of the Water Supply Needs Analysis was to help local water systems and residents identify where and when additional water would be needed and how much would be required.

C10. *EPA is not convinced that a water supply alternative is needed at this time for the area of concern, particularly the Bedford and Marshall County service areas. In regard to Maury and southern Williamson County, we believe the determined unmet need during droughts starting in 2015 through 2025 (4 mgd or 6 cfs) could and should be met through water conservation. The 2035 unmet need (9 mgd or 14 cfs) could arguably also be met through conservation. The unmet need for 2050 (14 mgd or 22 cfs), however, is approximately 50% above the 40 cfs baseline Normandy flows, and therefore would likely require additional water supply. However, that need is many years away and would only apply during drought situations. As such, based on the DEIS, EPA believes the need for additional water supply is unfounded for the Bedford and Marshall Counties and can be met by conservation methods for some time (through approximately 2025 or 2035) for the Maury and southern Williamson Counties during droughts. At this time, therefore, EPA favors the No Action Alternative (A) for the near term. We recognize, however, the value of early planning for future needs in order to determine an adequate and environmental approach to additional source water.* **EPA, 51l**

Response to Comment C10: Section 2.8 of the EIS indicates that the estimated future water demand of the Bedford County and Marshall County Water Service Areas can be met by the Duck River and no action would be required to address water needs through 2050 in those water service areas. The estimated future water demand of the Maury/southern Williamson County Water Service Area would begin to exceed the amount of water available in the Duck River after the year 2015. Throughout the United States, water conservation efforts have been documented to accomplish about a 10 percent savings in average daily water use. If the Maury/southern Williamson County Water Service Area would implement a water conservation program and accomplish a 10 percent reduction in total water demand, the result could be a water savings of 3 mgd (4.6 cfs) in 2025, 3.5 mgd (5.5 cfs) in 2035, and 4.0 mgd (6.2 cfs) in 2050. These savings, while significant, would only partially offset the need for additional water. The additional water that would still need to be met by would be 1.4 cfs in 2025, 8.5 cfs in 2035, and 15.8 cfs in 2050.

Water conservation in the Bedford County and Marshall County Water Service Areas also could increase the amount of water available in the Duck River at Columbia and, if effective, could further delay the need for additional water sources. A 10 percent reduction in water use in Bedford and Marshall counties could defer the need for additional water in the Maury/southern Williamson County Water Service area until after the year 2025 and, if the conservation measures continued to reduce the demand by 10 percent, the additional water that would be needed in the Columbia area could be reduced to 5.5 cfs in 2035 and 12.3 cfs in the year 2050. Considering how long it takes to design, engineer, permit, and construct most possible water supply solutions (especially reservoirs), this examination of water supply needs and alternatives is both timely and appropriate.

C11. *Shelbyville is predicted to exceed the water supply allocation for Bedford County from Normandy Reservoir soon after 2050. Will the area be stopped from withdrawing water or will the Lewisburg area be forced to make due with a lower flow in the river?. Raising the height of the dam at Normandy Reservoir is clearly the best choice because it solves these existing problems with the releases from the dam and also solves the shortages at Columbia.* **Randal J. Braker, 70b**

C12. *The Alternative D, raising Normandy, this may be semi-acceptable but it is definitely better for the upper reaches of the Duck River than for the lower regions like Marshall, Murray, Hickman, Humphreys, that in the long run probably will not help solve us as well as they just said. We still* [would] *have to do water conservation in 2035, so basically that means our children will have to be back in 2035 to try to find another answer that we didn't solve.* **Wayne Romesberg, 72d**

Response to Comments G11 and C12: The purpose of this EIS is to evaluate ways of meeting the need for water in the upper Duck River basin through 2050. This evaluation used state-of-the-art projections about future population growth in the area that were provided by the U.S. Geological Survey. Local and regional planners will have to recognize when population growth and the demand for water begin to vary from these projections and start planning to meet the revised future needs. By 2035, it is quite likely that assumptions made in this EIS concerning the ways water is used and its value will have changed sufficiently to warrant renewed interest in long-term planning for water needs in the area.

C13. *To the people here, consider the source. In 1965, we had the same people* [TVA] *telling us we were fast approaching a water shortage. In 1965, there was a little biddy blue book in Murray County library published by TVA that said by the year 2000, Murray County would be using 40 million gallons a day. We don't come anywhere near that. They were wrong then, what's to say you are right now?* **Carolyn Derryberry, 74a**

Response to Comment C13: In 1965, Maury County had several industries which used large amounts of water to wash and process phosphate ore. Those industries have since ceased operations in the area, considerably lowering the industrial water demand. Even though population has increased substantially, industrial water use in the Columbia area has declined from about 29 mgd in 1965 to about 4mgd in 2000.

C14. *We are concerned that future use projections were based upon the assumption that "no new large water-consuming industries would locate in any of the water service areas in the upper Duck River basin." We feel that the leadership of the cities and*

countries of the area should have the opportunity to be involved in the adoption of any such assumption as its use might, unintentionally, place a "water cap" on economic growth in the region. The I-65 corridor is an area in heavy demand for industrial development. While extremely heavy water users (5-10 MGD+) would probably not consider the area due to its basic scarcity of water and lack of large receiving streams, a few new industrial users in the 1-2 MGD range could be vital to the area's future economy. More importantly, existing water using industries may be negatively impacted in their future decisions regarding expanding in place or having to relocate. **Wilton Burnett, Jr., Special Projects, Department of Economic and Community Development, 63a**

Response to Comment C14: As indicated in Section 2.5, the future demand for water in the upper Duck River watershed used in this EIS was determined by the U.S. Geological Survey in conjunction with the DRDA. The specific set of projections used as worst case conditions in the EIS include additional industrial growth in the Maury/southern Williamson County Water Service Area beyond the steady growth projected to occur in the Marshall and Bedford County water service areas. This liberal growth projection for the Maury/southern Williamson County Water Service Area would accommodate a good deal of additional industrial water use but does not, and cannot, account for any specific, large, self-served, water-using industries which might decide to locate in the watershed at some time in the future. As indicated in the comment, however, extremely heavy water users would probably not consider locating or expanding in this area due to its basic scarcity of water and lack of streams capable of assimilating large volumes of wastewater.

C15. *The draft EIS addresses anticipated water demand without considering the impacts of low flow scenarios - similar to those presently being experienced - on maintaining river function. TVA's experience this summer in managing the water supply for Chattanooga and northeast Tennessee speaks to what happens when God does not provide enough rain to create adequate runoff.* **Marty Marina, Executive Director, Tennessee Conservation League, 58d**

Response to Comment C15: The analysis of water available in the Duck River for water supply withdrawal is based on severe drought conditions such as occurred in 1953 when a U.S. Geological Survey team observed that there was no flow entering the Duck River from tributary streams between Shelbyville and Columbia. Under such a scenario, the only flow in the river would be that supplied by releases from Normandy Dam, wastewater return flow, and drought flow from Fountain Creek. Sections 2.6 and 2.7 describe these conditions. The dry summer months experienced in the Duck River during 1999 and 2000 were not as severe as the drought conditions used in the Water Needs Analysis and evaluated in the EIS.

C16. *It's unfortunate Columbia and the Duck River watershed are outgrowing their natural resources. However that is their problem. Rather than rob Peter to pay Paul, Peter should adjust his lifestyle to fit his resources. If the Duck River cannot supply sufficient water needs in the years to come, then growth and expansion should be minimized rather than maximized. Also, the overflow from Davidson County is fast filling Williamson County. By 2050, all of Williamson County will need much more water to meet those growth needs and you will be looking for ways to provide that increase. If you're drawing from Tims Ford, you'll want to draw even more. Once the cycle is started, bureaucrats find it easy to make the cycle even larger.* **Jerry C. Lashlee, 26b**

C17. *Quoting the EIS "The primary focus of the EIS is the future water supply needs in the Columbia area .... and .... form the basis for completing the remainder of this evaluation". This primary focus does not take into account the water supply needs in the Franklin County area. One might describe this view as "tunnel vision".(Page 11)* **Mark H. Dudley, 24c**

C18. *We're growing in the Elk River watershed also. Our needs are also increasing. Have those been addressed and the increase been included into your equation? I saw nothing in your brief that would lead me to think so. In fact, there was nothing in there that made any kind of mention to the effects on the Elk River watershed, either present or future.* **Jerry C. Lashlee, 26e**

C19. *There is an even greater reason for TVA not to consider Alternative E. The water in the Tennessee Valley belongs to the citizens of the Valley, not to TVA. By moving water from one area to another, TVA is assuming they have ownership of the water. If the citizens in this (Winchester) area objected, and this action was contested in court, I do not believe it would be judged legal.* **Eugene J. Sanders, 39b**

C20. *Steal the water from the Cumberland River; blast the rock away and put in an enormous pipeline to serve the burgeoning South Nashville Metro Population! Tell the COE to cooperate!* **Don F. Lee, 6d**

Response to Comments C16 - C20: The future water needs of the Elk River watershed are as important to TVA as those in the upper Duck River watershed. Local water districts and local governments, with the assistance of various state agencies will decide which water supply alternative(s) should be pursued in the future. The Tims Ford Pipeline alternative would likely be viewed as unreasonable if the water transfer would constrain economic growth in, or otherwise adversely affect residents of, the Elk River area. In anticipation of residential and industrial growth, TVA included large amounts of water for municipal and industrial water supply use in Tims Ford Reservoir. Based on the estimated population growth in Franklin and Moore counties, a surface water withdrawal of about 10 mgd could reasonably be expected by the year 2050. At the normal summer pool elevation of 888 feet, the reservoir holds 535,000 acre-feet of water and the estimated future water need of 10 mgd is small in comparison to the volume available. There would be enough water in Tims Ford reservoir to meet growing water needs in Franklin and Moore counties as well as supply water to the Duck River without impacting existing uses of the reservoir.

The water transfer to the Duck River from Tims Ford Reservoir would not be needed every year or for longer than 3 or 4 consecutive months at a time. In most years, the Duck River has enough water to meet even the projected future needs within the watershed. To evaluate potential impacts of a water transfer, TVA analyzed what would have happened during the severe drought of 1987-1988 if a pipeline had been withdrawing 22 cfs from Tims Ford Reservoir from June to October. The analysis showed that the withdrawal would have lowered the reservoir pool elevation by 8 inches in 1987 and 7 inches in 1988 during the recreation period. If Alternative E was to be considered for implementation, additional analysis would be performed to better document the potential impacts on the recreation pool level, as well as effects of increased water withdrawals by public water supply systems.

C21. *I believe business and residential water rates in the Duck River watershed should be increased to allow demand to match their local supply without "raiding" the Elk River's watershed. I do not want to sacrifice the Elk River merely to allow cheaper water rates in other areas.* **Ken McGarry, 13b**

Response to Comment C21: A review of existing water rates would be one of the first logical steps in implementing a water conservation program. One of the first adjustments that a water system could make would be to revise water rate structures to encourage conservation instead of water use. TVA believes it would be beneficial for all water systems to implement water conservation programs.

C22. *The document fails to discuss water conservation as an alternative or supplement to the action or no action alternatives. Efficient use of existing supplies can save money, obviate the need for additional water storage capacity, and prolong the use of existing supplies during shortages. Successful implementation of water conservation measures depends on regulatory action by state and local governments and management decisions by the local utility. Typical measures are codes and ordinances that mandate water conservation through the use of plumbing fixtures, use of reclaimed water, installation of meters, leak detection programs, rate structure changes, and public education programs. As previously indicated, voluntary conservation methods should be encouraged and employed regardless of the alternative selected, with incentives and disincentives provided by local authorities for complying customers. Conservation should target those activities that consume water (e.g., lawn watering) as opposed to those that return a large portion of the water to its source (e.g., wastewater).* **EPA, 51r**

Response to Comment C22: TVA agrees that water systems in the upper Duck River watershed should implement water conservation programs regardless of the outcome of this EIS. The typical conservation measures identified in this comment have proven to be effective in reducing water use. Specific components of water conservation programs implemented in the upper Duck River watershed could be tailored to the size and capability of each individual water supply system. The discussion of water conservation in Section 3.8 has been expanded to include this concept.

D. Alternative A - No Action

D1. *The most sensible and logical course is to use alternative "A" or take no action.* **Douglas K. Mitchener, 59a**

D2. *I believe the "no action", Alternative A is the correct course of action. The bunch of morons that stopped the Columbia Dam must reap what they sowed. If the dam could not be constructed because changes to the river threatened "the rich flora and fauna of the Duck River", then other changes to the river and local environment cannot be allowed, either. Sorry, Charlie.* **John Albright, 2**

D3. *Alternative A, the alternative of doing nothing, to me that is not an answer, so we should not even consider that.* **Wayne Romesberg, 72b**

D4. *Based on our evaluation of the Draft EIS, we agree that Alternative A (no action) is untenable given the projected population growth of this region.* **Leslie Colley, The Nature Conservancy of Tennessee, 44b**

D5. *Using the present resources is an untenable solution because the system is presently functioning near its limits.* **Marty Marina, Executive Director, Tennessee Conservation League, 58f**

D6. *One of the things that I know we do not need to do is to do nothing. One of the things that most concerns me, not only as a resident of Murray County but also as a businessman in Marshall County, is the ability to have water to use for not only drinking but for fire protection and all the many associated needs of water.* **Randy Short, 80a**

Response to Comments D1 - D6: Comments noted.

D7. *According to your introductory or cover letter accompanying this Draft EIS, the purpose of the Study was to identify "potential ways to meet the projected water supply needs..." Based on this statement, a "do nothing" alternative does not meet this basic criterion and is therefore academic.* **Frank M. Tamberrino. President, Maury Alliance, 66a**

Response to Comment D7: Consideration of the No Action Alternative is a required part of a NEPA review. In this EIS, the function of the No Action Alternative is to indicate what would happen in the area if nothing was done to address the projected future water needs. Routinely, the No Action Alternative establishes a baseline for evaluating the effects of the action alternatives.

E. Alternative B - Fountain Creek Reservoir

E1. *Build Dam on Fountain Creek.* **Joe P. Due, 49**

E2. *In favor of Fountain Creek Reservoir.* **Doug Wooten, 36**

E3. *In favor of Fountain Creek Reservoir for fishing.* **Steve Sacchinelli, 37**

E4. *I would choose the fountain creek option if I were to choose.* **Kent Curtis, 4a**

E5. *After reviewing all of the alternatives that were discussed at the public hearing in Columbia, it is my opinion that the Fountain Creek impoundment would be the best alternative for Marshall County.* **Terry Wallace, Marshall County Executive, 65a**

Response to Comments E1 - E5: Comments noted.

E6. *Fountain Creek Dam, I feel, would be helpful in our water supply. I believe the people of Maury County would support the Fountain Creek Dam. We need the water supply. I hope the damage to our land would be minimal* [c]*ompared to what has already been damaged by the Big dam project.* **Debbie J. Grissom, 68**

E7. *So the solution I see is B, the Fountain Creek Dam. Granted, it is more expensive but sometimes you do have to bite the bullet to solve a problem and this is the bullet. . . . . But in the long haul, I do feel like Alternative B, the Fountain Creek, is our best alternative for us, our children. and generations to come.* **Wayne Romesberg, 72g**

E8. *In looking at all the alternatives to having enough water for the area of Murray, Marshall, Bedford Counties and also Williamson County, I feel the best solution would be a reservoir in the Fountain Creek area. It's going to provide more water than all the other three alternatives combined. . . . . Let's build a reservoir; let's get it over with; and let's get on with the future.* **Randy Short, 80b**

E9. *The only long-term quality answer for Maury County is the reservoir on Fountain Creek. The money will come from local money and benefit the people of Southern Middle Tennessee. This resolves a problem that many people have realized existed for a long time - need for quality water supply. Its time has come. Dam up Fountain Creek.* **W. Roger Witherow, 11**

E10. *This department recommends a serious consideration of the Fountain Creek alternative, Alternative B, because it presents the greatest buffer or excess water availability for future use. Alternative B projects to give a 39-40 CFS excess over the 100 CFS baseline needed in the Duck River while C and E project to give excesses of only 10 and 2 CFS respectively and D will go below the baseline need. These figures are based upon the "no new heavy water users" projection.* **Wilton Burnett, Jr., Special Projects, Department of Economic and Community Development, 63b**

Response to Comments E6 - E10: Comments noted. Alternative B does have the potential to provide the most water to the Columbia area.

E11. *I think that the Fountain Creek impoundment would enhance the region of Marshall and Maury County by providing this two-county region with a source of water for drinking as well as recreation. The impoundment could also be used as an emergency*

source of water. A plan could be worked out for a water treatment plant to be built that could serve Marshall, Maury, and southern Williamson County with a water supply that could possibly connect a water grid system to help get water to parts of the counties that do not have a public water supply. **Terry Wallace, Marshall County Executive, 65b**

E12. *I am strongly in favor of the development of Fountain Creek Reservoir for several reasons. Firstly, it encourages economic enhancement in a positive and non-toxic (industrial) growth. Secondly, it would become a central recreational magnet for Colombians and surrounding counties to enjoy in every season. Lastly, it is an ample and manageable water supply that's not shipped in via pipeline from Normandy or Tims Ford. It would also demand that our ancient H_{20} treatment facility be upgraded to accommodate the lake. This alone, is a gain. Though I am aware that the estimated cost is higher for the lake project, the benefits our community would receive, far outweigh the cost of completion. We deserve to have this lake project completed after enduring all the burdens from the entangled Duck River Dam project.* **Marian J. Haynes, 48**

E13. *Certainly the Fountain Creek Reservoir would benefit all of lower Middle Tennessee in more ways than just water supply. Doesn't this community deserve this kind of economic and recreational stimulation after suffering the twenty-five year debacle of the Columbia Dam? With substantial resources and infrastructure already committed to support this proposal, let us move ahead with the commitment to finish this reservoir project. No other alternative redresses the travesty which has been the earmark of this project heretofore.* **Lewis P. Haynes, 40**

Response to Comments E11 - E13: Alternative B could supply a large quantity of water; however as indicated in Sections 5.4 and 5.11, protection of that water supply source probably would involve restrictions on recreational and other use of the reservoir.

E14. *The Fountain Creek Reservoir is the most practical solution to Maury County's and southern Williamson County's fifty year water needs, and does not disturb Duck River downstream. Alternative "B" Fountain Creek Reservoir appears to be the only solution Maury County can consider concerning the economical growth. Water is the first thing a prospective employer asks about. Depending on a pipe line supply or over-worked (90 miles away) Normandy Reservoir would bring the growth of our county to a halt: if not now, in ten to fifteen years. Maury and Williamson counties, along with the other partner along the path of the Duck River, cannot let the need for water impede our growth.* **Ralph G. Maddux, 23a**

Response to Comment E14: Each of the action alternatives could meet the projected water needs of the Columbia area through 2035 or 2050.

E15. [T]*he Board of Directors of the Maury Alliance, a public-private partnership for economic development in Maury County,* [has passed a resolution] *which clearly states our support for the Fountain Creek alternative. This alternative provides a long-term solution to the current and projected water needs of this area, much as the original dam was supposed to.* [T]*he Maury Alliance Board of Directors believes that: a) The recognized time for projected water demand to exceed existing water supply in the Columbia region is the year 2015 and that action to address the issue well before that time should begin now, b) The Fountain Creek Reservoir alternative can supply the*

largest amount of water of the proposed alternative, in fact almost the same volume as the other alternatives combined, and c) The Fountain Creek alternative is the best, most logical solution to an imminent water supply issue, best approximates the earlier and original conceptual solution to address the long-term water needs of the greater Columbia area and appears to be cost-effective from the preliminary analysis. **Frank M. Tamberrino, President, Maury Alliance, 47a**

Response to Comment E15: Comments and recommendations noted.

E16. *I am opposed to Alternative B (Fountain Creek Reservoir) on the basis of cost and habitat destruction.* **Dennis D. Horn,10b**

E17. *I oppose the environmentally damaging alternatives B&D.* **Louise Gnenflo, 25a**

E18. *I wish it known that I am strongly opposed to Alternatives B, D, and E.* **Robert F. Shanks, 34b**

E19. *TCWP strongly opposes the two alternatives, B and D, that are identified as having "substantially more potential for adverse environmental effects" and that would alter substantial areas through inundation and associated damages.*

- *Alternative B, construction of a 3,600-acre reservoir on Fountain Creek, would consume at least 3,600 acres (800 to be acquired plus 2,800 already in public ownership). It would also be by far the costliest alternative, estimated at $50 million.*

Liane B. Russell, for the Tennessee Citizens for Wilderness Planning Board of Directors, 30b

Response to Comments E16 - E19: Comments noted.

E20. *I was raised on Fountain Creek in my early years and the water there, when it gets dry, won't support a dam. Now this last summer on each Sunday, . . . after church I go over and check the water as it goes into Duck River and Fountain Creek would go through a 4-inch pipe at natural flow. There was no pressure at it's lowest stage before the first rain came.* **Glenn Stevenson, 78a**

Response to Comment E20: Available information indicates that a reservoir in the Fountain Creek watershed similar to that evaluated under Alternative B would receive enough rainfall during even a drought period to meet the projected needs of the Columbia area through 2050.

E21. [T]*here are concerns with the Fountain Creek Proposal . . . . Water quality issues are the main concern with the Fountain Creek Reservoir proposal. The Division is concerned that the iron and manganese levels and aquatic growth will cause a water quality issue for the customers of the Columbia Water System.* **W. David Draughon, Jr., Division of Water Supply, TDEC, 62c**

E22. *Impoundment of Fountain Creek would create a relatively small, shallow, nutrient rich reservoir. As a public water supply, such a reservoir may experience significant taste and odor problems. Fountain Creek Reservoir would provide ideal habitat for aquatic plants, algae, and phytoplankton. Seasonal oxygen depletion at depth would result in the build up of dissolved minerals including iron and manganese. In addition to loss of the relatively diverse community of fish and aquatic life currently supported by Fountain Creek, an impoundment may result in seriously degraded tailwater*

discharges. Oxygen depletion, elevated dissolved minerals, hydrogen sulfide, and significant fluctuations in flow, could contribute to water quality and habitat degradation in the tailwaters and the Duck River. When combined with anticipated loss of wetlands, Alternative B has potential for serious negative environmental consequences. **Abrey McKinney, Environmental Services Division, TWRA, 61a**

E23. *Page 147 indicates that the Fountain Creek watershed that would contain the reservoir proposed under Alternative B "...contains relatively high levels of nitrogen and phosphorus from natural sources as well as non-point sources." This page further states that "[t]hese levels of nutrients would be quite likely to support excessive algal growth in the upper layers of the reservoir." Page 149 similarly states that "...construction and use of the Fountain Creek water supply reservoir would create a relatively small, nutrient-rich reservoir which probably would have to be carefully monitored and the watershed strictly managed to protect the quality of the source water." Accordingly, EPA is concerned that the Fountain Creek Reservoir proposed under B could become eutrophic and not comply with the Clean Water Act.* **EPA, 51s**

Response to Comments E21 - E23: The information available to TVA indicates that each of these water quality effects could occur. If Alternative B was implemented, each of these issues would have to be addressed to protect the water supply source and downstream uses of the Duck River.

E24. *Of the four presented action alternatives (B-E), EPA does not environmentally favor the construction of Fountain Creek Reservoir. This is due to the projected substantial loss of forested wetlands and uplands, potential ground-water effects due to local karstic geology, the potential for shoreline development and its associated impacts on water quality, the expectation for a small nutrient-rich reservoir with a slow flushing rate which may result in noncompliance with water quality standards associated with eutrophication, the potential for aquatic ecology effects downstream of the proposed dam due to reduced flows, the need to acquire an additional 800 acres of land, the uncertainty of the undocumented impacts of the new water treatment plant and associated five-mile long pipeline, and the existence of two nearby reservoirs (Normandy and Tims Ford) which might be utilized.* **EPA, 51k**

E25. *Of the four action alternatives, the Fountain Creek Reservoir (Action Alternative B) is the least favorable. This alternative will result in the greatest costs, both environmental and economic. The Draft EIS projects a net loss of 140 species, a loss of 200 acres of wetlands which would probably result in mitigation costs, a considerable expense for dam construction and the maintenance of long-term water quality in this reservoir, and the greatest negative impact on prime farmland and community noise. The projected benefit of additional water volume of 74cfs is contingent upon the function and capacity of this reservoir in an area that is characterized by karst geology and seldom has surface water in even mild drought conditions. While addressing the projected water needs for Maury and southern Williamson counties, the Fountain Creek reservoir may provide no benefit to residents of Marshall and Bedford counties.* **Leslie Colley, The Nature Conservancy of Tennessee, 44c**

Response to Comments E24 - E25: These comments summarize many of the potential adverse effects which could be associated with Alternative B. By way of clarification, the available information indicates that the stream-dwelling species which would be displaced by the reservoir also occur in many other streams in the adjacent part of the Duck River watershed.

E26. *I also object to damming Fountain Creek (Alternative B). Please consider the environmental impact and the cost effectiveness of the proposed alternatives. Short Springs and the Fountain Creek water shed deserve protection for future generations and most importantly, the diverse life present there.* **Kevin C. Fitch, 54b**

Response to Comment E26: Each action alternative would have both benefits and adverse effects. The challenge in projects such as this is to maximize as many of the benefits as possible while avoiding or minimizing the potential adverse effects.

E27. *Building Fountain Creek Reservoir is an expensive alternative, reminiscent of choices made in the '60s and '70s. TVA and its stakeholders will do well to learn from previous experience and save itself and the taxpayer's dollars by choosing another scenario. This area of Fountain Creek is not suited to a reservoir because of the shallow water depth. As noted in the draft EIS, the Fountain Creek Reservoir will be a shallow, nutrient rich reservoir. By definition, we believe it will provide a poor water supply and poor aquatic habitat. It also has a potential for creating more public expectation and suffering the same sociological conflicts over resources presently experienced on TVA's Nickajack, Chickamauga and Guntersville reservoirs. These were unintended consequences in those areas. Neither TVA, the state, or county governments can afford the cost of managing the natural resource conflicts and it would be inexcusable to knowingly create them. Further, building the reservoir will cause biological loss and maintaining it under low dissolved oxygen and low flow circumstances will likely to continue this trend.* **Marty Marina, Executive Director, Tennessee Conservation League, 58g**

E28. *I feel that the Fountain Creek option should be given the lowest priority ranking of the five options. The capital cost (given the actual water demand) is excessive. The project is essentially "overkill", and the amount of environmental/ social destruction is therefore unwarranted. The operational costs will also be exorbitant, given the regional attitude to develop every water body as a luxury golf course development. The best the locals could hope for would be a Radnor Lake scenario.* **Richard E. Lockwood, 31b**

E29. *The Fountain Creek Dam Alternative is fraught with both opportunity and limitations. This alternative appears to provide an adequate water supply. The Columbia Dam land use EIS, associated deed restrictions and agency agreements provide for environmental mitigation. Other permit issues must be resolved before project approval. Moreover, reservoir's shallow nature creates challenges for water quality. In no event, however, should the Fountain Creek Dam alternative be abandoned until provisions have been made for an adequate water supply through 2050.* **Justin P. Wilson, Deputy to the Governor,43d**

Response to Comments E27 - E29: These comments highlight the serious, long-term considerations which will have to be carefully evaluated before a decision is made concerning this alternative. All of the potential adverse effects would have to be resolved or substantially overshadowed by the expected benefits before this alternative should be built.

E30. *The land currently reserved for alternative "B" (Fountain Creek) should be retained in that status for the foreseeable future. TWRA would be allowed to operate the land area with a ban on any permanent structures. This would remain a possible impoundment area.* **Douglas K. Mitchener, 59g**

E31. *All land presently owned by TVA/ State of Tennessee shall be managed by TWRA. None should be sold to the public or be allowed to be squandered by our local govts* [governments ?]. *This 12,600 acres will be a jewel of this area if left whole and not systematically sold or developed. Our local govts and agencies cannot handle owning any of this land. They will turn it into trailer parks. The people that gave it up and our next generation deserve better.* **Mike D. Penrod, 67b**

Response to Comments E30 - E31: At present, the federal land in the Fountain Creek watershed is proposed to be transferred to the State of Tennessee with restrictions on its use that were described under the preferred alternative in the 1999 Land Use EIS. Those restrictions would exclude many kinds of activities on the land and maintain the possibility of building a water supply reservoir in the Fountain Creek watershed until 2050 or when a decision was made not to build such a reservoir.

E32. [W]*e recognize that the Fountain Creek Reservoir would apparently become part of the TVA system and would therefore be managed by TVA, which has demonstrated significant expertise and success in reservoir management.* **EPA, 51l**

Response to Comment E32: Information presented in Section 1.3 and 3.2 indicates that TVA is not proposing to design or construct any of these alternatives. While any reservoir built in the Fountain Creek basin would be within the Tennessee River watershed, TVA is not planning to manage such a project.

E33. *The Fountain Creek proposal is costly, of high environmental and landowner impact, and has risk of failure for the same reasons Columbia Reservoir Project failed.* **John M. Procter, Elk/Duck River Chapter, Trout Unlimited, 60b**

Response to Comment E33: The EIS identifies all of the known issues which would need to be evaluated before a decision is made to construct any additional water supply project(s). Both the EIS and many of the comments on that document highlight issues about a possible reservoir which would have to be addressed before such a project should be built.

E34. *Before you get too excited about any one of these alternatives, take a good look at the people who are going to have to give up their homes and their farms. We've done it once, it didn't work. Fool me once, shame on you; fool me twice, shame on me. And he who would ignore history is doomed to repeat it. Please dear God, let there be a wise head in this crowd. Don't do it again.* **Carolyn Derryberry, 74c**

E35. *There needs to be somebody to check this out to see if the environmentalists are going to let you build* [a dam] *before you go out there and start taking land like you did before. They got the cart before the horse the last time and they went out there and started taking land and then they found out they couldn't complete it. The blame was laid on Congress. They said Congress gave them the money and told them to do it and that's the reason it was done. The three Judges we stood before in Cincinnati told our lawyers that we needed to take this to Congress and it's their job to straighten it up and that's where it's at today, in Congress.* **William Derryberry, 73c**

Response to Comments E34 - E35: All of the important issues associated with building and operating this reservoir should be resolved before any action is taken to move people off of their land. TVA and the other cooperating agencies are very much aware of the anguish many people in the Columbia area feel about the loss of their land for a reservoir project that was never built.

E36. *Very little has been said about the recreational advantages this project offers. Our city and county elected officials have made the county a recreation center and are attempting to do more at the present time with the land that has been purchased by TVA. The people are paying 5 cents per 1000 gallons of water used. The Fountain Creek Reservoir is a part of the Columbia Dam project. So lets finish a part of the Columbia Dam Project.* **Ralph G. Maddux, 23b**

E37. [T]*he average depth* [of a Fountain Creek Reservoir] *would only be 19 feet. I don't know about you but I see a few sportsmen out here, 19 feet would be some pretty good fishing, especially for some Crappie and Brim and that's what I enjoy fishing for. We didn't talk about the recreational uses. There will be recreational uses for Fountain Creek.* **Wayne Romesberg, 72h**

Response to Comments E36 - E37: As described in the Land Use EIS, the recreation benefits that were part of the Columbia Dam Project are now proposed to be met in the future uses of the land along the Duck River. As described in Section 3.4, the purpose of Alternative B would be water supply. Also as described in Sections 5.4 and 5.11, recreational and other uses of the reservoir probably would have to be substantially restricted to protect the quality of that water supply.

E38. *The cost, I'm not sure about the dollar figures I've seen tonight because I don't know if we are talking about today's dollars or tomorrow's dollars. If it's tomorrow's dollars, I would say you are way out of line.* **Randy Short, 80c**

E39. [T]*he . . . approximate $50M cost* [of a Fountain Creek Reservoir], *it was also put in that could be plus or minus 30%. Well that means if we watch our construction cost, this dam could be completed for as little as $35M if we pinch pennies. If we don't pinch pennies, it could $65M. I also noticed when we talked about the pipelines, we never did say if that was going to be plus or minus 30%, Being that it was not said, I am going to assume that it wasn't so when we are looking at possibly a $35M versus some of these $11M and $18M alternatives, hey we are in the neighborhood.* **Wayne Romesberg, 72i**

Response to Comments E38 - E39: The "order of magnitude" cost estimates included in the EIS have a wide accuracy range ($\pm$ 30 percent) and were presented only to help compare the alternatives. The present (Year 2000) cost estimates would be refined considerably as details of the project(s) were identified.

E40. [I]*f we do decide to go with Alternative B, what we need to do is make a solid commitment behind it, no bailing out from pressures of any group. I don't know if TVA will even have anything to do with it, but if they do, I would like to make sure that TVA does fight for Fountain Creek like they did fight for Tellico years ago because when they fought for Tellico, they won all the way to the Supreme Court.* **Wayne Romesberg, 72k**

Response to Comment E40: Federal and state agencies can evaluate future water needs on a regional scale, identify conceptual options, and conduct generic evaluations of those options. Meeting the day-to-day water needs of the Columbia area will require the leadership and cooperation of local agencies and officials. TVA itself is not planning to build or operate a reservoir on Fountain Creek.

E41. *I think that the Fountain Creek Dam would probably do a lot to settle a lot of emotions and a lot of the defeated attitudes around here, that finally somebody has a chance to do something right in this county if they can follow through.* **Sharon Vaughn, 79c**

Response to Comment E41: TVA also is very much aware that the Duck River Project has been "underway" for over 30 years and that most of the "activity" has been conflict between one group and another. Completing the last part of this project (identifying ways to meet the water needs) will allow everyone to close out this part of our history and focus on new opportunities.

E42. [T]*he Maury Alliance Board of Directors recommends that: a) work begin on the planning and financing of the Fountain Creek alternative in order to meet the timetable necessary to avert any potential water shortage issues, and b) TVA and the State of Tennessee support local and regional agencies in their pursuit of their collectively agreed upon best alternatives to water supply and wastewater disposal that benefit the community, its residents, and the quality of life in middle Tennessee.* **Frank M. Tamberrino, President, Maury Alliance, 47b**

Response to Comment E42: TVA has prepared this EIS to help everyone in the upper Duck River basin understand the alternatives that are available to meet future water needs and the potential effects those alternatives could have on the area. Now, local water supply agencies have to consider all of the available information, develop detailed plans for likely alternatives, and gain public support for those projects.

F. Alternative C - Downstream Water Intake

F1. *Please opt for the river mile 100 intake alternative.* **P. F. Clemens, 22**

F2. *I have looked over the alternatives proposed, the one outlining a downstream intake for Columbia appears to be the least damaging and also the least expensive.* **Jeff Stewart, 52b**

F3. *Of the four alternatives presented, "Alternative C Downstream water Intake", provides the most water in cubic feet per second for the least cost and has the least potential for adverse environmental effects.* **Marjorie S. Collier, President, Friends of Short Springs, 27e**

F4. *After studying the Draft EIS, Executive Summary, of the Future Water Supply Needs in the Upper Duck River Basin, and consulting respected knowledgeable individuals concerning the potential impact of the alternative proposals to address such needs, I have concluded that Alternative C would be in the best long run interests of area residents. Please, then, show that I favor Alternative C.* **Robert F. Shanks, 34a**

F5. *As a lifelong resident and owner of river bottoms and banks along the Duck River below Normandy Dam, I would like to ask support from TVA for Alternative C (Downstream Water Intake) in what would seem to be the most practical and least objectionable answer to providing more water for Columbia and other downstream communities.* **Polly Dement Oettinger, 41a**

F6. *Of the options listed for assuming a water supply for Maury/ Williamson counties in the Upper Duck River Basin, I believe the Duck River Interface Conduit at mile 100 plan is the one to implement and I cast my vote in its favor. We need to use and conserve our water reservoir carefully and I appreciate TVA's efforts to do so.* **Henry Lewis, 21**

F7. *Of all the solutions offered, it appears that the only logical path is the "Duck River Intake Conduit" at river mile 100. This would provide the longest supply for the best price and would avoid doing harm to the Short Springs State Natural Area. The State Natural Area was declared after many years of work and study. It is a place of natural beauty to be preserved as the town and county continue to grow.* **Angela B. Arnold, 19**

F8. *Of the five alternatives presented to supply the water needs of the Upper Duck River Basin, Alternative C (Downstream Water Intake) is the preferred alternative. This alternative is the most cost effective. In terms of cost per cubic foot of water supplied, Alternative C is the lowest cost by over a factor of two! Alternative C will also provide the required water needed through the year 2050. . . . . Alternative C is the only alternative that meets the water needs at a reasonable cost and is not detrimental to the environment.* **Dennis D. Horn, 10a**

F9. *After an open discussion, we unanimously agreed that the Downstream Water Intake is the least objectionable proposal . . . . for the benefit of the Elk and Duck River tailwaters. Additionally it is the least disturbing for communities in the Duck River basin outside the need area of Columbia. The EIS was very thorough, and although it lacks in specific detail regarding issues important to preserving cold water fisheries, there is plenty of information to conclude this best option. Second lowest cost, least*

environmental impact, proximity to need (Columbia), shortest pipeline, sufficient cfs increase to satisfy 2050 projections, all clearly support this option. There is little water need downstream of Columbia, so it seems most just for Columbia to draw water closer to home and without impacting a larger population outside this need area upstream. **John M. Procter, Elk/Duck River Chapter, Trout Unlimited, 60a**

Response to Comments F1 - F9: Comments noted. Present information concerning the effects of each alternative are discussed in Chapter 5 and are summarized in Section 3.9.

F10. *I support one of the pipeline alternative (C&E) with C probably being superior to E.* **Louise Gnenflo, 25b**

F11. *Alternatives C and E, respectively, will provide the most cost effective results, will provide longer-term results, and are the least destructive to the environment.* **Kevin C. Fitch, 54c**

F12. *There are two alternatives, C and E, that would cause less land disturbance and have far less potential for adverse environmental effects. Of these, Alternative C supplies more water, requires a shorter pipeline, and is less costly than Alternative E (Tims Ford pipeline). For these reasons Tennessee Citizens for Wilderness Planning prefers Alternative [C]. If, however, other environmental considerations (e.g., significant habitat) should make Alternative E preferable, it would be acceptable to us.* **Liane B. Russell, for the Tennessee Citizens for Wilderness Planning Board of Directors, 30d**

F13. *Action Alternatives C and E (the Downstream Water Intake and the Tims Ford Pipeline, respectively) present solutions that The Nature Conservancy believes are more positive and balanced. Both of these alternatives have lower projected environmental impacts than Alternatives B and D and are an order of magnitude less expensive than the Fountain Creek reservoir. An intake below Columbia at Duck River Mile 104 would meet projected needs for Maury and southern Williamson counties but does not address potential water needs in Marshall and Bedford counties, particularly if population growth in these counties exceeds projections. . . . . Concerns that surround Alternatives C and E include construction of the pipeline, placement of the discharge point, increased erosion and turbidity, alteration of water temperature, and transfer of species. However, these concerns would ultimately be addressed during the design and implementation process.* **Leslie Colley, The Nature Conservancy of Tennessee, 44f**

F14. *This letter is in opposition to all the alternatives proposed in your Draft Environmental Impact Statement on the Future Water Supply Needs in the Upper Duck River Basin. We regard the proposed alternatives as a highly undesirable course of action for several reasons.* [Comments are provided in several subject areas] *However, if any of the proposed alternatives must be chosen, we support Alternative C: Downstream Water Intake.* **Environmental Science Graduate Students, University of Tennessee at Chattanooga, 33a**

Response to Comments F10 - F14: Comments noted.

F15. *Additional consideration of low-flow impacts from implementation of Alternative C, the pipeline to downstream reaches of the Duck River, should be further evaluated and discussed. All impacts should be weighed and assessed to contrast each alternative fully.* **Justin P. Wilson, Deputy to the Governor,43h**

F16. *It is difficult to assess the impact of this alternative without having solid information on future cumulative withdrawal demands on the Duck River, including direct industrial and agricultural use. As the percentage of Duck River low flow comprised of treated wastewater increases, there is a corresponding increase in the vulnerability of Duck River fish and aquatic life to pollution episodes. The potential adverse impacts of this alternative during periods of extended low flow should be further explored.* **Abrey McKinney, Environmental Services Division, TWRA, 61b**

F17. *Taking water from downstream of the Columbia discharge needs more information before it can be a viable choice. This EIS does not consider construction or low-flow impacts to ground water, surface water, aquatic life, terrestrial life, or endangered species. Further it does not address consequences to the supply or biological life from continuously recycling water so close to the outflow pipe. What will be the attendant cost of wastewater and freshwater treatment or biological loss?* **Marty Marina, Executive Director, Tennessee Conservation League, 58h**

Response to Comments F15 - F17: The information presented in Section 3.9 summarizes and compares what is known about the potential effects of each alternative on the environment. As indicated there and in the more detailed discussions presented in Chapter 5, the present concept of this alternative would not reduce the flow downstream from the new intake below 100 cfs or substantially degrade the quality of aquatic habitat conditions in that area, but would offset or augment the flow and habitat conditions in the river downstream from the present Columbia water intake. As with each of the other alternatives, the likely effects of Alternative C would have to be confirmed and updated as the specific details of the project(s) were developed.

F18. [T]*here are concerns with . . . pumping water from below Columbia back to the water treatment plant. If water is to be pumped from below Columbia back to the plant, it is suggested that the discharge be into the Duck River below the intake. This would provide the additional water to meet the low flow conditions established for the Duck River while allowing Columbia to withdraw more water from the Duck at the current intake location. The Division is not receptive to the idea of using this returned water in the intake.* **W. David Draughon, Jr., Division of Water Supply, TDEC, 62d**

Response to Comment F18: This suggestion is a subject which local agencies may want to consider if they choose to pursue some form of Alternative C. As indicated in Sections 3.10 and 5.4, the existing treatment plant in Columbia does not have the capacity to treat all of the water that is projected to be needed starting some time after 2015. If additional space for expansion of the water treatment plant becomes available in Columbia, local interests might consider withdrawing all of the needed water through the existing intake and, when necessary, augmenting the flow in the river using water withdrawn some distance downstream. Alternative approaches already mentioned in the description of Alternative C in Section 3.5 include treating water from a downstream intake closer to the source or closer to customers living in that part of the service area. As indicated in Section 5.4, the water in the Duck River near River Mile 100 presently meets all applicable water quality criteria and is classified for domestic water supply use. Especially if all appropriate source water protection measures were followed, TVA sees no reason why a municipal water supply intake could not be located in that part of the river.

F19. *Alternative C is Cathy's Creek Pumping Station. I don't believe this is an acceptable alternative because I don't know about you all but I don't think the idea of drinking my own sewer water is acceptable. I understand the people in California have been doing that for years and we see some of the problems they have.* **Wayne Romesberg, 72c**

Response to Comment F19: Water is a finite resource that we all use, treat, and recycle on a daily basis. In fact, some water used in Columbia has passed through both the Shelbyville and Lewisburg wastewater treatment plants before it was withdrawn from the river. Standard treatment methods are adequate to ensure that this common practice poses no risks to human health.

F20. *I don't know whether the thing that Mr. Jacobs just talked about* [Tims Ford Pipeline] *is the best or not. I feel like you start at the head of a stream when you want to get some water and I feel like we're going to do just like he said, leave Marshall County and Bedford County out if we go down below Columbia and start pumping water back up here. We let it get by us, maybe we just need to stop it somewhere.* **Jack Craig, 77b**

Response to Comment F20: Comment noted.

F21. *Alternative "C" could be implemented at a later date and put into service in approximately 30 months.* **Douglas K. Mitchener, 59f**

Response to Comment F21: TVA has not attempted to estimate the construction time associated with any of the action alternatives. The length of the construction period would depend on the size and type of any new water treatment plant and the lengths of any new supply lines and/or new distribution lines which would be included in the project. Pipelines can be built in just a few months; other facilities often take substantially longer.

G. Alternative D - Raise Normandy Pool Level

G1. *The Division believes the Normandy Dam proposal will help ensure the needs of the area until 2050 and is not opposed to this alternative.* **W. David Draughon, Jr., Division of Water Supply, TDEC, 62b**

G2. *The League has investigated the choices and believes raising Normandy Dam to be the optimal choice. . . . . As usual, we look forward to supporting TVA in creating a well-balanced solution to this issue.* **Marty Marina, Executive Director, Tennessee Conservation League, 58a**

G3. *Raising the Normandy pool level has a moderate cost and the best chance of answering short and mid-term supply, with minimal biological or sociological impacts. While there will be some short-term loss, this alternative seems to accommodate management of the State Natural Area for its intended purpose and other habitat concerns at the reservoir. It will also improve present habitat conditions on the Duck.* **Marty Marina, Executive Director, Tennessee Conservation League, 58i**

Response to Comments G1 - G3: Comments noted.

G4. *I feel that the highest priority ranking should be given to the Raise Normandy Dam option, but with serious reconsideration of a water conservation method in the Columbia area* [including the use of cisterns]. **Richard E. Lockwood, 31c**

Response to Comment G4: The use of cisterns could be one way of conserving water in the Columbia area under this or any of the other alternatives.

G5. *As far as the Normandy Dam, that would be fine to raise it as high as you could go but that is going to be hard to do with those people up there.* **Glenn Stevenson, 78c**

G6. [I]*f you raise the dam up at Normandy five feet, you are going to cover up some more land; you're going to dislocate some more people; you're going to have all kind of problems.* **Ed Jacobs, 76d**

Response to Comments G5 and G6: As indicated in Section 5.10, all of the land which would be affected by raising the Normandy pool five feet is already owned by the federal government; no private land would be required to complete that project as it is presently defined.

G7. *We recommend the Final EIS attempt to more fully predict the impact Alternative D would have on water quality in both the reservoir and Normandy tailwaters. Of particular interest is the quality of water available for tailwater release and as provided to TWRA's Normandy Fish Hatchery. This alternative may well improve the quality and quantity of tailwater releases, providing a significant environmental benefit to the Duck River while resolving the water supply issue.* **Abrey McKinney, Environmental Services Division, TWRA, 61c**

Response to Comment G7: Section 5.4 presents the results of a careful evaluation of the possible effects of this conceptual alternative on both the water quality in Normandy Reservoir and in the Duck River downstream from Normandy Dam. If this project was proposed to be built, these results would be confirmed or refined during an evaluation using the detailed construction and operational plans that would have been developed.

G8. *The Friends of Short Springs . . . . are strongly opposed to Alternative D, "Raising Normandy Pool Level 5 Feet"* **Marjorie S. Collier, President, Friends of Short Springs, 27a**

G9. *Action Alternative D (raising the pool level of Normandy Lake) would not meet projected needs beyond 2035 and is second only to impounding Fountain Creek in potential negative environmental impacts.* **Leslie Colley, The Nature Conservancy of Tennessee, 44d**

G10. *I oppose the environmentally damaging alternatives B&D.* **Louise Gnenflo, 25c**

G11. *Cities upstream from Columbia are not interested in Columbia's future and will oppose alternatives "D" and "E".* **Douglas K. Mitchener, 59c**

G12. *I also wish it known that I am strongly opposed to Alternatives B, D, and E.* **Robert F. Shanks, 34c**

Response to Comments G8 - G12: Comments noted.

G13. *I certainly do think it is advisable to do this planning and be concerned about future water demands but I think we need to take into account the affect on the environment and economics of the situation and make the make* [?] *choice. Clearly, Normandy pool level raising should be ruled out.* **Marjorie Collier, 75b**

G14. *I am opposed to Alternative D (Raise Normandy Lake Level) on the basis of cost and habitat destruction. . . . I am opposed to Alternative [D] (Raise Normandy Lake Level) because that would be detrimental to the Short Springs State Natural Area. This alternative will not satisfy the water needs through the year 2050. Alternative D is not the most cost effective option.* **Dennis D. Horn, 10c**

G15. *This correspondence is to register my opposition to the proposed alternative to "Raise the pool level on Normandy Reservoir." If implemented, this action would destroy the richest and most environmentally valuable part of the Short Springs State Natural Area lying downstream of Machine Falls and along Bobo Creek. This is more environmentally damaging than other available alternatives and provides only a short term solution to Columbia's water needs.* **J. P. Christopher, 42**

G16. *I am writing regarding the possibility of flooding of the Short Spring Natural area to provide water for Columbia, Tennessee or another area. The lower portion is a beautiful area for wild flowers, some of which are native to that area only. Much work has been done to make this area accessible to groups to hike and enjoy one of God's many gifts. I would like to go on record in strong opposition to raising Normandy Dam (Alternative D). It would be complete destruction of a natural area which violates the Act of 1971, Natural Areas Preservation.* **Agnes Miller Smedley, 46**

G17. *I am writing to urge TVA not to raise the Normandy Lake level five feet for the purposes of providing additional water to the Columbia, TN area (Alternative D). . . . . Please consider the environmental impact and the cost effectiveness of the proposed alternatives. Short Springs and the Fountain Creek watershed deserve protection for future generations and, most importantly, the diverse life present there.* **Kevin C. Fitch, 54a**

G18. *My understanding is that if the Normandy dam is raised, Short Springs will be* [?] *about five feet. Short Springs consists of two small ravines, and raising the water level five feet will flood the bottom land where most of the wildflowers are. It will flood out the trails that lead to Machine Falls and wander along Bobo creek. Because of the steepness of the slopes, new trails above the waterline will be impractical. Most of the spring water in the area appears just prior to the two main creeks entering Normandy lake. Raising the lake will effectively submerge a couple of large springs on Bobo creek and will reduce the 'dean' spring water exposure from Machine Falls to just a few feet. In addition, all of the flotsam and jetsam associated with lake coves will inundate the Short Springs area and greatly affect its beauty.* **Jeff Stewart, 52a**

G19. *TCWP strongly opposes the two alternatives, B and D, that are identified as having "substantially more potential for adverse environmental effects" and that would alter substantial areas through inundation and associated damages.*

- *Alternative D, raising the height of Normandy Dam, and the pool level of Normandy Reservoir, by 5 feet, would, (a) have disastrous effects on prime wildflower habitat in the 420-acre Short Springs State Natural Area NE of Tullahoma, and (b) flood a 60-acre TVA Small Wild Area adjacent to the Natural Area. Further, this is the only Alternative that fails to meet the water-supply objective. Thus, the additional water volume supplied by Alternative D is only 16 cfs (instead of the 22 cfs minimum objective), and the water needs would be met only through the year 2035 (instead of through 2050).*

Liane B. Russell, for the Tennessee Citizens for Wilderness Planning Board of Directors, 30c

G20. *I'm Marjorie Collier; I'm from Tullahoma; I'm President of Friends of Short Springs, which is a support group for Short Springs state natural area, which is located in the city limits of Tullahoma in Coffee County and lies adjacent and part of it's along the Normandy impoundment. We object very strongly to the option of raising the Normandy pool level five feet. Our objections are fourfold:*

- *it is environmentally destructive of a state natural area. It would come up over the lower part of the natural area where two creeks come together below a beautiful waterfall and has an outstanding group of wildflowers in that area. It's very rich. The state of Tennessee designated the area as a designated state natural area under the Natural Area Preservations Act and, at that time,*
- *it would be illegal, frankly, to come up and inundate, raise that level five feet onto that natural area. Not only environmentally destructive but really illegal to do that to a designated natural area. TVA set aside 60 acres along the Normandy impoundment as a small wild area and, when the state made it a designated state natural area, that 60 acres became part of it.*
- *it's not the most economical alternative. The cost of getting water downstream from Columbia is half the cost of the Normandy alternative and the downstream alternative is also much less environmentally damaging than the Normandy alternative.*
- *The fourth objection we have is that the Normandy alternative would not meet projected future demands beyond the year 2035 and the other three will meet the projected future demand up to year 2050 or even later than 2050.*

Marjorie Collier, 75a

G21. *Under Alternative D, the suggested maximum pool of Normandy Lake would be raised from 875 feet to 880 feet. Alternative D would flood portions of Short Springs*

Designated State Natural Area along Bobo Creek at contours below 880 feet during the normal maximum pool elevation of the reservoir. The bottom-land habitat receives seasonal inundation. By raising the lake level there would be prolonged periods of occasional inundation as well as longer periods of more permanent flooding of the habitat. We would expect this habitat and associated biological diversity to change community type and floristic composition along with the associated forest habitat. The forest type is a high quality mesic area with rich displays of spring wildflowers along Normandy Lake between the 875 and 880-foot contours. These areas could be impacted by inundation under Alternative D and could significantly impact the natural area through the destruction of the flora and fauna depending upon the timing and duration of inundation. This impact is cited in table 7 on page 63; however, it is not mentioned in the impacts described under Alternative D pages 48 - 56. The environmental impact of flooding the bottomland riparian forest could be a violation of Natural Resources Areas Rules, {TCA Section, 0400-2-8-.08 Intrusions, 0400-2-8-.22 Water Level Control} and may require additional Departmental permits for wetland impacts. **Andrew N. Barrass, Environmental Review Coordinator, Division of Natural Heritage, 641**

Response to Comments G13 - G21: Comments noted. The potential significant adverse effects of this alternative on part of the Short Springs Natural Area are presented in Section 5.11 and are summarized in Section 3.9. If the pool level of Normandy Reservoir was to be raised, appropriate measures should be included in the project to avoid or mitigate those adverse effects on this Natural Area.

G22. *Raising Normandy Dam has additional benefits independent of the water needs identified in this study.* **Justin P. Wilson, Deputy to the Governor,43f**

Response to Comment G22: The focus of this EIS is on meeting future water supply needs. If Alternative D was proposed to be built, the detailed plans for and evaluation of that project should include all of the benefits and potential adverse effects which could occur. Local planners probably would appreciate input from state agencies on the possible benefits of this project, as well as state agency perspectives on its possible adverse effects.

G23. [Under Alternative D,] *An increase in shoreline erosion associated with additional access to Federal lands, encouraged by the proposed raising of water levels, could result directly in an increase in water pollution (especially sedimentation). The Draft EIS does not provide documentation for adequate protection of natural resources that could result in net losses of the State's biological and natural resources as well as increases in shoreline erosion. Perhaps TVA could suggest shoreline management strategies that would be implemented to protect natural resources and biodiversity if this alternative were selected.* **Andrew N. Barrass, Environmental Review Coordinator, Division of Natural Heritage, 64o**

G24. [T]*he proposed Alternative D could increase shoreline erosion, decrease water quality, reduce aquatic habitat, manipulate and significantly reduce forested and riparian habitat, and reduce contiguous forested tracts (communities) simply as a result of prolonged inundation by sustained higher lake levels. We suggest that TVA fully document these losses and compare them to anticipated habitat improvements associated with increasing the lake shoreline area by raising the lake levels. Managed shorelines, with increased efforts toward restoring habitat (particularly by erosion control through bioengineering techniques), are paramount to long term water quality improvements and protection of the State's rare, threatened or endangered species. By*

utilizing specific reservoir-wide management strategies throughout Normandy Lake, TVA could demonstrate habitat improvements associated by raising the lake levels with increasing the lake shoreline area. Additional documentation is needed to outline steps that will be taken by TVA to protect the current recreational uses and diverse habitat along the shoreline. **Andrew N. Barrass, Environmental Review Coordinator, Division of Natural Heritage, 64p**

Response to Comments G23 and G24: If this alternative is proposed to be built, the detailed evaluation of possible effects on the environment would need to include a wide variety of subject areas, probably including all of the issues mentioned in these comments. As indicated in Section 3.6, all of the work on this project would be conducted using appropriate methods to minimize construction impacts and to comply with pertinent NPDES permits. Operation of the enlarged project probably would include measures to maximize recreational and other benefits around the reservoir and to avoid or minimize adverse effects to natural resources in the area.

H. Alternative E - Tims Ford Pipeline

H1. *I support one of the pipeline alternative (C&E) with C probably being superior to E.* **Louise Gnenflo, 25d**

H2. *Based on information provided by the EIS, the Tennessee Department of Environment and Conservation's Division of Water Supply states that the Tim's Ford pipeline alternative provides the highest quantity and quality water. This alternative may also provide benefits to other communities along its route who face increasing water needs.* **Justin P. Wilson, Deputy to the Governor,43e**

H3. *After careful review of the alternatives discussed, the Division of Water Supply is of the opinion that the Tims Ford alternative is the best alternative for meeting the water supply needs of the Columbia area. Tims Ford Lake has the best water quality of any of the alternatives presented. It also has the quantity available to supply the 2050 demand in Columbia. An added benefit is that it could be designed to help with any underestimation of water demand in the Shelbyville/Lewisburg area. This is an alternative that adds additional water to this area.* **W. David Draughon, Jr., Division of Water Supply, TDEC, 62a**

H4. *As you have already heard, each plan has been discussed here, each one has pretty well been opposed, and the pros and cons on it. I won't try to get into arguing about which one and why you might have some complications, but the simplest thing that I see and, actually, I proposed it when we had out meeting here before about the pipeline. If you've ever been on Tims Ford, it's a big lake. It's got a lot of water and no doubt that water is not being used. They aren't letting it out and the reason I proposed the pipeline is real simple. As they have already told here tonight, you can run the pipeline down the road, and it will only have to be used two or three months out of the year. If you don't need it, you don't have to use it.* [It is] *one of the cheapest forms of answering our problems. . . . . With a pipeline, you're not bothering anybody. You're guaranteed you got the water - you know you got it. There's not any problem with it. So to me, I'd like to say that the pipeline is the simplest, the best, and the most economical to operate, . . . and it's got the best future for it too without creating any problems.* **Ed Jacobs, 76b**

Response to Comments H1 - H4: Comments noted.

H5. *Action Alternatives C and E (the Downstream Water Intake and the Tims Ford Pipeline, respectively) present solutions that The Nature Conservancy believes are more positive and balanced. Both of these alternatives have lower projected environmental impacts than Alternatives B and D and are an order of magnitude less expensive than the Fountain Creek reservoir. . . . Alternative E, the Tims Ford pipeline, also has a lesser degree of environmental impacts, while still meeting projected needs through 2050. In fact, this pipeline would increase flow across a wider region, maximizing benefits to the most residents and to aquatic life. Concerns that surround Alternatives C and E include construction of the pipeline, placement of the discharge point, increased erosion and turbidity, alteration of water temperature, and transfer of species. However, these concerns would ultimately be addressed during the design and implementation process.* **Leslie Colley, The Nature Conservancy of Tennessee, 44g**

Response to Comment H5: As noted in this comment and in the EIS, if this alternative was proposed to be built the detailed planning and subsequent evaluation would include an more-detailed evaluation of potential adverse effects on the environment.

H6. *I wish it known that I am strongly opposed to Alternatives B, D, and E.* **Robert F. Shanks, 34d**

H7. *I have read the proposals for supplying water to Columbia via accessing water from Tims Ford Lake (Alternative E) and as a long term home owner on the lake. I oppose this measure, as do my neighbors in the Highland Ridge subdivision of Estill Springs.* **Tom Willingham, 17**

H8. *[I have] lived on Big and Little Duck. [I am] opposed to proposed Tim's Ford water line and think it is a disgrace that so much money has been spent on Columbia.* **J. D. Spencer, 14**

H9. *TVA has done much to improve the quality of life in the Southeast for which we are grateful. Alternative E, the proposal to divert Elk River water for the benefit of the few in a small area, would serve to diminish our overall quality of life. It might be one of the least expensive of the four proposals, but it is not one of the two best. It is the worst.* **Floyd and Linda Ayers, 32e**

Response to Comments H6 - H9: Comments noted.

H10. *The report is deficient in that it does not address effects on Tims Ford Reservoir should that option be elected; how much drawdown, etc.* **Jerry C. Lashlee, 26a**

H11. *Of the proposed plans, I would like to register my objection to Plan E, which will spoil the pristine setting and environment of Tim's Ford lake which the former controlling agency TERDA and TVA has worked so hard to ensure over the years. It is not worth sacrificing this area to support growth in Columbia, TN.* **Lane and Tom Willingham, 18**

H12. *I am appalled at TVA's consideration of pumping water out of Tims Ford Reservoir to satisfy the Duck River Basin water supply demand. Tims Ford does not have enough water coming in now to properly flush the system and alleviate the poor dissolved oxygen problem. The water quality in this lake is continually deteriorating; your proposal would only aggravate this problem.* **Don F. Lee, 6a**

H13. *I do not like the idea of pumping water out of Tims Ford lake for Columbia, TN. It would greatly damage the ecology of our water. I certainly do not like this water being replaced with Tullahoma sewer water. We have a beautiful lake and we should not do anything that would hurt the quality of water we now have. It's bad enough having the city of Winchester empty their sewer water into the lake.* **Kay & Ron Hall, 50**

H14. *As a property owner at Tims Ford lake, I should like to strongly urge that pumping water out of Tims Ford NOT be allowed for diversion into the Duck River. This would cause the water level in Tims Ford to drop and would impair the lake for recreational use. The water level is already too low at times. As a taxpayer, there are cheaper alternatives which would take care of Columbia's water needs. For instance, 8 million for the proposed Normandy elevation vs. 13 million for the proposed Tims Ford*

pumping project. We have been blessed with a wonderful asset in Tims Ford Lake. Let us not succumb to the temptation to imperil this treasure. **David L. Hudson, 38**

H15. *We [Tims Ford Council] are objecting to "Alternate E" of the proposed water-supply alternatives for the Duck River Basin. Any additional draw on the waters of Tims Ford will have a tremendous adverse effect on the attractiveness and recreational usability of this lake. This would be especially noticeable during hot, dry summers like we have had the past two years when TVA has used Tims Ford for power generation and downstream flow. As a consequence, lake levels have lowered considerably before the end of summer usage periods. Tims Ford Lake is of immense economic benefit to Franklin County and all of southern Middle Tennessee. We want to see this lake continue to be a valuable asset to the region and be maintained for the enjoyment of property owners and recreational users of the lake.* **Tims Ford Council, 3**

Response to Comments H10 - H15: Existing information, presented in Section 5.4, indicates that, even in a severe drought, use of this pipeline would draw Tims Ford Reservoir down just 7 or 8 inches more than would occur if this project were not in place. This additional reduction in the pool level would not be noticeable to most people and would not adversely affect the use of the reservoir. If this alternative was proposed to be built, the planning for this project would include a up-to-date, more-detailed evaluation of the potential effects on water levels in Tims Ford Reservoir.

H16. *As a landowner whose property borders on the Elk River in western Lincoln County, Tennessee, I am against ANY plan that involves transferring water resources out of the Elk River watershed. I believe such a plan would negatively affect low-water flows on the Elk River, seriously impacting the use of the river for irrigation and recreation.* **Ken McGarry, 13a**

H17. [As a] *Property owner on Tims Ford,* [I am] *concerned about water quality and failure to maintain minimum flow below dam.* [My impression is that] *flows for October are in the range of 64 to 75 rather than 80 cfs. Odor and clarity also are problems during low flow periods.* [I am concerned that] *Piping water* [to the Duck River] *will drop lake levels, impact dock owners, and affect fishing quality.* [I think the actual] *cost of building pipeline will be higher that what has been projected by the time it's planned and constructed.* **Bill Balsley, 45**

Response to Comments H16 and H17: The preliminary planning that has been done concerning this alternatives is based on the assumption that no changes would be made in the quantity or quality of the releases from Tims Ford Dam. If this alternative was proposed to be built, a more-detailed evaluation of this potential effect on water releases into the Elk River would be conducted using specific information about the details of the project.

H18. *Building a pipeline from the Tims Ford Reservoir to the Duck River will unnaturally favor a county outside the Tims Ford Reservoir and handicap counties within the reservoir as they struggle to meet their existing and current demands for clean and plentiful water. There will also be negative impacts to flora and fauna as the pipeline is constructed and maintained over the years.* **Marty Marina, Executive Director, Tennessee Conservation League, 58j**

H19. *It was with great disbelief & disgust that I learned of TVA's plan to build a pipeline to transfer water from Tims Ford Lake to the Duck River. This does not seem to be a solution but a contrivance to allow unlimited, unregulated & poorly planned development in the Duck River Basin. . . .TVA has been instrumental in advancing the southwest to a position of prominence and TVA should have the integrity to say enough is enough and discard this alternative.* **Robert N. Reed, 28a**

H20. *I disagree with the Alternative E, "Tims Ford Pipeline" because it is effectively "robbing Peter to pay Paul". Removing a portion of a valuable water resource from a viable and fast growing area could be very detrimental to the economic future of the Franklin County area. In conclusion, it would be an example of poor planning, in my view, to remove precious water resources from the Franklin County area without thorough considerations of the long term effects on this area.* **Mark H. Dudley, 24i**

H21. *Tims Ford pipeline would generate revenue, from the sale of water, for the repayment of debt obligations of concerns outside of the region, the Duck River Development Agency. (Page 4) These debt obligations were part of the original agreement covering* ***local participation*** *in the overall project. Again, "robbing Peter to pay Paul".* **Mark H. Dudley, 24b**

Response to Comments H18 - H21: This alternative would use water stored in Tims Ford Reservoir to meet drought-related needs in the Columbia area part of the Duck River basin. Water that would occasionally be used this way would, otherwise, be passed on down the Elk River. As indicated in Section 5.4 and 3.9, Tims Ford Reservoir is not expected to be adversely affected by this alternative; however if this project was proposed to be built, additional more-detailed analyses would be conducted to confirm or revise this conclusion. It should be noted that TVA is not proposing to build this project; rather, TVA and the cooperating agencies have simply identified it as one of several reasonable ways to meet the future water supply needs of the Columbia area.

H22. *How can you take water out of Elk River and* [away from] *the people in Athens, I don't believe they would like that.* **Glenn Stevenson, 78b**

H23. *Alternative E also proposed interbasin transfer of water from Tims Ford Reservoir to Duck Creek, with which there also could be some associated environmental issues.* **EPA, 51o**

H24. *Tims Ford and the Elk River are for the people Southern Middle Tennessee or, at least, in that watershed. There are several large towns already drawing on those water resources. Periods of drought are also felt here in the form of decreased summer pool level and minimum flow into the river; i.e., low level and brackish river water conditions. This will only be felt more should water be drawn off for the Duck River people.* **Jerry C. Lashlee, 26c**

H25. *TVA's proposal to steal water from Elk River and divert it to Duck River for the sake of real estate development in the Maury and Williamson County area is obscene. It demonstrates TVA's disrespect for our natural environment and for the people who inhabit the Elk River Valley. How can you glibly state that it would have only "short-term and minor effects" on Elk River when you are proposing to permanently reduce the flow of this river? How much Elk River water will be needed to support growth in the Duck River area during the following fifty years? The following one and two hundred years? This proposal totally ignores the needs of future generations in the Elk River Valley.* **Floyd and Linda Ayers, 32a**

H26. *I am strongly opposed to Alternative E, taking water from Tims Ford reservoir to supply the upper Duck river basin. I think this would establish a bad precedent, and lead to a situation such as exists at the present out west with the Colorado river. The growth potential for the Tims Ford area is very great, e.g., Nissan's plans to hire a thousand new employees at Decherd, which will bring at least five thousand new people to the area. In a few years, we may need the water worse than Franklin and Columbia.* **Eugene J. Sanders, 39a**

H27. *The pumping station from Tims Ford, I don't believe that's good. I do not like the idea of taking water from one river valley and pumping it to another river valley. It sets a precedent. What could happen in the future there, if someone wants to come into the Duck River valley, take water out of the Duck River valley, say pump it into the Harpeth River valley, or maybe even go back to the Elk. That's entirely possible. If we take this action, then we are setting a precedent. I don't believe this is good.* **Wayne Romesberg, 72e**

Response to Comments H22 - H27: As described in Section 3.7, this pipeline would be used only during drought conditions to meet critical needs in the Maury/southern Williamson County Water Service Area (excluding Franklin and other distant parts of Williamson County). The present concept of this project would not alter the discharge from Tims Ford Dam or reduce the pool level in Tims Ford Reservoir more than 7 or 8 inches, even during drought conditions. If this project was proposed to be built, detailed plans for the pipeline and its operation would have to be developed, details of the project would have to be evaluated further for environmental effects, and the public would have an opportunity to comment on the project and its potential effects. All of the issues identified in these comments should be evaluated and addressed during that process.

H28. *Cities upstream from Columbia are not interested in Columbia's future and will oppose alternatives "D" and "E".* **Douglas K. Mitchener, 59d**

Response to Comment H28: As indicated in many of the comments presented in Sections G and H of this Appendix, people have a variety of views about both of these alternatives, in addition to each of the others. Some of those views include reasons related to interests quite different from providing water to the Columbia area.

H29. *Why not use 36" pipeline from Tim's Ford instead of 30". Cost difference is negligible and this could allow for more water to meet needs further into the future.* **Mike D. Penrod, 67a**

H30. *The pipeline length could be reduced by 50% if the north end terminated on a Flat Creek tributary having maximum natural flow equal to the pipelines capacity. The benefits of having more and better water at the Shelbyville intake may not be worth the extra cost of 10 more miles of pipeline. this would provide only an occasional benefit during drought conditions for Shelbyville. I would prefer to see Flat Creek never run dry.* **Fred H. Horn, 5**

Response to Comments H29 and H30: The present concept of this alternative includes features designed to meet the projected need for water through 2050. While a variety of other features could be included in this project, each of them also could add potential adverse effects at one or both ends of the pipe, wherever the pipeline might start or end. All components of the full project should be evaluated in detail before this, or any other, water supply project is proposed to be built.

H31. *I am not opposed to Alternative E (Tims Ford Pipeline), but that option is more expensive, both in actual cost and in cost per cubic foot of water supplied, than Alternative C.* **Dennis D. Horn,10d**

Response to Comment H31: The present order of magnitude cost estimate indicates this is likely to be true. If the decision about which alternative should be built comes down to cost, the present construction estimates would have to be refined and operational costs would have to be determined before that cost comparison is completed.

I. Climate, Geology, and Soils

I1. *EPA is concerned over the apparent lack of geotechnical studies in the document to determine the suitability of the site soils to hold water relative to the reservoir alternative (B). Local soils should ideally be relatively impermeable in order to retain desired water levels without creating zones of saturated soils adjacent to the project. Leakage and erosion of the proposed earthen dam are also a concern. The FEIS should contain estimates of impacts of water loss through the permeable parent soil materials that will make up the basin of the proposed reservoir.* **EPA, 51z**

Response to Comment I1: A foundation feasibility study for a possible reservoir in the Fountain Creek watershed was performed by the U.S. Army Corps of Engineers in 1997. This study provided information used in the description of Alternative B presented in Section 3.4 and various parts of the evaluation of potential effects discussed in Chapter 5. The feasibility study, though limited in scope, concluded that it would be geologically feasible to construct a reservoir at the location and to the elevation described in the EIS. The report on the feasibility study also indicated that the limestone terrain would be highly susceptible to leakage, the karst drainage system would require treatment, and a grouting program would be needed to reduce the potential for leakage. The report also pointed out the need for additional evaluations of the underlying geology before proceeding with detailed design and specifications of the possible reservoir project.

J. Ground Water

J1. *The project area is generally karstic and as such has sinkholes and other natural conduits to the water table. Construction of a reservoir in these areas could promote contamination of ground water if the reservoir water quality and sediment quality becomes degraded and migrate into the water table. The DEIS mentions (pg. 142) the potential for grouting the bottom of the reservoir area during construction to prevent such interconnection. Special engineering methods would be needed in these karstic areas, particularly those involving excavation, low elevations, caves, and similar geologic features. The greatest potential for ground water impacts among the alternatives appears to be the construction of the reservoir.* **EPA, 51u**

Response to Comment: J1: TVA agrees that construction of a reservoir in this karst area could promote contamination of the ground water if water in the reservoir became degraded and migrated into the water table. This was acknowledged in Section 5.3 of the EIS, accompanied by the suggestion that grouting may be required to prevent intrusion into the ground water. If this alternative was selected, geologic surveys would need to be conducted to determine the extent of potential surface/subsurface connections. Based on those surveys, measures to prevent extensive surface water intrusion (such as grouting or sealing) would be determined through special engineering studies as part of the detailed planning for that project.

J2. *Adoption of Alternative C entails the development of a 13-mile pipeline and the subsequent construction of its downstream Duck River booster station. The sinkholes and caves at this venue often form delicate conduits or natural water pipes. There are concerns that, during construction, the sinkholes and caves may be impacted. Such impacts during construction might involve irreversible collapsing of the fragile karst topography, quite possibly increasing the likelihood of ground water contamination.* **Environmental Science Graduate Students, University of Tennessee at Chattanooga, 33b**

Response to Comment J2: The installation of pipelines in karst terrain is routinely done for water, natural gas, and various petroleum products. As indicated in Section 5.3, a variety of avoidance and engineering techniques are available for mitigating impacts to the subsurface environment during the installation of a pipeline. It is true that karstic geology may contain sinkholes, fissures, and caves; however, those areas are still rock strata and, as such, are normally very stable and solid. Should this alternative be selected, specific measures to mitigate subsurface impacts would be addressed in the subsequent engineering evaluations and the evaluation of possible environmental effects.

J3. *What effect on the ground water resources in the Elk River Watershed as a whole would result from the reduction in the capacity of the Tims Ford Reservoir to recharge groundwater supplies.* **Mark H. Dudley, 24g**

Response to Comment J3: There would be no measurable effect on the groundwater resources in the Elk River watershed. The only time Tims Ford reservoir would have water removed to the Duck River would be during a drought year. During such a time, the elevation of the reservoir could be reduced by 7-8 inches, which is well within the normal operating range of Tims Ford Reservoir and would not have any effect on ground water.

K. Surface Water

K1. [I]*t is unclear what criteria TDEC uses to determine that one stream segment is suitable for an industrial water supply designated use, and not for a municipal water supply designated use.* **EPA, 51ab**

Response to Comment K1: Many of the use classifications in effect today were assigned to streams several years ago when Tennessee initially adopted water quality standards. At that time, a stream reach was classified for water supply use if it was being used for water supply or if a sufficient volume of water was available to support that use. In recent years, TDEC has been diligent to classify all streams for fish and aquatic life and recreation uses in accordance with the Clean Water Act. TDEC has not gone back and added the industrial and domestic water supply use classifications to all stream reaches not currently classified for those uses; however, they would likely respond to a local request to have a use added. TDEC probably would use its EPA-approved water quality criteria for Domestic Water Supply and Industrial Water Supply when determining the suitability of a specific stream reach.

K2. *We note from page 82 that: "The domestic water supply use classification is excluded in these areas because the State of Tennessee (TDEC) considers stream reaches immediately downstream from municipal wastewater discharges to be unsuitable for domestic water supply withdrawal." The state's criteria and scientific basis for this decision is unclear. How does TDEC determine where such an exclusion zone should no longer exist? Although not a TVA decision, we would appreciate some discussion on this matter in the FEIS.* **EPA, 51aa**

Response to Comment K2: As a matter of policy, TDEC no longer considers the first five miles of stream reach downstream from a wastewater discharge to be unsuitable for domestic water supply use. If TDEC were to allow a domestic water supply intake to be sited in a specific reach of the Duck River not presently classified for domestic water supply, the reach would be reclassified to protect that use. Reference to the previous policy in Section 4.4 has been deleted.

K3. [S]*ediments and disinfection-by-products (THMs) have been a significant issue for the public water supply system currently using the Duck River as its source water. The source, effects and control of THMs should be discussed in the FEIS.* **EPA, 51t**

Response to Comment K3: The suggested discussion has been added to Section 4.4.

K4. [S]*ediments and disinfection-by-products (THMs) have been a significant issue for the public water supply system currently using the Duck River as its source water. THM precursors include algae and high Total Organic Carbon (TOC) levels, which are in turn related to elevated nutrients. We strongly recommend a TVA commitment for source water protection as part of the preferred alternative in the FEIS. We believe such protection should be part and parcel of any potential approval of a water supply project.* **EPA, 51ac**

Response to Comment K4: Information presented in Section 5.4 identifies the need to protect the additional water supply source. TVA agrees that management of potential sources of contamination through source water protection efforts is a critical need in the upper Duck River watershed. TDEC has an EPA-approved Source Water Assessment Program and assessments for individual water systems

are presently underway. Regardless of which water supply alternative is pursued, the state program would be the appropriate avenue for ensuring that source water protection is implemented.

K5. *The draft EIS does not address cumulative impacts of projected development on water quality or the water supply needed to clean the anticipated Total Maximum Daily Load (TMDL) created by development. Failures to address this issue can be found among the many streams listed on the Tennessee Department of Environment and Conservation's 303D list.* **Marty Marina, Executive Director, Tennessee Conservation League, 58e**

Response to Comment K5: State and local governments, which regulate public and private wastewater systems, are responsible for ensuring that growth and development do not aggravate existing water quality conditions or adversely affect water quality and stream uses.

K6. *Additionally, we were concerned that increased water surface on the lake increases the evaporation rate, offsetting the benefit. No analysis of this offset was presented. Was it studied?* **John M. Procter, Elk/Duck River Chapter, Trout Unlimited, 60d**

Response to Comment K6: The slope of the shoreline surrounding Normandy Reservoir is very steep, so raising the normal summer pool elevation by five feet would increase the surface area by just 230 acres (from 3230 acres to 3460 acres - see Section 3.6), about a seven percent increase. Because evaporative loss is related to the amount of surface area, no more than a seven percent increase would be expected in the volume of water lost to evaporation.

K7. *At the time Normandy Lake was on the planning board, it was pointed out that due to the small flow of the Duck River an amount equal to the actual flow would evaporate each day from the lake. Thus there was not much gain as far as water supply is concerned. Now here we are, with the need for water increasing. If Franklin and Moore County have been limited in the amount of development in the name of water quality, then it is time to put the brakes on development in the Upper Duck River Basin.* **F. Montgomery Adams, Jr., Franklin County Executive, 29e**

Response to Comment K7: Evaporative losses would be greatest in hot dry months such as July, August, and September. In August, when evaporative losses in the Duck River watershed would be highest and the volume of water flowing into Normandy Reservoir would be lowest, the volume of water entering the reservoir would still exceed the evaporative loss by 25 percent.

K8. *To help further assess the potential success or problems associated with the reservoir alternative, we suggest that water quality monitoring data for the nearby Normandy Reservoir (which by now has aged or equilibrated as a reservoir) be provided in the FEIS for comparison, to the extent the two reservoirs are similar. We have also enclosed an EPA Region 4 checklist (EPA Section 404 Reservoir Review) prepared by our wetlands section that should provide additional guidance in assessing potential reservoir projects.* **EPA, 51m**

Response to Comment K8: Water quality conditions in Normandy Reservoir are discussed extensively in Section 4.4, especially with respect to low dissolved oxygen concentrations, high concentrations of iron and manganese, and high chlorophyll-a concentrations. Section 4.4 summarizes findings from many years of water quality analysis on Normandy Reservoir and uses that information, in part, as the basis for

the predictions of water quality conditions expected in a reservoir on Fountain Creek. Section 5.4 also summarizes the undesirable water quality conditions identified on Normandy Reservoir that would be expected to occur in a Fountain Creek reservoir and predicts conditions even more severe at Fountain Creek due to the slower flushing rate. The most recent data report on Normandy Reservoir has been added in the list of references (Section 6.3).

K9. *The modification of introducing cold, oxygen-depleted, bottom water into the system will possibly further deplete the dissolved oxygen -- possibly disrupting the complex thermal stratification layers in the water. Such a disruption could also interfere with nutrient cycling -- a necessity for all life in aquatic systems. Accurate impact assessments dealing with such intricately complex cycles and oxygen depletion effects (often exponential) in Alternative B should be approached with caution.* **Environmental Science Graduate Students, University of Tennessee at Chattanooga, 33g**

Response to Comment K9: These are important issues that can and should be dealt with in the detailed design of the outlet structure for a Fountain Creek reservoir if that alternative is pursued. The outlet probably would be designed to ensure that releases from the dam would contain at least 5 mg/l of dissolved oxygen. Water released from the reservoir also probably would not be allowed to adversely affect aquatic life or other beneficial uses in the reach of Fountain Creek immediately downstream from the dam or in the adjacent reach of the Duck River.

K10. *Additionally, many bivalent metal ions tend to dissolve out of solution and into the soils over time. However, a lowered pH and depleted dissolved oxygen will cause many metals (calcium, manganese, etc.) to dissolve back into the water. This alone can have a hazardous effect upon humans via primary ingestion, secondary, ingestion or prolonged contact.* **Environmental Science Graduate Students, University of Tennessee at Chattanooga, 33h**

K11. *The extraction of soils necessary for construction would subject the nearby waters to high amounts of dissolved metals, petroleum and organic acids that have been long since trapped within the soils. This contamination could effectively lower the pH, possibly affecting nearby ground water tables. In addition, increased amounts of freshly killed plant matter and the introduction of carbon rich humus into the heterogeneous waters may cause many species of heterotrophic bacteria to bloom. Collectively, potential effects of lowering the dissolved oxygen content in the reservoir as well as increasing the chance for an outbreak of dangerous bacteria such as Cryptosporidium sp., E coli and other fecal coliform merits further rejection of Alternative B.* **Environmental Science Graduate Students, University of Tennessee at Chattanooga, 33f**

Response to Comments K10 and K11: Dissolved metals such as iron and manganese would be expected to be present in the deeper water of a Fountain Creek reservoir when dissolved oxygen concentrations were very low. Concentrations of iron and manganese would be regulated under the secondary standards of the Safe Drinking Water Act because they would affect the aesthetic quality of drinking water but not human health. Dissolved oxygen depletion in the deeper water of a Fountain Creek reservoir would likely be more severe during the first 2-5 years after impoundment than in later years due to the decay of vegetation left in the reservoir and the breakdown of oxygen-demanding material present in the inundated soil. Effective control of non-point sources in the Fountain Creek watershed would be essential to prevent potentially harmful bacteria from entering the water supply reservoir.

K12. *The Fountain Creek reservoir does not appear to be a viable alternative in light of the estimated cost and potential for eutrophication caused by the nutrient rich Fountain Creek basin. Both TVA and the Tennessee Department of Agriculture have identified many nonpoint source water pollution issues throughout the watershed. These water pollution issues could have long-term impacts on the biodiversity of the area, particularly aquatic species. Correction of these problems is not a documented cost nor included in the discussion of impacts of this proposed alternative.* **Andrew N. Barrass, Environmental Review Coordinator, Division of Natural Heritage, 64d**

Response to Comment K12: Available information suggests that the Fountain Creek watershed has significant non-point sources which should be corrected regardless of which alternative is selected. Non-point contamination sources would be a continuing threat to a water supply intake directly in the reservoir or one located downstream of the mouth of Fountain Creek. The cost of a watershed-wide non-point source pollution management program was not included in the order of magnitude cost estimate for the Fountain Creek reservoir alternative. Fountain Creek is listed on the TDEC Section 303(d) list which means that in the future non-point pollution sources will have to be corrected to restore use of the stream. If the Fountain Creek reservoir alternative was selected for implementation by local governments before the non-point source management program is in place, then an accelerated correction program probably would be needed. In addition, the non-point source pollution management program required to correct current use impacts to the free flowing Fountain Creek would not be as extensive or as costly as the program needed to protect a water supply reservoir.

K13. *The letter dated April 6, 1979, from D. L. Muland, then the Director of Division of Water Quality Control, to Mr. John L. Ferguson, then TVA Project Manager, stated that Columbia Reservoir would have limited water quality related to the summertime eutrophic conditions that future water user in the Columbia area have not been made aware of. Well, I didn't know anything about it until about three years ago when we ran across this information.* **William Derryberry, 73d**

K14. *We've already spent $84M on a dam and then had it tore down and not a drop of water put behind it. The reason they tore it down is the same reason they can't be none put behind a Fountain Creek Dam. In a letter dated June 6, 1979, from Steve Anderson of the Tennessee Department of Public Health to the Commissioner of Health, Eugene W. Bowwinkle, MD, states that the Columbia Reservoir would have severe water quality problems, would not be another high quality Tennessee lake, and the Tennessee public health recommended that certification of Columbia Dam be denied. The Columbia Reservoir would degrade the water quality of the Duck River. Now if the Columbia Dam would degrade the water of Duck River, what would Fountain Creek do? In this book right here on page 20 of the EIS, it states that in 1953, there was no streams running into the river from Normandy to Columbia, so at that time Fountain Creek was not even running. That was in 1953 and between there and 1960 I know there were two or more years that the water was not running because I lived on the creek and I went down there many a time and played in the mudholes and there was no water running, so what kind of quality of water are we going to have?* **William Derryberry, 73b**

Response to Comments K13 and K14: The water quality impacts of the four alternatives are fully described in the EIS, including water quality conditions expected in a reservoir on Fountain Creek. Water quality conditions in a Fountain Creek reservoir would be similar to the conditions predicted to occur in the

Columbia Reservoir, had it been completed. TDEC would likely require the water released from a reservoir on Fountain Creek to meet all pertinent water quality standards of the state of Tennessee, which would prevent any adverse impacts on water quality in the Duck River.

K15. *From a water-quality point of view, we believe Alternative C will have the Least Minimal Impact on water quality from both the natural reservoir and the reservoir construction area is minimal and does not run the risk of contaminating water from exposed soil runoff or wiping out entire communities of organisms. The amount of water transferred is sufficiently small enough, greatly reducing the risk of affecting nutrient cycling and thermal stratification or the lowered dissolved oxygen levels within certain population parameters.* **Environmental Science Graduate Students, University of Tennessee at Chattanooga, 33d**

Response to Comment K15: Comment noted.

K16. *Alternative D is projected to meet Columbia area water needs only through year 2035 while the other alternatives are projected to meet water needs up to or later than year 2050.* **Marjorie S. Collier, President, Friends of Short Springs, 27d**

Response to Comment K16: If Alternative D was pursued, water supply systems in the Maury/southern Williamson County Water Service Area would need to implement water conservation measures or adopt other means of meeting the anticipated water needs beyond the year 2035. A 10 percent conservation savings is a reasonable expectation since, throughout the United States, water utilities routinely accomplish at least this percentage of reduction in water use through conservation programs.

K17. *Allowing Alternative E [would] reduce valuable water supplies in the Elk River Watershed to allow more development in the Duck River Watershed, a watershed area whose capacity is limited is an example of poor planning. One, this encourages further development to occur in an area that is outgrowing the already limited resource of its watershed supplies. Secondly, [this] discourages development in the Elk River Watershed by reducing the impoundment's supplies and reducing groundwater recharge.* **Mark H. Dudley, 24a**

K18. *Recharging one river with another is not really solving the problem, for it creates other problems. A typical dry period in the Upper Duck River Basin is a typical dry period in our watershed, also. Water quality here is not very good now and during dry periods is less so. Dropping Tims Ford Reservoir by 7-9 inches in a dry period is not wise and would lead to further water quality problems here. As Franklin County grows, and you know we are, our water needs will grow too.* **F. Montgomery Adams, Jr., Franklin County Executive, 29c**

K19. *This study does not comment on potential effects downstream from Tims Ford Dam during periods of drought which might result from the reduced water supply in Tims Ford Reservoir.* **Mark H. Dudley, 24f**

K20. *We also want to bring to the committee's attention that promised minimum flows of 75 cfs have not been maintained in recent weeks and months on the Elk River below Tims Ford. This effect, coupled with the adverse effect of the new water cress operation, has many trout anglers who normally fish the Elk now preferring to fish the Duck. It has been a dry Fall season. I do not know if we are in drought conditions, but it sure*

does not seem we have had our 10 inches of rainfall to not be in one. Surely, everyone recognizes a drought in Columbia likely means a drought for the Elk River basin as well. It seems illogical to steal water from Tims when minimum flows already cannot be met. **John M. Procter, Elk/Duck River Chapter, Trout Unlimited, 60e**

Response to Comments K17 - K20: Tims Ford Reservoir holds 4.5 times more water in storage than Normandy Reservoir (approximately 535,000 acre-feet in Tims Ford compared to 117,000 acre-feet in Normandy). In 1995, the water systems in Franklin and Moore counties used 2.1 mgd of surface water and 1.7 mgd of groundwater from wells and springs, for a total water demand in both counties of 3.8 mgd. That level of water use would be equivalent to 12 acre-feet per day if all of the water was withdrawn from Tims Ford Reservoir. With steady or even additional growth in Franklin and Moore counties, there would be enough water in Tims Ford Reservoir to meet future water supply demands in the Elk River area while helping to meet the needs of adjacent water service area. The estimated lowering of Tims Ford reservoir pool elevation by 7 to 8 inches in drought years would have no measurable effect on water quality. TVA's ability to maintain an instantaneous minimum flow of 80 cubic feet per second downstream from Tims Ford Dam to support downstream uses also would not be affected by the operation of a pipeline similar to the one described under Alternative E.

K21. *I suggest that all water taken out of Normandy re-enter the Duck River watershed.* **Nancy L. Penrod, 69a**

K22. *One solution that might be considered would be to have City of Tullahoma, who draws its water from Normandy Lake, to deposit its treated wastewater into the Duck River instead of depositing into Tims Ford Lake as it now does.* **Robert N. Reed, 28c**

K23. *One possibility would be to discharge back to the Duck River all treated water originally drawn from it. This would include Tullahoma, among others.* **F. Montgomery Adams, Jr., Franklin County Executive, 29d**

K24. *If you need to increase the flow of Duck River, we have a proposal for you. Currently, the City of Tullahoma draws its municipal water from Normandy Reservoir on Duck River, but dumps its treated wastewater into Tims Ford Reservoir on Elk River. It would be far less costly to return the City of Tullahoma's wastewater to Duck River than to construct a twenty mile pipeline from Tims Ford Lake to Shelbyville. This would return both rivers to a more natural flow volume and would improve the water quality in Tims Ford Lake. If the resulting increase in water flow in Duck River should be insufficient to meet future demand in the Maury/southern Williamson County Water Service Area, then that demand is unreasonable and should be lowered by placing limits on development in that area.* **Floyd and Linda Ayers, 32b**

K25. *We recommend that a modification of Alternative E (which we name here as Modified E) be considered to the extent that it might be feasible. Modified E relates to the Tullahoma Wastewater Treatment Plant (Tullahoma) discussed on pages 152-153. Tullahoma purchases water from the Duck River Utility Commission which withdraws from the Normandy Reservoir. Tullahoma then discharges its treated wastewater into Rock Creek which is a tributary of the Elk River, which is connected to and drains into the Tims Ford Reservoir. As such, water is being removed from the Duck River system and discharged into Tims Ford and, with Alternative E, Tims Ford water is being withdrawn and discharged into the Duck River. We suggest that the potential for Tullahoma returning its Duck River water to Duck River as Modified E be explored.*

This would avoid interbasin transfer and the Tims Ford 20-mile pipeline (albeit, the logistics and volumes of Modified E are unclear and the need for a pipeline of uncertain Tullahoma to the Duck River exists). **EPA, 51p**

Response to Comments K21 - K25: TVA does not consider the discharge of this wastewater into the Duck River to be a viable alternative to meet future water needs of the Columbia area. The present volume of the Tullahoma wastewater discharge is about 3.0 mgd and, even with growth over the next 50 years, the volume of water available from this wastewater discharge would not be sufficient to meet the 14 mgd water supply shortfall which is projected to occur in the Maury/southern Williamson County Water Service Area by 2050. Furthermore, relocating the discharge to the Duck River downstream from Normandy Dam would require the construction of a 12- to 15-mile long pipeline and a pumping station to transport the wastewater from the Tullahoma treatment plant. Also, the cost of constructing a pipeline through the urban area of Tullahoma would be substantial.

K26. *My calculations indicate that just by retrofitting the present 17,500+ residences (based on the population numbers listed for the Columbia/Spring Hill/Thompson Station service area) with cisterns of 0.75gal/sq.ft. of house, the equivalent of 3+ mgd (at 50 inches of rain per year) would be captured. This is roughly 50% of residential use, which is probably used primarily for landscape irrigation anyway. Furthermore, there is no reason why cisterns could not be incorporated into commercial and industrial applications. Each system could be installed for less than $0.50 per gallon of capacity. This is expensive compared to the other options, but this option would provide multiple secondary benefits. Furthermore, as growth continues the installation of cisterns could be incorporated into local building codes, with costs added to new homes and businesses (possibly with incentives like In Lieu of a portion of Impact fees).* **Richard E. Lockwood, 31d**

Response to Comment K26: Studies suggest that about 32 percent of the total water used by an average household is used outdoors. If this is true and if every household used a cistern for outdoor use, by 2050, the potential water savings in the Columbia area would be about 4 mgd. The estimated additional water supply needed in the Maury/southern Williamson County Water Service Area in 2050 is 14 mgd. Therefore, the 4 mgd estimated to be saved by household cisterns would not, by itself, be enough to meet the future needs of the area. The concept of cisterns falls into the category of water conservation measures individual homeowners on a public water system could implement to save water. Other water saving measures which have been adopted by homeowners include retrofitting inside plumbing fixtures with water saving faucets, shower heads, and toilets. General public acceptance of cisterns would probably be low due to the construction cost, siting considerations for each residence, construction inconvenience, operation and maintenance difficulties, and potential liability. Most citizens probably would rather pay to have water supplied to them through pipes than deal with a household cistern system.

L. Aquatic Life

L1. *We were told it was snail darters and everything else and mussels but that couldn't be so because they turned lose those otters and they've eaten nearly every one of those mussels. There are mussel shells everywhere over there.* **William Derryberry, 73e**

Response to Comment L1: Recent surveys of mussel resources indicate that a wide variety of species and large number of individuals still occur in suitable habitat along the length of the Duck River. River otters apparently do eat some mussels; however, they also apparently reduce the number of muskrats, which would lower the number of mussels that muskrats would eat.

L2. *Alternative B will have the greatest effects on the quality of surface and ground water. The large area necessary for construction will have adverse effects on a complex array of aquatic ecosystems. For example, by destroying undetermined species within the large non-surveyed areas, we cannot be certain of the impacts that one or perhaps three or four species disappearance would have on the system as a whole.* **Environmental Science Graduate Students, University of Tennessee at Chattanooga, 33e**

Response to Comment L2: Comment noted. Available information suggests that the aquatic species present in this potential project area are relatively widespread and common in the Duck River watershed. If future studies indicate that endangered or other rare species occur in either the surface or ground water which could be affected by this project, that information would be considered during the evaluation of potential environmental effects of building the project.

L3. *All minimum flows downstream of the proposed dam for Alternative B should be consistent with the U.S. Fish and Wildlife (FWS) and EPA guidelines that include minimum flow rates and variable flows consistent with sustainability requirements for fish and other aquatic inhabitants.* **EPA, 51ad**

L4. *There appear to be few impacts on the aquatic fauna associated with the adoption of Alternative C. Of the alternatives suggested by TVA, Alternatives C and E appear to be the most reasonable alternatives concerning aquatic life. Due to the relatively low amount of water that is being withdrawn from the proposed site in Alternative C, few negative effects would be likely. Sedimentation from construction could present localized problems in terms of disturbing habitats of benthic and lithophilic species, especially certain percid and cyprind fishes which utilize these habitats for spawning (12 darter species and 16 shiner/chub species).* **Environmental Science Graduate Students, University of Tennessee at Chattanooga, 33i**

L5. *Additionally, there is concern that the project* [Alternative C] *may pose some localized threats to the mollusk fauna, as they, too, are sensitive to sedimentation from construction activities. Fortunately, the mollusk fauna at the potential withdrawal site (RM 104) does not contain some of the more sensitive mussel species (Epioblasma sp., Lemiox sp.). However, little or no survey data concerning the gastropod fauna from this reach is available. Given the presence of an endemic gastropod in the Duck River system (*Lithasia genticulata*), and the rich species diversity present in the Duck, it is incumbent on TVA to conduct a gastropod inventory in this proposed withdrawal area. TVA needs to be aware of what aquatic fauna is to be reasonably affected by a withdrawal station.* **Environmental Science Graduate Students, University of Tennessee at Chattanooga, 33j**

L6. *The proposed Alternative C would construct a water supply intake at a point downstream from Columbia in the Duck River and downstream from Cathy's Creek. The Draft EIS outlines suggested short-term impacts to ground water, surface water, aquatic life, terrestrial life, endangered species, etc. The document fails to identify the probable impacts of the proposed construction and water withdrawal. Although the document discusses the withdrawal of approximately a fifth of the maximum flow, the document does not acknowledge the potential impacts to reduced flow as seen during the most recent drought and low flow conditions (summer flow gauge records for 1998-2000).* **Andrew N. Barrass, Environmental Review Coordinator, Division of Natural Heritage, 64k**

L7. *Alternative E proposes to transfer water from Tims Ford reservoir to a downstream site through a 20-mile pipeline and booster pumping station to the lower Duck River. The transfer of large volumes of water between watersheds (inter-basin) could result in artificial range extensions for aquatic species or increase the likelihood that exotic species could invade these watersheds e.g., zebra mussels. The Draft EIS does not consider these potential impacts. The long-term impact by minor but continued drawdowns is not fully addressed considering the reduction of water from Tims Ford reservoir as part of this proposal. The Draft EIS does not consider aquatic biodiversity impacts in the reservoir resultant from sustained water withdrawals during drought conditions.* **Andrew N. Barrass, Environmental Review Coordinator, Division of Natural Heritage, 64q**

Response to Comments L3 - L7: Section 5.5 addresses many of the possible effects on aquatic life which could occur if one or more of the action alternatives was adopted. As noted in that section, Alternative C would involve the withdrawal of up to 31 cfs near River Mile 100, which would reduce the minimum flow from approximately 147 cfs to approximately 116 cfs, a 21 percent reduction. This amount of flow reduction is not likely to have a substantial change in aquatic habitats or aquatic life in that part of the river. These and the other possible effects of the action alternatives would have to be reviewed or reevaluated and, perhaps, other issues would have to be addressed as part of the subsequent evaluation of whatever version of each alternative might be proposed to be built. As a point of clarification, the potential withdrawal associated with Alternative C would be approximately one-fifth of the minimum flow downstream from Catheys Creek.

L8. *Support for cool water fishery in Duck and Elk, a put and take fishery, and an increase in water releases. Reduced flows on the Elk results in poor water quality.* **Michael Finks, 35**

Response to Comment L8: Comment noted.

L9. [Alternative E] *would mean less water going downstream and therefore less water in Tims Ford Tailwaters thereby causing problems for the trout fishery enjoyed by numerous people from far and wide.* **Don F. Lee, 6b**

Response to Comment L9: If Alternative E was built essentially as proposed in Section 3.7, existing information and preliminary studies suggest there would be no change in the quantity or quality of the discharge from Tims Ford Dam and, therefore, no effect on the trout fishery downstream from that dam.

L10. *What is most concerning to our Chapter are the proposals to Raise Normandy Pool Level or add a Tims Ford Pipeline. Raising Lake Normandy is a disturbing project far from Columbia and individuals who likely don't appreciate this existing water source provision for their community. For a tailwater fisherman, a deeper reservoir at first sounds exciting. I regularly fish the Colorado River at Lees Ferry, Arizona, below Glen Canyon Dam. This 725 ft. high dam provides 48 degree water year round, even in the heat of summer! This river supports an incredible blue ribbon rainbow trout fishery. But I agree with the EIS - you have to realize that a larger operating minimum flow will expend the cool layer of lake water faster.* **John M. Procter, Elk/Duck River Chapter, Trout Unlimited, 60c**

Response to Comment L10: Once any of the alternatives was proposed to be built, detailed planning would have to be done, including specifically how the project would be operated. After that, the careful evaluation of potential environmental effects would have to include a review or reevaluation of the discussion presented in Section 5.5 concerning the possible impacts on aquatic life in each stream reach which would be affected.

M. Wetlands

M1. *As previously stated in the DE1S, the implementation of Alternative C would have short-term minor effects on some known wetlands. The minor effects are further defined as probable minimal construction effects in the DEIS. The severity of the minor short-term effects is apparently dependent on the proper siting, design, and construction of the contiguous facilities. Long-term effects and net loss or total displacement assessments for those wetlands are not adequately addressed in the DEIS. . . . . The wetlands in peril need proper denotations as either forested and scrub-shrub type or emergent type wetlands.* **Environmental Science Graduate Students, University of Tennessee at Chattanooga, 33k**

M2. *The greatest wetland losses are associated with B (reservoir) and D (raising Normandy pool). B would result in the loss of some 225 acres of forested wetlands as well as the loss of the reach of Fountain Creek that would be inundated. It is unclear if perhaps other non-forested wetlands may also be lost within the 2,200 acres to be inundated for the reservoir (the FEIS should therefore total all the estimated jurisdictional wetlands that would be inundated by the reservoir). It should be noted that EPA considers both vegetated wetlands and creek water as wetlands, and water inundation of the reservoir wetlands and creek water is considered the same as filling wetlands with soil.* **EPA, 51v**

M3. *The 225 acres of wetlands were not precisely determined in the field but were estimated by aerial false-color infra-red photography. A jurisdictional determination of these wetland habitats needs to be made pursuant to Section 404/U.S. Army Corps of Engineer regulations. Following this determination, an avoidance or mitigation strategy should be provided. The mitigation strategies (pg. 163) indicated in the DEIS were general in nature and should be refined to indicate a more specific mitigation plan. Although not required, a draft mitigation plan should be included in the FEIS as well as a commitment to provide wetland compensation to the satisfaction of the resource agencies.* **EPA, 51w**

M4. *Implementation of Alternative D, which would raise the elevation of Normandy Reservoir by five feet, would result in the inundation of riparian vegetation including "...several forested wetlands that now occur at the upstream ends of some reservoir embayments" (pg. 164) as well as herbaceous fringe wetlands along the current Normandy shoreline. It is unclear what wetland losses or conversions may be associated with the pipeline alternatives C and E. The FEIS should be more specific as to the kind, quality and function of the wetlands that would be lost for each alternative.* **EPA, 51x**

M5. *Consistent with 404 (b)(l) guidelines, the loss of wetlands associated with B and D would need to be considered in the alternatives analysis, especially since other practicable alternatives with less wetland impacts exist.* **EPA, 51y**

Response to Comments M1 - M5: As stated in Section 1.1, the analysis presented in this EIS has been conducted at a general (programmatic) level. With respect to wetlands, this level of analysis allows an initial assessment of wetland impacts, using existing data about wetland resources in the likely project areas. Specific, detailed assessments of the type, extent, and function of jurisdictional wetlands would be completed in the subsequent evaluation(s) of whatever projects are proposed to be built. Those evaluations would be consistent with state and federal

wetland protection regulations, and would include detailed mitigation strategies developed to offset the specific wetland losses associated with each project. Long-term effects and net loss of wetlands associated with the project(s) would be assessed in detail as part of the subsequent evaluation and environmental review. The wetland types associated with each alternative are described in Section 4.6.

N. Floodplains

N1. *Since the purpose of this project is to supply water, the pipeline and the intake will have to be constructed in the flood plain because there is no other feasible alternative. This will cause some disruption to the areas around the construction of the pipeline, but if the disturbed areas are reverted back to their natural state there should not be any long-term effects. The route chosen for the pipeline would take it across numerous streams. It is at these points that it will be crucial for the construction of the pipeline to follow best management practices to minimize the impacts of the crossings. The pipelines will also have to be constructed in a way to make them able to withstand flood like conditions and to comply with the National Flood Insurance Act. Alternative C would* [a]*ffect only small areas during construction, but without any major impacts. . . . . The effects upon the soils and the flood plain will be negligible.* **Environmental Science Graduate Students, University of Tennessee at Chattanooga, 33m**

Response to Comment N1: Comments noted. Because the pipeline would be underground, there should be no long-term problems with flooding impacts.

P. Terrestrial Life

P1. *Given the length of the proposed pipeline (13 miles), certain species could be affected either by directly disturbing habitat or through disturbance of foraging ability, nesting, etc. . . . . Most importantly to consider are habitat fragmentation effects associated with a pipeline right-of-way. This would have the potential to destroy underground nests/burrows of terrestrial species and potentially impact a species metapopulation. TVA should address potential impact areas for whatever terrestrial species are located there, and provide some attempt to relocate species that most likely affected by pipeline construction. Additionally, TVA should investigate the possibility of co-locating the proposed pipeline in existing right-of-ways.* **Environmental Science Graduate Students, University of Tennessee at Chattanooga, 33n**

Response to Comment P1: TVA appreciates the concern related to the placement of the proposed pipelines and their potential effects on wildlife resources. The intent of the EIS is to outline the different options that are available for meeting future water needs in the upper Duck River basin and not to delineate or evaluate specific utility routes for each alternative. Evaluating the specific potential effects of an alternative proposed to be built would occur once each project was described in detail. Impacts to terrestrial resources would be better determined through additional, project-specific environmental reviews. Any populations of rare organisms and their habitats which could be affected by the project would be addressed as provided by appropriate State or federal laws.

Q. Endangered Species

Q1. *Attention to sensitive species (such as the Indiana Gray Bat) should be considered.* **Environmental Science Graduate Students, University of Tennessee at Chattanooga, 33r**

Q2. *Furthermore, a vascular and non-vascular inventory for endangered or threatened species is appropriate, if not imperative.* **Environmental Science Graduate Students, University of Tennessee at Chattanooga, 33l**

Q3. *As a part of our review of the subject Draft EIS, please be advised that we have reviewed our Departmental data bases and find recorded State and/or Federally listed species, within a one mile radius of the proposed Tennessee Valley Authority (TVA) project boundaries and within a one mile radius of the proposed managed lands (project alternatives). These species have very specific or rare habitat. Our records also indicate additional species occurrence records, sensitive ecological sites, and management areas, within an approximate four mile radius of the proposed project site(s). Your agency is aware of these records and we suggest that these records be further evaluated in cooperation with your Heritage Program in Norris, TN.* **Andrew N. Barrass, Environmental Review Coordinator, Division of Natural Heritage, 64a**

Response to Comments Q1 - Q3: The information presented in this EIS includes up-to-date knowledge about the status of endangered and threatened species in the areas which could be affected by the water supply alternatives. If and when one or more of these alternatives are designed and proposed to be built, the information about protected species would have to be reviewed and up-dated to cover whatever changes would have occurred in the status and known distribution of the protected species.

Q4. *Environmentalist will import some rare nonnative mussel or plant to the alternative "B" area and cause problems.* **Douglas K. Mitchener, 59e**

Q5. *I find it hard to believe that the area where the Columbia dam was being built is the only place that Snail Darters live. Even if it is, I don't think this is a valid reason to not complete something that is so valuable to human life. The people that caused this probably never had to haul water for their livestock or home. Just the way I feel.* **Kent Curtis, 4b**

Q6. *Given the fact that endangered mussels caused the Columbia Dam to be discontinued, TVA should ensure that no such endangered species or other unresolvable "show-stoppers" exist in the nearby Fountain Creek watershed if the reservoir alternative (B) is pursued.* **EPA, 51af**

Response to Comments Q4 - Q6: Whenever one or more additional water supply projects are proposed to be built in the area around Columbia (or elsewhere), federal law probably would require that the project be evaluated for possible adverse effects to any species then listed as endangered or threatened. At present, and as described in Section 5.9, none of the action alternatives is known to include activities which would have direct adverse effects on federal endangered or threatened species.

Q7. Schwalbea americana *and* Xyris tennesseensis *found in Coffee and Lewis Counties respectively are both considered not potentially affected or likely to occur in any of the*

alternative project areas. These assumptions are based on an 1879 site record and an eight-mile separation from a proposed alternative project area. The issue here does not concern itself with tangible distances and uncommonly intermittent records, or even distributions amongst physiographic provinces of protected plants near probable affected areas. But simply how can statements in the DEIS be made concerning the potential or likelihood of at least sixty-eight protected species occurring in alternative areas without a complete baseline vascular plant inventories. **Environmental Science Graduate Students, University of Tennessee at Chattanooga, 33q**

Q8. *The Water stitchwort (*Arenaria fontinalis*) is a Tennessee threatened and obligate wetland plant (OBL). The Water stitchwort occurs in seepages and other wet areas along creeks. The OBL plant would not survive prolonged inundation. The Duck river bladderpod (*Lesquerella densipila*) is a Tennessee threatened and globally rare plant, which also occurs in the area of a proposed reservoir on Fountain Creek. Field surveys conducted in the spring of this year by the Division of Natural Heritage staff have documented serious declines in populations of this plant in the majority of its range. Several bottomland areas adjoining Silver Creek continue to support populations of this plant. These populations would be inundated under the Draft EIS, Alternative B.* **Andrew N. Barrass, Environmental Review Coordinator, Division of Natural Heritage, 64g**

Q9. *A change in water flow rates (downstream) or significant water withdrawals from the* [Normandy] *reservoir could affect two rare plants that occur in the Duck River. These are Water stitchwort (*Arenaria fontinalis*) a Tennessee threatened and obligate wetland plant, and Limestone blue star (*Amsonia tabernaemontana *var.* gattingeri*), a Tennessee special concern listed species and a facultative wetland plant. Comparing these two rare species, the Water stitchwort is more dependent on water (an obligate wetland plant) and would be sensitive to changes in hydrology (reduced seepage and flow rates). Occurrences of both species are found in the Duck River watershed, both above and below the confluence of Fountain Creek. It is unclear how the rare plant populations in the Duck River would be affected under the different alternatives, however the increased minimum flow under Alternative D could be beneficial to these rare species.* **Andrew N. Barrass, Environmental Review Coordinator, Division of Natural Heritage, 64n**

Q10. *It is important to note that the Division of Natural Heritage staff did not survey the area south of State Route 50 on Fountain Creek in the spring of this year for the Duck River bladderpod. This area could also support populations of the protected plant species (potentially inundated by the proposed Fountain Creek reservoir).* **Andrew N. Barrass, Environmental Review Coordinator, Division of Natural Heritage, 64h**

Q11. *Considering endangered or otherwise protected vascular plant species of Tennessee, the DEIS methodology of determining the potential for a protected species to occur in any of the Upper Duck River Basin alternative project areas is unacceptable. Furthermore, simply stating the likelihood of a protected species occurring in an affected area as either 'yes' or 'no' is also unacceptable. For example,* Helianthus eggertii *occurs in nine (not eight) Tennessee counties (Chester et al., 1997). This composite, as noted in the DEIS, occurs approximately twelve miles SW of Columbia in Maury County. As stated in the DEIS,* H. eggertii *is not known to occur in the Central Basin Physiographic Province of Tennessee. However, significant portions of Maury, Bedford, and Davidson Counties each with a site record of the composite subsequently occur in the Central Basin Physiographic Province (Chester), including the station at*

Maury County. This alone establishes that the protected plant is not associated exclusively with the Highland Rim Provinces (East and West). Six counties in the Eastern and Western Highland Rim Provinces support H. eggertii *(Chester), not including the station at Coffee County as stated in the DEIS. Three of the nine known and documented Tennessee stations of the composite are supported in the Central Basin Province contradictory to statements issued in the DEIS.* **Environmental Science Graduate Students, University of Tennessee at Chattanooga, 33o**

Q12. *Considering that three of the populations [of* Helianthus eggertii*] occur in the Highland Rim Province and, more importantly three in the Central Basin Province, should not a complete vascular plant inventory be conducted before any alternative is implemented? Although surveys were conducted on Columbia Project Lands, their methodologies are poorly if at all delineated in the DEIS - merely stated as extensive surveys were conducted. Did the surveys intend to find only* H. eggertii *or all the state's listed and federal species? How is an extensive survey defined? Complete vascular inventories should entail a systematic collection within all affected areas, not merely probable habitats. Sampling should run through two growing seasons depending on the area and number of habitats and documentation of specimens (voucher specimens if applicable for protected species or even pictures) and their respective locations should all be obtainable by the public. Furthermore, extensive surveys are not tantamount to baseline inventories. Surely, a single voucher specimen for every vascular plant encountered was collected and identified in the Columbia Project Lands area. If not, how can the species probability or likelihood of occurrence be stated with any confidence?* **Environmental Science Graduate Students, University of Tennessee at Chattanooga, 33p**

Q13. [T]*his alternative* [B] *would inundate known populations of a number of rare plant species and could impact several registered State Natural Areas. The Glade cress (*Leavenworthia exigua *var.* exigua*), Tennessee milk-vetch (*Astragalus tennesseensis*), and Limestone fame-flower (*Talinum calcaricum*) are Tennessee special concern plants, which occur in the area of proposed inundation by a reservoir on Fountain Creek. These limestone cedar glade plants, that are globally rare and the plant communities (habitat), would be destroyed by inundation.* **Andrew N. Barrass, Environmental Review Coordinator, Division of Natural Heritage, 64f**

Q14. *A population of the Tennessee and Federally listed (endangered) Leafy prairie-clover (*Dalea foliosa*) occurs between 620 feet and 630 feet elevation in the Moore Lane Glade Registered State Natural Area. This area is outside of the Fountain Creek watershed, but would require protection from inundation (629-foot elevation) by the two proposed extension (saddle) dam structures west of the proposed Fountain Creek reservoir.* **Andrew N. Barrass, Environmental Review Coordinator, Division of Natural Heritage, 64i**

Response to Comment Q7 - 14: As indicated in Sections 1.1 and 3.9, the EIS evaluates the relative potential for environmental impacts associated with each of the five alternatives. A detailed review of potential environmental effects would have to be conducted if one or more of the action alternatives were proposed to be built. In addition, as stated in Section 1.8 with regard to the Endangered Species Act, "The evaluations also would have to focus on the species protected at the federal and state level at that time and comply with the laws and regulations then in existence." Project-specific field investigations would be conducted at that time, and any potential impacts identified at that time would be assessed. As indicated in Section 5.9 and documented in Appendix E, the U.S. Fish and Wildlife Service has

concurred with this approach to addressing any potential impacts on federal endangered species.

Q15. *The information presented indicates that the Moore Lane Glade Registered State Natural Area (west of State Route 50) will be directly affected by the proposed location of the dam and construction area. A raised water table resulting from the impoundment could effect stream flow throughout the proposed project area. Due to the karst features of the area, a small, unnamed tributary to the Duck River (within the Natural Area) could have increased flow from ground water inflow. It is not clear how this change in hydrology would affect the Leafy prairie clover populations, which occur within the Natural Area.* **Andrew N. Barrass, Environmental Review Coordinator, Division of Natural Heritage, 64j**

Response to Comment Q15: Based on information provided by the Tennessee Division of Natural Heritage since the publication of the draft EIS, *H. eggertii* is presently known from 12 counties in Tennessee. This change has been made in Section 4.9 in the final EIS. Although portions of some of these counties occur in the Central Basin physiographic province, a review of the specific localities of each *H. eggertii* population confirms that no populations are known from sites actually located within the Central Basin.

Q16. [T]*here are a number of Tennessee endangered, threatened and special concern plants which occur on lands above the 900 foot contour, around Normandy Lake at sites known as Rutledge Falls, Copperas Branch, and Short Springs Designated State Natural Area. The Division of Natural Heritage has no records of Tennessee endangered, threatened or special concern plants below the 900-foot contour of Normandy Lake.* **Andrew N. Barrass, Environmental Review Coordinator, Division of Natural Heritage, 64m**

Response to Comment Q16: Comment noted. As stated in Sections 5.9, TVA is not aware of any protected species records from the area around Normandy Reservoir which could be adversely affected by raising the pool level. That conclusion would be reviewed and, if necessary, revised if some form of Alternative D was proposed to be built.

Q17. *Although not documented in the Draft EIS, there are numerous rare, threatened or endangered aquatic species records at the mouth of Fountain Creek and immediately downstream in the Duck River. Assuming suitable habitat exists within Fountain Creek, these species could be present in the watershed e.g., Coppercheek Darter (*Etheostoma aquali*) and Slabside Pearlymussel (*Lexingtonia dolabelloides*).* **Andrew N. Barrass, Environmental Review Coordinator, Division of Natural Heritage, 64e**

Response to Comment Q17: Information presented in the EIS includes the results of recent fish and mussel surveys in the Duck River and in the Fountain Creek watershed (see especially Appendix B). The survey results indicate that the coppercheek darter does occur in Fountain Creek; however, very few native mussels were encountered there. The coppercheek darter is a threatened species in Tennessee but is not, at present, listed as either endangered or threatened by the U.S. Fish and Wildlife Service. TVA believes the available information is sufficient to address the present status of any potential effects of building a Fountain Creek reservoir on protected aquatic species. That information probably would need to be up-dated if and when a reservoir was proposed to be built in that area.

R. Land Use

R1. *Alternative C would only have short-term adverse effects on land use, primarily because the location and construction of the pipeline, intake, and booster station can be adjusted so as to minimize their effects on prime farmland and other uses of the land in the area. Due to its minimum requirements for land (estimated to be 2 acres plus 130 acres of easement for the pipeline), this alternative is preferred over Alternative B which would require the disturbance of 3,600 acres of land.* **Environmental Science Graduate Students, University of Tennessee at Chattanooga, 33s**

R2. *The soils that are present in the Duck River area range from well to moderately well drained silty/loamy soils to highly acidic and low nutrient content soils. The silty/loamy soils are productive for a variety of different crops and considered prime farmland. Grazing cattle frequently use such soils. The economic cost of changing the land use of these few productive agricultural areas merits further investigations before implementing Alternative C.* **Environmental Science Graduate Students, University of Tennessee at Chattanooga, 33c**

Response to Comments R1 and R2: Comments noted. Under the present concepts, Alternative C would involve the permanent use of about two acres of land (to be occupied by the intake structure and the booster station). All other land along the route of the pipeline would be affected only during the construction period, after which the owner could decide how to use it. If these concepts carry forward into actual plans for this project (if it is to be built), Alternative C would not have any long-term impact on land use in the project area.

R3. *The fluctuation that occurs now from the necessary winter/summer pool flows have caused continuous loss of trees which are being undercut by the changing currents along the banks. In an effort to hold as much of the dirt along the banks as possible, we have planted trees along some of the most stressed areas. We would certainly like to see them grow and aid in the protection from erosion that more and higher water levels would make impossible.* **Polly Dement Oettinger, 41b**

Response to Comment R3: The changes in flow patterns which would occur under any of the action alternatives would take place only during drought conditions. None of the alternatives would have any effect on the conditions described in this comment.

R4. *The disposition, ownership, and management of the environs surrounding the reservoir proposal (B) are a major shortcoming of the DEIS. As other reservoir projects in the nation have experienced, control of nutrients in the reservoirs and lakes in the southern U.S. are a continuing challenge. Shallow, warm water bodies enriched with nutrients from farmland and agricultural runoff and natural sources quickly become colonized with mats of aquatic plants and algae. To control nutrient enrichment and eutrophication, the drainage basin containing the reservoir will likely require management measures and land use controls including but not limited to: creation of buffer zones in perennial and intermittent streams in the watershed; timber cutting and agricultural use restrictions in buffer zones; lot size and housing density restrictions; policies on septic tank placement and maintenance, and other strategies to prevent pollutants and nutrients from entering the proposed reservoir. If Alternative B is selected by TVA as its preferred alternative, the FEIS should provide at least a draft basin management plan that includes TVA policies and procedures on shoreline*

management, water quality, monitoring, aquatic weed control, fisheries, etc. as they relate to the proposed Fountain Creek Reservoir. As an example of reservoir management techniques that may be useful in addition to TVA's management EISs such as the recent Shoreline Management EIS, we have enclosed the watershed management rules that the State of North Carolina required for the Lake Randleman watershed (Randleman Watershed Management Rules) in 1998. **EPA, 51ae**

Response to Comment R4: TVA concurs with the basic points made in this comment; however, TVA is not planning to make the decision to construct one or more of these alternatives and TVA probably would not select any additional purpose(s) to be included in one or more of these water supply projects. The EIS identifies that the source of additional water for the Columbia area would have to be protected from contamination and nutrient enrichment. Insuring that appropriate land and water use decisions are made can best be accomplished by the project sponsor(s) and the regulatory agencies.

R5. *Surely the history of overdevelopment in some of the Western states without adequate water sources should play in mind when forming water and land use strategies for this area. The Tennessee Department of Environment and conservation has taken the initiative to limit development along the shores of Tims Ford Lake; not soon enough, but a step in the right direction. Other watersheds should do the same.* **Robert N. Reed, 28b**

R6. *Pumping Tims Ford Reservoir water to discharge into the Duck River, although an engineering possibility, is contrary to what the TVA envisioned and documented in the Tims Ford Reservoir Land Management and Disposition Plan and EIS. The number one consideration with the Tims Ford Reservoir plan, and what amounts to severely restricted development of the 6000 public acres in Franklin and Moore counties surrounding the reservoir, is land conservation in the name of water quality. Just as when water quantity issues were correctly foreseen for one purpose of the Columbia Dam, water quality issues are at the forefront of Tims Ford Reservoir Land Management Plan and EIS. If, in the name of water quality, we are not allowed to put large areas of tax producing real estate on the market and develop them in the name of expanding our tax base and are, then, compelled to sign on to a project that will degrade further the quality of Tims Ford Reservoir water; I strongly take issue. We would be in effect rewarding unbridled growth in one area of the state by limiting growth in another. At the same time, our area would suffer without direct or indirect benefit.* **F. Montgomery Adams, Jr., Franklin County Executive, 29b**

Response to Comments R5 and R6: Comments noted. Under the recent amendments to the Clean Water Act, the protection of water quality probably would essentially dictate land use decisions in both the Duck and Elk River watersheds, regardless of whether a pipeline connection is constructed or not. The long-term quality and optimum use of these river systems and reservoirs would depend on the ways land use decisions are made all across each watershed.

R7. *While TVA may still claim ownership of 60 acres at Short Springs along the present Normandy Reservoir, this land was designated a TVA Small Wild Area and has subsequently been made a part of the Designated Short Springs State Natural Area under the Natural Areas Preservation Act of 1971. The purpose of the act is to protect areas possessing scenic, scientific, including biological, geological and/or recreational values which are in prospect and peril of being destroyed. Short Springs Natural Area*

is a Class I - Scenic/Recreational Area under T.C.A. 11-14-108 (b)(1)(O). **Marjorie S. Collier, President, Friends of Short Springs, 27c**

Response to Comment R7: Comment noted.

S. Visual, Recreation, & Natural Areas

S1. *Alternative C would have only a minimum impact upon the recreational use of the Duck River - and for only a brief period of time. Only a very small (< 1 acre) would be required for the intake structure. Also, neither the presence nor operation of the underground pipeline would negatively impact the recreational use of this river.* **Environmental Science Graduate Students, University of Tennessee at Chattanooga, 33t**

Response to Comment S1: Comment noted.

S2. [T]*he potential for mitigation measures to protect Short Springs Natural Area should be documented in the EIS.* **Justin P. Wilson, Deputy to the Governor, 43i**

Response to Comment S2: As indicated in Sections 5.11 and 3.9, raising the pool level on Normandy Reservoir as described under Alternative D would have adverse effects on a small part of Short Springs State Natural Area where substantial wildflower populations occur. If that alternative was proposed to be built, detailed plans for the project would be prepared and an appropriate environmental evaluation would be conducted. At that time, project-specific issues, including avoidance and/or mitigation measures in the natural area, would be addressed based on the detailed plans for the project.

S3. *We feel that any negative impact to Short Springs State Natural Area, which has been designated as biologically significant by the State of Tennessee for nearly 20 years, sets an unacceptable precedent.* **Leslie Colley, The Nature Conservancy of Tennessee, 44e**

S4. *I have always been impressed with the willingness of TVA, the state of Tennessee, and the city of Tullahoma to join together to protect the truly unique environs containing Short Springs. It dismays me to think that all of that hard work could disintegrate so quickly. Please consider carefully the legacy that will be left.* **Jeff Stewart, 52c**

S5. *Raising the Normandy Pool Level would be detrimental to Short Springs State Natural Area by inundating lower portions, particularly the area where Bobo Creek and Machine Branch join and where a rich profusion of wildflowers occurs. A portion of the Natural Area extends along Bobo Creek as far down as Carroll Creek and this would also be detrimentally affected.* **Marjorie S. Collier, President, Friends of Short Springs, 27b**

S6. *I wish to urge TVA to not recommend Alternative D in the final Environmental Impact Statement. Short Springs is one of the most beautiful natural wildflower areas around. This small area contains many, many specimen of flowers and is enjoyed by all ages. I love to take my grandchildren there, they love it. Please do not ruin this special place. Surely one of the other alternatives would work as well without destroying the natural beauty of Short Springs.* **Mrs. Herschel McDonald, 57**

S7. *I have just received the very discouraging and disappointing news that your company (TVA) is considering the expansion of services in this particular area of the State (Short Springs). To me it is ludicrous to even think of increasing the services of Normandy Dam; which would entail the destruction (perhaps extinction) of a considerable amount of plant and animal life in some of the most beautiful natural area's of this portion of*

our state. I am also surprised such corporations as TVA would challenge (violate) existing legislation as the preservation law of 1971. I therefore, am vehemently opposed to such action and will do all in my power to convince others to do and feel likewise. **A. E. Smedley, 56**

Response to Comment S3 - S7: TVA recognizes the unique suite of natural features which exist along the reservoir shoreline in the Short Springs State Natural Area and shares the agency and public commitment to this site. If the decision is made to raise the pool level on Normandy Reservoir, TVA would actively participate in determining the potential effects on Short Springs and assist in minimizing or mitigating losses to the site which could not be avoided.

S8. *Currently, residents near the area of the proposed* [Tims Ford] *intake, "regular" boaters and fishermen, and transient boaters and fishermen enjoy a quiet zone, free from industrial type noise....like the continuous hum of high speed electric pumps. This would change dramatically in this area, noting that sound carries well over water, particularly on a quiet night.* **Mark H. Dudley, 24h**

Response to Comment S8: If Alternative E was proposed to be built, appropriate measures would be taken to minimize noise levels associated with the intake structure. As indicated in Section 5.10, these measures could include using low-noise equipment, and locating and designing the intake to minimize noise production. Properly located, designed, and constructed, this alternative would have insignificant effects on local noise levels.

T. Cultural Resources

T1. *When compared with Alternative E (requiring a 20-mile-long pipeline), and Alternative B (requiring the disturbance of 3,600 acres), Alternative C would only disturb a small amount of land. Therefore, assuming that the potential cultural resources are evenly distributed, the Alternative C would have the least impact on any existing cultural resources. In addition, after the site/route is reviewed by the Tennessee State Historic Preservation Office, the pipeline construction could be adjusted to minimize further disturbance to cultural resources under this alternative.* **Environmental Science Graduate Students, University of Tennessee at Chattanooga, 33u**

Response to Comment T1: Comment noted. Assuming a maximum corridor width of 50 feet for pipeline construction, Alternative C would affect approximately 130 acres of land and Alternative E would affect approximately 200 acres. Enlargement of Normandy Reservoir under Alternative D would affect 230 acres and the construction of a reservoir in the Fountain Creek watershed as described under Alternative B would affect approximately 3,650 acres.

T2. *Considering available information, we find, after applying the Criteria of Adverse Effect codified at 36 CFR Part 800, that the project as currently proposed will ADVERSELY AFFECT PROPERTIES THAT ARE ELIGIBLE FOR LISTING IN THE NATIONAL REGISTER OF HISTORIC PLACES. Therefore, this office has an objection to the implementation of this project. You should now, through TVA, inform the Advisory Council on Historic Preservation of this adverse effect determination and begin immediate consultation with our office. Please enclose a copy of this determination in your notification to the Council as delineated at 36 CFR Part 800. Until you have received a final comment on this project from this office and the Council, you have not completed the Section 106 review process.* **Herbert L. Harper, Tennessee State Historic Preservation Office, 12**

Response to Comment T2: These comments were made by the Tennessee State Historic Preservation Officer (SHPO) in a letter dated September 14, 2000. The SHPO provided amended comments by letter dated October 19, 2000 (see Appendix E) indicating that this undertaking is limited to the drafting of a programmatic EIS for future project implementation and, as such, will not affect any properties listed or eligible for listing on the National Register of Historic Places. Appropriate review of the detailed plans for any alternative proposed to be built would be conducted as a part of the subsequent evaluation of potential environmental effects.

U. Socioeconomics

U1. *We do not accept the premise in the Draft EIS that there will be no growth in "new large, water consuming industries." The Tennessee Department of Economic and Community Development believes that industrial growth will be critical to the future growth of the region.* **Justin P. Wilson, Deputy to the Governor,43g**

U2. *While the DEIS indicates that the Fountain Creek alternative will be the most expensive and may have the greatest environmental impact, it could be penny wise and pound foolish to try to cut it so close with the economic future of the area. Past investments in community infrastructure developments have made possible industrial locations and expansions which simply would not have occurred without such investments. These locations and expansions have been vital to the region's economy and have more than repaid the investments made. The same will be true in the future. Further, our expanding environmental capabilities and regulatory protections ensure more than ever that such growth can occur with minimal, if any, negative impact upon our environment.* **Wilton Burnett, Jr., Special Projects, Department of Economic and Community Development, 63c**

U3. *The DEIS analyses assume that no new water-consuming industries were to site in the watershed and increase the water demands. In addition, it is somewhat unclear if agricultural needs were adequately included. Page 24 of the DEIS states that "[t]he amount of water withdrawn for agricultural irrigation is not known, but given the intensive agricultural land use in the three county area, significant amounts could be drawn during an extended drought." Similarly, page 25 states that the USGS, in their 1996 needs evaluation estimates, "...did not include any water for new, self-supplied industries or major expansions of agricultural water use in any of the three water service areas." The FEIS should further discuss agricultural needs and the potential for agricultural expansion and additional water-consuming industries siting in the area.* **EPA, 51e**

Response to Comments U1 - U3: As indicated in Section 2.5, the projections used in the EIS allow for increases in industrial water use in excess of recent growth in the area. They do not, however, include provision for new, large, self-served, water-using industries such as chemical plants, paper mills, or major agricultural expansions. While those types of industries are not likely to locate in the area, if such a facility did locate in the watershed, it would require revision of the water needs projections. It should also be noted that many industries now employ processes that use considerably less water than in the past. A good example is the Saturn plant at Spring Hill, which uses only about one-fifth the water a comparable older automobile manufacturing plant would use (see sidebar on page 19 of the 1998 *Water Supply Needs Analysis for Bedford, Marshall, Maury, and Southern Williamson Counties Tennessee*).

U4. *The draft EIS is geared to providing enough water for Columbia to grow at the present rate for the next 50 years. We believe the present rate was not anticipated when the dam was originally projected and cannot be sustained for so long a period. Further, planning for it (or failing to recognize this) will eventually negatively impact Colombians' quality of life and the economic viability of other counties in the watershed. Atlanta could serve as a poster child for unbridled development.* **Marty Marina, Executive Director, Tennessee Conservation League, 58c**

U5. *Take a look at the current water problems in Los Angeles, California, and Phoenix, Arizona, caused by over-development for the available water supply. We should be learning from their greed centered errors, rather than emulating them. Tennessee is blessed with abundant fresh water. Why concentrate too much development in an area with insufficient water to sustain it? Once this pattern is established, it feeds upon itself and becomes irreversible.* **Floyd and Linda Ayers, 32c**

Response to Comments U4 - U5: Based on present trends and conditions, the existing water supply in the Maury/southern Williamson County Water Service Area is expected to be adequate until during drought conditions some time after 2015. If the demand continues to increase as projected, a decision will be necessary regarding whether to augment the supply and, if so, how to do it. A decision to not increase the supply and thereby restrict population and economic activity to a level that could continue to be supported by the existing supply is the No Action Alternatives.

U6. *I also want to know if anybody has considered the impact of Highway or In-State 840 upon this area and what it is going to do in the areas of Marshall, Murray, and Williamson Counties. Continued growth in Marshall County was too low on that screen; I can tell you today it will more than double, it will more than triple in size simply because of the location of factories and industrial base we have in Marshall County. Murray County will soon see a major growth in industry as it is already doing due to the Saturn Plant at Spring Hill. Satellite factories will continue to come in; that means more people, that means more need for water, and we don't have it.* **Randy Short, 80d**

Response to Comment U6: When it is completed, Highway 840 is expected to have significant impacts on the northern end of Maury County and on southern Williamson County. These effects have been included in the projections of local economic growth. The impact of this new highway on Franklin County is less clear; however, the population projection for Franklin County recognizes and builds on the recent growth in the county.

U7. *The Related Documents identified in the EIS (Page 12) listed only the Draft EIS on the use of land surrounding Tims Ford Reservoir. Again, a myopic view without proper consideration of other effects on the area, does not take other important factors into account. Socioeconomic impacts listed in the EIS do not address any potential impacts to the Franklin County area, other than construction and related activities.* **Mark H. Dudley, 24e**

U8. *The Franklin County area is in a "growth spurt". New major highways have been created, old highways are being widened, our industrial base has seen multi-national industrial companies relocating to this area, most notably Nissan's Decherd facility, and the numbers of residential and commercial Building Permits have increased by about 80% over the numbers just six years ago. It is a distinct possibility, given that Nissan located in this area, new roads have been created, our central location, our recreational resources, that other large, water consuming industries may locate in Franklin County in the near term. This EIS, in my opinion, does not see beyond the boundaries of the study area, particularly at the future adverse socioeconomic impact of reducing precious water supplies to the Elk River Watershed.* **Mark H. Dudley, 24d**

Response to Comments U7 - U8: This programmatic EIS focuses on the water needs of the three water service areas in the upper Duck River watershed However, because of the concern expressed and the potential impact of one of the alternatives on Franklin County in the Elk River watershed, we have looked at the water needs situation in that county. Tims Ford Reservoir holds 4.5 times more water in storage than Normandy Reservoir (approximately 535,000 acre-feet in Tims Ford compared to 117,000 acre-feet in Normandy). In 1995, the water systems in Franklin and Moore counties used 2.1 mgd of surface water and 1.7 mgd of groundwater from wells and springs, for a total water demand in both counties of 3.8 mgd. That level of water use would be equivalent to 12 acre-feet per day if all of the water was withdrawn from Tims Ford Reservoir. With steady or even additional growth in Franklin and Moore counties, there would be enough water in Tims Ford Reservoir to meet future water supply demands in the Elk River area while helping to meet the needs of adjacent water service area.

V. Environmental Justice

V1. *We note that the Environmental Justice Executive Order (EO 12898) was not listed on pages 16-17 under Other Review and Permit Processes. The FEIS should list it and, more importantly, consider potential E*[nvironmental] *J*[ustice] *impacts relative to the alternatives.* **EPA, 51ag**

V2. *Page 137 discusses demographics of the project area. It appears that minority and low-income percentages are similar among project counties and lower than the state average. One exception is the Bethesda Division of Williamson County for low-income groups, which is noticeable greater (12.6%) than that of the total county (5.8%). This should be considered during infrastructure construction of the alternative. However, since the overall effect of the project would be to increase water supply in these counties, this may or may not be a great E*[nvironmental] *J*[ustice] *concern.* **EPA, 51ah**

Response to Comments V1 - V2: TVA is not subject to this Executive Order; however, TVA typically addresses environmental justice issues in the EIS documents we prepare. Accordingly, the Environmental Justice Executive Order (EO 12898) has been added to Section 1.8 in the final EIS. While potential disproportionate impacts have been considered in this study, detailed analyses cannot be conducted until more information about the location of structures and any proposed pipeline routes becomes available. This would be done as a part of the subsequent environmental review of any action alternative proposed to be constructed, depending on the extent of federal agency participation in the project. However, at this time and based on the data shown in Tables 23 and 24, we do not anticipate disproportionate impacts on any segment of the population. The discussion in Section 5.14 will be changed in the FEIS to clarify this.

Commenter Index

Adams, F. Montgomery, Jr., Franklin County Executive
Log No. 29; Comments B12, C8, K7, K18, K23, and R6.
Albright, John, Log No. 2; Comment D2.
Arnold, Angela B., Log No. 19; Comment F7.
Ayers, Floyd and Linda, Log No. 32; Comments B16, H9, H25, K24, and U5.

Balsley, Bill, Log No. 45; Comment H17.
Barrass, Andrew N., Environmental Review Coordinator, Division of Natural Heritage,
Log No. 64; Comments A26, A27, A33, G21, G23, G24, K12, L6, L7, Q3, Q8, Q9, Q10, Q13, Q14, Q15, Q16, and Q17.
Braker, Randal J., Log No. 70; Comments C5 and C11.
Burnett, Wilton, Jr., Special Projects, Department of Economic and Community Development, Log No. 63; Comments C14, E10, and U2.

Christopher, J. P., Log No. 42; Comment G15.
Clemens, P. F., Log No. 22; Comment F1.
Colley, Leslie, The Nature Conservancy of Tennessee,
Log No. 44; Comments A7, A41, D4, E25, F13, G9, H5, and S3.
Collier, John R., Jr., Chairman, Board of Public Utilities of Columbia, Tennessee,
Log No. 53; Comments A1, A43, and A44.
Collier, Marjorie, Log No. 75; Comments G13 and G20.
Collier, Marjorie S., President, Friends of Short Springs,
Log No. 27; Comments F3, G8, K16, R7 and S5.
Craig, Jack, Log No. 77; Comments A20, A37, B3, and F20.
Curtis, Kent, Log No. 4; Comments E4 and Q5.

Derryberry, Carolyn, Log No. 74; Comments B17, C13, and E34.
Derryberry, William, Log No. 73; Comments A22, A23, B18, E35, K13, K14, and L1.
Draughon, W. David, Jr., Division of Water Supply, TDEC,
Log No. 62; Comments E21, F18, G1, and H3.
Dudley, Mark H.,
Log No. 24; Comments C17, H20, H21, J3, K17, K19, S8, U7, and U8.
Due, Joe P., Log No. 49; Comment E1.

EPA, Log No. 51; Comments A12, A13, A14, A16, A17, A24, A28, A29, A30, A31, A32, C9, C10, C22, E23, E32, H23, I1, J1, K1, K2, K3, K4, K8, K25, L3,M2, M3, M4, M5, Q6, R4, U3, V1 and V2.
Environmental Science Graduate Students, University of Tennessee at Chattanooga,
Log No. 33; Comments A25, F14, J2, K9, K10, K11, K15, L2, L4, L5, M1, N1, P1, Q1, Q2, Q7, Q11, Q12, R1, R2, S1, and T1.

Finks, Michael, Log No. 35; Comment L8.
Fitch, Kevin C., Log No. 54; Comments E26, F11, and G17.

Gnenflo, Louise, Log No. 25; Comments E17, F10, G10 and H1.
Grissom, Debbie J., Log No. 68; Comment E6.

Hall, Kay & Ron, Log No. 50; Comment H13.
Harper, Herbert L., Tennessee State Historic Preservation Office,
Log No. 12; Comment T2
Haynes, Lewis P., Log No. 40; Comment E13
Haynes, Marian J., Log No. 48; Comment E12.

Hillman, Jim, Log No. 16; Comment B4.
Horn, Dennis D., Log No. 10; Comments E16, F8, G14, and H31.
Horn, Fred H., Log No. 5: Comment H30.
Hudson, David L., Log No. 38; Comment H14.

Jacobs, Ed, Log No. 76; Comments B5, C6, G6, and H4.
Jones, Larry E., Log No. 1; Comments A9 and A35.

Lashlee, Jerry C., Log No. 26; Comments A15, C2, C16, C18, H10, and H24.
Lee, Don F., Log No. 6; Comments B1, C20, H12, and L9.
Lewis, Henry, Log No.21; Comment F6.
Lockwood, Richard E., Log No. 31; Comments A4, E28, G4, and K26.

Maddux, Ralph G., Log No. 23; Comments E14 and E36.
Marina, Marty, Executive Director, Tennessee Conservation League,
Log No. 58; Comments A40, C15, D5, E27, F17, G2, G3, H18, K5, and U4.
McDonald, Mrs. Herschel, Log No. 57; Comment S6.
McGarry, Ken, Log No. 13; Comments C21 and H16.
McKinney, Abrey, Environmental Services Division, TWRA,
Log No. 61; Comments E22, F16, And G7.
Mitchener, Douglas K.,
Log No. 59; Comments A38, B13, B15, D1, E30, F21, G11, H28, and Q4.

Nannie, Linda, Chairman, Duck River Agency,
Log No. 20: Comments A8, A36, A42, and C7.
Nannie, Linda, Chairman Duck River Agency,
Log No. 71; Comments A8, A36, A42, and C7.

Oettinger, Polly Dement, Log No. 41; Comments F5 and R3.

Penrod, Mike D., Log No. 67; Comments E31 and H29.
Penrod, Nancy L., Log No. 69; Comments B7 and K21.
Procter, John M., Elk/Duck River Chapter, Trout Unlimited,
Log No. 60; Comments E33, F9, K6, K20, and L10.

Reed, Robert N., Log No. 28; Comments H19, K22, and R5.
Romesberg, Wayne,
Log No. 72; Comments A39, B2, B10, C12, D3, E7, E37, E39, E40, F19, and H27.
Russell, Liane B., for the Tennessee Citizens for Wilderness Planning Board of Directors, Log No. 30; Comments A11, E19, F12, and G19.

Sacchinelli, Steve, Log No. 37; Comment E3.
Sanders, Charles, Log No. 15; Comments A3 and B11.
Sanders, Eugene J., Log No. 39; Comments C19 and H26.
Shanks, Robert F., Log No. 34; Comments E18, F4, G12, and H6.
Short, Cindy, Log No. 81: Comment B6.
Short, Randy, Log No. 80; Comments D6, E8, E38, and U6.
Smedley, Agnes Miller, Log No. 46; Comment G16.
Smedley, A. E., Log No. 56; Comment S7.
Spencer, J. D., Log No. 14; Comment H8.
Stevenson, Glenn, Log No. 78; Comments B19, C3, E20, G5, and H22.
Stewart, Jeff, Log No. 52; Comments F2, G18, and S4.

Tamberrino, Frank M., President, Maury Alliance, Log No. 47; Comments E15 and E42.
Tamberrino. Frank M., President, Maury Alliance,
Log No. 66; Comments A2, A6, and D7.
Tims Ford Council, Log No. 3; Comment H15.

Vaughn, Sharon, Log No. 79; Comments A5, A21, A34, B8, and E41.

Wallace, Terry, Marshall County Executive, Log No. 65; Comments C4, E5, and E11.
Willingham, Land and Tom, Log No. 18; Comment H11.
Willingham, , Tom, Log No. 17; Comment H7.
Wilson, Justin P., Deputy to the Governor,
Log No. 43; Comments A10, A18, A19, B9, C1, E29, F15, G22, H2, S2, and U1.
Witherow, W, Roger, Log No. 11; Comment E9.
Wooten, Doug, Log No. 36; Comment E2.

APPENDIX E

Results of Endangered Species and National Historic Preservation Act Consultations

United States Department of the Interior

FISH AND WILDLIFE SERVICE
446 Neal Street
Cookeville, TN 38501

December 20, 2000

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

Dear Mr. Loney:

I have reviewed the draft Environmental Impact Statement (DEIS) on Future Water Supply Needs in the Upper Duck River Basin, as requested in your September 19, 2000, letter transmitting this document. The DEIS is well written and the likely impacts of each of the alternatives studied are clearly presented.

Because the water supply need for the area would not have to be addressed until some time after the year 2015, I support the decision to present the DEIS to the public without identifying a preferred alternative. And, since no federal agency or other entity has specific plans for, or has proposed to construct, any of the possible projects described in this DEIS; and since the document includes language indicating that detailed, site-specific endangered and threatened species studies would have to be conducted if any of the alternatives were proposed to be built, and that further evaluation of possible impacts would be needed at that time, I concur with your conclusion that this water supply analysis would not have any effect on federal endangered and threatened species.

Thank you for the opportunity to comment. If you have questions, please call me at 931/528-6481, ext. 212.

Sincerely,

Lee A. Barclay, Ph.D.
Field Supervisor

TENNESSEE HISTORICAL COMMISSION
DEPARTMENT OF ENVIRONMENT AND CONSERVATION
2941 LEBANON ROAD
NASHVILLE, TN 37243-0442
(615) 532-1550

October 19, 2000

Mr. J. Bennett Graham
Tennessee Valley Authority
Cultural Resources
NRB 2C
17 Ridgeway Road, Box 920
Norris, Tennessee 37828-0920

RE: TVA, UPPER DUCK RIVER BASIN WATER NEEDS/EIS, UNINCORPORATED, MULTI COUNTY

Dear Mr. Graham:

The Tennessee State Historic Preservation Office has reviewed the above-referenced undertaking received on Friday, October 13, 2000 for compliance by the participating federal agency or applicant for federal assistance with Section 106 of the National Historic Preservation Act. The Procedures for implementing Section 106 of the Act are codified at 36 CFR 800 (64 FR 27044, May 18, 1999).

The undertaking considered for this review is limited to the drafting of the Programmatic Environmental Impact Statement (EIS) for future project implementation. Upon selection, the chosen alternative from the EIS must undergo independent Section 106 review.

Therefore, after considering the documentation submitted, it is our opinion that there are no National Register of Historic Places listed or eligible properties affected by this undertaking. This determination is made either because of the location, scope and/or nature of the undertaking, and/or because of the size of the area of potential effect; or because no listed or eligible properties exist in the area of potential effect; or because the undertaking will not alter any characteristics of an identified eligible or listed property that qualify the property for listing in the National Register or alter such property's location, setting or use. Therefore, this office has no objections to your proceeding with the project.

If you are applying for federal funds, license or permit, you should submit this letter as evidence of compliance with Section 106 to the appropriate federal agency, which, in turn, should contact this office as required by 36 CFR 800. If you represent a federal agency, you should submit a formal determination of eligibility and effect to this office for comment. You may direct questions or comments to Jennifer M. Bartlett (615) 741-1588, ext. 17. This office appreciates your cooperation.

Sincerely,

Herbert L. Harper
Executive Director and
Deputy State Historic
Preservation Officer

HLH/jmb

Appendix 6-A

ARAP NRS23.228

STATE OF TENNESSEE
DEPARTMENT OF ENVIRONMENT AND CONSERVATION
Division of Water Resources
Natural Resources Unit
Davy Crockett Tower, 9th Floor
500 James Robertson Parkway
Nashville, TN 37243

June 11, 2025

Jonathan Hardin, President / CEO
Columbia Power and Water Systems
201 Pickens Lane, P.O. Box 379
Columbia, TN 38401

Subject: Section 401 Water Quality Certification
Aquatic Resource Alteration Permit
File# NRS23.228, Duck River, Maury County, TN

Dear Mr. Hardin:

The Division has reviewed your application for the modification of Columbia Power and Water Systems' permit (file number NRS23.228), which authorizes withdrawal of up to 20 million gallons a day from the Duck River near Columbia near river mile 134, and construction of a new intake downstream near river mile 100. The purpose of the work is for public water supply. The Aquatic Resource Alteration Permit has been issued with a modification date of June 2, 2025 (enclosed).

The Division has reasonable assurance the activity as proposed and in accordance with all permit conditions herein will not violate applicable water quality standards. The attached permit (enclosed) authorizes the activity pursuant to *The Tennessee Water Quality Control Act of 1977* (T.C.A. §69-3-101 et seq.) and serves as §401 water quality certification (pursuant to the *Federal Clean Water Act* 33 U.S.C. 1341).

The state of Tennessee may modify, suspend, or revoke this authorization or seek modification or revocation should the state determine that the activity results in more than an insignificant violation of applicable water quality standards or violation of the TWQCA. Failure to comply with permit terms may result in penalty in accordance with T.C.A. §69-3-115.

It is the responsibility of the permittee to read and understand all permit conditions before the project begins. If you need any additional information or clarification, please contact me at 615-532-0710 or by e-mail at robert.d.baker@tn.gov.

Sincerely,

Robert Baker

Robert Baker
Natural Resources Unit

Enclosure

Cc: Matthew Wheeler - Project Manager, CPWS, matt.wheeler@cpws.com
Robbie Sykes - U. S. Fish & Wildlife Service; Cookeville, TN. robbie_sykes@fws.gov
Julia Botz - U. S. Environmental Protection Agency; Atlanta, GA., Botz.Julia@epa.gov
Amy Robinson - Corps of Engineers, Nashville District, amy.m.robinson@usace.army.mil
Sherry Glass – Mgr. DWR Columbia Environmental Field Office, sherry.glass@tn.gov
Bradley Hubbard - Tennessee Valley Authority, bdhubbard0@tva.gov



§401 Water Quality Certification

Aquatic Resource Alteration Permit

NRS23.228

Pursuant to the *Tennessee Water Quality Control Act of 1977* (T.C.A. §§ 69-3-101 et seq.) and supporting regulations, a permit is required to alter the properties of waters of the state. Also, pursuant to section 401 of the *Clean Water Act* (33 U.S.C. § 1341), an applicant for a federal license or permit which may result in a discharge into the waters of the U.S., shall provide the federal licensing or permitting agency a certification from the State in which the discharge will originate. Accordingly, the Division of Water Resources requires reasonable assurance that the activity will not violate provisions of the Tennessee Water Quality Control Act or provisions of sections 301, 302, 303, 306 or 307 of the Clean Water Act.

Subject to conformance with accepted plans, specifications, and other information submitted in support of the application, the state of Tennessee hereby certifies pursuant to 33 U.S.C. § 1341, and permits pursuant to T.C.A. § 69-3-108(b), the activity described below:

PERMITTEE Columbia Power and Water Systems
201 Pickens Lane, P.O. Box 379
Columbia, TN 38401

AUTHORIZED WORK: Withdrawal of water from the Duck River at an instantaneous rate of up to 13,900 gallons per minute to obtain up to 20 million gallons per day for public water supply from an existing intake structure located along the Duck River near river mile 134. Withdrawal from the existing intake is not authorized if the flow is below 100 cubic feet per second as measured at the USGS gage 03599500 at river mile 132.8.

Construction of a new intake and withdrawal of water from the Duck River at an instantaneous rate of up to 22,222 gallons per minute to obtain up to a combined total for the two intakes of 32 million gallons per day for public water supply from near river mile 100.

LOCATION: The activity is located in the Duck River in Maury County near river mile 134 and near river mile 100. Pursuant to T.C.A. § 10-7-504 and Rule 0400-01-01(4)(c)2, the precise locations are confidential. Therefore, the exact locations of the intake sites will not be disclosed in this permit or otherwise made available to the public.

EFFECTIVE DATE: March 15, 2024

MODIFICATION DATE: June 2, 2025

EXPIRATION DATE: March 14, 2029

April Grippo, Director
Division of Water Resources

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PART I

Authorized Alterations

This permit authorizes aquatic alterations associated with the withdrawal of water from the Duck River at the instantaneous rate of up to 13,900 gallons per minute (GPM) to obtain up to 20 million gallons per day (MGD) for public water supply from an existing intake structure located along the Duck River near river mile 134. Of this amount, 13.95 MGD constitutes an existing water withdrawal as of July 25, 2000. Pursuant to Rule 0400-40-07-.02(4), this withdrawal amount is exempted from the requirements of this permit if it does not adversely alter or affect classified uses in the Duck River. Withdrawal of water from the Duck River at the existing intake at mile 134, including the grandfathered amount, is not authorized if the flow is below 100 cubic feet per second as measured at the USGS gage 03599500 at river mile 132.8.

Columbia Power and Water Services (CPWS) is requesting to increase the authorized withdrawal from the Duck River from 20 MGD to 32 MGD, divided between two separate intakes. CPWS water treatment plant has a rated capacity of 20 MGD. Raw water is currently supplied by an intake in the Duck River near river mile 134. CPWS has determined that the increased withdrawal is necessary to supply water to its water treatment facilities. The increase will require a new water intake near Duck River mile 100 with a maximum intake capacity of 32 MGD. Although CPWS will maintain the existing 20 MGD withdrawal near Duck River mile 134, the authorized maximum combined withdrawal rate for the two intakes will not exceed 32 MGD.

Special Conditions

1. The withdrawal rate near river mile 134 shall not exceed 13,900 GPM or 20 MGD.
2. The withdrawal rate near river mile 100 shall not exceed 22,222 GPM or 32 MGD.
3. Withdrawal at the existing intake near river mile 134 shall not cause the flow to be diminished below 100 cubic feet per second (CFS) gaged at the USGS gage 03599500 as measured as the 1-day average.
4. Raw water withdrawal volumes shall be monitored and recorded daily.
5. Withdrawal data shall be reported to the Division on the corresponding comprehensive monthly operations reports for the Public Water Supply ID TN0000128.
6. The permittee shall conduct an annual water loss audit in accordance with the American Water Works Association (AWWA M36 Water Audits and Loss Control Programs v6 audit procedures), with a goal of achieving no more than 15% annual real loss. For purposes of this provision, “annual real loss" means physical water losses from the pressurized system (water mains and customer service connections) and the utility's storage tanks, up to the point of customer consumption during a calendar year.

a. The permittee shall submit the annual water loss audit report for the previous calendar year to the Division not later than January 31 of each year.

b. The permittee may exclude data associated with an extraordinary water loss event (e.g., line breaks resulting from an extreme weather event such as a deep freeze or flooding, or an accident caused by a person other than the permittee) from the calculation of annual real loss. To exclude such data, the permittee shall submit written documentation to demonstrate to the satisfaction of the Division that:

    i. The water loss event was unavoidable;

    ii. The permittee was operating the water distribution system in a prudent and workmanlike manner and in compliance with proper operation and maintenance procedures at the time of the water loss event;

    iii. The permittee promptly implemented appropriate measures to stop the water loss event;

    iv. The permittee complied with all applicable reporting requirements; and

    v. The permittee complied with any remedial measures required under "Adverse Impact."

c. If the annual real loss reported to the Division exceeds 15% of water supplied, after accounting for outlier events, the permittee shall develop a plan to reduce annual real loss. This plan shall be submitted to the Division for its approval not later than 90 days after submission of the audit report. The permittee shall implement the plan beginning not later than 30 days after receiving approval from the Division.

d. The permittee shall submit a plan that details the process and timelines by which it will operate and maintain its system to achieve no more than 15% annual real loss to the Division for review and approval not later than six months after the modification date of this permit.

7. As reasonable and appropriate, the permittee shall provide, participate in or perform studies necessary to determine the presence and extent of threatened and endangered mussels and other fish and aquatic life in the downstream portion of the Duck River impacted by the permittee's withdrawals, to include assessment of the flow requirements necessary to sustain these populations. These studies will include, but not be limited to, an evaluation of the efficacy of tapering permittee's withdrawal rates gradually downward under drought conditions to reduce impacts on federally listed species.

8. The permittee shall comply with the provisions of the Duck River Regional Drought Management Plan, including revisions approved by the Department. The provisions include, but are not limited to:

    a. triggers for drought restrictions

b. water use restrictions for drought stages, and

c. levels of enforcement for drought management stages.

9. The permittee shall develop a plan describing restricted and prohibited activities and enforcement mechanisms for drought management specific to the CPWS service area.

    a. This plan shall be submitted to the Division for review and approval within 180 days of the effective date of this permit.

    b. CPWS shall implement this plan independently or, if the plan is incorporated into the DRA's Duck River Regional Drought Management Plan, as part of compliance with item #8.

10. The permittee shall develop a plan describing measures it will pursue to provide public education to encourage water conservation, including but not limited to the method(s) of public education it will use, the frequency of its public education efforts, any circumstances that trigger it to pursue additional or increased public education effort, and a description of the type and nature of intensified public education measures. The permittee shall submit the plan to the Department not later than 180 days after the modification date of the permit.

General Conditions

1. It is the responsibility of the permittee to convey all terms and conditions of this permit to all contractors. A copy of this permit, approved plans, and any other documentation pertinent to the activities authorized by this permit shall be maintained on site at all times during periods of construction activity.
2. All activities must be accomplished in conformance with the approved plans, specifications, data, and other information submitted in support of the ARAP application and the limitations, requirements, and conditions set forth herein. Failure to comply with the terms and conditions of this permit is a violation of the Act.
3. The permittee is responsible for obtaining the federal section 404 permit from the U. S. Army Corps of Engineers and section 26a permit from the Tennessee Valley Authority where necessary.
4. The permittee is responsible for obtaining coverage under the National Pollutant Discharge Elimination System (NPDES) General Permit for Storm Water Discharges from Construction Activities where clearing, grading or excavation results in an area of disturbance of one or more acres, or activities that result in the disturbance of less than one acre if it is part of a larger common plan of development or sale.
5. All work shall be carried out in such a manner as will prevent violations of water quality criteria established in Rule 0400-40-03-.03. This consists of, but is not limited to, the

prevention of any discharge that causes a condition in which visible solids, bottom deposits, or turbidity impairs the usefulness of waters of the state for any of the uses designated by Rule Chapter 0400-40-04. These uses include fish and aquatic life (including trout streams and naturally reproducing trout streams), livestock watering and wildlife, recreation, irrigation, industrial water supply, domestic water supply, and navigation.

6. Impacts to waters of the state other than those specifically addressed in the plans and this permit are prohibited. All streams, springs, and wetlands shall be fully protected prior, during, and after construction until the area is stabilized. Any questions, problems or concerns that arise regarding any stream, spring, or wetland either before or during construction shall be addressed to the Division of Water Resource's Columbia Environmental Field Office - 1421 Hampshire Pike, Columbia, TN 38401 931-380-3371 or the permit coordinator in the Division's Natural Resources Unit – 615-532-0710.
7. Adverse impact to formally listed state or federal threatened or endangered species or their critical habitat is prohibited.
8. This permit does not authorize adverse impacts to cultural, historical, or archeological features or sites.
9. Clearing, grubbing, and other disturbance to riparian vegetation shall be kept at the minimum necessary for slope construction and equipment operations. Unnecessary native riparian vegetation removal, including tree removal, is prohibited. Native riparian vegetation must be reestablished in all areas of disturbance outside of any permanent authorized structures after work is completed. Coverage under this permit does not serve to waive any local riparian buffer protection requirement, and permittees are responsible for obtaining any necessary local approval.
10. To minimize wildlife entanglement and plastic debris pollution, temporary erosion and sediment control products that either do not contain netting, or that contain netting manufactured from 100 percent biodegradable non-plastic materials such as jute, sisal, or coir fiber shall be specified. Netting used in these products should have a loose-weave wildlife-safe design with movable joints between the horizontal and vertical twines, allowing the twines to move independently. Degradable, photodegradable, UV-degradable, oxo-degradable, or oxo-biodegradable plastic netting (including polypropylene, nylon, polyethylene, and polyester) are not acceptable alternatives.
11. Appropriate steps shall be taken to ensure that petroleum products or other chemical pollutants are prevented from entering waters of the state. Any equipment proposed to be used in-stream shall be free of noticeable leaks of fluids, e.g., hydraulic, transmission, crankcase, and engine coolant fluids and oils. All spills must be reported to the appropriate emergency management agency, and measures shall be taken immediately to prevent the pollution of waters of the state, including groundwater, should a spill occur.

12. This permit shall not be used incrementally to combine with other activities resulting in an appreciable permanent loss of water resource values.
13. This activity may not result in a disruption or barrier to the movement of fish or other aquatic life. The completed activities may not disrupt or impound stream flow.
14. The activity may not result in the discharge of waste or other substances that may be harmful to humans or wildlife.
15. This permit does not authorize access to public or private property. Arrangements concerning the use of public or private property shall be made with the landowner. The permittee is responsible for obtaining any additional permitting or maintenance agreements with other government or public agencies or lands.

PART II

Mitigation Requirements and Monitoring Procedures

Required Mitigation Activities

There are no mitigation requirements.

Monitoring Requirements and Procedures

The permittee shall submit the annual project report as described in Special Condition 6.c. by October 31 of each year.

Submission of Monitoring Results

All reports must be submitted in report form to the Division of Water Resources, Natural Resources Unit, Division of Water Resources, Davy Crockett Tower, 9th Floor, 500 James Robertson Parkway, Nashville, Tennessee 37243, or via email at ARAP.permits@tn.gov. Please be sure to indicate the ARAP permit number on your submittal.

Records Retention

All records and information resulting from the monitoring activities required by this permit including all records of analyses performed and calibration and maintenance of instrumentation shall be retained for a minimum of five years, or longer, if requested by the Division.

Falsifying Results and/or Reports

Knowingly making any false statement on any report required by this permit or falsifying any result may result in the imposition of criminal penalties as provided for in Section 309 of the Federal Water Pollution Control Act, as amended, and in Section 69-3-115 of the Tennessee Water Quality Control Act.

PART III

Duty to Reapply

The withdrawal of water from the Duck River beyond the expiration date of this permit is not authorized. If the permittee chooses to continue this activity, it must submit a complete application to the Division not later than 90 days prior to the expiration of the permit.

Property Rights

The issuance of this permit does not convey any property rights in either real or personal property, or any exclusive privileges, nor does it authorize any injury to private property or any invasion of personal rights, nor any infringement of federal, state, or local laws or regulations.

Water Rights

The waters of Tennessee are the property of the state and are held in public trust for the use of the people of the state. This permit does not grant or convey any prescriptive rights, appropriation, or allocation of water, nor does it authorize any injury to the riparian rights of others.

Other Permits

This permit does not preclude requirements of other federal, state, or local laws. This permit serves as both a section 401 certification and as a state of Tennessee aquatic resource alteration permit (ARAP) pursuant to the *Tennessee Water Quality Control Act of 1977* (T.C.A. § 69-3-101 to -148).

Other Information

If the permittee becomes aware that it failed to submit any relevant facts in a permit application or submitted incorrect information in a permit application or in any report to the Director, then it shall promptly submit such facts or information.

Changes Affecting the Permit Transfer/Change of Ownership

This permit may be transferred to another party, provided:

1. There are no activity or project modifications, no pending enforcement actions, or any other changes which might affect the permit conditions contained in the permit.
2. The permittee notifies the Director of the proposed transfer at least 30 days in advance of the proposed transfer date.
    a. The notice consists of a written agreement between the existing and new permittees containing a specified date for transfer of permit responsibility, coverage, and contractual liability between them; and
    b. The Director does not notify the current permittee and the new permittee, within 30 days of his or her intent to modify, revoke, reissue, or terminate the permit, or require that a new application be filed rather than agreeing to the transfer of the permit.
3. The permittee must provide the following information to the Division in its formal notice of intent to transfer ownership:
    a. the permit number of the subject permit,
    b. the effective date of the proposed transfer,
    c. the name and address of the transferor,
    d. the name and address of the transferee,
    e. the names of the responsible parties for both the transferor and transferee,
    f. a statement that the transferee assumes responsibility for the subject permit,
    g. a statement that the transferor relinquishes responsibility for the subject permit,

h. the signatures of the responsible parties for both the transferor and transferee, and

i. a statement regarding any proposed modifications to the permitted activities or project, its operations, or any other changes which might affect the permit conditions contained in the permit.

Change of Mailing Address

The permittee shall promptly provide to the Director written notice of any change of mailing address. In the absence of such notice the original address of the permittee will be assumed to be correct.

Noncompliance

Effect of Noncompliance

All withdrawals shall be consistent with the terms and conditions of this permit. Any permit noncompliance constitutes a violation of applicable state and federal laws and is grounds for enforcement action, permit termination, permit modification, or denial of permit reissuance.

Reporting of Noncompliance

24-Hour Reporting

In the case of any noncompliance which could cause a threat to public drinking supplies, or any other withdrawal which could constitute a threat to human health or the environment, the required notice of non-compliance shall be provided to the Division of Water Resources in the appropriate Environmental Field Office within 24-hours from the time the permittee becomes aware of the circumstances. (The Environmental Field Office should be contacted for names and phone numbers of environmental response personnel).

1. A written submission must be provided within five days of the time the permittee becomes aware of the circumstances unless this requirement is waived by the Director on a case-by-case basis. The permittee shall provide the Director with the following information:

   a. a description of the withdrawal and cause of noncompliance;

   b. the period of noncompliance, including exact dates and times or, if not corrected, the anticipated time the noncompliance is expected to continue; and

   c. the steps being taken to reduce, eliminate, and prevent recurrence of the non-complying withdrawal.

Scheduled Reporting

For instances of noncompliance which are not reported under subparagraph a. above, the permittee shall report the noncompliance by contacting the permit coordinator and provide all information concerning the steps taken or planned to reduce, eliminate, and prevent recurrence of the violation and the anticipated time the violation is expected to continue.

Adverse Impact

The permittee shall take all reasonable steps to minimize any adverse impact to the waters of Tennessee resulting from noncompliance with this permit, including but not limited to, accelerated or additional monitoring as necessary to determine the nature and impact of the noncompliance. It shall not be a defense for the permittee in an enforcement action that it would have been necessary to halt or reduce the permitted activity to maintain compliance with the conditions of this permit.

Liabilities

Civil and Criminal Liability

Nothing in this permit shall be construed to relieve the permittee from civil or criminal penalties for noncompliance. Notwithstanding this permit, the permittee shall remain liable for any damages sustained by the state of Tennessee, including but not limited to fish kills and losses of aquatic life and/or wildlife, as a result of the withdrawal from any surface waters. Additionally, notwithstanding this permit, it shall be the responsibility of the permittee to conduct its withdrawal activities in a manner such that public or private nuisances or health hazards will not be created.

Liability under State Law

Nothing in this permit shall be construed to preclude the institution of any legal action or relieve the permittee from any responsibilities, liabilities, or penalties established pursuant to any applicable state law or the Federal Water Pollution Control Act, as amended.

Reopener Clause

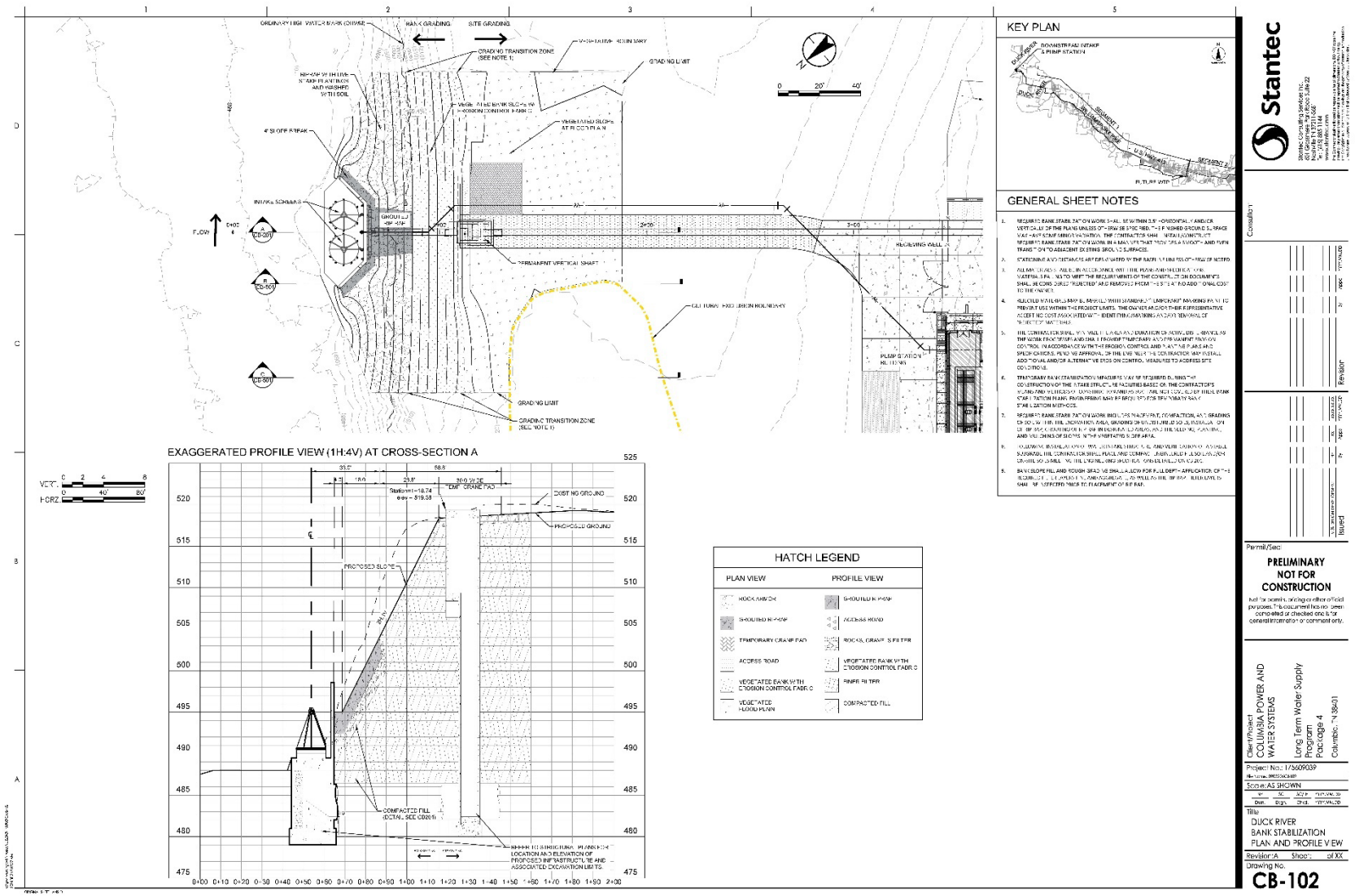
This permit may be modified, suspended, or revoked for cause, including:

1. Violation of any of the terms or conditions of this permit or of T.C.A §§ 69-3-101 to –148,
2. Obtaining the permit by misrepresentation or failing to disclose fully all relevant facts, or
3. A change in any condition that requires either a temporary or permanent change in the conditions of this permit.

Appeal

An appeal of this action may be made as provided in T.C.A. § 69-3-105(i) and Rule 0400-40-07-.04(9) by submitting a petition for appeal:

1. The petition must be filed within 30 days after notification of the issuance of the permit.
2. The petition must specify the basis for the appeal and state a claim for relief based on an alleged violation of the Tennessee Water Quality Control Act or the rules promulgated thereunder. Third parties shall specify facts sufficient to establish that they have satisfied the statutory and regulatory preconditions and otherwise have standing to appeal.
3. The petition should be submitted electronically to TDEC.Appeals@tn.gov. Alternatively, an appeal may be submitted to the technical secretary of the Tennessee Board of Water Quality, Oil and Gas at the following address: April Grippo, Director, Division of Water Resources, Davy Crockett Tower, 500 James Robertson Parkway, Nashville, TN 37243. Any hearing would be in accordance with T.C.A. §§ 69-3-110 and 4-5-301 et seq.


KEY PLAN
GENERAL SHEET NOTES
EXAGGERATED PROFILE VIEW (1H:4V) AT CROSS-SECTION A
HATCH LEGEND
PLAN VIEW
PROFILE VIEW
Stantec
PRELIMINARY
NOT FOR CONSTRUCTION
DUCK RIVER
BANK STABILIZATION
PLAN AND PROFILE VIEW
CB-102

APPENDIX

Rationale

Columbia Power and Water Services
201 Pickens Lane, P.O. Box 379
Columbia, TN 38401

May 30, 2025

Permit Writer: Robert Baker

Summary

Permittee:	Columbia Power and Water Services
Contact:	Jonathan Hardin, President / CEO Telephone #: 931-388-4833

Activity Location: The existing withdrawal is located in the Duck River in Maury County near river mile 134. The authorized location for the new intake is near river mile 100. Pursuant to T.C.A. § 10-7-504 and Rule 0400-01-01(4)(c)2, the precise location is confidential. Therefore, the exact location of the intake site will not be disclosed in this permit or otherwise made available to the public.

Authorized Activity: The existing authorized alteration to waters is withdrawal of water from the Duck River at the instantaneous rate of up to 13,900 gallons per minute to obtain up to 20 million gallons per day. The purpose of the withdrawal is for public water supply. The authorized increased withdrawal includes construction of a new intake near river mile 100 for additional water withdrawal. The total combined withdrawal from both intakes would be up to 32 million gallons per day.

Waterbody Name / ID:	Duck River /TN06040003016_1000 Duck River / TN06040003026_2000

Permit Status

Permit Type:	ARAP
Effective Date:	March 15, 2024
Modification Date:	June 2, 2025
Expiration Date:	March 14, 2029

Status of Affected Waters

Duck River – ID TN06040003026_2000
Duck River from Little Bigby Creek to Iron Bridge Road (upstream of Bear Creek).
Ecoregion - Outer Nashville Basin, 71h, Maury County
Hydrologic Unit Code - HUC_8 - 06040003 Lower Duck River
Assessment Date - September 13, 2021

Designated Use	Use Support	Causes	Sources
livestock watering & wildlife	fully supporting		
irrigation	fully supporting		
recreation	not assessed		
fish and aquatic life	fully supporting		
industrial water supply	fully supporting		
domestic water supply	fully supporting		

Duck River – ID TN06040003016_1000
Duck River from Lick Creek to Big Bigby Creek
Ecoregion - Outer Nashville Basin, 71h, Maury County
Hydrologic Unit Code - HUC_8 - 06040003 Lower Duck River
Assessment Date – January 29, 2025

Designated Use	Use Support	Causes	Sources
livestock watering & wildlife	fully supporting		
irrigation	fully supporting		
recreation	not supporting	Escherichia coli	Grazing in Riparian or Shoreline Zones
fish and aquatic life	fully supporting		
industrial water supply	fully supporting		
domestic water supply	fully supporting		

The Duck River segment TN06040003016_1000 was assessed January 29, 2025. All uses were supported with the exception of recreation, which is impaired because of Escherichia coli, the source of which is grazing in riparian or shoreline zones.

Based on this information, the Division determined that the affected waters have available water withdrawal parameters.

This segment of the Duck River from the Tennessee River (Kentucky Lake) to River Mile 137.7 is Exceptional Tennessee Waters. The basis for inclusion is critical habitat under the Federal *Endangered Species Act* for Fluted Kidneyshell (*Ptychobranchus subtentum*) and Slabside Pearlymussel (*Pleuronaia dolabelloides*), Purple Bean, Cumberlandian Combshell, Clubshell, Pygmy Madtom, Birdwing Pearlymussel, Oyster Mussel, and state threatened Coppercheek Darter and Water Stitchwort. Also, portions of the river that are within the Natchez Trace Parkway National Park, the Hugh Link Farm State Archeological Area, and the Tennessee National Wildlife Refuge.

Authorized Alterations

Columbia Power and Water Services' (CPWS) water treatment plant has a rated capacity of 20 MGD. Raw water is currently supplied by an intake in the Duck River near river mile 134. Of this amount, 13.95 MGD constitutes an existing water withdrawal as of July 25, 2000. Pursuant to Rule 0400-40-07-.02(4), this withdrawal amount is exempted from the requirements of this permit if it does not adversely alter or affect classified uses in the Duck River. CPWS supplies finished water to retail customers and two primary wholesale customers, Maury County Water System and the City of Spring Hill.

CPWS is requesting modification of this permit to increase the authorized withdrawal from the Duck River from 20 MGD to 32 MGD. CPWS states that the increased withdrawal is necessary to supply water to its water treatment facilities.

The authorized increase would require a new water intake that is authorized near Duck River mile 100 with a maximum intake capacity of 32 MGD. Although CPWS would maintain the existing 20 MGD withdrawal at approximate Duck River mile 134, the authorized maximum combined withdrawal rate would not exceed 32 MGD.

Alternatives Analysis and Selection of Least Impactful Practicable Alternative[1]

The stated purpose of the authorized alterations to state water resources is to provide public water supply. The applicant has submitted an analysis of potentially practicable alternatives to the authorized activity and provided the following discussion of those alternatives:

2.1 Non-Viable Alternatives

Hazen conducted an initial evaluation of the alternatives listed above as well as the alternative to raise the elevation of Normandy Dam. The purpose of the initial evaluation was to eliminate those alternatives that would not meet the purposes of the project. Through this effort, Hazen determined that the following alternatives would not meet project objectives:

[1] It should be noted the cost estimates for the alternatives were developed in 2021.

• *Water conservation (including pricing structure). Water conservation is already practiced by CPWS measures such as the inclining block pricing structure and public education messaging to encourage wise water use. Additionally, CPWS has an effective water loss prevention program that typically results in a rolling average annual water loss that ranges between 10 and 15 %. Though CPWS can expect to increase the efficiency of their system, that alone will not impact the projected 20-year water demand.*

• *Reuse/recycling, connection to another water supply. Large scale water reuse involves using reclaimed water from a wastewater treatment system. Although technologically, water reuse is entirely possible, wide-spread public acceptance is essential for a successful reuse program. To be used for residential irrigation, the reclaimed water must be treated to a higher level than what is typically required for direct discharge. A dedicated distribution system is also necessary for large scale water reuse. However, there are limitations to the amount of demand that can be offset by beneficial reuse. The additional treatment along with the distribution system would require a large capital investment. In this case, a different utility, the City of Columbia, is responsible for the collection and treatment of wastewater. This alternative may not fully offset growth-based demand and presents both logistical and financial barriers. In addition, many of CPWS customers are on septic systems or other decentralized systems so that the demand for water is greater than the amount able to be reclaimed from the City's wastewater.*

• *Withdrawing from a larger body of water (Tim's Ford Reservoir). This alternative was addressed in TVA's 2001 Columbia Water Supply Final EIS and included construction of a pipeline to transfer water from Tim's Ford Reservoir across the divide and discharge into the Duck River near Shelbyville. The pipeline would be able to provide up to 22 cfs (14 mgd) of additional flow into the Duck River during drought conditions. This alternative would not meet the project objectives for supply capacity. Further, the estimated cost for this alternative is greater than $300 million.*

• *Use of groundwater. In 1993, the USGS evaluated groundwater availability in the Upper Duck River Basin4. The study's statistical analyses suggested that it would be unlikely that a well located in Maury County would have a yield even as large as 100 gal/min, which would be approximately 1% of the projected demand. More recently, TVA's 2001 Columbia Water Supply Final EIS stated, "To summarize, in this project area groundwater is used predominately for individual home and agricultural purposes. Most wells provide low yields, generally less than 10 gpm, and very few wells produce more than 20 gpm…While sufficient groundwater seems to be present to supply individual residences, there is very little likelihood of drilling wells that could produce enough high-quality groundwater to supply large communities."*

• *Raising Normandy Dam. This alternative was first considered in TVA's 2001 EIS, which predicted that raising the elevation of Normandy Dam by 5 feet would only increase Duck River flow by 10 mgd. In addition to not providing adequate flow to meet the predicted demand, this alternative has potentially significant environmental impacts including inundation of habitat for a rare plant species.*

Hazen identified three viable alternatives that could provide an adequate quantity of water to both the existing and future Columbia water treatment plants and would also facilitate regionalization:

1. Off-Stream Impoundment at Fountain Creek. This alternative was identified and evaluated in TVA's 2001 EIS as a potential future water source for the Columbia area. This alternative included construction of a dam on Fountain Creek at its confluence with the Duck River to create an impoundment in the Fountain Creek Drainage. The alternative would take advantage of property within the drainage that TVA purchased as part of the abandoned Columbia Dam project. The Fountain Creek impoundment would require acquisition of approximately 800 additional acres of land and would affect 3,600 total acres of land. The TVA EIS concluded that this alternative would be able to provide an estimated 74 cfs (48 mgd) during drought conditions. Hazen included this alternative in its analysis since it would provide adequate flow to meet the project objectives.

Although the project as described in the TVA EIS would be operated to always discharge the natural minimum low flow of 10 cfs, significant environmental impacts would be expected with this alternative. Impounding Fountain Creek would result in permanent loss of aquatic and terrestrial habitat including that of endangered and threatened species and their critical habitats. In fact, Fountain Creek is designated as an Exceptional Tennessee Water (ETW) due to the presence of the state threatened Coppercheek Darter. In addition, this alternative would be subject to the antidegradation requirements applicable to ETWs which prohibit degradation if less degrading practicable alternatives exist. In this case, the two Duck River withdrawal alternatives would result in significantly less degradation.

This alternative includes construction of the Fountain Creek Dam, additional land purchase and easements, new intake structure and an 8-mile transmission line to CPWS's existing treatment plant. The Class V OPCC of this alternative is $146,950,000

2. Water Harvesting near RM 100 to a Constructed Storage Reservoir. Water harvesting is the practice of withdrawing water when flows in the source river are above a specified threshold. This alternative would include an intake and raw water pump station to pump water to large storage reservoir. Raw water would then be pumped from the reservoir to the WTPs. For this alternative, three main variables must be considered: the flow threshold for making diversions from the river, the size of the intake and the reservoir storage. First, a flow threshold at the 25th percentile was selected which means that withdrawal would occur when stream flow is at or above 360 cfs. The amount withdrawn would need to supply the new WTP, the existing WTP and the storage reservoir and is estimated to be between 40 and 50 mgd. Historical flows at the Columbia USGS gage 03599500 were used to approximate historical flows at the Shady Grove USGS gage. An analysis of historical flows and proposed withdrawals determined that a 1500 MG basin would be necessary to ensure an adequate supply of water.

The proposed storage reservoir has a large footprint with the potential to impact wetlands and waters. The national wetlands mapper7 identifies two ponds and surface drainages that would need to be evaluated to determine if they are considered jurisdictional wetlands or streams as defined by the Tennessee Water Quality Control Act. Other site reviews would include an evaluation

for potential archeological impacts as well as an evaluation of threatened and endangered species.

It was assumed this alternative would have less of an impact on flows in the Duck River than a continuously operating withdrawal since these withdrawals would only occur during high flows. However, the evaluation of impacts for the continuously operating withdrawal suggests that there would not be a significant difference in Duck River ecology associated with the water harvesting alternative.

The estimated cost of this alterative included the land cost and a Class V OPCC estimate of the construction cost of the intake, transmission lines and a 1500 MG storage reservoir. The cost estimate for this alternative is $150,935,000.

3. Continuous Withdrawal near RM 100 of Duck River (proposed modification). This alternative would implement one of the primary action items in the Duck River Comprehensive Regional Water Supply Plan and consists of a new intake located approximately at RM 100 of the Duck River with a continuous withdrawal capacity of 32 mgd. As previously stated, this intake would have the capability of serving both CPWS's new and existing WTPs. The operation regime would range from 12 mgd to 32 mgd, depending on the amount withdrawn near RM 134. However, the combined withdrawals from RM 100 and 134 would not exceed 32 mgd. This flexibility is key to ensuring adequate water for all users during periods of low flow.

A reduction in stream flow would be the primary cause of potential environmental impacts with a continuous withdrawal at RM 100. Hazen conducted OASIS modeling and Ecological Flows Modeling to evaluate flow and ecological impacts at both RMs 100 and 134 using the following operating regimes:

- *Option 1 – 20 mgd withdrawal from the existing intake at RM 134 (existing, baseline)*
- *Option 2 – 36 mgd withdrawal from the proposed intake at RM 100*
- *Option 3 – 16 mgd withdrawal from RM134 and 20 mgd withdrawal from RM 100*
- *Option 4 – 20 mgd withdrawal from RM134 and 16 mgd withdrawal from RM 100*

Option 1 is the baseline condition and is used as the basis for comparison against the other 3 operating regimes. The use of the 2050 predicted demand of 36 mgd, which is larger than the currently requested withdrawal of 32 mgd adds an additional layer of conservatism to the evaluation.

At RM 134, Options 2 and 3 represent departures from the baseline with Option 2 providing the greatest flow benefit at RM 134. Option 3 would provide a small increase in flow probability over the baseline condition while Option 4 is equivalent to the baseline condition. In all scenarios, the probability of the stream flow at RM 134 to fall below 100 cfs is nearly zero. At RM 100, the departure from the baseline condition (Option 1) is essentially the same for Options 2, 3 and 4.

The estimated cost of this alternative included the land cost and a Class V OPCC estimate of the construction cost of the intake and transmission lines and is $89,357,000.

Based on the available information, the Division has determined that the authorized modification represents the least impactful practicable alternative to accomplish the project's purpose and goals**.** *See* Rules 0400-40-03-.06(4)(c)2 and 0400-40-07-.04(5)(b).

Existing Conditions/Authorized Loss of Resource Values

The Duck River in this segment is considered fully supporting of its classified uses. Over 50 freshwater mussel species are extant in this reach of the Duck River including the federally endangered Birdwing Pearlymussel, Cumberland Monkeyface, Fanshell, Duck River Dartersnapper, Cumberland Combshell, Catspaw, Snuffbox, Pink Mucket, Slabside Pearlymussel, Fluted Kidneyshell, and Pale Liliput as well as the federally threatened Rabbitsfoot. This reach of the Duck River specifically harbors the only viable populations of the Birdwing Pearlymussel, Cumberland Monkeyface, and Duck River Dartersnapper throughout their global range.

The applicant conducted flow modeling using the Operational Analysis and Simulation of Integrated Systems (OASIS) modeling program for the Duck River. The river model for this region utilizes approximately 95 years of United States Geological Survey (USGS) gage readings to develop simulated flows within the system. The simulation begins above Normandy Dam within the reservoir and extends through Centerville, TN, at approximate river mile 72. OASIS models the controlled dam release established by the Tennessee Valley Authority (TVA) and takes into consideration tributary inflow, return flows and other water withdrawals.

Impacts to fish species richness were also quantified in the applicant's analysis. The results are computed using Ecological Limit Functions for fish groups developed by the USGS. At RM 100, with the higher baseflows and lesser net withdrawal impacts noted previously, no changes in species richness across the options were predicted. At RM 133, there are some reductions in species richness when the amount of water withdrawn is reduced. This is due to some species being dependent upon the constancy metric and is likely due to the Duck being a regulated river. The USGS[2] found that for these rivers the % gains in species richness associated with increased withdrawals and the % losses associated with decreased withdrawals are considered mathematical artifacts and not an indication of fish health. This leads to the conclusion [by the applicant] that none of the evaluated options are predicted to result in negative ecological impacts at either location.

Based upon the applicant's OASIS and Ecological Limit Function model outputs, the Division has determined that the activity will not result in an appreciable permanent loss of resource values. The existing withdrawal, including the grandfathered amount, is limited to its current authorization and must be ceased at 100 CFS low flow. The new withdrawal is from a portion of the Duck River with significantly more flow than the existing location. Moreover, during

[2] Species-Richness Responses to WaterWithdrawal Scenarios and Minimum Flow Levels: Evaluating Presumptive Standards in the Tennessee and Cumberland River Basins. Water 2020, 12, 1334 (Driver, L.J.; Cartwright, J.M.; Knight, R.R.; Wolfe, W.J)

low flows the total water production will be withdrawn at the downstream location, leaving the former volume withdrawn at the upstream location in the river. A significant portion of the withdrawn water at river mile 100 will be discharged back to the Duck River as treated effluent at river mile 130, with the benefit of adding flow at upstream river segment.

Antidegradation

Antidegradation review applies to new or increased withdrawals. The Department's rules state a single water withdrawal will be considered de minimis if it removes less than five percent of the minimum 7-day average streamflow with a 10-year recurrence interval (7Q10) flow of the stream. If more than one withdrawal has been authorized or proposed in a segment and the total of the authorized and proposed withdrawals uses no more than 10% of the 7Q10 low flow, they are presumed to be de minimis.

In waters identified as Exceptional Tennessee Waters, new or increased water withdrawals that would cause degradation of any available parameter above the level of de minimis will only be authorized if the applicant has demonstrated to the Department that there are no practicable alternatives to prevent or lessen degradation associated with the proposed activity and the degradation is necessary to accommodate important economic or social development in the area and will not violate the water quality criteria for uses existing in the receiving waters.

The existing 20 MGD withdrawal near river mile 134 is in river segment ID TN06040003026_2000. The calculated 7Q10, using the USGS Hydrologic Toolbox 1.0.0 for the period of record from April 1, 1994 - March 31, 2024, at the USGS Gage 03599500 DUCK RIVER AT COLUMBIA, TN in this river segment is 131.96 CFS. The maximum authorized withdrawal accounts for 23.45% of the 7Q10 at that location, which constitutes greater than *de minimis* degradation. However, it is not subject to antidegradation review at this time because it is an existing permitted withdrawal.

The authorized new withdrawal near river mile 100 is in river segment ID TN06040003016_1000 and is subject to antidegradation review. The calculated 7Q10, using the USGS Hydrologic Toolbox 1.0.0 for the period of record from April 1, 2016 – March 31, 2024, at the USGS Gage 03601600 DUCK RIVER NEAR SHADY GROVE, TN. in this river segment is 200.19 CFS.

The withdrawal rate authorized by this permit is 32 MGD or 49.51 CFS. The maximum withdrawal is 24.73% of the 7Q10 flow. As defined in rule 0400-40-03-.04(4) the authorized withdrawal is greater than *de minimis* degradation of water quality parameters.

The applicant has provided the following written justification to demonstrate that greater than *de minimis* degradation is necessary to accommodate important social or economic development in the area in which the waters are located:

The CPWS service area MDD for water is projected to outstrip the capacity of the current WTP by 2022. The ADD for the CPWS service area is forecasted to exceed current capacity in 2033. An

adequate and reliable supply of water of potable water is critical to a jurisdiction's economic growth. Without a sufficient water supply, restrictions on new residential development or business permits would need to be imposed in the service area. Even organic growth could be constrained because business expansions and increases in natural population growth (i.e., nonmigratory growth) would eventually stress the current water supply capacity. Issuance of water restrictions, especially water uses for discretionary purposes such as landscaping would become more frequent and more stringent over time and degrade the overall wellbeing of the service area population.

To quantify these impacts, the economic benefits analysis evaluates Maury County economic conditions from 2024 to 2040 under two Scenarios:

• Unconstrained Water Supply Scenario

• Constrained Water Supply Scenario

Under the "Unconstrained Water Supply Scenario", CPWS would build the proposed infrastructure and the service area would receive the necessary water to supply the projected population growth and associated economic development. Economic growth would continue unimpeded by the water supply constraint. Under the "Water Supply Constrained Scenario", CPWS would not build the proposed water supply infrastructure, which would result in diminished economic output compared to the unconstrained water supply scenario. The year 2024 is used as the first year of the impact evaluation, because this is the year in which the projected water supply deficit becomes significant compared to the projected MDD. Impacts are quantified through 2040, the last year of CPWS water demand projections.

The IMPLAN regional economic model was used to quantify the projected economic losses that would be attributable to a water supply constraint. IMPLAN is an economic input-output model that is used to measure the direct, indirect, and induced effects of a public or private sector policy or activity on a regional economy.

The projected number of households combined with their average annual household income were input into the IMPLAN Model to calculate the annual "induced impacts" of these future households on the County's economy. If the number of households are reduced because of permit restrictions, then the magnitude of household spending is reduced proportionately, depending on the income of those households. Under the unconstrained water supply scenario, there would be an additional 9,966 households between 2020 and 2040 with an average income of $85,000 (in 2020 dollars).

The residential construction sector in Maury County has undergone relatively robust growth over the past decade to accommodate the needs of a growing population. The residential construction sector includes three subsectors including: (1) Single family Residential (SFR) Construction; (2); Multifamily Residential (MFR) Construction; (3) Other Residential Construction. Other Residential Construction includes construction of group homes, assisted living facilities, residential additions, and remodeling. SFR Construction is the largest of the three subsectors producing structures with

a total County output valued at $67.4 million. Construction of Other Residential Structures topped $61 million, and Multi-family Residences accounted for an additional $15.3 million in economic output. The total economic output for the residential construction sector was $145.9 million in 2018 (2020 dollars). To put these values into perspective the total economic output for Maury County in 2018 (2020 dollars) was $12.69 billion.

Total Value of Output by the Residential Construction Sector - Current (2018) and Forecasted under the Unconstrained Water Supply Scenario (2020 dollars)

Sector	2018	2024	2029	2034	2040
SFR Structures	$67,406,731	$80,957,566	$94,308,879	$109,862,057	$131,947,723
MFR Structures	$15,289,445	$16,838,781	$18,249,169	$19,777,688	$ 21,781,835
Other Residential Structures	$63,223,239	$72,912,894	$82,112,764	$92,473,438	$106,646,008
Total	**$145,919,415**	**$170,709,241**	**$194,670,812**	**$222,113,184**	**$260,375,566**

Source: Projections based on IMPLAN historical data base for Maury County

The economic benefit analysis modeled each of three constrained water supply scenarios for the years 2024 to 2040 assuming a 25 percent, 50 percent, and 100 percent reduction in household growth and residential housing construction. Specifically, the forecasted value of residential construction for a modeled year (e.g., 2024) was reduced by 25 percent, 50 percent, or 100 percent, depending on the scenario, and the value was entered into the IMPLAN model to calculate the economic impacts of that reduction compared to the unconstrained scenario.

In accordance with the Tennessee Antidegradation Statement (Rule 0400-40-03-.06), the Division has determined that greater than *de minimis* degradation is necessary to accommodate important economic or social development in the area because of existing and projected water demand resulting from population growth and industrial expansion.

For more information, please reference Tennessee's Antidegradation Statement which is found in Chapter 0400-40-03 of the Rules of the Tennessee Department of Environment and Conservation.

Reference Documents

Frequency_Statistics_report_03599500 DUCK RIVER AT COLUMBIA, TN

```
Program SWStat         U.S. GEOLOGICAL SURVEY             Seq 00001
Ver. 5.0      Log-Pearson & Pearson Type III Statistics   Run Date / Time
03/13/2018           based on USGS Program A193           2/26/2025 7:53 AM

 Notice -- Log-Pearson Type III or Pearson Type III distributions are used
           for these computations. Users are responsible for assessment
           and interpretation.


       Description:  03599500 DUCK RIVER AT COLUMBIA, TN
    Year Boundaries:  April  1 - March 31
  Period in report:  April  1, 1994 - March 31, 2024
         Parameter:  7-day low
    Non-zero values:    29
        Zero values:     0
    Negative values:     1  (ignored)

Input time series (zero and negative values not included in listing.)

   186.570   194.570   148.290   164.710   143.860   164.000   212.860   167.570
   212.570   244.710   168.140   162.140   125.140   123.860   153.570   133.000
   144.710   123.570   177.000   168.710   192.710   129.570   319.860   190.430
   162.430   214.860   241.860   176.140   160.290


  LOG PEARSON TYPE III Frequency Curve Parameters
  (based on logs of the non-zero values)

  Mean (logs)                                 2.235
  Variance (logs)                             0.009
  Standard Deviation (logs)                   0.097
  Skewness (logs)                             0.705
  Standard Error of Skewness (logs)           0.434
  Serial Correlation Coefficient (logs)       0.187
  Coefficient of Variation (logs)             0.043


Frequency Curve - Parameter values at selected probabilities

   Non-                                 Variance    95-Pct Confidence
 exceedance     Recurrence  Parameter      of          Intervals
 Probability     Interval     Value     Estimate    Lower      Upper
 -----------    ----------  ---------   --------  ---------  ---------
      0.1000        10.00     131.960      1.004    118.830    142.200


↑
Program SWStat         U.S. GEOLOGICAL SURVEY             Seq 00002
Ver. 5.0      Log-Pearson & Pearson Type III Statistics   Run Date / Time
03/13/2018           based on USGS Program A193           2/26/2025 7:53 AM
```

Frequency_Statistics_report_03601600 DUCK RIVER NEAR SHADY GROVE

and interpretation.

Description: 03601600 DUCK RIVER NEAR SHADY GROVE, TN.
Year Boundaries: April 1 - March 31
Period in report: April 1, 2016 - March 31, 2024
Parameter: 7-day low
Non-zero values: 8
Zero values: 0
Negative values: 0 (ignored)

Input time series (zero and negative values not included in listing.)

193.570 414.140 292.570 235.430 349.430 369.140 244.140 226.860

LOG PEARSON TYPE III Frequency Curve Parameters
(based on logs of the non-zero values)

Mean (logs)	2.450
Variance (logs)	0.014
Standard Deviation (logs)	0.117
Skewness (logs)	0.159
Standard Error of Skewness (logs)	0.752
Serial Correlation Coefficient (logs)	-0.341
Coefficient of Variation (logs)	0.048

Frequency Curve - Parameter values at selected probabilities

Non-exceedance Probability	Recurrence Interval	Parameter Value	Variance of Estimate	95-Pct Confidence Intervals Lower	Upper
0.1000	10.00	200.190	1.007	130.930	245.110

Appendix 6-B

ARAP NRS22.320

STATE OF TENNESSEE
DEPARTMENT OF ENVIRONMENT AND CONSERVATION
Division of Water Resources
Natural Resources Unit
Davy Crockett Tower, 9th Floor
500 James Robertson Parkway
Nashville, TN 37243

June 11, 2025

Randy Head, General Manager
Bedford County Utility District
P. O. Box 2755
Shelbyville, Tennessee 37160

Subject: Aquatic Resource Alteration Permit
File# NRS22.320, Duck River, Bedford County

Dear Mr. Head:

The Division has reviewed your application for the withdrawal of drinking water from the Duck River. The Aquatic Resource Alteration Permit has been issued with an effective date of June 2, 2025 (enclosed).

The Division has reasonable assurance the activity as proposed and in accordance with all permit conditions herein will not violate applicable water quality standards. The attached permit (enclosed) authorizes the activity pursuant to *The Tennessee Water Quality Control Act of 1977* (T.C.A. §69-3-101 et seq.) and serves as §401 water quality certification (pursuant to the *Federal Clean Water Act* 33 U.S.C. 1341).

The state of Tennessee may modify, suspend, or revoke this authorization or seek modification or revocation should the state determine that the activity results in more than an insignificant violation of applicable water quality standards or violation of the TWQCA. Failure to comply with permit terms may result in penalty in accordance with T.C.A. §69-3-115.

It is the responsibility of the permittee to read and understand all permit conditions before the project begins. If you need any additional information or clarification, please contact me at 615-532-0710 or by e-mail at robert.d.baker@tn.gov.

Sincerely,

Robert Baker

Robert Baker
Natural Resources Unit

Enclosure

Cc: Sherry Glass – Columbia Environmental Field Office, Sherry.Glass@tn.gov
Gene Koonce – Bedford Co. Utility District, bkoonce@bedfordutility.com



Aquatic Resource Alteration Permit

NRS22.320

Pursuant to the *Tennessee Water Quality Control Act of 1977* (T.C.A. §§ 69-3-101 to -148) and supporting regulations, a permit is required to alter the properties of waters of the state. Subject to conformance with accepted plans, specifications, and other information submitted in support of the application, the state of Tennessee hereby authorizes the activity described below pursuant to T.C.A. § 69-3-108(b):

PERMITTEE: Bedford County Utility District
P. O. Box 2755
Shelbyville, Tennessee 37160

AUTHORIZED WORK: The authorized alteration to waters is withdrawal of a maximum of 4.07 million gallons of water per day from the Duck River for public water supply. Of this amount, 1.7 million gallons per day constitutes an existing water withdrawal as of July 25, 2000. Pursuant to Rule 0400-40-07-.02(4), this withdrawal amount is exempted from the requirements of this permit if it does not adversely alter or affect classified uses in the Duck River.

LOCATION: The activity is located in the Duck River in Bedford County near river mile 200. Pursuant to T.C.A. § 10-7-504 and Rule 0400-01-01(4)(c)2, the precise location is confidential. Therefore, the exact location of the intake site will not be disclosed in this permit or otherwise made available to the public.

EFFECTIVE DATE: March 15, 2024

MODIFICATION DATE: June 2, 2025

EXPIRATION DATE: March 14, 2029

April Grippo

April Grippo, Director
Division of Water Resources

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PART I

Authorized Alterations

This permit authorizes aquatic alterations associated with the withdrawal of a maximum of 4.07 million gallons of water per day (MGD) from the Duck River for public water supply. Of this amount, 1.7 MGD constitutes an existing water withdrawal as of July 25, 2000. Pursuant to Rule 0400-40-07-.02(4), this withdrawal amount is exempted from the requirements of this permit if it does not adversely alter or affect classified uses in the Duck River.

The Bedford County Utility District (BCUD) currently owns and operates an existing 4 MGD water treatment plant in Bedford County that serves potable water to nearly 8,000 customers. Raw water is supplied by an intake in the Duck River near river mile 200. Precise location data is confidential under Tennessee law. BCUD serves industrial, commercial, and residential customers located within Bedford County outside the city limits of the City of Shelbyville, City of Bell Buckle and City of Wartrace.

BCUD is currently in the process of constructing new mixing, flocculation, and sedimentation facilities capable of providing primary treatment of up to 8 MGD of raw water. BCUD expects this project will be completed and placed into service in early 2023. BCUD plans to expand its existing 4 MGD water treatment plant to one capable of treating 6 MGD. These upgrades are within existing structures. No new construction is necessary to add additional filtration capacity to the water plant.

Special Conditions

1. The withdrawal volume shall not exceed 4.07 MGD.
2. Raw water withdrawal volumes shall be monitored and recorded daily.

3. Withdrawal data shall be reported to the Division on the corresponding comprehensive monthly operations reports for the Public Water Supply ID - TN0000517.
4. Withdrawal above 1.7 MGD shall cease when flow in the Duck River as measured at the Milltown USGS Gage (03599240) is at or below 175 cubic feet per second (CFS), subject to the following schedule of compliance.
    a. The permittee shall develop a plan for reducing the withdrawal of water from the Duck River to coincide with certain drought triggers. This reduction shall be measured either by a reduction in the instantaneous rate of withdrawal or total daily volume. This plan shall be submitted to the Division for its review not later than one year after the effective date of this permit. The permittee shall implement the plan beginning no later than 30 days after receiving written approval from the Division.
    b. The permittee shall conduct an annual water loss audit in accordance with the American Water Works Association (AWWA M36 Water Audits and Loss Control Programs v6 audit procedures), with a goal of achieving no more than 20% annual real loss. For purposes of this provision, "annual real loss" means physical water losses from the pressurized system (water mains and customer service connections) and the utility's storage tanks, up to the point of customer consumption during a calendar year.
        i. The permittee shall submit the annual water loss audit report for the previous calendar year to the Division not later than January 31 of each year.
        ii. The permittee may exclude data associated with an extraordinary water loss event (e.g., line breaks resulting from an extreme weather event such as a deep freeze or flooding, or an accident caused by a person other than the permittee) from the calculation of annual real loss. To exclude such data, the permittee shall submit written documentation to demonstrate to the satisfaction of the Division that:
            (a) The water loss event was unavoidable;
            (b) The permittee was operating the water distribution system in a prudent and workmanlike manner and in compliance with proper operation and maintenance procedures at the time of the water loss event;
            (c) The permittee promptly implemented appropriate measures to stop the water loss event;
            (d) The permittee complied with all applicable reporting requirements; and
            (e) The permittee complied with any remedial measures required under "Adverse Impact."

iii. If the annual real loss reported to the Division exceeds 20% of water supplied, after accounting for outlier events, the permittee shall develop a plan to reduce annual real loss. This plan shall be submitted to the Division for its approval not later than 90 days after submission of the audit report. The permittee shall implement the plan beginning not later than 30 days after receiving approval from the Division.

iv. The permittee shall submit a plan that details the process and timelines by which it will operate and maintain its system to achieve no more than 20% annual real loss to the Division for review and approval not later than six months after the effective date of this permit.

c. As reasonable and appropriate, the permittee shall participate in or perform studies necessary to determine the presence and extent of threatened and endangered mussels and other fish and aquatic life in the downstream portion of the Duck River impacted by the withdrawal, and flow requirements necessary to sustain these populations. These studies will include, but not be limited to, an evaluation of the efficacy of tapering withdrawal rates gradually downward. Participation may be through membership in the Duck River Agency.

d. The permittee shall implement Stage 2 of its drought management plan when the flow in the Duck River gaged at Milltown USGS Gage (03599240) is at or below 175 CFS for three consecutive days.

e. The special condition to cease withdrawal above 1.7 MGD when flow in the Duck River as gaged at the Milltown USGS Gage (03599240) is at or below 175 CFS shall become effective five years from the date of this permit.

5. The permittee shall comply with provisions of the Duck River Regional Drought Management Plan, including revisions approved by the Department. The provisions include, but are not limited to:
    a. triggers for drought restrictions
    b. water use restrictions for drought stages, and
    c. levels of enforcement for drought management stages.
6. The permittee shall develop descriptions of restricted and prohibited activities and enforcement mechanisms for drought management specific to Bedford County.
    a. This report shall be submitted to the Division for review and approval within 180 days of the modification date of this permit.
    b. The report shall be used for compliance with item # 5. above.
7. The permittee shall develop a plan describing measures it will pursue to provide public education to encourage water conservation, including but not limited to the method(s) of public education it will use, the frequency of its public education efforts, any circumstances that trigger it to pursue additional or increased public education efforts,

and a description of the type and nature of intensified public education measures. The permittee shall submit the plan to the Department not later than 180 after the modification date of the permit.

General Conditions

1. It is the responsibility of the permittee to convey all terms and conditions of this permit to all contractors. A copy of this permit, approved plans, and any other documentation pertinent to the activities authorized by this permit shall be maintained on site at all times during periods of construction activity.
2. All activities must be accomplished in conformance with the approved plans, specifications, data, and other information submitted in support of the ARAP application (form CN-1091) (except where no application is required as specified below) and the limitations, requirements, and conditions set forth herein. Failure to comply with the terms and conditions of this permit is a violation of the Act.
3. The permittee is responsible for obtaining the federal section 404 permit from the U. S. Army Corps of Engineers and section 26a permit from the Tennessee Valley Authority where necessary.
4. All work shall be carried out in such a manner as will prevent violations of water quality criteria as stated in Rule 0400-40-03-.03. This consists of, but is not limited to, the prevention of any discharge that causes a condition in which visible solids, bottom deposits, or turbidity impairs the usefulness of waters of the state for any of the uses designated by Rule 0400-40-04. These uses include fish and aquatic life (including trout streams and naturally reproducing trout streams), livestock watering and wildlife, recreation, irrigation, industrial water supply, domestic water supply, and navigation.
5. Impacts to waters of the state other than those specifically addressed in the plans and this permit are prohibited. All streams, springs, and wetlands shall be fully protected prior, during, and after construction until the area is stabilized. Any questions, problems or concerns that arise regarding any stream, spring, or wetland either before or during construction shall be addressed to the Division of Water Resource's Columbia Environmental Field Office - 1421 Hampshire Pike, Columbia, TN 38401 931-380-3371 or the permit coordinator in the Division's Natural Resources Unit – 615-532-0710.
6. Adverse impact to formally listed state or federal threatened or endangered species or their critical habitat is prohibited.
7. This permit does not authorize adverse impacts to cultural, historical, or archeological features or sites.
8. This permit shall not be used incrementally to combine with other activities resulting in an appreciable permanent loss of water resource values.

PART II

Mitigation Requirements and Monitoring Procedures

Required Mitigation Activities

There are no mitigation requirements.

Monitoring Requirements and Procedures

The permittee shall submit the annual project report as described in Special Condition 4.b.i. not later than January 31 of each year.

Submission of Monitoring Results

All reports must be submitted in report form to the Division of Water Resources, Natural Resources Unit, Division of Water Resources, Davy Crockett Tower, 9th Floor, 500 James Robertson Parkway, Nashville, Tennessee 37243, or via email at ARAP.permits@tn.gov. Please be sure to indicate the ARAP permit number on your submittal.

Records Retention

All records and information resulting from the monitoring activities required by this permit including all records of analyses performed and calibration and maintenance of instrumentation shall be retained for a minimum of five years, or longer, if requested by the Division.

Falsifying Results and/or Reports

Knowingly making any false statement on any report required by this permit or falsifying any result may result in the imposition of criminal penalties as provided for in Section 309 of the Federal Water Pollution Control Act, as amended, and in Section 69-3-115 of the Tennessee Water Quality Control Act.

PART III

Duty to Reapply

The withdrawal of water from the Duck River above 1.7 MGD beyond the expiration date of this permit is not authorized. If the permittee chooses to continue this activity, it must submit a complete application to the Division not later than 90 days prior to the expiration of the permit.

Property Rights

The issuance of this permit does not convey any property rights in either real or personal property, or any exclusive privileges, nor does it authorize any injury to private property or any invasion of personal rights, nor any infringement of federal, state, or local laws or regulations.

Water Rights

The waters of Tennessee are the property of the state and are held in public trust for the use of the people of the state. This permit does not grant or convey any prescriptive rights,

appropriation, or allocation of water, nor does it authorize any injury to the riparian rights of others.

Other Permits

This permit does not preclude requirements of other federal, state, or local laws. This permit serves as both a section 401 certification and as a state of Tennessee aquatic resource alteration permit (ARAP) pursuant to the Tennessee Water Quality Control Act of 1977 (T.C.A. § 69-3-101 to -148).

Other Information

If the permittee becomes aware that it failed to submit any relevant facts in a permit application or submitted incorrect information in a permit application or in any report to the Director, then it shall promptly submit such facts or information.

Changes Affecting the Permit Transfer/Change of Ownership

This permit may be transferred to another party, provided:

1. There are no activity or project modifications, no pending enforcement actions, or any other changes which might affect the permit conditions contained in the permit.
2. The permittee notifies the Director of the proposed transfer at least 30 days in advance of the proposed transfer date.
    a. The notice consists of a written agreement between the existing and new permittees containing a specified date for transfer of permit responsibility, coverage, and contractual liability between them; and
    b. The Director does not notify the current permittee and the new permittee, within 30 days of his or her intent to modify, revoke, reissue, or terminate the permit, or require that a new application be filed rather than agreeing to the transfer of the permit.
3. The permittee must provide the following information to the Division in its formal notice of intent to transfer ownership:
    a. the permit number of the subject permit,
    b. the effective date of the proposed transfer,
    c. the name and address of the transferor,
    d. the name and address of the transferee,
    e. the names of the responsible parties for both the transferor and transferee,
    f. a statement that the transferee assumes responsibility for the subject permit,
    g. a statement that the transferor relinquishes responsibility for the subject permit,
    h. the signatures of the responsible parties for both the transferor and transferee, and

i. a statement regarding any proposed modifications to the permitted activities or project, its operations, or any other changes which might affect the permit conditions contained in the permit.

Change of Mailing Address

The permittee shall promptly provide to the Director written notice of any change of mailing address. In the absence of such notice the original address of the permittee will be assumed to be correct.

Noncompliance

Effect of Noncompliance

All withdrawals shall be consistent with the terms and conditions of this permit. Any permit noncompliance constitutes a violation of applicable state and federal laws and is grounds for enforcement action, permit termination, permit modification, or denial of permit reissuance.

Reporting of Noncompliance

24-Hour Reporting

In the case of any noncompliance which could cause a threat to public drinking supplies, or any other withdrawal which could constitute a threat to human health or the environment, the required notice of non-compliance shall be provided to the Division of Water Resources in the appropriate Environmental Field Office within 24-hours from the time the permittee becomes aware of the circumstances. (The Environmental Field Office should be contacted for names and phone numbers of environmental response personnel).

1. A written submission must be provided within five days of the time the permittee becomes aware of the circumstances unless this requirement is waived by the Director on a case-by-case basis. The permittee shall provide the Director with the following information:
   a. a description of the withdrawal and cause of noncompliance;
   b. the period of noncompliance, including exact dates and times or, if not corrected, the anticipated time the noncompliance is expected to continue; and
   c. the steps being taken to reduce, eliminate, and prevent recurrence of the non-complying withdrawal.

Scheduled Reporting

For instances of noncompliance which are not reported under subparagraph a. above, the permittee shall report the noncompliance by contacting the permit coordinator and provide all information concerning the steps taken or planned to reduce, eliminate, and prevent recurrence of the violation and the anticipated time the violation is expected to continue.

Adverse Impact

The permittee shall take all reasonable steps to minimize any adverse impact to the waters of Tennessee resulting from noncompliance with this permit, including but not limited to, accelerated or additional monitoring as necessary to determine the nature and impact of the noncompliance. It shall not be a defense for the permittee in an enforcement action that it would have been necessary to halt or reduce the permitted activity in order to maintain compliance with the conditions of this permit.

Liabilities

Civil and Criminal Liability

Nothing in this permit shall be construed to relieve the permittee from civil or criminal penalties for noncompliance. Notwithstanding this permit, the permittee shall remain liable for any damages sustained by the state of Tennessee, including but not limited to fish kills and losses of aquatic life and/or wildlife, as a result of the withdrawal from any surface waters. Additionally, notwithstanding this permit, it shall be the responsibility of the permittee to conduct its withdrawal activities in a manner such that public or private nuisances or health hazards will not be created.

Liability under State Law

Nothing in this permit shall be construed to preclude the institution of any legal action or relieve the permittee from any responsibilities, liabilities, or penalties established pursuant to any applicable state law or the Federal Water Pollution Control Act, as amended.

Reopener Clause

This permit may be modified, suspended, or revoked for cause, including:

1. Violation of any of the terms or conditions of this permit or of T.C.A §§ 69-3-101 to –148,
2. Obtaining the permit by misrepresentation or failing to disclose fully all relevant facts, or
3. A change in any condition that requires either a temporary or permanent change in the conditions of this permit.

Appeal

An appeal of this action may be made as provided in T.C.A. § 69-3-105(i) and Rule 0400-40-07-.04(9) by submitting a petition for appeal:

1. The petition must be filed within 30 days after notification of the issuance of the permit.
2. The petition must specify the basis for the appeal and state a claim for relief based on an alleged violation of the Tennessee Water Quality Control Act or the rules promulgated thereunder. Third parties shall specify facts sufficient to establish that they have satisfied the statutory and regulatory preconditions and otherwise have standing to appeal.
3. The petition should be submitted electronically to TDEC.Appeals@tn.gov. Alternatively, an appeal may be submitted to the technical secretary of the Tennessee Board of Water

Quality, Oil and Gas at the following address: April Grippo, Director, Division of Water Resources, Davy Crockett Tower, 500 James Robertson Parkway, Nashville, TN 37243. Any hearing would be in accordance with T.C.A. §§ 69-3-110 and 4-5-301 et seq.

APPENDIX

Permit Rationale

Bedford County Utility District
P. O. Box 2755
Shelbyville, Tennessee 37160

May 30, 2025

Permit Writer: Robert Baker

Summary

Permittee: Bedford County Utility District

Contact: Randy Head
Telephone #: 931-684-1667

Activity Location: The activity is located in the Duck River in Bedford County near river mile 200. Pursuant to T.C.A. § 10-7-504 and Rule 0400-01-01(4)(c)2, the precise location is confidential. Therefore, the exact location of the intake site will not be disclosed in this permit or otherwise made available to the public.

Authorized Activity: Withdrawal of a maximum of 4.07 million gallons of water per day (MGD) from the Duck River for public water supply.

Waterbody Name / ID: Duck River / TN06040002020_1000

Permit Status

Permit Type:	ARAP
Effective Date:	March 15, 2024
Modification Date:	June 2, 2025
Expiration Date:	March 14, 2029

Status of Affected Waters

Duck River ID TN06040002020_1000
Ecoregion - Inner Nashville Basin, 71i, Bedford County
Hydrologic Unit Code - 06040002 Upper Duck River

Designated Use	Use Support	Causes	Sources
livestock watering & wildlife	fully supporting		
irrigation	fully supporting		
recreation	not supporting	Escherichia coli (E. Coli)	Municipal (Urbanized High Density Area)

Designated Use	Use Support	Causes	Sources
fish and aquatic life	fully supporting		
industrial water supply	fully supporting		
domestic water supply	fully supporting		

Assessment Date: April 3, 2017

The affected waters have been determined to have available water withdrawal parameters.

The affected waters are designated as Exceptional Tennessee Waters. The basis for inclusion is as follows: Portion from river mile 133 to 179 USFWS designated Critical Habitat for Cumberlandian Fluted Kidneyshell, Slabside Pearlymussel and Purple Bean. Populations of federal endangered Tan Riffleshell, Birdwing Pearlymussel, and Cumberland Monkeyface, state threatened Striated Darter, Ashy Darter, Saddled Madtom and Coppercheek Darter. Portion designated state scenic river. Portions in Duck River Complex SNA and Henry Horton State Park.

Authorized Alterations

The Bedford County Utility District presently pumps 3.87 MGD during peak demand. This permit is predicated on providing a baseline for future permitting in the Duck River. The baseline is considered the recent peak demand plus water use projections for the five-year permit duration. The authorized maximum withdrawal rate is 4.07 MGD. The purpose of the withdrawal is for public water supply.

The authorized alteration to waters is withdrawal of a maximum of 4.07 million gallons of water per day (MGD) from the Duck River for public water supply. Of this amount, 1.7 million gallons per day constitutes an existing water withdrawal as of July 25, 2000. Pursuant to Rule 0400-40-07-.02(4), this withdrawal amount is exempted from the requirements of this permit if it does not adversely alter or affect classified uses in the Duck River

Alternatives Analysis and Selection of Least Impactful Practicable Alternative

The stated purpose of the authorized alterations to state water resources is to provide public water supply. The applicant has submitted an analysis of potentially practicable alternatives to the authorized activity and provided the following discussion of those alternatives:

1. Based on existing records, groundwater supply to supply this amount of water does not appear to exist near the vicinity of the plant.

2. Constructing off-site storage in the capacity needed by BCUD would be a very expensive and environmentally significant option. Construction costs to install such a facility, depending on land availability and location, would be in the tens of millions of dollars. The environmental hurdles to construct this alternative would be significant.

3. Purchasing water from SPWS would be costly and environmentally impactful due to water system improvements required by both systems. In addition, the unit cost of water would be more twice what BCUD can produce its treated water. The source of water for this option would be the Duck River.

4. BCUD can expand its filtration capacity by installing new filters, raw and finished water pumps, electrical and piping within the existing treatment plant facility. The cost to construct this option would be about $5,000,000. There would be virtually no environmental impacts associated with this project as work would take place within existing structures. Finally, the additional capacity at BCUD's water plant would provide greater redundancy and resilience for Bedford County and adjacent utilities and customers.

Based on the available information, the Division has determined that the authorized activities represent the least impactful practicable alternative to accomplish the project's purpose and goals**.**

Existing Conditions/Authorized Loss of Resource Values

The Duck River in this segment is fully supporting of its classified uses. This segment of the Duck River is Exceptional Tennessee Waters. Over 50 freshwater mussel species are extant in this reach of the Duck River including the federally endangered Birdwing Pearlymussel, Cumberland Monkeyface, Fanshell, Duck River Dartersnapper, Cumberland Combshell, Catspaw, Snuffbox, Pink Mucket, Slabside Pearlymussel, Fluted Kidneyshell, and Pale Liliput as well as the federally threatened Rabbitsfoot. This reach of the Duck River specifically harbors the only viable populations of the Birdwing Pearlymussel, Cumberland Monkeyface, and Duck River Dartersnapper throughout their global range.

The Department's rules exempt water withdrawals that existed on July 25, 2000, from permit requirements to the extent that they do not interfere with classified uses. BCUD's peak withdrawal during the summer of 2000 was 1.7 MGD. This amount is therefore exempted from permit requirements. The remaining portion of the withdrawal is considered new or increased. That total (4.07 MGD – 1.7 MGD) is 2.37 MGD.

The increased withdrawal is subject to the minimum flow restriction and schedule of compliance in the Special Conditions. These conditions are protective of the resource values of this river segment. The Division has determined that the activity will not result in an appreciable permanent loss of resource values.

Antidegradation

The Department's rules state a single water withdrawal will be considered de minimis if it removes less than five percent of the minimum 7-day average streamflow with a 10-year recurrence interval (7Q10) flow of the stream. If more than one withdrawal has been authorized or proposed in a segment and the total of the authorized and proposed withdrawals uses no more than 10% of the assimilative capacity, or 7Q10 low flow, they are presumed to be de minimis.

The calculated 7Q10 using the USGS SW Toolbox 1.0.4 for the period of record from April 1, 1994 – March 31, 2024, at the gage 03598000 Duck River near Shelbyville, TN in this river segment is 140.23 CFS or 90.63 MGD. There are no other registered withdrawals in this river segment.

The withdrawal rate authorized by this permit is 4.07 million gallons per day for public water supply. This amount is 4.49 % of the 7Q10 flow.

The affected waters are designated as Exceptional Tennessee Waters. In accordance with the Tennessee Antidegradation Statement (Rule 0400-40-03-.06), the Division has determined that the authorized activities will result in no more than *de minimis* degradation of water quality parameters of an Exceptional Tennessee Water

For more information, please reference Tennessee's Antidegradation Statement which is found in Chapter 0400-40-03 of the Rules of the Tennessee Department of Environment and Conservation.

Notice -- Log-Pearson Type III or Pearson Type III distributions are used
for these computations. Users are responsible for assessment
and interpretation.

Description: 03598000 DUCK RIVER NEAR SHELBYVILLE, TN
Year Boundaries: April 1 - March 31
Period in report: April 1, 1994 - March 31, 2024
Parameter: 7-day low
Non-zero values: 29
Zero values: 0
Negative values: 1 (ignored)

Input time series (zero and negative values not included in listing.)

194.570	223.000	177.430	181.570	159.860	163.710	174.430	175.860
182.290	158.860	165.570	146.710	136.570	122.290	165.140	152.710
173.140	142.710	178.000	154.290	182.140	129.290	249.430	204.140
181.710	226.570	183.140	174.430	166.570			

LOG PEARSON TYPE III Frequency Curve Parameters
(based on logs of the non-zero values)

Mean (logs)	2.234
Variance (logs)	0.005
Standard Deviation (logs)	0.069
Skewness (logs)	0.169
Standard Error of Skewness (logs)	0.434
Serial Correlation Coefficient (logs)	0.210
Coefficient of Variation (logs)	0.031

Frequency Curve - Parameter values at selected probabilities

Non-exceedance Probability	Recurrence Interval	Parameter Value	Variance of Estimate	95-Pct Confidence Intervals Lower	Upper
0.1000	10.00	140.230	1.001	127.250	149.600

Appendix 6-C

ARAP NRS19.148



Aquatic Resource Alteration Permit

NRS19.148

Pursuant to the *Tennessee Water Quality Control Act of 1977* (T.C.A. §§ 69-3-101 to -148) and supporting regulations, a permit is required to alter the properties of waters of the state. Subject to conformance with accepted plans, specifications, and other information submitted in support of the application, the state of Tennessee hereby authorizes the activity described below pursuant to T.C.A. § 69-3-108(b):

PERMITTEE: Lewisburg Water & Wastewater
100 Water Street
Lewisburg, Tennessee 37091

AUTHORIZED WORK: Withdrawal of water from the Duck River to obtain up to 6.0 million gallons per day for public water supply. Of this amount, 3.64 million gallons per day constitutes an existing water withdrawal as of July 25, 2000. Pursuant to Rule 0400-40-07-.02(4), this withdrawal amount is exempted from the requirements of this permit if it does not adversely alter or affect classified uses in the Duck River.

LOCATION: The activity is located in the Duck River in Marshall County upstream of the dam at Lillard's Mill near river mile 180. Pursuant to T.C.A. § 10-7-504 and Rule 0400-01-01(4)(c)2, the precise location is confidential. Therefore, the exact location of the intake site will not be disclosed in this permit or otherwise made available to the public.

EFFECTIVE DATE: draft

EXPIRATION DATE: draft

_____

April Grippo, Director
Division of Water Resources

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PART I

Authorized Alterations

This permit authorizes the withdrawal of water from the Duck River at the maximum 6.0 million gallons per day (MGD) for public water supply. Of this amount, 3.64 MGD constitutes an existing water withdrawal as of July 25, 2000. Pursuant to Rule 0400-40-07-.02(4), this withdrawal amount is exempted from the requirements of this permit if it does not adversely alter or affect classified uses in the Duck River.

The City of Lewisburg Water Treatment Plant has a rated capacity of 4.0 MGD. Raw water for the Lewisburg Water Treatment Plant is supplied by an intake in the Duck River. Lewisburg sells water to the Marshall County Board of Public Utilities, the Town of Cornersville, and the Fairview Utility District. The Marshall County Board of Public Utilities sells water to the Town of Chapel Hill as needed. The design of a new 6.0 MGD Water Treatment Plant is underway for the City of Lewisburg and is scheduled to bid in the summer of 2025.

The activity is located in the Duck River in Marshall County upstream of the dam at Lillard's Mill. Precise location data is confidential under Tennessee law.

Special Conditions

1. The withdrawal volume shall not exceed 6.0 MGD.
2. Raw water withdrawal volumes shall be monitored and recorded daily.
3. Withdrawal data shall be reported to the Division on the corresponding comprehensive monthly operations reports for the Public Water Supply ID # TN0000400.
4. The permittee shall conduct an annual water loss audit in accordance with the American Water Works Association (AWWA M36 Water Audits and Loss Control Programs v6 audit procedures), with a goal of achieving no more than twenty percent annual real loss. For purposes of this provision, "annual real loss" means physical water losses from the pressurized system (water mains and customer service connections) and the utility's storage tanks, up to the point of customer consumption during a calendar year.

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a. The permittee shall submit the annual water loss audit report for the previous calendar year to the Division not later than January 31 of each year.

b. The permittee may exclude data associated with an extraordinary water loss event (e.g., line breaks resulting from an extreme weather event such as a deep freeze or flooding, or an accident caused by a person other than the permittee) from the calculation of annual real loss. To exclude such data, the permittee shall submit written documentation to demonstrate to the satisfaction of the Division that:

   i. The water loss event was unavoidable;

   ii. The permittee was operating the water distribution system in a prudent and workmanlike manner and in compliance with proper operation and maintenance procedures at the time of the water loss event;

   iii. The permittee promptly implemented appropriate measures to stop the water loss event;

   iv. The permittee complied with all applicable reporting requirements; and

   v. The permittee complied with any remedial measures required under "Adverse Impact."

c. If the annual real loss reported to the Division exceeds twenty percent of water supplied, after accounting for outlier events, the permittee shall develop a plan to reduce annual real loss. For purposes of this provision, "water supplied" means water imported plus volume from own sources minus water exported. This plan shall be submitted to the Division for its approval not later than 90 days after submission of the audit report. The permittee shall implement the plan beginning not later than 30 days after receiving approval from the Division.

5. Withdrawal above 3.64 MGD shall cease when flow in the Duck River as measured at the Milltown USGS Gage (03599240) is at or below 175 cubic feet per second (CFS), subject to the following schedule of compliance.

a. The permittee shall develop a plan for reducing the withdrawal of water from the Duck River to coincide with drought triggers in the Duck River Regional Drought Management Plan. This reduction shall be measured either by a reduction in the instantaneous rate of withdrawal or total daily volume. This plan shall be submitted to the Division for its review not later than one year after the effective date of this permit. The permittee shall implement the plan beginning no later than 30 days after receiving written approval from the Division.

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b. As reasonable and appropriate, the permittee shall participate in or perform studies necessary to determine the presence and extent of threatened and endangered mussels and other fish and aquatic life in the downstream portion of the Duck River impacted by the withdrawal, and flow requirements necessary to sustain these populations. These studies will include, but not be limited to, an evaluation of the efficacy of tapering withdrawal rates gradually downward. Participation may be through membership in the Duck River Agency.

c. The special condition to cease withdrawal above 3.64 MGD when flow in the Duck River as gaged at the Milltown USGS Gage (03599240) is at or below 175 CFS shall become effective five years from the date of this permit, unless the Department determines that a different flow condition would be more appropriate.

6. The permittee shall comply with the provisions of the Duck River Regional Drought Management Plan, including revisions approved by the Department. The provisions include, but are not limited to:

   a. triggers for drought restrictions

   b. water use restrictions for drought stages, and

   c. levels of enforcement for drought management stages.

7. The permittee shall develop descriptions of restricted and prohibited activities and enforcement mechanisms for drought management specific to the City of Lewisburg.

   a. This report shall be submitted to the Division for review and approval within 180 days of the effective date of this permit.

   b. The report shall be used for compliance with item # 6. Above.

General Conditions

1. It is the responsibility of the permittee to convey all terms and conditions of this permit to all contractors. A copy of this permit, approved plans, and any other documentation pertinent to the activities authorized by this permit shall be maintained on site at all times during periods of construction activity.

2. All activities must be accomplished in conformance with the approved plans, specifications, data, and other information submitted in support of the ARAP application (form CN-1091) (except where no application is required as specified below) and the limitations, requirements, and conditions set forth herein. Failure to comply with the terms and conditions of this permit is a violation of the Act.

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3. The permittee is responsible for obtaining the federal section 404 permit from the U. S. Army Corps of Engineers and section 26a permit from the Tennessee Valley Authority where necessary.
4. All work shall be carried out in such a manner as will prevent violations of water quality criteria as stated in Rule 0400-40-03-.03. This consists of, but is not limited to, the prevention of any discharge that causes a condition in which visible solids, bottom deposits, or turbidity impairs the usefulness of waters of the state for any of the uses designated by Rule 0400-40-04. These uses include fish and aquatic life (including trout streams and naturally reproducing trout streams), livestock watering and wildlife, recreation, irrigation, industrial water supply, domestic water supply, and navigation.
5. Impacts to waters of the state other than those specifically addressed in the plans and this permit are prohibited. All streams, springs, and wetlands shall be fully protected prior, during, and after construction until the area is stabilized. Any questions, problems or concerns that arise regarding any stream, spring, or wetland either before or during construction shall be addressed to the Division of Water Resource's Columbia Environmental Field Office - 1421 Hampshire Pike, Columbia, TN 38401 931-380-3371 or the permit coordinator in the Division's Natural Resources Unit – 615-532-0710.
6. Adverse impact to formally listed state or federal threatened or endangered species or their critical habitat is prohibited.
7. This permit shall not be used incrementally to combine with other activities resulting in an appreciable permanent loss of water resource values.

PART II

Mitigation Requirements and Monitoring Procedures

Records Retention

All records and information resulting from the monitoring activities required by this permit including all records of analyses performed and calibration and maintenance of instrumentation shall be retained for a minimum of five years, or longer, if requested by the Division.

Falsifying Results and/or Reports

Knowingly making any false statement on any report required by this permit or falsifying any result may result in the imposition of criminal penalties as provided for in Section 309 of the Federal Water Pollution Control Act, as amended, and in Section 69-3-115 of the Tennessee Water Quality Control Act.

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PART III

Duty to Reapply

The withdrawal of water from the Duck River above 3.64 MGD beyond the expiration date of this permit is not authorized. If the permittee chooses to continue this activity, it must submit a complete application to the Division not later than 90 days prior to the expiration of the permit.

Property Rights

The issuance of this permit does not convey any property rights in either real or personal property, or any exclusive privileges, nor does it authorize any injury to private property or any invasion of personal rights, nor any infringement of federal, state, or local laws or regulations.

Water Rights

The waters of Tennessee are the property of the state and are held in public trust for the use of the people of the state. This permit does not grant or convey any prescriptive rights, appropriation, or allocation of water, nor does it authorize any injury to the riparian rights of others.

Other Permits

This permit does not preclude requirements of other federal, state, or local laws. This permit serves as both a section 401 certification and as a state of Tennessee aquatic resource alteration permit (ARAP) pursuant to the Tennessee Water Quality Control Act of 1977 (T.C.A. § 69-3-101 to -148).

Other Information

If the permittee becomes aware that it failed to submit any relevant facts in a permit application or submitted incorrect information in a permit application or in any report to the Director, then it shall promptly submit such facts or information.

Changes Affecting the Permit Transfer/Change of Ownership

This permit may be transferred to another party, provided:

1. There are no activity or project modifications, no pending enforcement actions, or any other changes which might affect the permit conditions contained in the permit.
2. The permittee notifies the Director of the proposed transfer at least 30 days in advance of the proposed transfer date.
    a. The notice consists of a written agreement between the existing and new permittees containing a specified date for transfer of permit responsibility, coverage, and contractual liability between them; and
    b. The Director does not notify the current permittee and the new permittee, within 30 days of his or her intent to modify, revoke, reissue, or terminate the permit, or

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require that a new application be filed rather than agreeing to the transfer of the permit.

3. The permittee must provide the following information to the Division in its formal notice of intent to transfer ownership:
   a. the permit number of the subject permit,
   b. the effective date of the proposed transfer,
   c. the name and address of the transferor,
   d. the name and address of the transferee,
   e. the names of the responsible parties for both the transferor and transferee,
   f. a statement that the transferee assumes responsibility for the subject permit,
   g. a statement that the transferor relinquishes responsibility for the subject permit,
   h. the signatures of the responsible parties for both the transferor and transferee, and
   i. a statement regarding any proposed modifications to the permitted activities or project, its operations, or any other changes which might affect the permit conditions contained in the permit.

Change of Mailing Address

The permittee shall promptly provide to the Director written notice of any change of mailing address. In the absence of such notice the original address of the permittee will be assumed to be correct.

Noncompliance

Effect of Noncompliance

All withdrawals shall be consistent with the terms and conditions of this permit. Any permit noncompliance constitutes a violation of applicable state and federal laws and is grounds for enforcement action, permit termination, permit modification, or denial of permit reissuance.

Reporting of Noncompliance

24-Hour Reporting

In the case of any noncompliance which could cause a threat to public drinking supplies, or any other withdrawal which could constitute a threat to human health or the environment, the required notice of non-compliance shall be provided to the Division of Water Resources in the appropriate Environmental Field Office within 24-hours from the time the permittee becomes aware of the circumstances. (The Environmental Field Office should be contacted for names and phone numbers of environmental response personnel).

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A written submission must be provided within five days of the time the permittee becomes aware of the circumstances unless this requirement is waived by the Director on a case-by-case basis. The permittee shall provide the Director with the following information:

1. a description of the withdrawal and cause of noncompliance;
2. the period of noncompliance, including exact dates and times or, if not corrected, the anticipated time the noncompliance is expected to continue; and
3. the steps being taken to reduce, eliminate, and prevent recurrence of the non-complying withdrawal.

Scheduled Reporting

For instances of noncompliance which are not reported under subparagraph a. above, the permittee shall report the noncompliance by contacting the permit coordinator and provide all information concerning the steps taken or planned to reduce, eliminate, and prevent recurrence of the violation and the anticipated time the violation is expected to continue.

Adverse Impact

The permittee shall take all reasonable steps to minimize any adverse impact to the waters of Tennessee resulting from noncompliance with this permit, including but not limited to, accelerated or additional monitoring as necessary to determine the nature and impact of the noncompliance. It shall not be a defense for the permittee in an enforcement action that it would have been necessary to halt or reduce the permitted activity in order to maintain compliance with the conditions of this permit.

Liabilities

Civil and Criminal Liability

Nothing in this permit shall be construed to relieve the permittee from civil or criminal penalties for noncompliance. Notwithstanding this permit, the permittee shall remain liable for any damages sustained by the state of Tennessee, including but not limited to fish kills and losses of aquatic life and/or wildlife, as a result of the discharge of pollutants to any surface or subsurface waters. Additionally, notwithstanding this permit, it shall be the responsibility of the permittee to conduct its withdrawal activities in a manner such that public or private nuisances or health hazards will not be created.

Liability under State Law

Nothing in this permit shall be construed to preclude the institution of any legal action or relieve the permittee from any responsibilities, liabilities, or penalties established pursuant to any applicable state law or the Federal Water Pollution Control Act, as amended.

Reopener Clause

This permit may be modified, suspended, or revoked for cause, including:

1. Violation of any of the terms or conditions of this permit or of T.C.A §§ 69-3-101 to –148,

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2. Obtaining the permit by misrepresentation or failing to disclose fully all relevant facts, or
3. A change in any condition that requires either a temporary or permanent change in the conditions of this permit.

Appeal

An appeal of this action may be made as provided in T.C.A. § 69-3-105(i) and Rule 0400-40-07-.04(9) by submitting a petition for appeal:

1. The petition must be filed within 30 days after notification of issuance of the permit.
2. The petition must specify the basis for the appeal and state a claim for relief based on an alleged violation of the Tennessee Water Quality Control Act or the rules promulgated thereunder. Third parties shall specify facts sufficient to establish that they have satisfied the statutory and regulatory preconditions and otherwise have standing to appeal.
3. The petition should be addressed to the technical secretary of the Tennessee Board of Water Quality, Oil and Gas at the following address: April Grippo, Director, Division of Water Resources, Davy Crockett Tower, 9th Floor, 500 James Robertson Parkway, Nashville, Tennessee 37243, or you may submit such petition electronically to TDEC.Appeals@tn.gov. Any hearing would be in accordance with T.C.A. §§ 69-3-110 and 4-5-301 et seq.

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APPENDIX

Draft Permit Rationale

Lewisburg Water & Wastewater
100 Water Street
Lewisburg, Tennessee 37091

December 18, 2024

Permit Writer: Robert Baker

Summary

Permittee: Lewisburg Water & Wastewater

Contact: Trigg Cathey, P.E.
Telephone #: 931-359-6831

Activity Location: The activity is located in the Duck River in Marshall County upstream of the dam at Lillard's Mill. Pursuant to T.C.A. § 10-7-504 and Rule 0400-01-01(4)(c)2, the precise location is determined to be confidential. Therefore, the exact location of the intake site will not be disclosed in this permit or otherwise made available to the public.

Proposed Activity: The proposed alteration to waters is withdrawal of water from the Duck River at a maximum rate of 6.0 million gallons per day. The purpose of the withdrawal is for public water supply.

Waterbody Name / ID: Duck River / TN06040002010_1000

Permit Status

Permit Type: ARAP

Effective Date: draft

Expiration Date: draft

Status of Affected Waters

Duck River - ID TN06040002010_1000
Ecoregion - Inner Nashville Basin, 71i, Marshall County
Hydrologic Unit Code - HUC_8 06040002 Upper Duck River

Designated Use	Use Support	Causes	Sources
livestock watering & wildlife	fully supporting		
irrigation	fully supporting		
recreation	fully supporting		
fish and aquatic life	fully supporting		

industrial water supply	fully supporting		
domestic water supply	fully supporting		

Assessment Date: April 3, 2017

The affected waters have been determined to have available water withdrawal parameters.

The affected waters are designated as Exceptional Tennessee Waters. The basis for inclusion is as follows: Portion USFWS designated Critical Habitat for Cumberlandian Combshell and Purple Bean. Populations of federal endangered Tan Riffleshell, Birdwing Pearlymussel, and Cumberland Monkeyface, state threatened Striated Darter, Ashy Darter, and Saddled Madtom.

Proposed Alterations

The City of Lewisburg Water Treatment Plant presently pumps 4.37 MGD during peak demand. This permit is predicated on providing a baseline for future permitting in the Duck River. The baseline is considered the recent peak demand plus water use projections for the five-year permit duration. The proposed maximum withdrawal rate is 6.0 MGD. The purpose of the withdrawal is for public water supply.

The City of Lewisburg Water Treatment Plant is located inside the City Limits and has a rated capacity of 4.0 million gallons per day (MGD). Raw water for the Lewisburg Water Treatment Plant is supplied by a raw water intake in the Duck River. Lewisburg sells water to the Marshall County Board of Public Utilities, the Town of Cornersville, and the Fairview Utility District. The Marshall County Board of Public Utilities sells water to the Town of Chapel Hill when requested since Chapel Hill owns and operates a water treatment plant utilizing groundwater as a raw water source.

Alternatives Analysis and Selection of Least Impactful Practicable Alternative

The stated purpose of the proposed alterations to state water resources is to provide public water supply. The applicant has submitted an analysis of potentially practicable alternatives to the proposed activity and provided the following discussion of those alternatives:

Alternative No. 1 relies on increasing the withdrawal rate from the Duck River but is technically feasible if adequate financing is obtained and if the proper permits are obtained. As a result, Alternative No. 1 is further examined hereinafter.

For Alternative No. 2, the Columbia Power and Water System (CPWS) was considered to supply adequate potable water to Lewisburg. Purchasing water from the CPWS is a technically feasible alternative and is further examined hereinafter. The CPWS utilizes the Duck River as a raw water source with a current raw water intake capacity of 20.0 MGD.

Alternative No. 3 consists of locating groundwater in sufficient capacity and quality to be used as a water source. Implementation of this alternative is likely not technically feasible due to the lack of groundwater in Marshall County of sufficient quantity to provide the required amounts

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Marshall County requires. The only known municipal source of groundwater in Marshall County is utilized by the Town of Chapel Hill which provides approximately 175 gallons per minute of raw water except during the later summer periods when the aquifer begins to deplete resulting in poor raw water quality and diminished supply. During these periods, Chapel Hill must purchase water from the Marshall County Board of Public Utilities to furnish water to their customers.

Examination of available studies reveal a 1993 report titled, "Water Availability, Use, and Estimated Future Water Demand in the Upper Duck Basin, Middle Tennessee" by Susan S. Hutson of the United States Geological Survey, Water Resources Investigation Report 92-4179. This report examined 5,938 wells in the study area with a diameter of 6 inches or greater and revealed that six wells in Marshall County contained a capacity of 100 GPM or more and that the median discharge of all studied wells in Marshall County was approximately six GPM. Another report titled, "Water Resources of the Duck River Watershed, Tennessee" by the United States Geologic Survey revealed that wells examined in Marshall County exhibited recharge during rainfall events suggesting direct connection to surface water and that wells located adjacent to the Duck River exhibited ground water levels that rose and fell in accordance with the stage of the Duck River. The study further stated in the conclusion the following: "Water-level data from wells in the study area indicate a good hydraulic connection between the aquifer and the river, with little long-term storage of water following recharge events. Water levels in wells near the river change in concert with the river level; water levels rise when the river stage rises and decline when the stage falls. However, water temperature data collected at a few wells near the river do not indicate that water is moving from the river into the aquifer in the areas where the wells were located. Ground water levels typically declined at a rate similar to which they rose, suggesting that little water is stored in the aquifer following recharge events."

The results of the aforementioned studies combined with the direct experience of Chapel Hill confirm that the possibility of locating an aquifer to produce 700 GPM are remote and highly unlikely.

For the growth calculation, we requested the actual number of residential water customers from the City which is 6,607. Next, we requested the City give us the actual number of residential units that are permitted for the construction which is 1,429. These permitted residential units have been permitted by the City and do not include commercial or industrial growth that will occur concurrent with residential development. In addition to the currently permitted residential lots, there are currently 1,317 residential units which are proposed to be presented to the Planning Commission in the next few months

Adding the currently approved 1,429 residential units and proposed 1,317 residential units to the current water customer count of 6,607 yields 9,353 customers and a corresponding growth rate of 41.56 percent. Applying a 41.56 percent growth rate to the peak day production of 4.39 MGD yields a five-year peak day production of 6.21 MGD.

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The design of a new 6.0 MGD Water Treatment Plant is underway for the City of Lewisburg and is scheduled to bid in the summer of 2025. This project will be complete before the proposed permit expires and as a result, the City requests a 6.0 MGD raw water withdrawal rate.

Based on the available information, the Division has made the preliminary determination that the proposed activities represent the least impactful practicable alternative to accomplish the project's purpose and goals**.**

Existing Conditions/Proposed Loss of Resource Values

The Duck River in this segment is fully supporting of its classified uses. Over 50 freshwater mussel species are extant in this reach of the Duck River including the federally endangered Birdwing Pearlymussel, Cumberland Monkeyface, Fanshell, Duck River Dartersnapper, Cumberland Combshell, Catspaw, Snuffbox, Pink Mucket, Slabside Pearlymussel, Fluted Kidneyshell, and Pale Liliput as well as the federally threatened Rabbitsfoot. This reach of the Duck River specifically harbors the only viable populations of the Birdwing Pearlymussel, Cumberland Monkeyface, and Duck River Dartersnapper throughout their global range.

The Department's rules exempt water withdrawals that existed on July 25, 2000, from permit requirements to the extent that they do not "adversely alter or affect the classified use" of the source stream. Lewisburg's peak withdrawal during the summer of 2000 was 3.64 MGD. Because this river segment fully supports its classified uses, this withdrawal does not interfere with achieving these uses. This amount is therefore exempted from permit requirements. The remaining portion of the withdrawal is a new or increased withdrawal subject to permit requirements. That total is (6.0 MGD – 3.64 MGD) 2.36 MGD.

The increased withdrawal is subject to the minimum flow restriction and schedule of compliance in the Special Conditions. These conditions are protective of the resource values of this river segment. The Division has determined that the activity will not result in an appreciable permanent loss of resource values.

Antidegradation

The Department's rules state a single water withdrawal will be considered de minimis if it removes less than five percent of the minimum 7-day average streamflow with a 10-year recurrence interval (7Q10) flow of the stream. If more than one withdrawal has been authorized or proposed in a segment and the total of the authorized and proposed withdrawals uses no more than 10% of the assimilative capacity, or 7Q10 low flow, they are presumed to be de minimis.

In waters identified as Exceptional Tennessee Waters, new or increased water withdrawals that would cause degradation of any available parameter above the level of de minimis will only be authorized if the applicant has demonstrated to the Department that there are no practicable alternatives to prevent or lessen degradation associated with the proposed activity and the degradation is necessary to accommodate important economic or social development in the area and will not violate the water quality criteria for uses existing in the receiving waters.

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The calculated 7Q10 using the USGS SW Toolbox 1.0.4 for the period of record from April 1, 2004 – March 31, 2024, at the Milltown USGS Gage (03599240) in this river segment is 147.98 CFS or 95.64 MGD.

The withdrawal rate authorized by this permit is 4167 GPM or 9.28 CFS. It is 6.27% of the 7Q10 flow. In accordance with the Tennessee Antidegradation Statement (Rule 0400-40-03-.06), the Division has made the preliminary determination that the proposed activities will result in greater than de minimis degradation, and that this degradation is necessary to accommodate important economic or social development in the area because of the existing water need within the service area.

For more information, please reference Tennessee's Antidegradation Statement which is found in Chapter 0400-40-03 of the Rules of the Tennessee Department of Environment and Conservation.

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Program SWStat         U.S. GEOLOGICAL SURVEY             Seq 00001
Ver. 5.0      Log-Pearson & Pearson Type III Statistics   Run Date / Time
03/13/2018           based on USGS Program A193           9/13/2024 8:42 AM

 Notice -- Log-Pearson Type III or Pearson Type III distributions are used
           for these computations. Users are responsible for assessment
           and interpretation.


       Description:  03599240 DUCK RIVER ABOVE MILLTOWN, TN
    Year Boundaries:  April  1 - March 31
  Period in report:  April  1, 2004 - March 31, 2024
         Parameter:  7-day low
     Non-zero values:    20
         Zero values:     0
     Negative values:     0  (ignored)

Input time series (zero and negative values not included in listing.)

   214.860   180.140   170.140   154.290   169.570   177.430   159.570   178.710
   143.710   171.140   170.430   184.430   129.290   298.860   180.570   181.140
   206.000   243.710   175.860   193.710


  LOG PEARSON TYPE III Frequency Curve Parameters
  (based on logs of the non-zero values)

  Mean (logs)                                  2.258
  Variance (logs)                              0.006
  Standard Deviation (logs)                    0.078
  Skewness (logs)                              1.009
  Standard Error of Skewness (logs)            0.512
  Serial Correlation Coefficient (logs)       -0.176
  Coefficient of Variation (logs)              0.035


Frequency Curve - Parameter values at selected probabilities

   Non-                                 Variance    95-Pct Confidence
 exceedance     Recurrence  Parameter      of          Intervals
 Probability     Interval     Value     Estimate    Lower      Upper
 -----------    ----------  ---------   --------  ---------  ---------
      0.1000        10.00     147.980      1.004    134.320    157.840
```

Appendix 6-D
ARAP NRS20.177

STATE OF TENNESSEE
DEPARTMENT OF ENVIRONMENT AND CONSERVATION
Division of Water Resources
William R. Snodgrass Tennessee Tower
312 Rosa L. Parks Avenue, 11th Floor
Nashville, Tennessee 37243

May 4, 2022

Tommy Whaley
Marshall County Board of Public Utilities
624 West Commerce Street
Lewisburg, Tennessee 37091

Subject: revised Aquatic Resource Alteration Permit - §401 Water Quality Certification NRS20.177; intake and water withdrawal, Duck River

Dear Mr. Whaley:

The Division has revised the ARAP and Water Quality Certification to reflect changes specified in the settlement agreement dated February 1, 2022. The permit has been issued with an effective date of May 3, 2022.

The Division has reasonable assurance the activity as proposed and in accordance with all permit conditions herein will not violate applicable water quality standards. The attached permit (enclosed) authorizes the activity pursuant to *The Tennessee Water Quality Control Act of 1977* (T.C.A. §69-3-101 et seq.) and serves as §401 water quality certification (pursuant to the *Federal Clean Water Act* 33 U.S.C. 1341).

The state of Tennessee may modify, suspend, or revoke this authorization or seek modification or revocation should the state determine that the activity results in more than an insignificant violation of applicable water quality standards or violation of the TWQCA. Failure to comply with permit terms may result in penalty in accordance with T.C.A. §69-3-115.

The §401 Water Quality Certification Justifications and Citations related to the procedural requirements of §121.7(d) can be found at https://www.tn.gov/environment/permit-permits/water-permits1/aquatic-resource-alteration-permit--arap-.html. A paper copy of the certifications and justifications can also be obtained by contacting water.permits@tn.gov or calling (615) 532-0359.

It is the responsibility of the permittee to read and understand all permit conditions before the project begins. If you need any additional information or clarification, please contact me at 615-532-0710 or by e-mail at robert.d.baker@tn.gov.

Sincerely,

Robert Baker

Robert Baker
Natural Resources Unit

Enclosure

Cc: Bradley Hubbard - Tennessee Valley Authority, bdhubbard0@tva.gov
Dan Elbert - U. S. Fish & Wildlife Service; Cookeville, TN. daniel_elbert@fws.gov
Ashley Monroe - U. S. Environmental Protection Agency; Atlanta, GA., monroe.ashley@epa.gov
Jason Wisniewski -Tennessee Wildlife Resources Agency; Nashville, TN., jason.wisniewski@tn.gov
Amy Robinson - Corps of Engineers, Nashville District, amy.m.robinson@usace.army.mil



§ 401 WATER QUALITY CERTIFICATION

Aquatic Resource Alteration Permit NRS20.177

Pursuant to the Tennessee Water Quality Control Act of 1977 (T.C.A. §§ 69-3-101 et seq.) and supporting regulations, a permit is required to alter the properties of waters of the state. Also, pursuant to section 401 of the Clean Water Act (33 U.S.C. § 1341), an applicant for a federal license or permit which may result in a discharge into the waters of the U.S., shall provide the federal licensing or permitting agency a certification from the State in which the discharge will originate. Accordingly, the Division of Water Resources requires reasonable assurance that the activity will not violate provisions of the Tennessee Water Quality Control Act of 1977 (T.C.A. §§ 69-3-101 et seq.) or provisions of sections 301, 302, 303, 306 or 307 of the Clean Water Act.

Subject to conformance with accepted plans, specifications, and other information submitted in support of the application, the state of Tennessee hereby certifies pursuant to 33 U.S.C. § 1341, and permits pursuant to T.C.A. § 69-3-108(b), the activity described below:

PERMITTEE: Marshall County Board of Public Utilities
624 West Commerce Street
Lewisburg, Tennessee 37091

AUTHORIZED WORK: The authorized work includes construction of a mid-river, passive screen water intake in the Duck River and to withdraw drinking water at the instantaneous rate of up to 2,100 gallons per minute.

LOCATION: The activity is located in the Duck River in Marshall County upstream of the dam at Lillard's Mill. Precise location data is confidential under Tennessee law.

EFFECTIVE DATE: May 3, 2022

EXPIRATION DATE: May 2, 2027

M Lee Barker

for Jennifer Dodd Director
Division of Water Resources

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PART I

Authorized Alterations

The authorized work includes construction of a mid-river, passive screen water intake in the Duck River and the withdrawal of drinking water at the instantaneous rate of up to 2,100 gallons per minute. The activity is located in the Duck River in Marshall County upstream of the dam at Lillard's Mill. Precise location data is confidential under Tennessee law.

The river intake and associated water treatment facilities and piping will provide public water supply to existing and future customers in northern Marshall County. The design capacities for the Authorized facilities are as follows:

1. Six million gallons per-day (mgd) submerged, mid-river, passive screen intake in the Duck River.
2. Three mgd raw water pumping station based on largest pump out-of-service (expandable to 6 mgd with largest pump out-of-service).
3. Twenty-inch raw water pipeline from raw water intake/pumping station to water treatment plant (roughly 2,700 feet).
4. Three mgd water treatment plant (expandable to 6 mgd).
5. 1,500,000-gallon capacity clearwell/ground level treated water storage.
6. Three mgd treated water pumping station with largest pump out-of-service (expandable to 6 mgd with largest pump out-of-service).

7. Twenty-inch treated water pipeline (roughly 300 feet) connecting the treated water pumping station to the existing (8-inch) and future treated water pipelines.

The raw water pumping station and water treatment plant are sized to withdraw and treat water from the Duck River at the instantaneous rate of up to 2,100 gpm. MCBPU is projected to need approximately 1 million gallons per day (mgd) in 2024 (anticipated date of water treatment plant startup) and will typically operate for a single 8-hour shift each day. A treated water storage tank (ground level) will allow MCBPU to continue pumping into the distribution system when the water treatment plant is off-line. Operation of the raw water pumping station and water treatment plant would increase from an average of 8 hours per day in 2024 up to 14 hours per day to achieve an average day withdrawal of 1.8 mgd (2045 projected average water withdrawal need), while maintaining the 2,100 gpm maximum instantaneous withdrawal rate. The projected maximum day withdrawal in 2045 is 3 mgd.

The intake screen will be located between the center of the river and the north embankment (approximately 35 feet from the north embankment). To maintain the integrity of the northern bank of the river and minimize excavation in and adjacent to the river, a microtunnel will be drilled from the bottom of the vertical shaft at the raw water pumping station building (wetwell) to the screen location in the river.

A concrete pad for the pipe supporting the intake screen will be constructed on top of the bedrock in the river. Soil and rock overlying the bedrock is authorized to be removed to install the concrete pad. The permittee estimates the material on top of the bedrock that will be dredged to be about one foot deep and estimated to be less than 50 CY.

The Duck River at the location of the authorized MCBPU water supply intake screen is approximately 150 feet wide and has a maximum depth of 18 feet. The intake screen would be about 12 inches above the bottom of the river. The intake screen will be approximately 100 feet from the wetwell in the intake building and approximately 35 feet from the north embankment of the Duck River. No clearing is authorized on the north embankment along the top of the escarpment above the river.

Special Conditions

1. The withdrawal rate shall not exceed 2,100 gallons per minute.
2. Raw water withdrawal volumes shall be monitored and recorded daily.
3. Withdrawal data shall be reported to the division on the corresponding comprehensive monthly operations reports for the Public Water Supply ID that this withdrawal supports.
4. Withdrawal shall cease when flow in the Duck River as gaged at the Milltown USGS Gage (03599240) reaches a low of 175 cfs.
5. The permittee shall comply with the provisions of the Duck River Regional Drought Management Plan developed by the Duck River Agency (DRA), April 20, 2013. The provisions include, but are not limited to the following components:
    a. drought triggers;
    b. water use restrictions for drought stages, and
    c. levels of enforcement for drought management stages.

6. The permittee shall develop descriptions of restricted and prohibited activities and enforcement mechanisms for drought management specific to the MCBPU.
    a. This report shall be submitted to the Division for review and approval within 180 days of the date of this permit.
    b. The report shall be used to update the DRA's Duck River Regional Drought Management Plan.
    c. The report shall be used for compliance with item # 5. above.
7. The permittee shall develop reasonable goals for leakage reduction to consist of lowering leakage approximately one percent per year with the goal of reduction to 15 percent volumetric treated water loss.
    a. A report that details the process and timelines by which the MCBPU would achieve this reduction shall be submitted to the Division for review and approval.
    b. This report is due within 180 days of the date of this permit.
8. The permittee shall submit a post construction inspection report that reflect the "as-constructed" condition of all constructed features authorized by this permit:
    a. The post construction inspection report shall include such information as needed to demonstrate conformance with the approved plans, specifications, and special conditions of this permit.
    b. The post construction inspection report shall be submitted within the valid duration of the permit.
    c. The post construction inspection report shall include photographic documentation.
    d. The report shall include adequate identifying information such as permit number and permittee name and shall be submitted via email to water.permits@tn.gov or to the following mailing address:

        Division of Water Resources
        Natural Resources Unit
        William R. Snodgrass - Tennessee Tower
        312 Rosa L. Parks Avenue, 11th Floor
        Nashville, Tennessee 37243-1102
9. Where ground disturbance results from activities directly associated with this permitted activity, temporary or permanent soil stabilization shall be accomplished within 15 days after final grading or other earth work.
    a. Permanent stabilization with perennial vegetation shall replace any temporary measures as soon as practicable.
    b. Vegetative species must be on approved native species planting list, (Landscaping with Natives; http://www.tneppc.org/pages/landscaping#native_plants).

c. Temporary cover of annual winter wheat or rye can be sown to establish and maintain cover until native grasses can establish themselves.

General Conditions

1. It is the responsibility of the permittee to convey all terms and conditions of this permit to all contractors. A copy of this permit, approved plans and any other documentation pertinent to the activities authorized by this permit shall be maintained on site at all times during periods of construction activity.
2. The permittee is responsible for obtaining the federal § 404 permit from the U. S. Army Corps of Engineers and § 26a permit from the Tennessee Valley Authority where necessary. these permits.
3. The permittee is responsible for obtaining coverage under the National Pollutant Discharge Elimination System (NPDES) General Permit for Storm Water Discharges from Construction Activities where clearing, grading or excavation results in an area of disturbance of one or more acres, or activities that result in the disturbance of less than one acre if it is part of a larger common plan of development or sale.
4. All work shall be carried out in such a manner as will prevent violations of water quality criteria as stated in Rule 0400-40-03-.03 of the Rules of the Tennessee Department of Environment and Conservation. This includes, but is not limited to, the prevention of any discharge that causes a condition in which visible solids, bottom deposits, or turbidity impairs the usefulness of waters of the state for any of the uses designated by Rule 0400-40-04. These uses include fish and aquatic life (including trout streams and naturally reproducing trout streams), livestock watering and wildlife, recreation, irrigation, industrial water supply, domestic water supply, and navigation.
5. Impacts to waters of the state other than those specifically addressed in the plans and this permit are not authorized by this permit. All streams, springs, and wetlands shall be fully protected prior to, during, and after construction until the area is stabilized. Any questions, problems or concerns that arise regarding any stream, spring, or wetland either before or during construction, shall be addressed to the Division of Water Resource's Columbia Environmental Field Office - 1421 Hampshire Pike, Columbia, TN 38401 931-380-3371 or the permit coordinator in the Division's Natural Resources Unit – 615-532-0710.
6. Adverse impact to formally listed state or federal threatened or endangered species or their critical habitat is prohibited.
7. This permit does not authorize adverse impacts to cultural, historical or archeological features or sites.
8. Clearing, grubbing, and other disturbance to riparian vegetation shall be kept at the minimum necessary for slope construction and equipment operations. Unnecessary native riparian vegetation removal, including tree removal, is prohibited. Native riparian vegetation must be reestablished in all areas of disturbance outside of any permanent authorized structures after work is completed. Coverage under this permit does not serve to waive any local riparian buffer protection requirement, and permittees are responsible for obtaining any necessary local approval(s).

9. To minimize wildlife entanglement and plastic debris pollution, temporary erosion and sediment control products that either do not contain netting, or that contain netting manufactured from 100 percent biodegradable non-plastic materials such as jute, sisal, or coir fiber, shall be specified. Netting used in these products should have a loose-weave wildlife-safe design with movable joints between the horizontal and vertical twines, allowing the twines to move independently. Degradable, photodegradable, UVdegradable, oxo-degradable, or oxo-biodegradable plastic netting (including polypropylene, nylon, polyethylene, and polyester) are not acceptable alternatives.
10. Appropriate steps shall be taken to ensure that petroleum products or other chemical pollutants are prevented from entering waters of the state. Any equipment proposed to be used in-stream shall be free of noticeable leaks of fluids; e.g., hydraulic, transmission, crankcase, and engine coolant fluids and oils. All spills must be reported to the appropriate emergency management agency, and measures shall be taken immediately to prevent the pollution of waters of the state, including groundwater, should a spill occur.
11. The authorized activity may not result in a disruption or barrier to the movement of fish or other aquatic life. The completed activities may not disrupt or impound stream flow.
12. The activity may not result in the discharge of waste or other substances that may be harmful to humans or wildlife.
13. This permit does not authorize access to public or private property. Arrangements concerning the use of public or private property shall be made with the landowner. The permittee is responsible for obtaining any additional permitting or maintenance agreements with other government or public agencies or lands.
14. All activities must be carried out in such a manner as will prevent violations of water quality criteria as stated in TDEC Rule Chapter 0400-40-03, or impairment of the uses of streams and wetlands as designated by Rule Chapter 0400-40-04.

PART II

Mitigation Requirements and Monitoring Procedures

Required Mitigation Activities

There are no mitigation requirements.

Monitoring Requirements and Procedures

Withdrawal data shall be reported to the division on the corresponding comprehensive monthly operations reports for the Public Water Supply ID that this withdrawal supports.

Submission of Monitoring Results

Withdrawal data shall be reported to the Division on the corresponding comprehensive monthly operations reports for the Public Water Supply ID that this withdrawal supports.

The post construction inspection report shall be submitted to the Division of Water Resources, Natural Resources Unit, William R. Snodgrass Tennessee Tower 11th Floor, 312 Rosa L. Parks Avenue, Nashville, Tennessee 37243, via email at water.permits@tn.gov Please be sure to indicate the ARAP permit number on your submittal.

Records Retention

All records and information resulting from the monitoring activities required by this permit including all records of analyses performed and calibration and maintenance of instrumentation shall be retained for a minimum of five years, or longer, if requested by the Division of Water Resources.

Falsifying Results and/or Reports

Knowingly making any false statement on any report required by this permit or falsifying any result may result in the imposition of criminal penalties as provided for in Section 309 of the Federal Water Pollution Control Act, as amended, and in Section 69-3-115 of the Tennessee Water Quality Control Act.

PART III

Duty to Reapply

The permittee is not authorized to discharge or conduct an activity that alters the properties of waters of the state, including withdrawal of water, after the expiration date of this permit. In order to receive authorization to discharge or to conduct an activity that alters the properties of waters of the state after the expiration date, the permittee shall submit a timely and complete application including such information and forms as are required to the director of the Division of Water Resources. Such applications must be properly signed and certified.

Property Rights

The issuance of this permit does not convey any property rights in either real or personal property, or any exclusive privileges, nor does it authorize any injury to private property or any invasion of personal rights, nor any infringement of federal, state, or local laws or regulations.

Water Rights

The waters of Tennessee are the property of the state and are held in public trust for the use of the people of the state. This permit does not grant or convey any prescriptive rights, appropriation, or allocation of water, nor does it authorize any injury to the riparian rights of others.

Other Permits

This permit does not preclude requirements of other federal, state or local laws. This permit also serves as a state of Tennessee aquatic resource alteration permit (ARAP) pursuant to the Tennessee Water Quality Control Act of 1977 (T.C.A. § 69-3-101 et seq.).

Other Information

If the permittee becomes aware that it failed to submit any relevant facts in a permit application or submitted incorrect information in a permit application or in any report to the director, then it shall promptly submit such facts or information.

Changes Affecting the Permit Transfer/Change of Ownership

This permit may be transferred to another party, provided there are no activity or project modifications, no pending enforcement actions, or any other changes which might affect the permit conditions contained in the permit, by the permittee if:

1. The permittee notifies the Director of the proposed transfer at least 30 days in advance of the proposed transfer date;
2. The notice includes a written agreement between the existing and new permittees containing a specified date for transfer of permit responsibility, coverage, and contractual liability between them; and
3. The Director does not notify the current permittee and the new permittee, within 30 days, of his or her intent to modify, revoke, reissue, or terminate the permit, or require that a new application be filed rather than agreeing to the transfer of the permit.
4. The permittee must provide the following information to the division in their formal notice of intent to transfer ownership:
    a. the permit number of the subject permit;
    b. the effective date of the proposed transfer;
    c. the name and address of the transferor;
    d. the name and address of the transferee;
    e. the names of the responsible parties for both the transferor and transferee;
    f. a statement that the transferee assumes responsibility for the subject permit;
    g. a statement that the transferor relinquishes responsibility for the subject permit;
    h. the signatures of the responsible parties for both the transferor and transferee, and;
    i. a statement regarding any proposed modifications to the permitted activities or project, its operations, or any other changes which might affect the permit conditions contained in the permit.

Change of Mailing Address

The permittee shall promptly provide to the director written notice of any change of mailing address. In the absence of such notice the original address of the permittee will be assumed to be correct.

Noncompliance

Effect of Noncompliance

All discharges shall be consistent with the terms and conditions of this permit. Any permit noncompliance constitutes a violation of applicable state and federal laws and is grounds for enforcement action, permit termination, permit modification, or denial of permit reissuance.

Reporting of Noncompliance

24-Hour Reporting

1. In the case of any noncompliance which could cause a threat to public drinking supplies, or any other discharge which could constitute a threat to human health or the environment, the required notice of non-compliance shall be provided to the Division of Water Resources in the appropriate Environmental Field Office within 24-hours from the time the permittee becomes aware of the circumstances. (The Environmental Field Office should be contacted for names and phone numbers of environmental response personnel).
2. A written submission must be provided within five (5) days of the time the permittee becomes aware of the circumstances unless this requirement is waived by the director on a case-by-case basis. The permittee shall provide the director with the following information:
    a. A description of the discharge and cause of noncompliance;
    b. The period of noncompliance, including exact dates and times or, if not corrected, the anticipated time the noncompliance is expected to continue; and
    c. The steps being taken to reduce, eliminate, and prevent recurrence of the non-complying discharge.

Scheduled Reporting

For instances of noncompliance which are not reported under subparagraph a. above, the permittee shall report the noncompliance by contacting the permit coordinator, and provide all information concerning the steps taken or planned to reduce, eliminate, and prevent recurrence of the violation and the anticipated time the violation is expected to continue.

Adverse Impact

The permittee shall take all reasonable steps to minimize any adverse impact to the waters of Tennessee resulting from noncompliance with this permit, including but not limited to, accelerated or additional monitoring as necessary to determine the nature and impact of the noncompliance. It shall not be a defense for the permittee in an enforcement action that it would have been necessary to halt or reduce the permitted activity in order to maintain compliance with the conditions of this permit.

Liabilities

Civil and Criminal Liability

Nothing in this permit shall be construed to relieve the permittee from civil or criminal penalties for noncompliance. Notwithstanding this permit, the permittee shall remain liable for any damages sustained by the state of Tennessee, including but not limited to fish kills and losses of aquatic life and/or wildlife, as a result of the discharge of pollutants to any surface or subsurface waters. Additionally, notwithstanding this Permit, it shall be the responsibility of the permittee to

conduct its discharge activities in a manner such that public or private nuisances or health hazards will not be created.

Liability under State Law

Nothing in this permit shall be construed to preclude the institution of any legal action or relieve the permittee from any responsibilities, liabilities, or penalties established pursuant to any applicable state law or the Federal Water Pollution Control Act, as amended.

Reopener Clause

This permit may be modified, suspended, or revoked for cause, including:

1. Violation of any of the terms or conditions of this permit or of T.C.A § 69-3-101 et. seq.;
2. Obtaining the permit by misrepresentation or failing to disclose fully all relevant facts;
3. A change in any condition that requires either a temporary or permanent change in the conditions of this permit.

Appeal

An appeal of this action may be made as provided in T.C.A. § 69-3-105(i) and Rule 0400-40-07-.04(9) by submitting a petition for appeal:

1. The petition must be filed within 30 days after public notice of the issuance of the permit.
2. The petition must specify the basis for the appeal and state a claim for relief based on an alleged violation of the Tennessee Water Quality Control Act or the rules promulgated thereunder. Third parties shall specify facts sufficient to establish that they have satisfied the statutory and regulatory preconditions and otherwise have standing to appeal.
3. The petition should be addressed to the technical secretary of the Tennessee Board of Water Quality, Oil and Gas at the following address: Jennifer Dodd, Director, Division of Water Resources, William R. Snodgrass - Tennessee Tower, 312 Rosa L. Parks Avenue, Nashville, Tennessee 37243-1102, or you may submit such petition electronically to TDEC.Appeals@tn.gov. Any hearing would be in accordance with T.C.A. §§ 69-3-110 and 4-5-301 et seq.

Design Drawings

RAW WATER INTAKE SCREENS

1) The following summarizes the preliminary intake screen sizing for planning purposes. Planning considerations and assumptions include the following:

1. Standard Stainless Steel construction
2. 0.125" (1/8" or 3.175 mm) intake slot opening
3. 65% open area of screen (Figure 8-C-1)
4. Maximum velocity through slots less than 0.5 fps to minimize entrainment and impingement of aquatic life
5. Passive screen (non-moving parts) to minimize impacts to aquatic life
6. Use 27-inch diameter Tee-Screen for planning purposes
7. 27-inch passive Tee-Screen with flow capacity of approximately 4,200 gpm (6 mgd) as shown in Figure 8-C-2)
8. 48-inch outlet pipe from intake screen in river to the intake structure wetwell
9. Outlet pipe velocity will be 0.4 feet/second at 2,100 gpm (3 mgd) and 0.8 feet/second at 4,200 gpm (6 mgd)
10. Equip screen with an air burst system (2-inch line) to remove debris from screen surface (Figure 8-C-3)
11. The proposed MCBPU intake is located in approximately 18 feet of water and the top of the intake would be approximately 14.75 feet below the water surface

2)

3) Due to the difficult construction and permit requirements associated with work in the Duck River, MCBPU is proposing to install a single screen (27 inches) with a preliminary capacity of 4,200 gpm (6 mgd) along with a spare port (blind flange) for bolting on a second intake at some point in the future (if needed). The proposed outlet pipe from the screen to the wetwell will be 48 inches in diameter.

4)

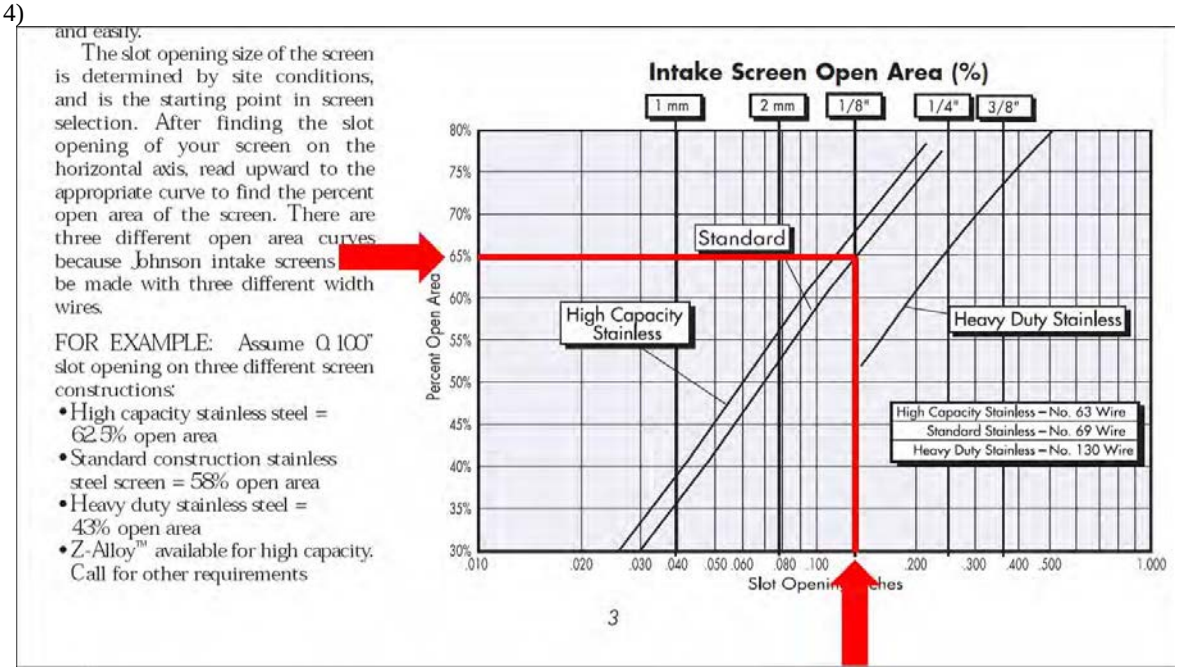


Figure 8-C-1: Intake screen open area (%)

1)

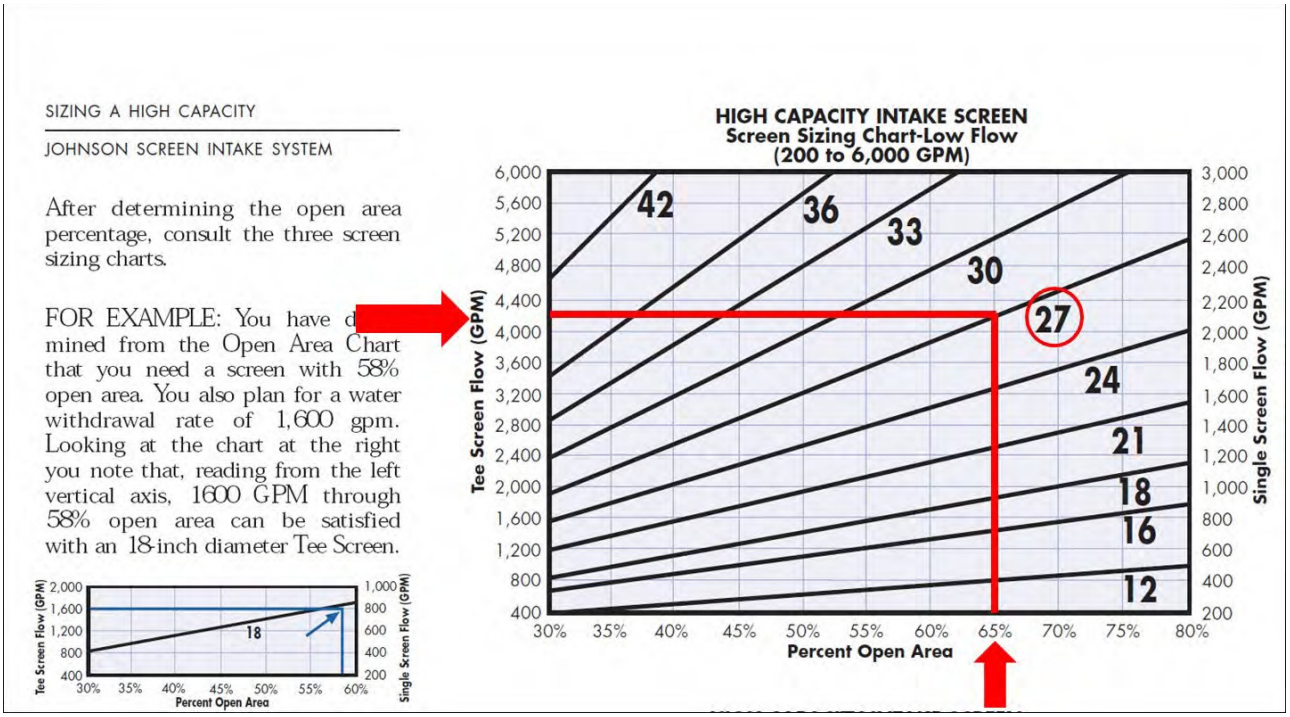
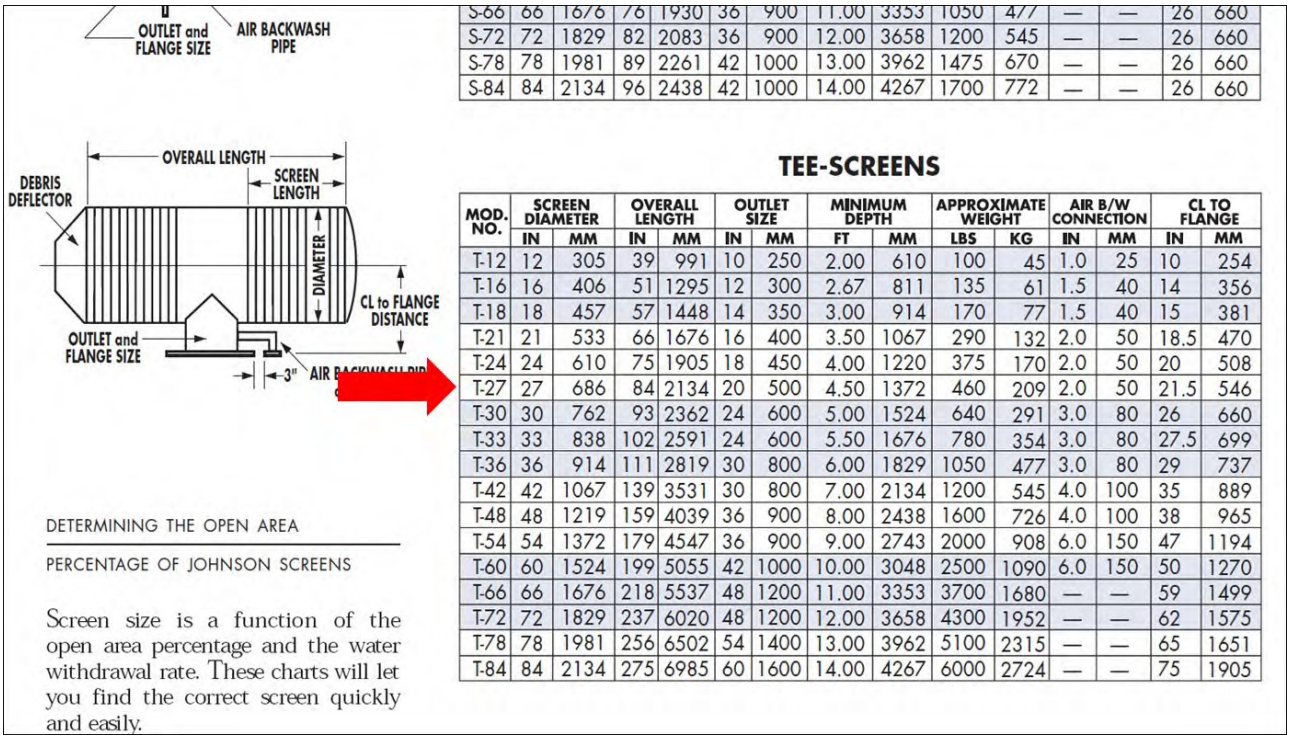


Figure 8-C-2: Diameter of screen based on percent open area and flow (gpm)

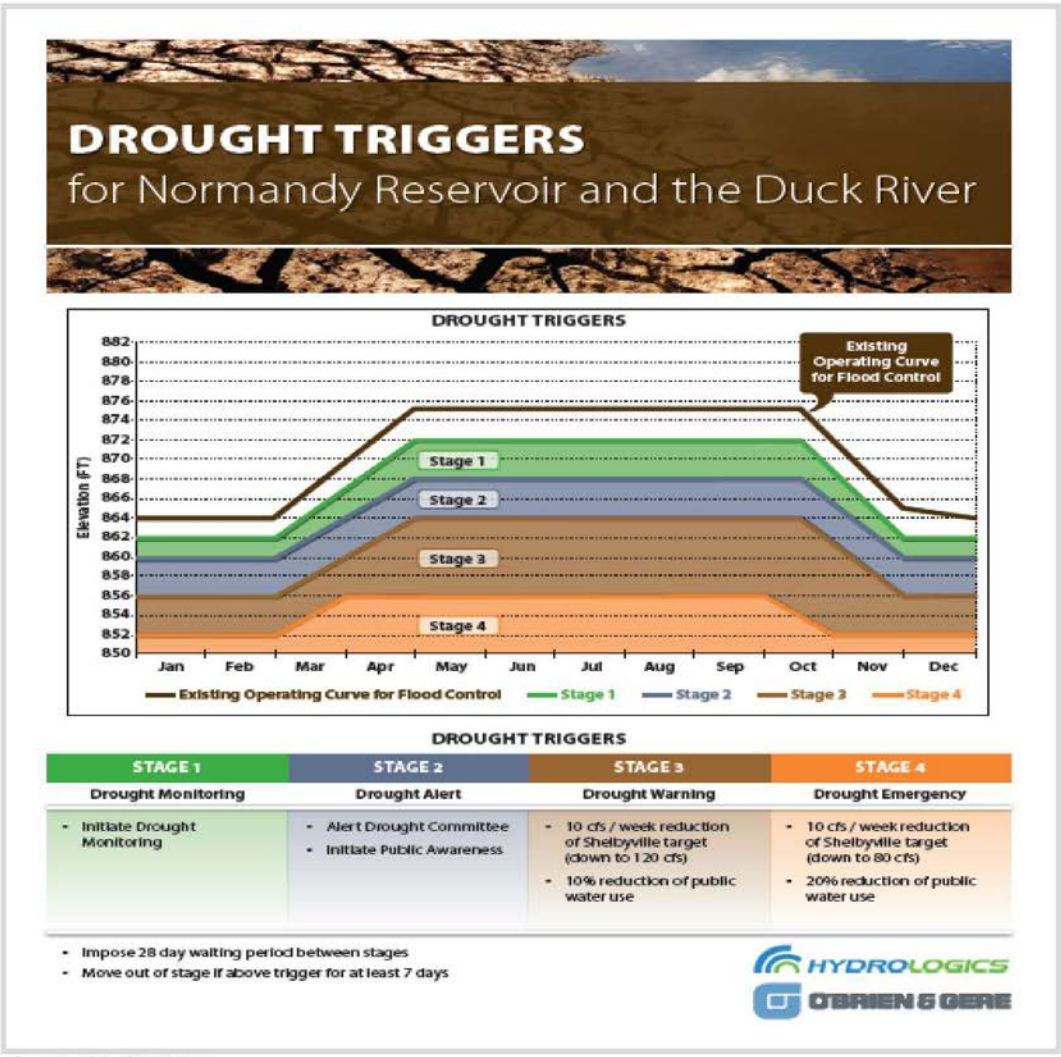


S-66	66	1676	76	1930	36	900	11.00	3353	1050	477	—	—	26	660
S-72	72	1829	82	2083	36	900	12.00	3658	1200	545	—	—	26	660
S-78	78	1981	89	2261	42	1000	13.00	3962	1475	670	—	—	26	660
S-84	84	2134	96	2438	42	1000	14.00	4267	1700	772	—	—	26	660

TEE-SCREENS

MOD. NO.	SCREEN DIAMETER		OVERALL LENGTH		OUTLET SIZE		MINIMUM DEPTH		APPROXIMATE WEIGHT		AIR B/W CONNECTION		CL TO FLANGE	
	IN	MM	IN	MM	IN	MM	FT	MM	LBS	KG	IN	MM	IN	MM
T-12	12	305	39	991	10	250	2.00	610	100	45	1.0	25	10	254
T-16	16	406	51	1295	12	300	2.67	811	135	61	1.5	40	14	356
T-18	18	457	57	1448	14	350	3.00	914	170	77	1.5	40	15	381
T-21	21	533	66	1676	16	400	3.50	1067	290	132	2.0	50	18.5	470
T-24	24	610	75	1905	18	450	4.00	1220	375	170	2.0	50	20	508
T-27	27	686	84	2134	20	500	4.50	1372	460	209	2.0	50	21.5	546
T-30	30	762	93	2362	24	600	5.00	1524	640	291	3.0	80	26	660
T-33	33	838	102	2591	24	600	5.50	1676	780	354	3.0	80	27.5	699
T-36	36	914	111	2819	30	800	6.00	1829	1050	477	3.0	80	29	737
T-42	42	1067	139	3531	30	800	7.00	2134	1200	545	4.0	100	35	889
T-48	48	1219	159	4039	36	900	8.00	2438	1600	726	4.0	100	38	965
T-54	54	1372	179	4547	36	900	9.00	2743	2000	908	6.0	150	47	1194
T-60	60	1524	199	5055	42	1000	10.00	3048	2500	1090	6.0	150	50	1270
T-66	66	1676	218	5537	48	1200	11.00	3353	3700	1680	—	—	59	1499
T-72	72	1829	237	6020	48	1200	12.00	3658	4300	1952	—	—	62	1575
T-78	78	1981	256	6502	54	1400	13.00	3962	5100	2315	—	—	65	1651
T-84	84	2134	275	6985	60	1600	14.00	4267	6000	2724	—	—	75	1905

Figure 8-C-3: Intake screen characteristics



DROUGHT TRIGGERS

STAGE 1	STAGE 2	STAGE 3	STAGE 4
Drought Monitoring	Drought Alert	Drought Warning	Drought Emergency
• Initiate Drought Monitoring	• Alert Drought Committee • Initiate Public Awareness	• 10 cfs / week reduction of Shelbyville target (down to 120 cfs) • 10% reduction of public water use	• 10 cfs / week reduction of Shelbyville target (down to 80 cfs) • 20% reduction of public water use

- Impose 28 day waiting period between stages
- Move out of stage if above trigger for at least 7 days

HYDROLOGICS
O'BRIEN & GERE

Figure 5. Drought triggers

APPENDIX

Permit Rationale

NRS20.177

Marshall County Board of Public Utilities
624 West Commerce Street
Lewisburg, Tennessee 37091

May 3, 2022

Permit Writer: Robert Baker

Summary

Permittee:	Marshall County Board of Public Utilities 624 West Commerce Street Lewisburg, Tennessee 37091
Contact:	Jessie T. Whaley Superintendent
Activity Location:	The activity is located in the Duck River in Marshall County. Precise location data is confidential under Tennessee law.
Authorized Activity:	The authorized work includes construction of a mid-river, passive screen water intake in the Duck River and to withdraw drinking water at the instantaneous rate of 2,100 gallons per minute.
Waterbody Name / ID:	Duck River / TN06040002010_1000

Permit Status

Permit Type:	ARAP
Classification:	Major
Effective Date:	May 3, 2022
Expiration Date:	May 2, 2027

Status of Affected Waters

Duck River. Ecoregion Inner Nashville Basin 71I, Marshall County

Designated Use	Use Support	Causes	Sources
livestock watering & wildlife	fully supporting		
irrigation	fully supporting		
recreation	fully supporting		

fish and aquatic life	fully supporting		
industrial water supply	fully supporting		
domestic water supply	fully supporting		

Assessment Date: April 3, 2017

The affected waters have been determined to have available habitat parameters and water withdrawal parameters.

The affected waters are designated as Exceptional Tennessee Waters. The basis for inclusion is U. S. Fish and Wildlife Service designated Critical Habitat for Cumberlandian Combshell and Purple Bean. Populations of federal endangered Tan Riffleshell, Birdwing Pearlymussel, and Cumberland Monkeyface, state threatened Striated Darter, Ashy Darter, and Saddled Madtom.

Authorized Alterations

The raw water pumping station and water treatment plant are sized to withdraw and treat water from the Duck River at the instantaneous rate of 2,100 gallons per minute (GPM). MCBPU projects to need approximately 1 million gallons per day (mgd) in 2024 (anticipated date of water treatment plant startup) and will typically operate for a single 8-hour shift each day. A treated water storage tank (ground level) will allow MCBPU to continue pumping into the distribution system when the water treatment plant is off-line. Operation of the raw water pumping station and water treatment plant would increase from an average of 8 hours per day in 2024 up to 14 hours per day to achieve an average day withdrawal of 1.8 mgd (2045 projected average water withdrawal need), while maintaining the 2,100 gpm maximum instantaneous withdrawal rate. The authorized maximum day withdrawal in 2045 is projected to be 3 mgd.

The intake screen will be located between the center of the river and the north embankment (approximately 35 feet from the north embankment). To maintain the integrity of the northern bank of the river and minimize excavation in and adjacent to the river, a microtunnel would be drilled from the bottom of the vertical shaft at the raw water pumping station building (wetwell) to the screen location in the river.

A concrete pad for the pipe supporting the intake screen would be constructed on top of the bedrock in the river. Soil and rock overlying the bedrock is authorized to be removed to install the concrete pad. The permittee estimates the material on top of the bedrock that would be dredged to be about one foot deep and estimated to be less than 50 CY.

The Duck River at the location of the authorized MCBPU water supply intake screen is approximately150 feet wide and has a maximum depth of 18 feet. The intake screen would be about 12 inches above the bottom of the river. The intake screen will be approximately 100 feet from the wetwell in the intake building and approximately 35 feet from the north embankment of the Duck River. No clearing is authorized on the north embankment along the top of the escarpment above the river.

Alternatives Analysis and Selection of Least Impactful Practicable Alternative

The stated purpose of the authorized alterations to water resources is to provide drinking water to northern Marshall County. MCBPU currently purchases all its water for the northern portion of Marshall County from two utilities and can currently obtain up to roughly 0.9 mgd from Lewisburg Water and Wastewater and up to 0.22 mgd from Consolidated Utility District (CUD)/City of Murfreesboro (Murfreesboro). This maximum amount of available supply (1.12 mgd) will approximate MCBPU's peak day water needs (i.e., MCBPU's customers plus supplemental water sales to Chapel Hill) in northern Marshall County within the next few years.

MCBPU plans to replace the LWW and CUD/Murfreesboro supplies to northern Marshall County with its own water supply in 2024 to meet current and future water needs, improve reliability and enhance treated water quality. Based on projections, the estimated maximum daily water withdrawal from the Duck River by MCBPU for northern Marshall County (including Chapel Hill) will reach approximately 3 million gallons in 2045. MCBPU reviewed many alternatives over the past two decades and determined that constructing a water treatment plant (WTP) on the north side of the Duck River was the most cost-effective and environmentally responsible option to meet future water needs in this region. Consequently, the purpose of MCBPU's water supply and treatment project is to provide 2,100 gpm (3 mgd) of additional municipal drinking water to meet customer needs in the northern portion of Marshall County through 2045.The permittee has submitted an analysis of potentially practicable alternatives to the authorized activity and provided the following discussion of those alternatives:

1. Expand LWW's Duck River intake and water treatment plant (WTP). This alternative is not preferred by the permittee because it requires pumping raw water south to Lewisburg for treatment and return of treated water to northern Marshall County; it is the most expensive option and does not recognize capacity limitations at LWW's existing intake and WTP.
2. Expand LWW's Duck River Intake and Construct New WTP along Duck River (This alternative was preferred by all three water systems in 2018. After several meetings and correspondence with LWW regarding the improvements and estimated costs associated with upgrade and expansion of LWW's existing raw water intake and pumping station and after learning that LWW did not have 6 mgd of permitted withdrawal capacity, MCBPU determined that constructing a new raw water intake would be a more cost-effective and sustainable long-term solution for the region).
3. Purchase of wholesale water from Columbia Power & Water Systems (CPWS). This is considered not feasible by the permittee because of infrastructure improvements that would be needed along Bear Creek Pike and lack of contract arrangements for the sale of treated water to MCBPU.
4. The permittee states that other alternatives such as water conservation, water loss reduction, water reuse or recycling, regionalization, and water pricing structures that encourage a reduction in consumption, are alternatives that are or will be a component in MCBPU's water supply program but satisfy only a portion of the projected water need.

Based on growth projections for the service area, capacity limitations at LWW's existing intake and WTP, inadequate existing infrastructure to purchase wholesale water from CPWS, efficiency and

resiliency components of added local treatment capacity balanced with the *de minimis* impact of the withdrawal and construction of the intake, the Division has determined that the authorized activities represent the least impactful practicable alternative to accomplish the project's purpose and goals.

Existing Conditions/Loss of Resource Values

The Duck River is fully supporting of its classified uses. The Department's rules state a single water withdrawal will be considered *de minimis* if it removes less than five percent of the minimum 7-day average streamflow with a 10-year recurrence interval (7Q10) flow of the stream. If more than one withdrawal has been authorized or proposed in a segment and the total of the authorized and proposed withdrawals uses no more than 10% of the assimilative capacity, or 7Q10 low flow, they are presumed to be *de minimis*.

The calculated 7Q10 using the USGS SW Toolbox 1.0.4 for the period of record from April 1, 2004 – March 31, 2021 at the Milltown USGS Gage (03599240) in this river segment is 146.69 cfs.

An existing water withdrawal, the Lewisburg Water and Wastewater (LWW) drinking water intake is located in the same river segment and has a capacity of 6.19 cfs (4 mgd). The LWW proposes to increase their withdrawal to five mgd or 7.75 cfs.

The withdrawal authorized by this permit is 2,100 gpm or 4.64 cfs. The MCBPU withdrawal is 3.2% of 146.69 cfs (7Q10 flow). The combined authorized and proposed withdrawals for LWW and MCBPU is 12.39 cfs, which is 8.45% of the 7Q10.

The Division has determined that the activity will not result in an appreciable permanent loss of resource values.

Antidegradation

The authorized and proposed withdrawals in this segment of the Duck River are no more than 10% of the 7Q1O low flow of 146.69 cfs, and this withdrawal individually is 3.2% of the 7Q1O flow which meets the definition of *de minimis.* In accordance with the Tennessee Antidegradation Statement (Rule 0400-40-03-.06), the Division has determined that the authorized activities will result in no more than *de minimis* degradation of water quality parameters.

For more information, please reference Tennessee's Antidegradation Statement which is found in Chapter 0400-40-03 of the Rules of the Tennessee Department of Environment and Conservation.

Appendix 6-E

ARAP NRS24.226

STATE OF TENNESSEE
DEPARTMENT OF ENVIRONMENT AND CONSERVATION
Division of Water Resources
Natural Resources Unit
Davy Crockett Tower, 9th Floor
500 James Robertson Parkway
Nashville, TN 37243

April 28, 2025

Jonathan Hardin, President/CEO
Columbia Power and Water Systems
201 Pickens Lane
Columbia, Tennessee 38401

Subject: §401 Water Quality Certification
NRS24.226; Duck River and tributaries, Maury County

Dear Mr. Hardin:

The Division has reviewed your application to cross 27 stream and wetlands with a 36-inch raw water transmission main pipeline by open cut, horizontal directional drill, and jack and bore. The raw water transmission main pipeline is to connect and new intake in the Duck River near Duck River mile 99.7 to the existing water treatment plant in Columbia, Maury County. The water quality certification has been issued with an effective date of April 18, 2025 (enclosed).

The Division has reasonable assurance the activity as proposed and in accordance with all permit conditions herein will not violate applicable water quality standards. The attached permit (enclosed) authorizes the activity pursuant to *The Tennessee Water Quality Control Act of 1977* (T.C.A. §69-3-101 et seq.) and serves as §401 water quality certification (pursuant to the *Federal Clean Water Act* 33 U.S.C. 1341).

The state of Tennessee may modify, suspend, or revoke this authorization or seek modification or revocation should the state determine that the activity results in more than an insignificant violation of applicable water quality standards or violation of the TWQCA. Failure to comply with permit terms may result in penalty in accordance with T.C.A. §69-3-115.

It is the responsibility of the permittee to read and understand all permit conditions before the project begins. If you need any additional information or clarification, please contact me at 615-532-0710 or by e-mail at robert.d.baker@tn.gov.

Columbia Power and Water
NRS24.226
April 28, 2025

Sincerely,



Robert Baker
Natural Resources Unit

Enclosure

Cc: Paul Pearman - Senior Manager, Tennessee Valley Authority, pjpearman@tva.gov
Robbie Sykes - U. S. Fish & Wildlife Service; Cookeville, TN. robbie_sykes@fws.gov
Julia Botz - U. S. Environmental Protection Agency; Atlanta, GA., Botz.Julia@epa.gov
Sherry Glass – Columbia Environmental Field Office, sherry.glass@tn.gov
Carolyn Honeycutt – Stantec, Carolynn.Honeycutt@stantec.com
Katie Murphy – Tennessee Wildlife Resources Agency, katie.m.murphy@tn.gov
Nashville District Corps of Engineers, NashvilleRegulatory@usace.army.mil



§401 Water Quality Certification

Aquatic Resource Alteration Permit

NRS24.226

Pursuant to the *Tennessee Water Quality Control Act of 1977* (T.C.A. §§ 69-3-101 et seq.) and supporting regulations, a permit is required to alter the properties of waters of the state. Also, pursuant to section 401 of the *Clean Water Act* (33 U.S.C. § 1341), an applicant for a federal license or permit which may result in a discharge into the waters of the U.S., shall provide the federal licensing or permitting agency a certification from the State in which the discharge will originate. Accordingly, the Division of Water Resources requires reasonable assurance that the activity will not violate provisions of the Tennessee Water Quality Control Act or provisions of sections 301, 302, 303, 306 or 307 of the Clean Water Act.

Subject to conformance with accepted plans, specifications, and other information submitted in support of the application, the state of Tennessee hereby certifies pursuant to 33 U.S.C. § 1341, and permits pursuant to T.C.A. § 69-3-108(b), the activity described below:

PERMITTEE: Columbia Power and Water Systems
201 Pickens Lane
Columbia, Tennessee 38401

AUTHORIZED WORK: Twenty-seven stream and wetlands crossings with a 36-inch raw water transmission main pipeline by open cut, horizontal directional drill, and jack and bore. The raw water transmission main pipeline is to connect and new intake in the Duck River near Duck River mile 99.7 to the existing water treatment plant in Columbia, Maury County.

LOCATION: Streams and wetlands in Maury County.

EFFECTIVE DATE: April 18, 2025

EXPIRATION DATE: April 17, 2030

for April Grippo, Director
Division of Water Resources

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PART I

Authorized Alterations

The authorized alterations to waters of the state are stream crossings of 27 waterbodies with a 36-inch raw water transmission pipe (includes multiple crossings of some waterbodies), including six perennial streams, 16 intermittent streams, and four wetlands.

The raw water transmission main (RWTM) is approximately 87,500 feet and extends from the authorized intake pump station near Duck River Mile (DRM) 99.7 to the existing water treatment plant. Beginning at the pump station, the RWTM proceeds south and then east along Greenfield Bend Road. The pipeline will cross the Duck River via microtunneling near DRM 113.2, continuing east until it intersects State Highway 50 (Williamsport Pike). The pipeline generally parallels Williamsport Pike for approximately 5.5 miles, staying outside of the roadway right-of-way (ROW).

Feature Name	Description	Latitude/Longitude (from)	Latitude/Longitude (to)
STR-01	Duck River Mile 113.2	35.689781, -87.227895	35.627351, -87.035141
STR-01	Duck River Mile 132.1	35.626076, -87.034713	35.705274, -87.252557

STR-02	Unnamed Stream	35.687540, -87.226392	35.687305, -87.226793
STR-03	Unnamed Stream	35.678559, -87.203609	35.678610, -87.203724
STR-04	Unnamed Stream	35.678418, -87.203322	35.678564, -87.203621
STR-05	John Branch	35.669445, -87.190393	35.668834, -87.190731
STR-06	Unnamed Stream	35.663831, -87.184219	35.663502, -87.184850
STR-07	Unnamed Stream	35.663102, -87.184157	35.003000, -87.184034
STR-08	Perennial Stream	35.653902, -87.171105	35.657398, -87.177930
STR-09	Unnamed Stream	35.656525, -87.173305	35.656182, -87.173709
STR-10	Unnamed Stream	35.654801, -87.171962	35.654883, -87.172209
STR-11	Unnamed Stream	35.650373, -87.166890	35.651963, -87.169266
STR-12	Unnamed Stream	35.643960, -87.154490	35.643775, -87.154542
STR-13	Unnamed Stream	35.643175, -87.152068	35.642941, -87.150068
STR-14	Unnamed Stream	35.642765, -87.150194	35.642744, -87.150194
STR-15	Gin Branch	35.641330, -87.146416	35.641521, -87.146257
STR-16	Unnamed Stream	35.632559, -87.130481	35.632743, -87.130270
STR-17	Greenlick Creek	35.631073, -87.126588	35.632045, -87.127902
STR-17	Greenlick Creek	35.626834, -87.117866	35.627079, -87.117833
STR-18	Unnamed Stream	35.631046, -87.127295	35.631196, -87.127211
STR-19	Unnamed Stream	35.626281, -87.115294	35.626620, -87.115885
STR-20	Unnamed Stream	35.626329, -87.115384	35.626401, -87.115621
STR-21	Unnamed Stream	35.626039, -87.080193	35.626308, -87.080058
STR-22	Little Bigby Creek	35.624993,	35.625164,

	Perennial Stream	-87.068805	-87.068543
STR-23	Unnamed Stream	35.626905, -87.044520	35.627554, -87 .044851
WTL-01	Emergent/Forested	35.689082, -87.225999	
WTL-02	Emergent	35.686187, -87.226833	
WTL-03	Emergent	35.662977, -87.183984	
WTL-04	Emergent	35.650969, -87.167949	

The authorized project will impact 23 jurisdictional streams (includes multiple crossing of the same stream) and four wetlands. To reduce potential impacts, waterbodies, streams, and rivers will be crossed as quickly and safely as practicable. Efforts will be made to work during dry conditions for intermittent and ephemeral waterbodies, where practicable. Columbia Power and Water Systems (CPWS) states that they intend to reduce turbidity through best management practices (BMPs) outlined in the Project's Erosion and Sediment Control Plan (ESCP) (Permit Details). Adherence to the construction procedures throughout construction will help allow uninterrupted stream flow in streams that are flowing at the time of the pipeline crossing installation.

The pipeline will be installed across waterbodies using dry crossing or trenchless construction methods. Upland swales, ditches, and other such non-jurisdictional conveyances may be crossed using either an open cut technique if water is flowing at the time of crossing or by BMPs if there is no flow at the time of crossing. Waterbodies within the construction workspace but not crossed by the pipeline will be avoided or temporarily crossed using temporary pipe culverts. Authorized waterbody crossing methods for each waterbody crossed by the authorized pipeline are provided in the Project's ESCP (Permit Details).

Trenchless Duck River crossing site-specific plans are included in the Microtunneling and HDD Work Plan (Permit Details).

Temporary culvert crossings may be constructed across waterbodies during clearing and grading activities for construction equipment. These temporary crossings and associated in-stream support will be removed as part of the restoration process.

In general, construction equipment and vehicle refueling and lubricating will take place in upland areas located more than 100 feet from the edge of a waterbody (or wetland). In addition, fuels, lubricating oils, petroleum products, and other hazardous materials will not be stored within 100 feet an aquatic resource. However, instances may arise where equipment refueling and lubrication near or in a waterbody are necessary. For example, stationary equipment, such as a hydrostatic test water pump, may need to operate continuously on the bank of a waterbody. The Project's ESCP and Stormwater Pollution

Prevention Plan address the handling of fuel and other hazardous materials in or near a waterbody (Permit Details).

If trench dewatering is necessary in or near a waterbody, the removed trench water will be discharged into an energy dissipation/sediment filtration device, such as a geotextile filter bag or straw bale structure located in a well-vegetated upland area away from the water's edge to prevent heavily silt-laden water from flowing into the waterbody in accordance with the Project's ESCP and applicable permits. Monitoring will be conducted to help ensure that flow from the structure is infiltrating into the underlying soil.

CPWS plans to execute dry crossings at John Branch, Gin Branch, Greenlick Creek and Little Bigby Creek in late spring and summer when stream flow will generally be at seasonal lows due to the dry season. CPWS proposes to utilize the trenchless methods at two locations crossing the Duck River at DRM 113.2 and DRM 132.1.

Special Conditions

1. Temporary or permanent soil stabilization shall be accomplished within 15 days after final grading or other earth work.
2. Permanent stabilization with perennial vegetation or other permanently stable, non-eroding surface shall replace any temporary measures as soon as practicable.
    a. Vegetative species must be on approved native species planting list, (Landscaping with Natives; *https://www.tnipc.org/wp-content/uploads/2017/10/landscaping_2016_forweb.pdf*).
3. Temporary cover of annual winter wheat or rye can be sown to establish and maintain cover until native grasses can establish themselves.
4. The permittee shall submit as-built drawings of record that reflect the "as-constructed" condition of all authorized alterations to waters of the state.
    a. The drawings shall include sufficient information, including photographic documentation, to demonstrate conformance with the approved plans, specifications, and special conditions of this permit.
    b. The report shall be submitted within 90 days of completion of the authorized alterations to waters.
    c. The report may be submitted via email to water.permits@tn.gov or to the following address: Division of Water Resources, Natural Resources Unit, Davy Crockett Tower, 9th Floor, 500 James Robertson Parkway, Nashville, TN 37243

General Conditions

1. It is the responsibility of the permittee to convey all terms and conditions of this permit to all contractors. A copy of this permit, approved plans, and any other documentation

pertinent to the activities authorized by this permit shall be maintained on site at all times during periods of construction activity.

2. All activities must be accomplished in conformance with the approved plans, specifications, data, and other information submitted in support of the ARAP application (form CN-1091) (except where no application is required as specified below) and the limitations, requirements, and conditions set forth herein. Failure to comply with the terms and conditions of this permit is a violation of the Act.
3. The permittee is responsible for obtaining the federal §404 permit from the U. S. Army Corps of Engineers and §26a permit from the Tennessee Valley Authority where necessary.
4. The permittee is responsible for obtaining coverage under the National Pollutant Discharge Elimination System (NPDES) General Permit for Storm Water Discharges from Construction Activities where clearing, grading or excavation results in an area of disturbance of one or more acres, or activities that result in the disturbance of less than one acre if it is part of a larger common plan of development or sale.
5. All work shall be carried out in such a manner as will prevent violations of water quality criteria as stated in Rule 0400-40-03-.03 of the Rules of the Tennessee Department of Environment and Conservation. This consists of, but is not limited to, the prevention of any discharge that causes a condition in which visible solids, bottom deposits, or turbidity impairs the usefulness of waters of the state for any of the uses designated by Rule 0400-40-04. These uses include fish and aquatic life (including trout streams and naturally reproducing trout streams), livestock watering and wildlife, recreation, irrigation, industrial water supply, domestic water supply, and navigation.
6. Impacts to waters of the state other than those specifically addressed in the plans and this permit are prohibited. All streams, springs and wetlands shall be fully protected prior, during and after construction until the area is stabilized. Any questions, problems or concerns that arise regarding any stream, spring or wetland either before or during construction, shall be addressed to the Division of Water Resource's Columbia Environmental Field Office 1421 Hampshire Pike, Columbia, TN 38401 (931) 380-3371, or the permit coordinator in the division's Natural Resources Unit – 615-532-0710.
7. Adverse impact to formally listed state or federal threatened or endangered species or their critical habitat is prohibited.
8. This permit does not authorize adverse impacts to cultural, historical, or archeological features or sites.
9. Clearing, grubbing, and other disturbance to riparian vegetation shall be kept at the minimum necessary for slope construction and equipment operations. Unnecessary native riparian vegetation removal, including tree removal, is prohibited. Native riparian

vegetation must be reestablished in all areas of disturbance outside of any permanent authorized structures after work is completed. Coverage under this permit does not serve to waive any local riparian buffer protection requirement, and permittees are responsible for obtaining any necessary local approval.

10. To minimize wildlife entanglement and plastic debris pollution, temporary erosion and sediment control products that either do not contain netting, or that contain netting manufactured from 100 percent biodegradable non-plastic materials such as jute, sisal, or coir fiber shall be specified. Netting used in these products should have a loose-weave wildlife-safe design with movable joints between the horizontal and vertical twines, allowing the twines to move independently. Degradable, photodegradable, UV-degradable, oxo-degradable, or oxo-biodegradable plastic netting (including polypropylene, nylon, polyethylene, and polyester) are not acceptable alternatives.
11. Appropriate steps shall be taken to ensure that petroleum products or other chemical pollutants are prevented from entering waters of the state. Any equipment proposed to be used in-stream shall be free of noticeable leaks of fluids, e.g., hydraulic, transmission, crankcase, and engine coolant fluids and oils. All spills must be reported to the appropriate emergency management agency, and measures shall be taken immediately to prevent the pollution of waters of the state, including groundwater, should a spill occur.
12. This permit shall not be used incrementally to combine with other activities resulting in an appreciable permanent loss of water resource values.
13. This activity may not result in a disruption or barrier to the movement of fish or other aquatic life. The completed activities may not disrupt or impound stream flow.
14. The activity may not result in the discharge of waste or other substances that may be harmful to humans or wildlife.
15. This permit does not authorize access to public or private property. Arrangements concerning the use of public or private property shall be made with the landowner. The permittee is responsible for obtaining any additional permitting or maintenance agreements with other government or public agencies or lands.

PART II

Mitigation Requirements and Monitoring Procedures

Required Mitigation Activities

There are no mitigation requirements.

Monitoring Requirements and Procedures

The permittee shall submit the project report within 90 days of completion of the authorized alterations to waters.

Submission of Monitoring Results

All reports must be submitted in report form to the Division of Water Resources, Natural Resources Unit, Davy Crockett Tower, 9th Floor, 500 James Robertson Parkway, Nashville, TN 37243, via email at water.permits@tn.gov. Please be sure to indicate the ARAP permit number on your submittal.

Records Retention

All records and information resulting from the monitoring activities required by this permit including all records of analyses performed and calibration and maintenance of instrumentation shall be retained for a minimum of five (5) years, or longer, if requested by the Division of Water Resources.

Falsifying Results and/or Reports

Knowingly making any false statement on any report required by this permit or falsifying any result may result in the imposition of criminal penalties as provided for in Section 309 of the Federal Water Pollution Control Act, as amended, and in Section 69-3-115 of the Tennessee Water Quality Control Act.

PART III

Duty to Reapply

Permittee is not authorized to discharge or conduct an activity that alters the properties of waters of the state after the expiration date of this permit. To receive authorization to discharge or to conduct an activity that alters the properties of waters of the state beyond the expiration date, the permittee shall submit such information and forms as are required to the director of the Division of Water Resources. Such applications must be properly signed and certified.

If any portion of the permitted activities, including the authorized impacts to water resources, compensatory mitigation requirements, or post-project monitoring is not completed before the expiration date of this permit **the permittee must apply for permit extension or re-issuance**. The permittee shall submit such information and forms as are required to the director of the Division of Water Resources at least ninety (90) days prior to its expiration date. Such applications must be properly signed and certified.

Property Rights

The issuance of this permit does not convey any property rights in either real or personal property, or any exclusive privileges, nor does it authorize any injury to private property or any invasion of personal rights, nor any infringement of federal, state, or local laws or regulations.

Water Rights

The waters of Tennessee are the property of the state and are held in public trust for the use of the people of the state. This permit does not grant or convey any prescriptive rights,

appropriation, or allocation of water, nor does it authorize any injury to the riparian rights of others.

Other Permits

This permit does not preclude requirements of other federal, state or local laws. This permit also serves as a state of Tennessee aquatic resource alteration permit (ARAP) pursuant to the Tennessee Water Quality Control Act of 1977 (T.C.A. §69-3-101 et seq.).

Other Information

If the permittee becomes aware that he/she failed to submit any relevant facts in a permit application or submitted incorrect information in a permit application or in any report to the director, then he/she shall promptly submit such facts or information.

Changes Affecting the Permit Transfer/Change of Ownership

This permit may be transferred to another party, provided:

1. There are no activity or project modifications, no pending enforcement actions, or any other changes which might affect the permit conditions contained in the permit.
2. The permittee notifies the Director of the proposed transfer at least 30 days in advance of the proposed transfer date.
    a. The notice consists of a written agreement between the existing and new permittees containing a specified date for transfer of permit responsibility, coverage, and contractual liability between them; and
    b. The Director does not notify the current permittee and the new permittee, within 30 days of his or her intent to modify, revoke, reissue, or terminate the permit, or require that a new application be filed rather than agreeing to the transfer of the permit.
3. The permittee must provide the following information to the division in their formal notice of intent to transfer ownership:
    a. the permit number of the subject permit,
    b. the effective date of the proposed transfer,
    c. the name and address of the transferor,
    d. the name and address of the transferee,
    e. the names of the responsible parties for both the transferor and transferee,
    f. a statement that the transferee assumes responsibility for the subject permit,
    g. a statement that the transferor relinquishes responsibility for the subject permit,
    h. the signatures of the responsible parties for both the transferor and transferee, and,

i. a statement regarding any proposed modifications to the permitted activities or project, its operations, or any other changes which might affect the permit conditions contained in the permit.

Change of Mailing Address

The permittee shall promptly provide to the director written notice of any change of mailing address. In the absence of such notice the original address of the permittee will be assumed to be correct.

Noncompliance

Effect of Noncompliance

All discharges shall be consistent with the terms and conditions of this permit. Any permit noncompliance constitutes a violation of applicable state and federal laws and is grounds for enforcement action, permit termination, permit modification, or denial of permit reissuance.

Reporting of Noncompliance

24-Hour Reporting

In the case of any noncompliance which could cause a threat to public drinking supplies, or any other discharge which could constitute a threat to human health or the environment, the required notice of non-compliance shall be provided to the Division of Water Resources in the appropriate Environmental Field Office within 24-hours from the time the permittee becomes aware of the circumstances. (The Environmental Field Office should be contacted for names and phone numbers of environmental response personnel).

1. A written submission must be provided within five (5) days of the time the permittee becomes aware of the circumstances unless this requirement is waived by the director on a case-by-case basis. The permittee shall provide the director with the following information:
   a. a description of the discharge and cause of noncompliance,
   b. the period of noncompliance, including exact dates and times or, if not corrected, the anticipated time the noncompliance is expected to continue, and,
   c. the steps being taken to reduce, eliminate, and prevent recurrence of the non-complying discharge.

Scheduled Reporting

For instances of noncompliance which are not reported under subparagraph a. above, the permittee shall report the noncompliance by contacting the permit coordinator and provide all information concerning the steps taken or planned to reduce, eliminate, and prevent recurrence of the violation and the anticipated time the violation is expected to continue.

Adverse Impact

The permittee shall take all reasonable steps to minimize any adverse impact to the waters of Tennessee resulting from noncompliance with this permit, including but not limited to, accelerated or additional monitoring as necessary to determine the nature and impact of the noncompliance. It shall not be a defense for the permittee in an enforcement action that it would have been necessary to halt or reduce the permitted activity in order to maintain compliance with the conditions of this permit.

Liabilities

Civil and Criminal Liability

Nothing in this permit shall be construed to relieve the permittee from civil or criminal penalties for noncompliance. Notwithstanding this permit, the permittee shall remain liable for any damages sustained by the state of Tennessee, including but not limited to fish kills and losses of aquatic life and/or wildlife, as a result of the discharge of pollutants to any surface or subsurface waters. Additionally, notwithstanding this Permit, it shall be the responsibility of the permittee to conduct its discharge activities in a manner such that public or private nuisances or health hazards will not be created.

Liability under State Law

Nothing in this permit shall be construed to preclude the institution of any legal action or relieve the permittee from any responsibilities, liabilities, or penalties established pursuant to any applicable state law or the Federal Water Pollution Control Act, as amended.

Reopener Clause

This permit may be modified, suspended, or revoked for cause, including:

1. Violation of any of the terms or conditions of this permit or of T.C.A § 69-3-101 et. seq.,
2. Obtaining the permit by misrepresentation or failing to disclose fully all relevant facts,
3. A change in any condition that requires either a temporary or permanent change in the conditions of this permit.

Appeal

An appeal of this action may be made as provided in T.C.A. § 69-3-105(i) and Rule 0400-40-07-.04(9) by submitting a petition for appeal:

1. The petition must be filed within 30 days after public notice of the issuance of the permit.
2. The petition must specify the basis for the appeal and state a claim for relief based on an alleged violation of the Tennessee Water Quality Control Act or the rules promulgated thereunder. Third parties shall specify facts sufficient to establish that they have satisfied the statutory and regulatory preconditions and otherwise have standing to appeal.

3. The petition should be addressed to the technical secretary of the Tennessee Board of Water Quality, Oil and Gas at the following address: Director, Division of Water Resources, Natural Resources Unit, Davy Crockett Tower, 9th Floor, 500 James Robertson Parkway, Nashville, TN 37243, or you may submit such petition electronically to TDEC.Appeals@tn.gov. Any hearing would be in accordance with T.C.A. §§ 69-3-110 and 4-5-301 et seq.

Site Maps and Design Drawings

Topographic Maps

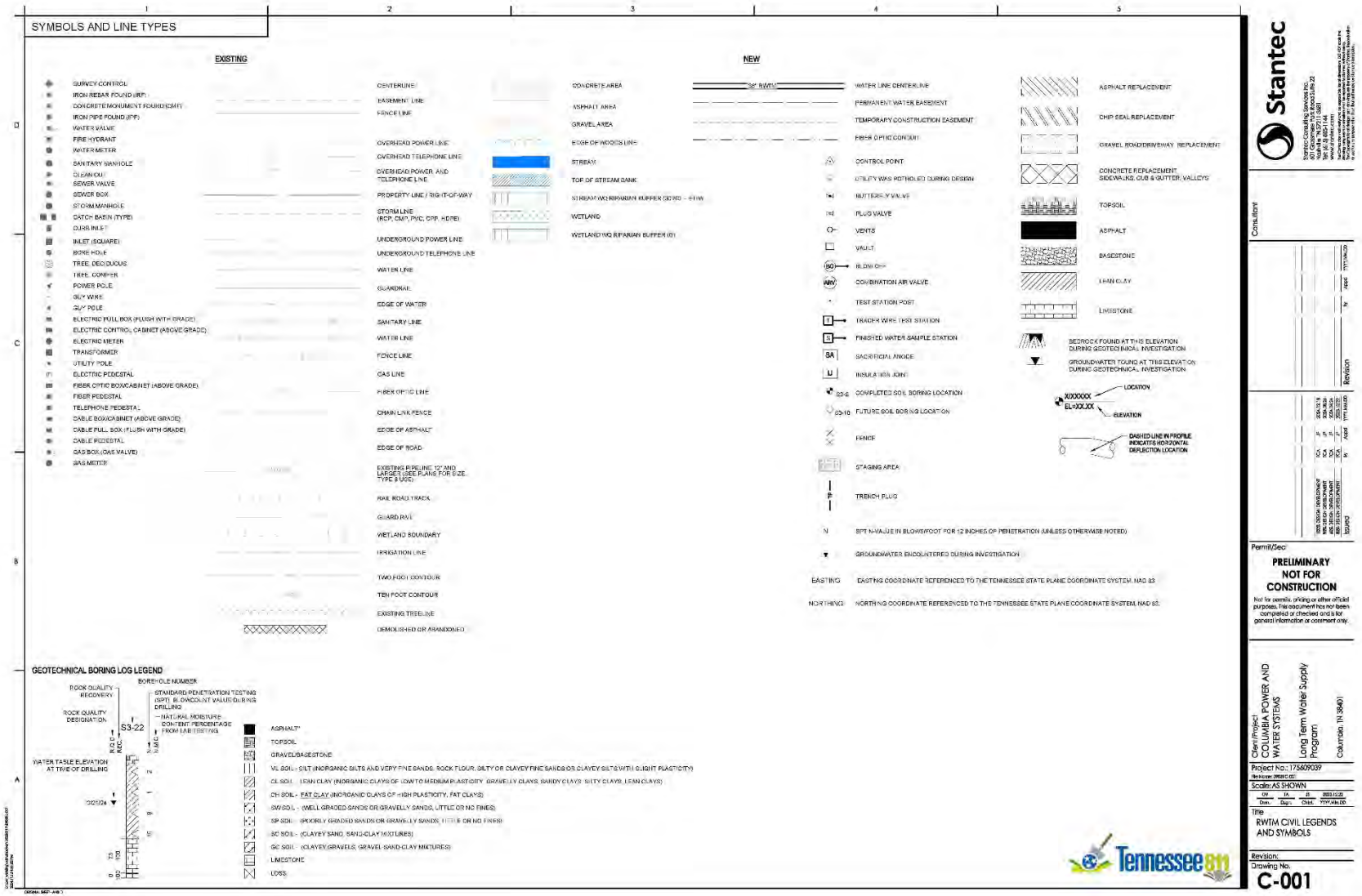


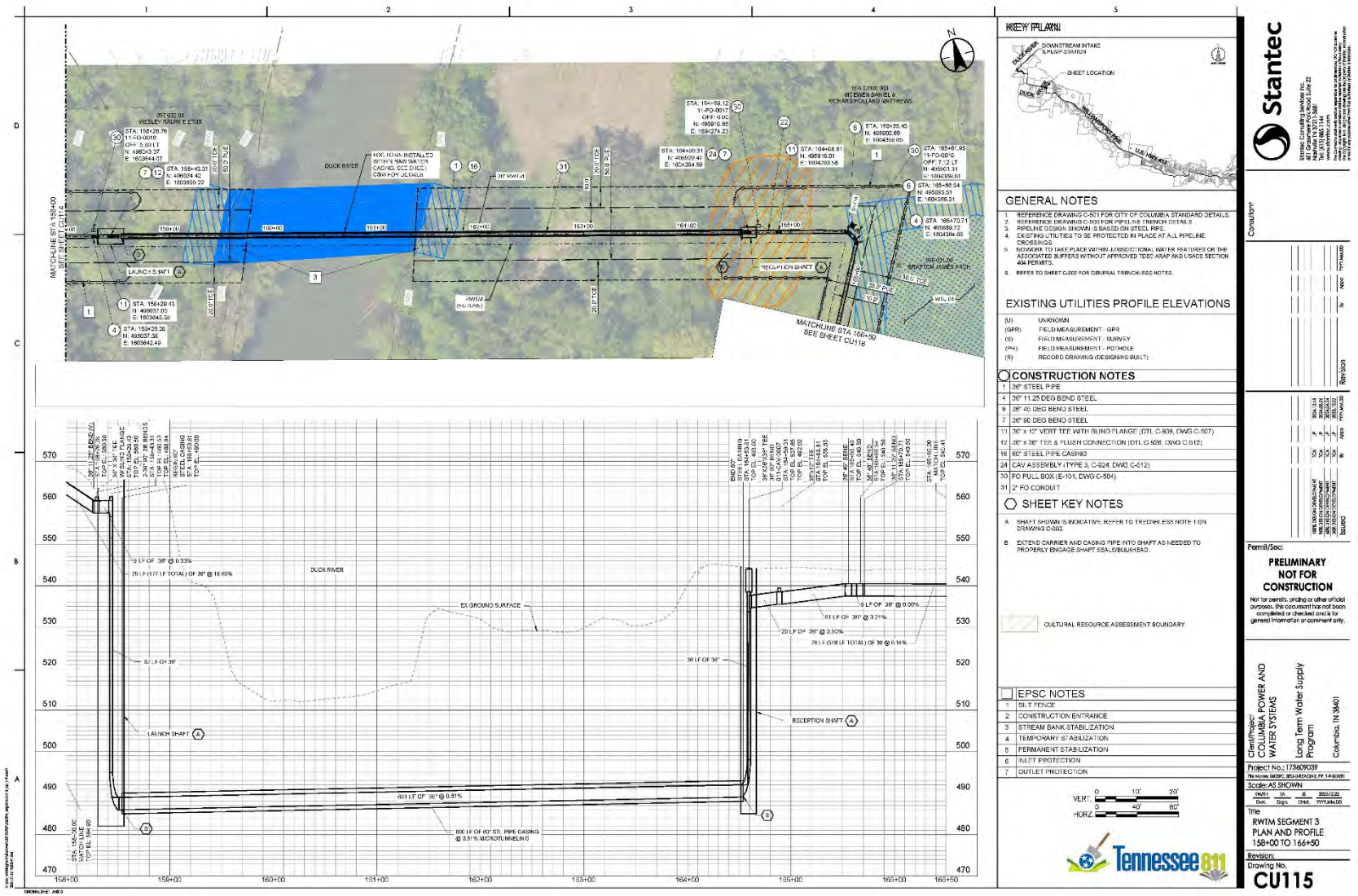

STR-12
STR-13
STR-14
STR-15
STR-16
STR-17
STR-18
STR-20
STR-21
STR-22
STR-23
STR-01
Alexander
DUCK
RIVER
Bond
Little
Bigby
Creek
Greenlick
Poplar Top
Bel Air
Forrest Hills
Columbia Gardens
MAURY COUNTY PARK
West Haven
Field Crest
Highland Park

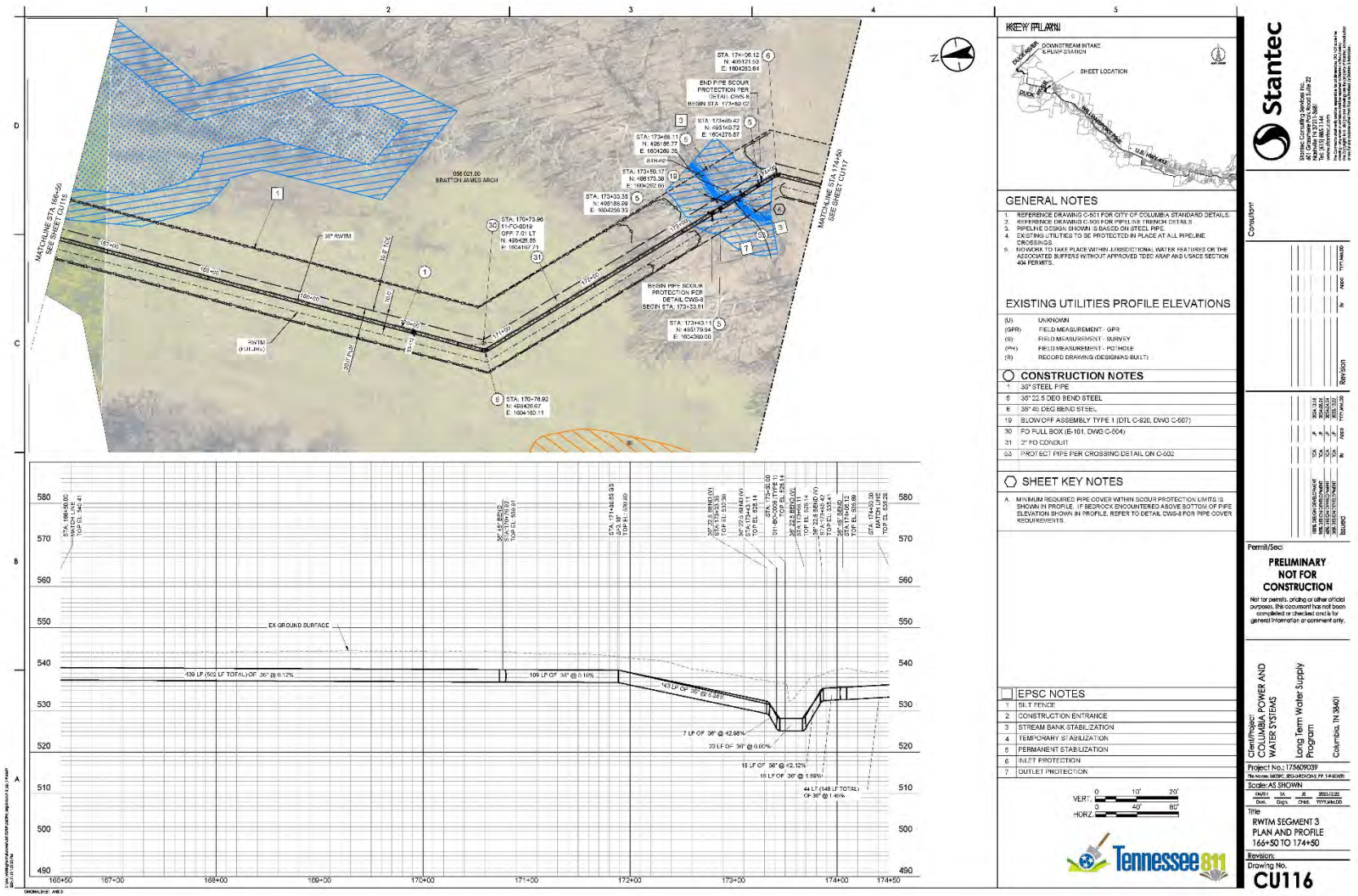
Aerial Image

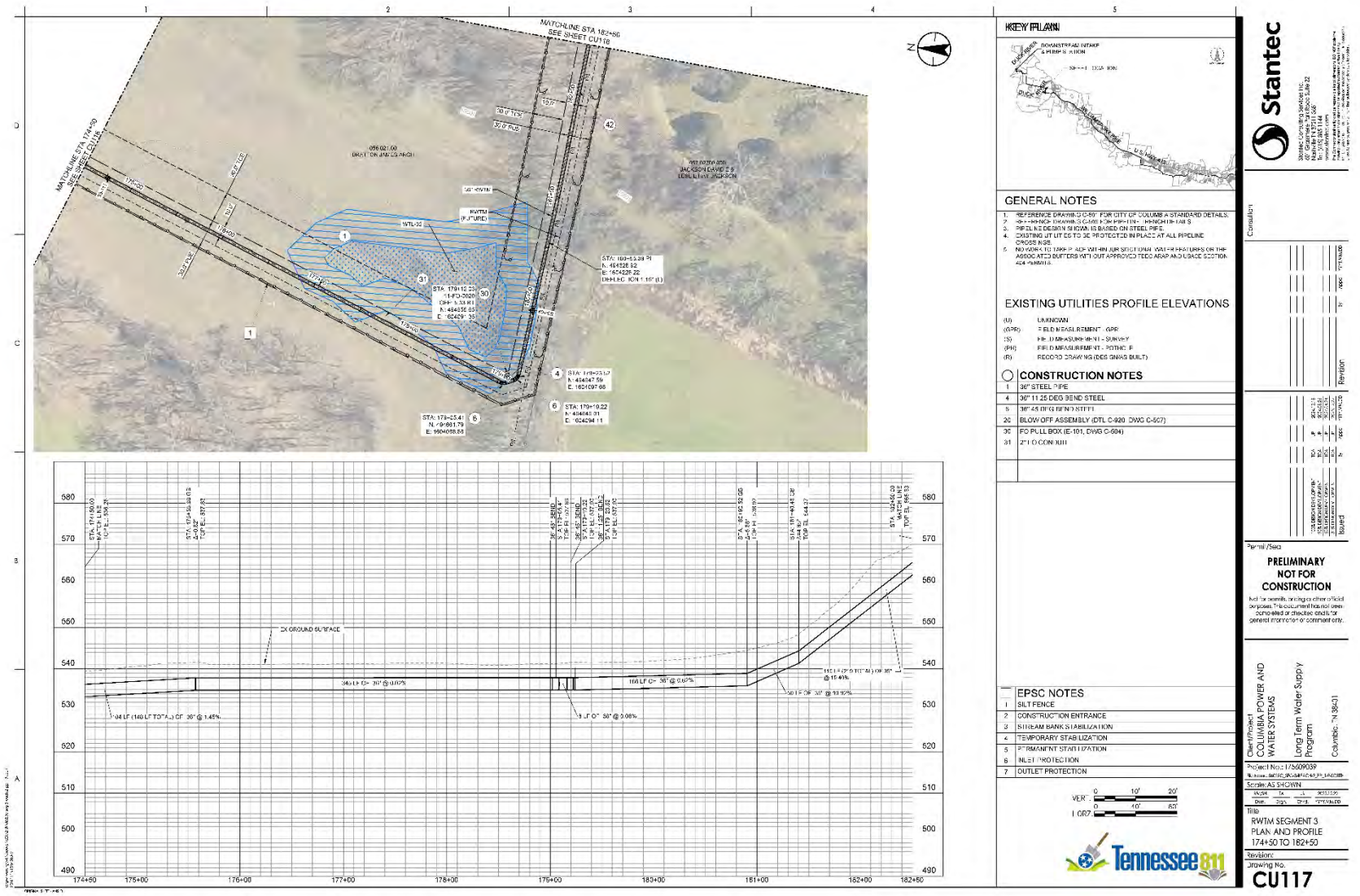


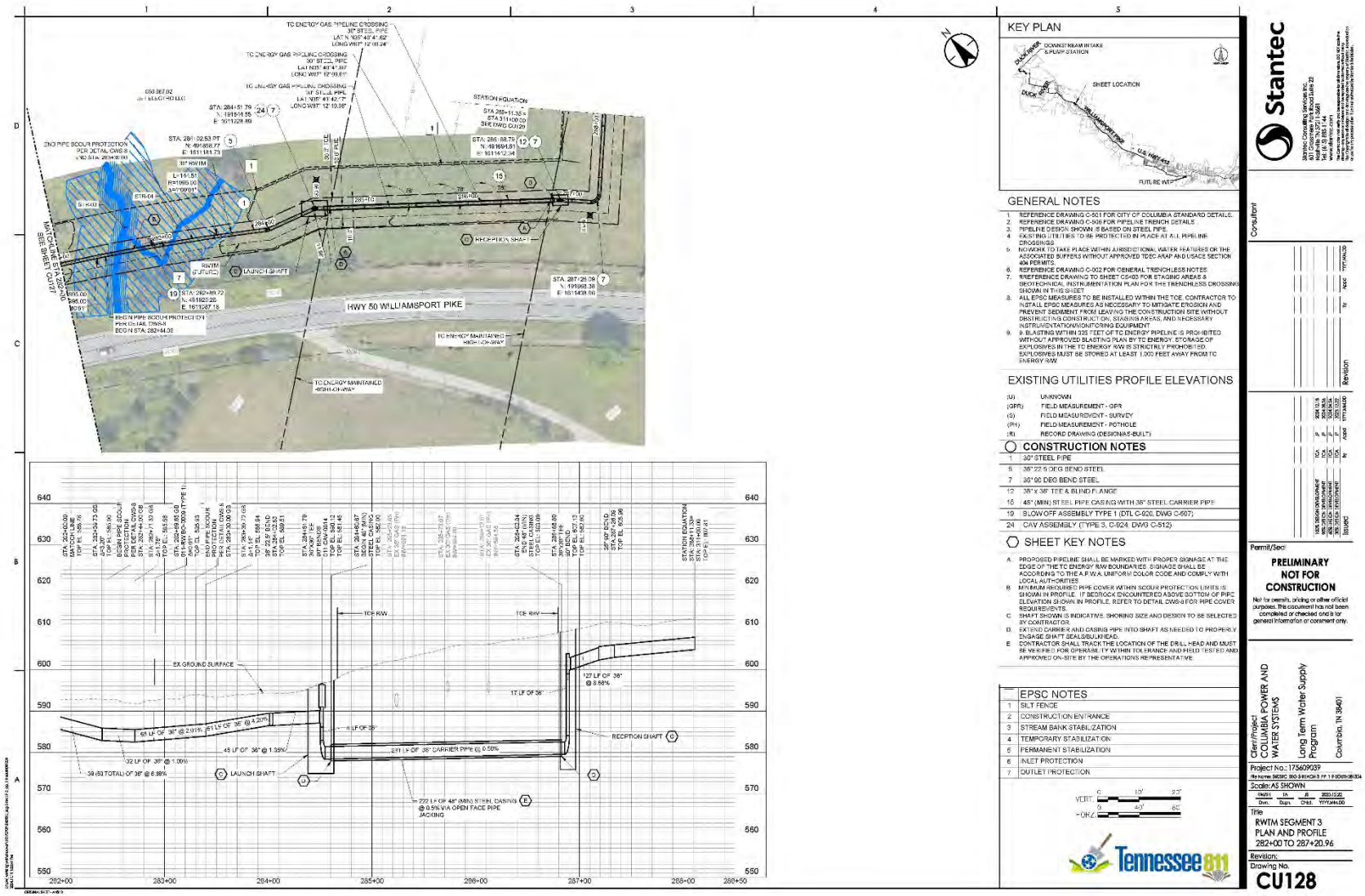
Plans

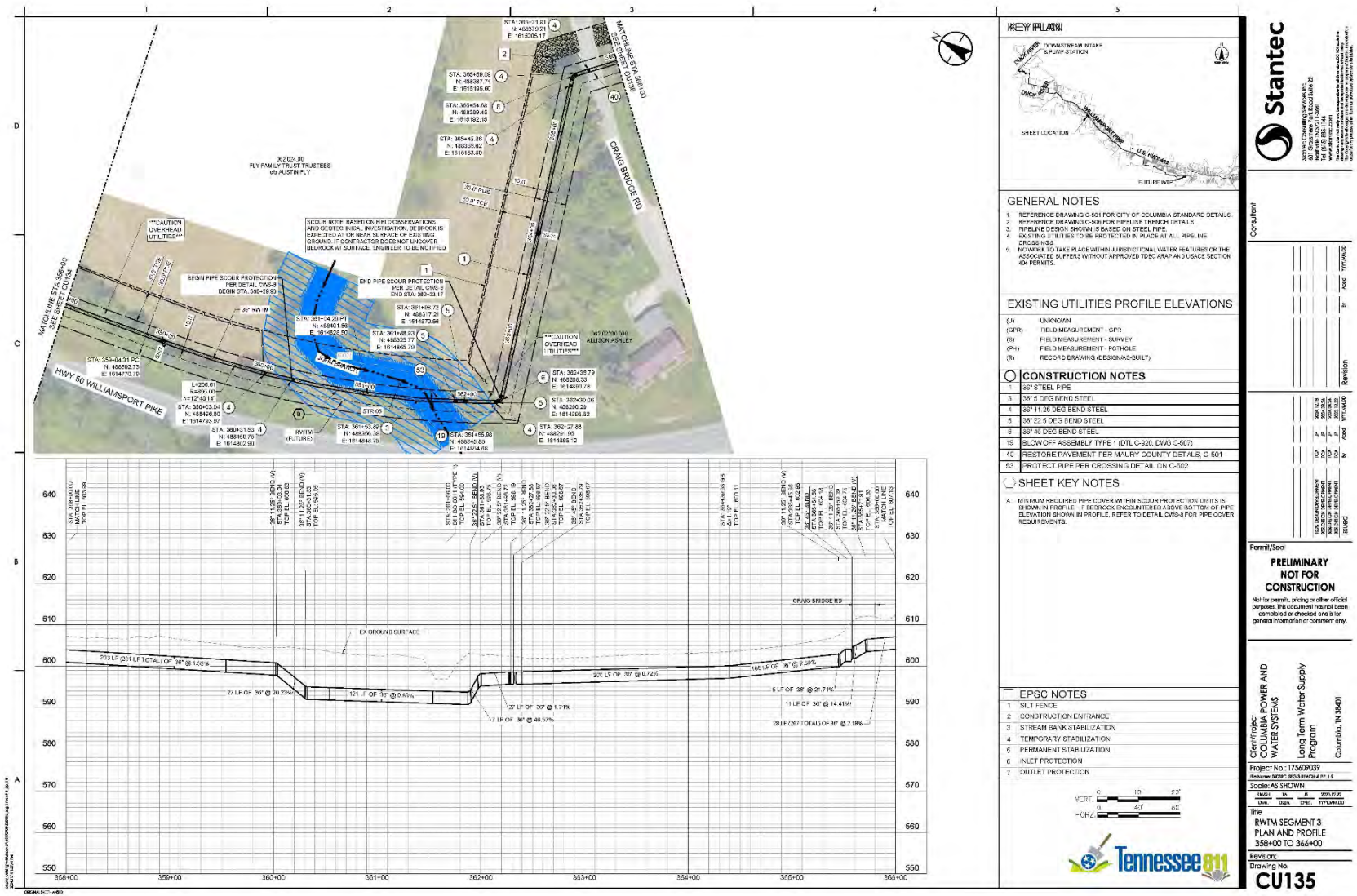

SYMBOLS AND LINE TYPES
EXISTING
NEW
GEOTECHNICAL BORING LOG LEGEND
Stantec
PRELIMINARY
NOT FOR
CONSTRUCTION
Client/Project
COLUMBIA POWER AND WATER SYSTEMS
Long Term Water Supply Program
Columbia, TN 38401
Project No.: 175609039
Scale: AS SHOWN
Title
RWTM CIVIL LEGENDS AND SYMBOLS
Drawing No.
C-001
Tennessee811

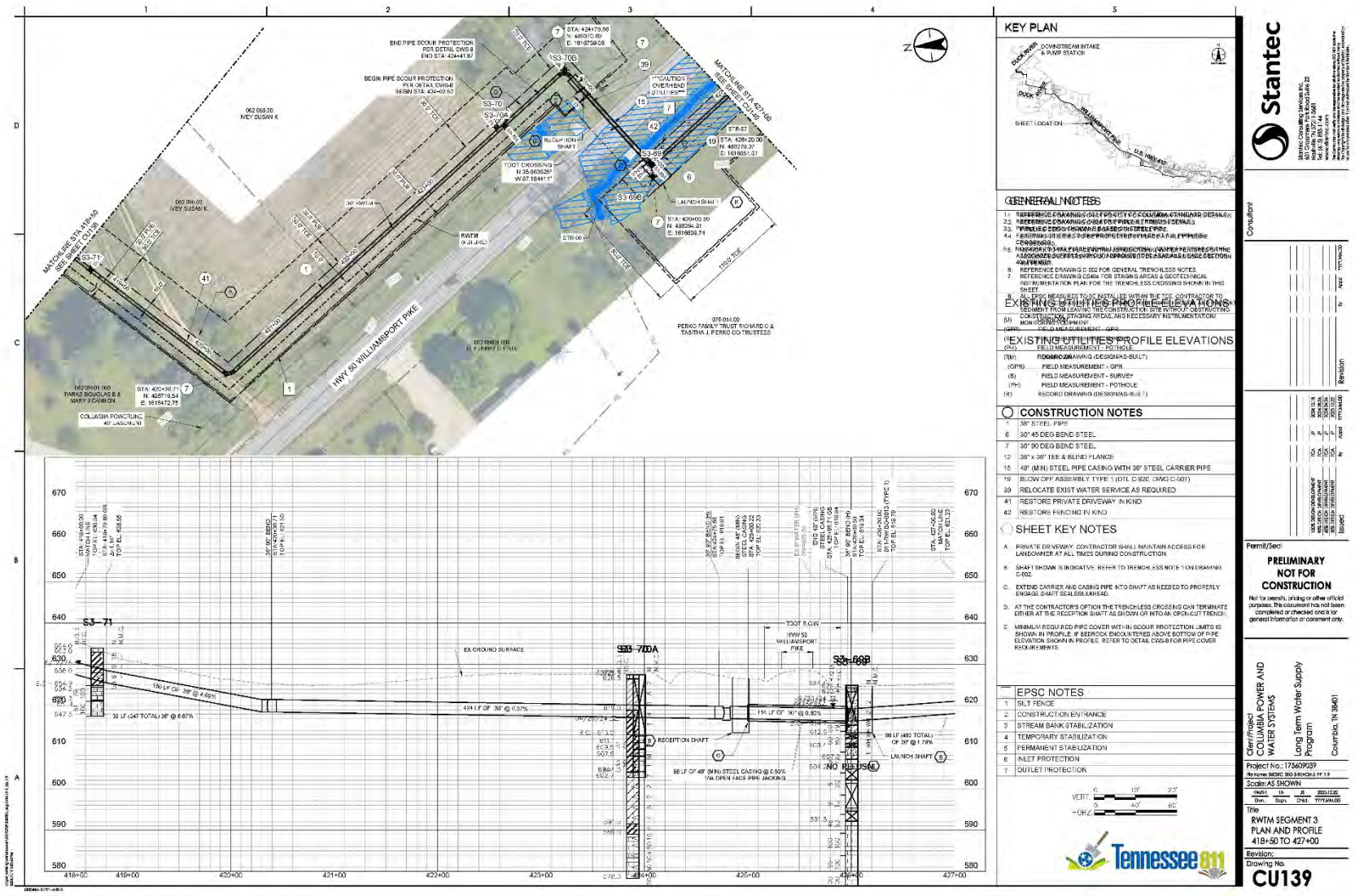

KEY PLAN
GENERAL NOTES
EXISTING UTILITIES PROFILE ELEVATIONS
CONSTRUCTION NOTES
SHEET KEY NOTES
EPSC NOTES
DUCK RIVER
EX GROUND SURFACE
LAUNCH SHAFT
RECEPTION SHAFT
MATCHLINE STA 158+00
SEE SHEET CU112
MATCHLINE STA 166+50
SEE SHEET CU116
Stantec
PRELIMINARY
NOT FOR
CONSTRUCTION
Tennessee 811
RWTM SEGMENT 3
PLAN AND PROFILE
158+00 TO 166+50
CU115

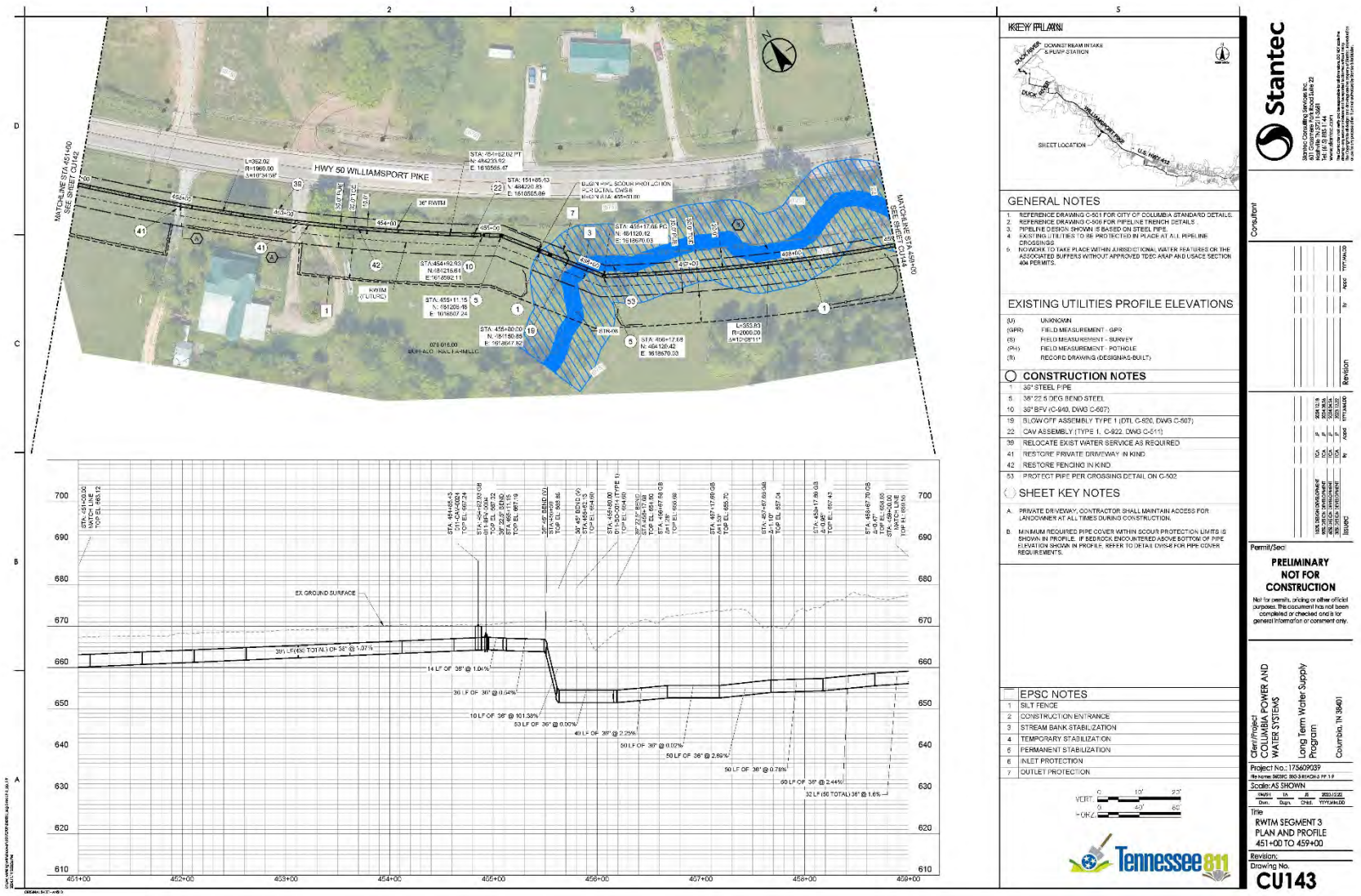

KEY PLAN
SHEET LOCATION
GENERAL NOTES
1. REFERENCE DRAWING C-501 FOR CITY OF COLUMBIA STANDARD DETAILS.
2. REFERENCE DRAWING C-505 FOR PIPELINE TRENCH DETAILS
3. PIPELINE DESIGN SHOWN IS BASED ON STEEL PIPE.
4. EXISTING UTILITIES TO BE PROTECTED IN PLACE AT ALL PIPELINE CROSSINGS.
5. NO WORK TO TAKE PLACE WITHIN JURISDICTIONAL WATER FEATURES OR THE ASSOCIATED BUFFERS WITHOUT APPROVED TDEC ARAP AND USACE SECTION 404 PERMITS.
EXISTING UTILITIES PROFILE ELEVATIONS
(U) UNKNOWN
(GPR) FIELD MEASUREMENT - GPR
(S) FIELD MEASUREMENT - SURVEY
(PH) FIELD MEASUREMENT - POTHOLE
(R) RECORD DRAWING (DESIGN/AS-BUILT)
CONSTRUCTION NOTES
1 36" STEEL PIPE
5 36" 22.5 DEG BEND STEEL
6 36" 45 DEG BEND STEEL
19 BLOW OFF ASSEMBLY TYPE 1 (DTL C-920, DWG C-607)
30 FO PULL BOX (E-101, DWG C-604)
31 2" FO CONDUIT
53 PROTECT PIPE PER CROSSING DETAIL ON C-502
SHEET KEY NOTES
A MINIMUM REQUIRED PIPE COVER WITHIN SCOUR PROTECTION LIMITS IS SHOWN IN PROFILE. IF BEDROCK ENCOUNTERED ABOVE BOTTOM OF PIPE ELEVATION SHOWN IN PROFILE, REFER TO DETAIL CWS-8 FOR PIPE COVER REQUIREMENTS.
EPSC NOTES
1 SILT FENCE
2 CONSTRUCTION ENTRANCE
3 STREAM BANK STABILIZATION
4 TEMPORARY STABILIZATION
5 PERMANENT STABILIZATION
6 INLET PROTECTION
7 OUTLET PROTECTION
EX GROUND SURFACE
109 LF (502 LF TOTAL) OF 36" @ 0.12%
109 LF OF 36" @ 0.10%
143 LF OF 36" @ 0.00%
7 LF OF 36" @ 42.86%
22 LF OF 36" @ 0.00%
18 LF OF 36" @ 42.12%
16 LF OF 36" @ 1.89%
44 LF (148 LF TOTAL) OF 36" @ 1.46%
Stantec
Consultant
Permit/Seal
PRELIMINARY
NOT FOR CONSTRUCTION
Client/Project
COLUMBIA POWER AND WATER SYSTEMS
Long Term Water Supply Program
Columbia, TN 38401
Project No.: 175609039
Scale: AS SHOWN
Title
RWTM SEGMENT 3
PLAN AND PROFILE
166+50 TO 174+50
Revision:
Drawing No.
CU116
Tennessee 811


MATCHLINE STA 182+50
SEE SHEET CU118
MATCHLINE STA 174+50
SEE SHEET CU116
KEY PLAN
GENERAL NOTES
1. REFERENCE DRAWING C-60" FOR CITY OF COLUMBIA STANDARD DETAILS.
2. REFERENCE DRAWING C-605 FOR PIPELINE PROFILE.
3. PIPELINE DESIGN SHOWN IS BASED ON STEEL PIPE.
4. EXISTING UTILITIES TO BE PROTECTED IN PLACE AT ALL PIPELINE CROSSINGS.
5. NO WORK TO TAKE PLACE WITHIN JURISDICTIONAL WATER FEATURES OR THE ASSOCIATED BUFFERS WITHOUT APPROVED TDEC ARAP AND USACE SECTION 404 PERMITS.
EXISTING UTILITIES PROFILE ELEVATIONS
(U) UNKNOWN
(GPR) FIELD MEASUREMENT - GPR
(S) FIELD MEASUREMENT - SURVEY
(PH) FIELD MEASUREMENT - POTHOLE
(R) RECORD DRAWING (DES GNWS BUILT)
CONSTRUCTION NOTES
1 36" STEEL PIPE
4 36" 11.25 DEG BEND STEEL
5 36" 45 DEG BEND STEEL
20 BLOW OFF ASSEMBLY (DTL C-920, DWG C-507)
30 FO PULL BOX (E-101, DWG C-604)
31 2" I.D CONDUIT
EPSC NOTES
1 SILT FENCE
2 CONSTRUCTION ENTRANCE
3 STREAM BANK STABILIZATION
4 TEMPORARY STABILIZATION
5 PERMANENT STABILIZATION
6 INLET PROTECTION
7 OUTLET PROTECTION
EX GROUND SURFACE
Stantec
PRELIMINARY
NOT FOR
CONSTRUCTION
Client/Project
COLUMBIA POWER AND WATER SYSTEMS
Long Term Water Supply Program
Project No: 175609039
Scale: AS SHOWN
Title
RWTM SEGMENT 3
PLAN AND PROFILE
174+50 TO 182+50
Drawing No.
CU117
Tennessee 811


HWY 50 WILLIAMSPORT PIKE
RECEPTION SHAFT
LAUNCH SHAFT
RWTM (FUTURE)
EX GROUND SURFACE
TOE R/W
TC ENERGY MAINTAINED 450' I-O-W
KEY PLAN
SHEET LOCATION
GENERAL NOTES
EXISTING UTILITIES PROFILE ELEVATIONS
CONSTRUCTION NOTES
SHEET KEY NOTES
EPSC NOTES
PRELIMINARY NOT FOR CONSTRUCTION
Stantec
Tennessee 811
Project No.: 175609039
Scale: AS SHOWN
RWTM SEGMENT 3 PLAN AND PROFILE 282+00 TO 287+20.96
Drawing No. CU128


KEY PLAN
GENERAL NOTES
EXISTING UTILITIES PROFILE ELEVATIONS
CONSTRUCTION NOTES
SHEET KEY NOTES
EPSC NOTES
Stantec
PRELIMINARY
NOT FOR
CONSTRUCTION
Tennessee 811
Project No.: 175609039
Scale: AS SHOWN
RWTM SEGMENT 3
PLAN AND PROFILE
358+00 TO 366+00
Drawing No.
CU135


KEY PLAN
GENERAL NOTES
EXISTING UTILITIES PROFILE ELEVATIONS
CONSTRUCTION NOTES
SHEET KEY NOTES
EPSC NOTES
PRELIMINARY
NOT FOR
CONSTRUCTION
Stantec
RWTM SEGMENT 3
PLAN AND PROFILE
418+50 TO 427+00
CU139
HWY 50 WILLIAMSPORT PIKE
RECEPTION SHAFT
LAUNCH SHAFT
EX GROUND SURFACE
Tennessee 811


HWY 50 WILLIAMSPORT PIKE
MATCHLINE STA 451+00 SEE SHEET CU142
MATCHLINE STA 459+00 SEE SHEET CU144
EX GROUND SURFACE
KEY PLAN
GENERAL NOTES
1. REFERENCE DRAWING C-501 FOR CITY OF COLUMBIA STANDARD DETAILS.
2. REFERENCE DRAWING C-506 FOR PIPELINE TRENCH DETAILS.
3. PIPELINE DESIGN SHOWN IS BASED ON STEEL PIPE.
4. EXISTING UTILITIES TO BE PROTECTED IN PLACE AT ALL PIPELINE CROSSINGS.
5. NO WORK TO TAKE PLACE WITHIN JURISDICTIONAL WATER FEATURES OR THE ASSOCIATED BUFFERS WITHOUT APPROVED TDEC ARAP AND USACE SECTION 404 PERMITS.
EXISTING UTILITIES PROFILE ELEVATIONS
(U) UNKNOWN
(GPR) FIELD MEASUREMENT - GPR
(S) FIELD MEASUREMENT - SURVEY
(PH) FIELD MEASUREMENT - POTHOLE
(R) RECORD DRAWING (DESIGN/AS-BUILT)
CONSTRUCTION NOTES
1 36" STEEL PIPE
5 36" 22.5 DEG BEND STEEL
10 36" BFV (C-640, DWG C-607)
19 BLOW OFF ASSEMBLY TYPE 1 (DTL C-620, DWG C-507)
22 CAV ASSEMBLY (TYPE 1, C-922, DWG C-511)
39 RELOCATE EXIST WATER SERVICE AS REQUIRED
41 RESTORE PRIVATE DRIVEWAY IN KIND
42 RESTORE FENCING IN KIND
53 PROTECT PIPE PER CROSSING DETAIL ON C-502
SHEET KEY NOTES
A. PRIVATE DRIVEWAY, CONTRACTOR SHALL MAINTAIN ACCESS FOR LANDOWNER AT ALL TIMES DURING CONSTRUCTION.
B. MINIMUM REQUIRED PIPE COVER WITHIN SCOUR PROTECTION LIMITS IS SHOWN IN PROFILE. IF BEDROCK ENCOUNTERED ABOVE BOTTOM OF PIPE ELEVATION SHOWN IN PROFILE, REFER TO DETAIL D/S5-E FOR PIPE COVER REQUIREMENTS.
EPSC NOTES
1 SILT FENCE
2 CONSTRUCTION ENTRANCE
3 STREAM BANK STABILIZATION
4 TEMPORARY STABILIZATION
5 PERMANENT STABILIZATION
6 INLET PROTECTION
7 OUTLET PROTECTION
Stantec
Consultant
Permit/Sec
PRELIMINARY
NOT FOR CONSTRUCTION
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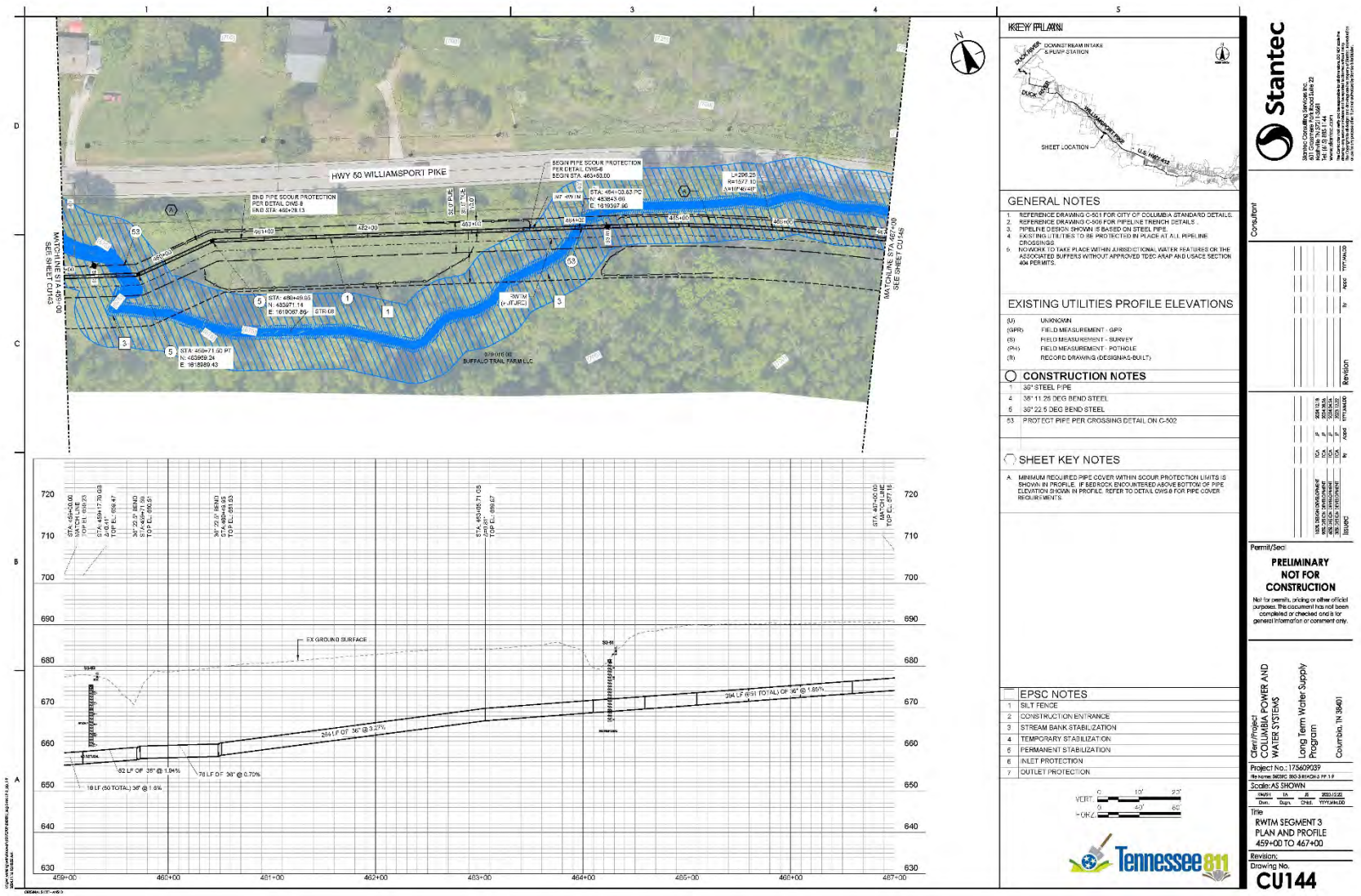
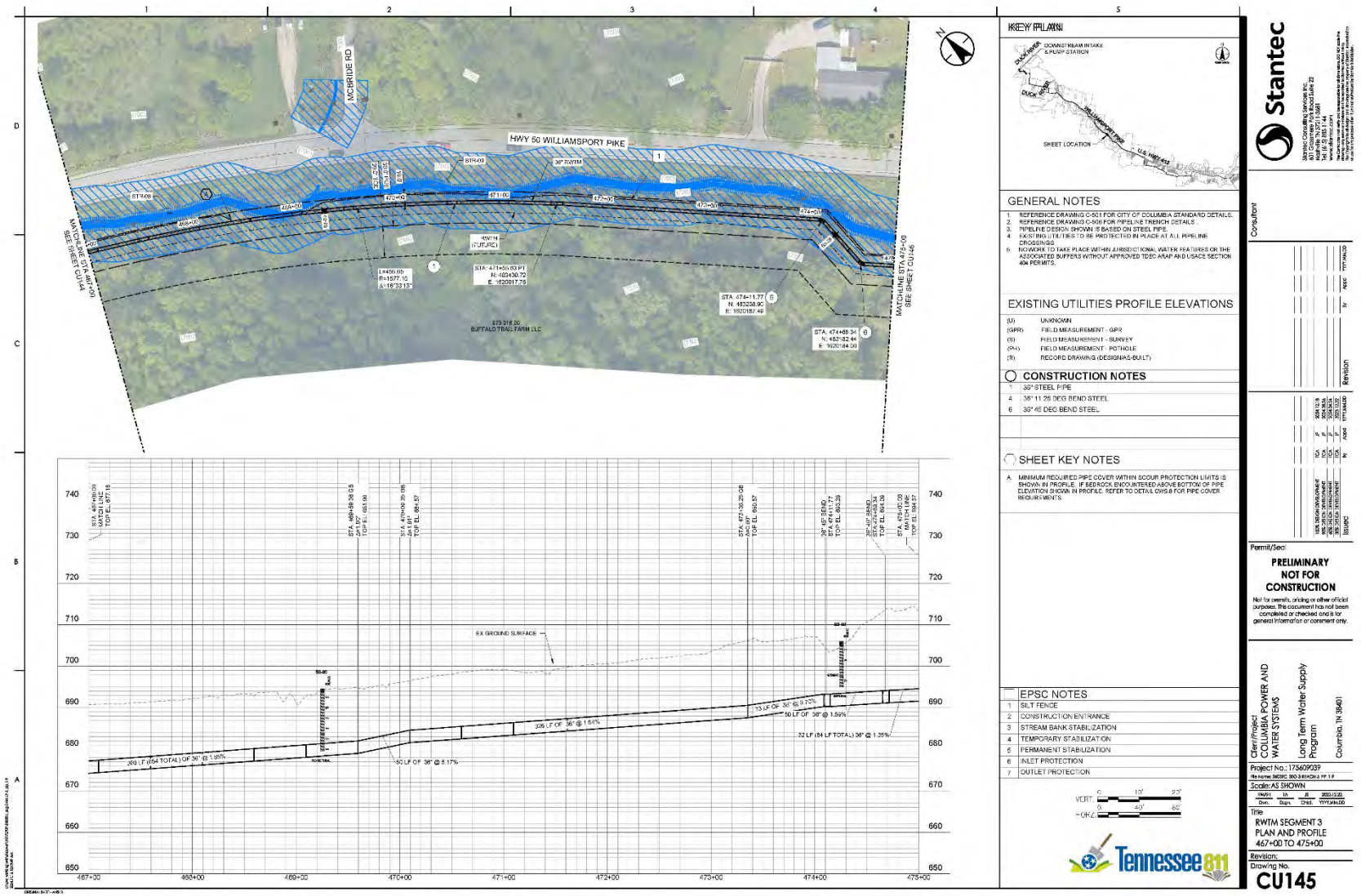
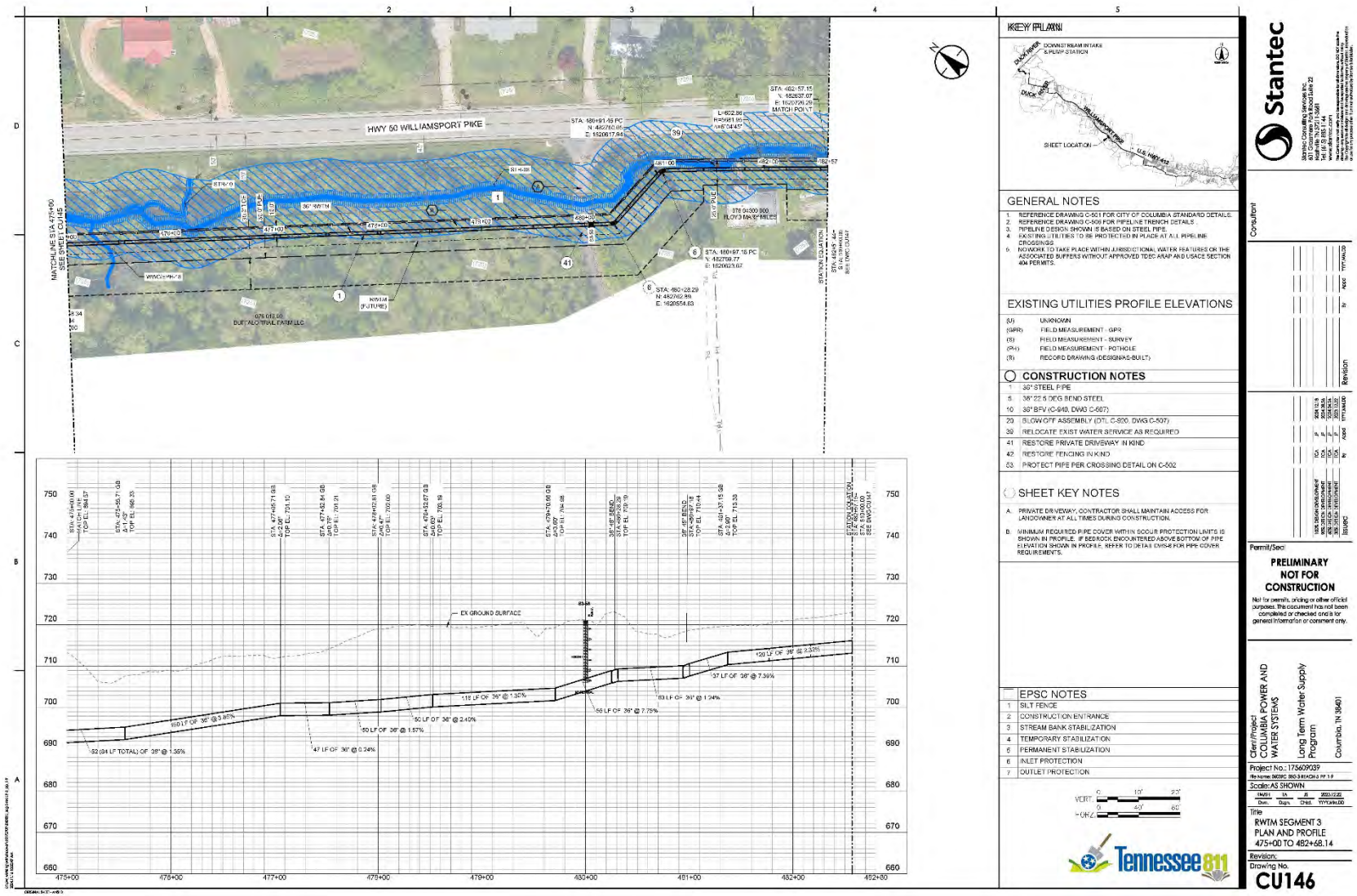
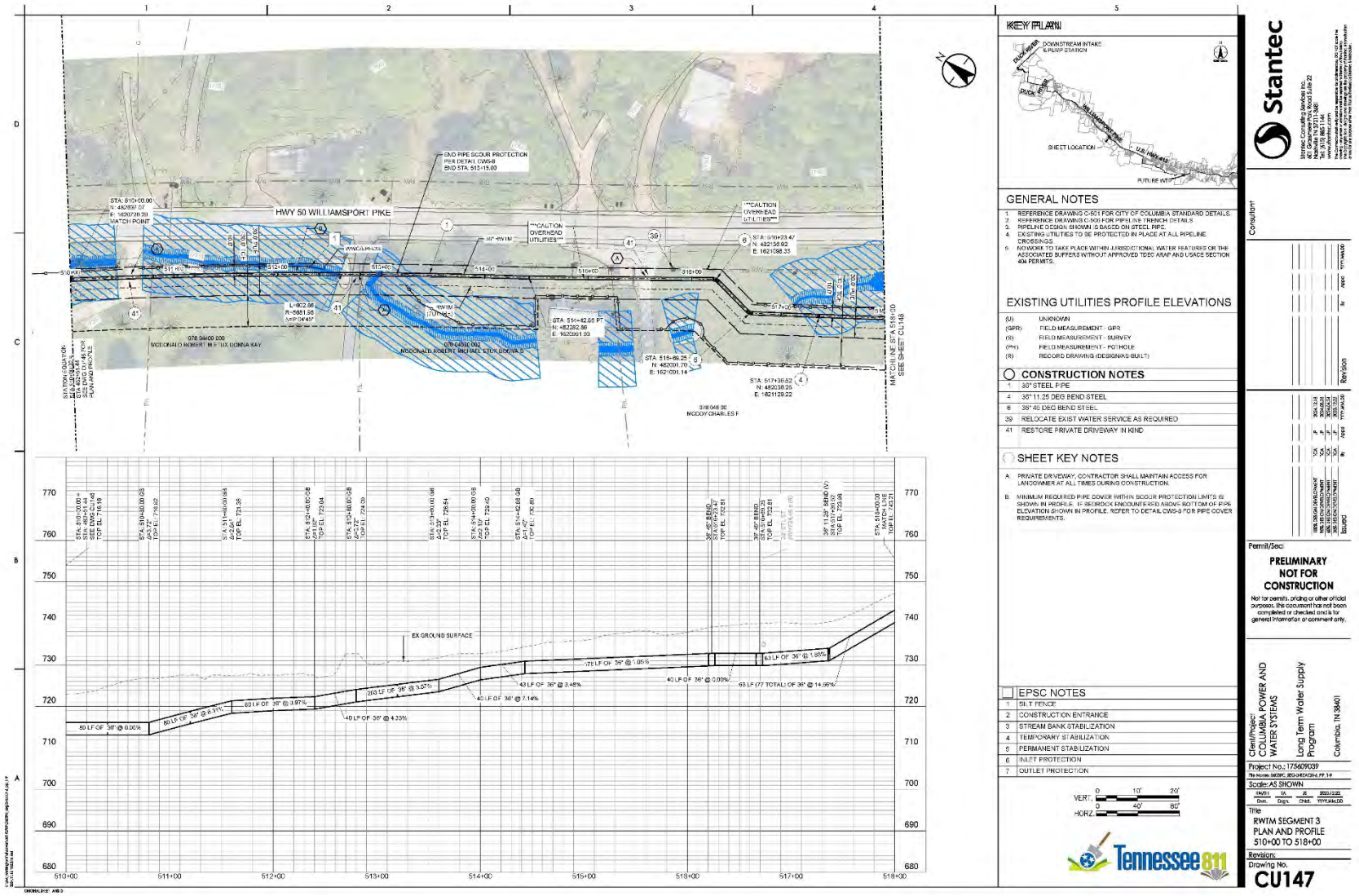
Client/Project
COLUMBIA POWER AND WATER SYSTEMS
Long Term Water Supply Program
Columbia, TN 38401
Project No.: 175609039
Scale: AS SHOWN
Title
RWTM SEGMENT 3
PLAN AND PROFILE
451+00 TO 459+00
Revision:
Drawing No.
CU143
Tennessee 811


HWY 50 WILLIAMSPORT PIKE
BEGIN PIPE SCOUR PROTECTION PER DETAIL CWS-8 BEGIN STA: 463+62.00
END PIPE SCOUR PROTECTION PER DETAIL CWS-8 END STA: 466+28.13
MATCHLINE STA 459+00 SEE SHEET CU143
MATCHLINE STA 467+00 SEE SHEET CU145
BUFFALO TRAIL FARM LLC
EX GROUND SURFACE
294 LF (REST TOTAL) OF 36" @ 1.80%
294 LF OF 36" @ 3.27%
82 LF OF 36" @ 1.94%
78 LF OF 36" @ 0.70%
18 LF (50 TOTAL) 36" @ 1.8%
KEY PLAN
DOWNSTREAM INTAKE & PUMP STATION
SHEET LOCATION
GENERAL NOTES
1. REFERENCE DRAWING C-501 FOR CITY OF COLUMBIA STANDARD DETAILS.
2. REFERENCE DRAWING C-505 FOR PIPELINE TRENCH DETAILS.
3. PIPELINE DESIGN SHOWN IS BASED ON STEEL PIPE.
4. EXISTING UTILITIES TO BE PROTECTED IN PLACE AT ALL PIPELINE CROSSINGS.
5. NO WORK TO TAKE PLACE WITHIN JURISDICTIONAL WATER FEATURES OR THE ASSOCIATED BUFFERS WITHOUT APPROVED TDEC ARAP AND USACE SECTION 404 PERMITS.
EXISTING UTILITIES PROFILE ELEVATIONS
(U) UNKNOWN
(GPR) FIELD MEASUREMENT - GPR
(S) FIELD MEASUREMENT - SURVEY
(PH) FIELD MEASUREMENT - POTHOLE
(R) RECORD DRAWING (DESIGN/AS-BUILT)
CONSTRUCTION NOTES
1 36" STEEL PIPE
4 36" 11.25 DEG BEND STEEL
5 36" 22.5 DEG BEND STEEL
53 PROTECT PIPE PER CROSSING DETAIL ON C-502
SHEET KEY NOTES
A MINIMUM REQUIRED PIPE COVER WITHIN SCOUR PROTECTION LIMITS IS SHOWN IN PROFILE. IF BEDROCK ENCOUNTERED ABOVE BOTTOM OF PIPE ELEVATION SHOWN IN PROFILE, REFER TO DETAIL CWS-8 FOR PIPE COVER REQUIREMENTS.
EPSC NOTES
1 SILT FENCE
2 CONSTRUCTION ENTRANCE
3 STREAM BANK STABILIZATION
4 TEMPORARY STABILIZATION
5 PERMANENT STABILIZATION
6 INLET PROTECTION
7 OUTLET PROTECTION
Stantec
Consultant
Permit/Seal
PRELIMINARY NOT FOR CONSTRUCTION
Not for permit, pricing or other official purposes. This document has not been completed or checked and is for general information or comment only.
Client/Project
COLUMBIA POWER AND WATER SYSTEMS
Long Term Water Supply Program
Columbia, TN 38401
Project No.: 175609039
Scale: AS SHOWN
Title
RWTM SEGMENT 3
PLAN AND PROFILE
459+00 TO 467+00
Revision:
Drawing No.
CU144
Tennessee 811


HWY 50 WILLIAMSPORT PIKE
MCBRIDE RD
36" RWTM
RWTM (FUTURE)
BUFFALO TRAIL FARM LLC
MATCH LINE STA 467+00 SEE SHEET CU144
MATCH LINE STA 475+00 SEE SHEET CU146
EX GROUND SURFACE
KEY PLAN
DOWNSTREAM INTAKE & PUMP STATION
SHEET LOCATION
GENERAL NOTES
1. REFERENCE DRAWING C-501 FOR CITY OF COLUMBIA STANDARD DETAILS.
2. REFERENCE DRAWING C-505 FOR PIPELINE TRENCH DETAILS.
3. PIPELINE DESIGN SHOWN IS BASED ON STEEL PIPE.
4. EXISTING UTILITIES TO BE PROTECTED IN PLACE AT ALL PIPELINE CROSSINGS.
5. NO WORK TO TAKE PLACE WITHIN JURISDICTIONAL WATER FEATURES OR THE ASSOCIATED BUFFERS WITHOUT APPROVED TDEC ARAP AND USACE SECTION 404 PERMITS.
EXISTING UTILITIES PROFILE ELEVATIONS
(U) UNKNOWN
(SPR) FIELD MEASUREMENT - GPR
(S) FIELD MEASUREMENT - SURVEY
(PH) FIELD MEASUREMENT - POTHOLE
(R) RECORD DRAWING (DESIGN/AS-BUILT)
CONSTRUCTION NOTES
1 36" STEEL PIPE
4 36" 11.25 DEG BEND STEEL
6 36" 45 DEG BEND STEEL
SHEET KEY NOTES
A MINIMUM REQUIRED PIPE COVER WITHIN SCOUR PROTECTION LIMITS IS SHOWN IN PROFILE. IF BEDROCK ENCOUNTERED ABOVE BOTTOM OF PIPE ELEVATION SHOWN IN PROFILE, REFER TO DETAIL CWS-8 FOR PIPE COVER REQUIREMENTS.
EPSC NOTES
1 SILT FENCE
2 CONSTRUCTION ENTRANCE
3 STREAM BANK STABILIZATION
4 TEMPORARY STABILIZATION
5 PERMANENT STABILIZATION
6 INLET PROTECTION
7 OUTLET PROTECTION
Stantec
Consultant
Revision
Issues
PRELIMINARY NOT FOR CONSTRUCTION
Not for permits, pricing or other official purposes. This document has not been completed or checked and is for general information or comment only.
Client/Project
COLUMBIA POWER AND WATER SYSTEMS
Long Term Water Supply Program
Columbia, TN 38401
Project No.: 175609039
Scale: AS SHOWN
Title
RWTM SEGMENT 3
PLAN AND PROFILE
467+00 TO 475+00
Revision:
Drawing No.
CU145
Tennessee 811


HWY 50 WILLIAMSPORT PIKE
EX GROUND SURFACE
KEY PLAN
GENERAL NOTES
EXISTING UTILITIES PROFILE ELEVATIONS
CONSTRUCTION NOTES
SHEET KEY NOTES
EPSC NOTES
Stantec
PRELIMINARY
NOT FOR
CONSTRUCTION
Tennessee 811
RWTM SEGMENT 3
PLAN AND PROFILE
475+00 TO 482+68.14
CU146


HWY 50 WILLIAMSPORT PIKE
END PIPE SCOUR PROTECTION
PER DETAIL CWS-8
END STA: 513+15.00
CAUTION OVERHEAD UTILITIES
EX GROUND SURFACE
KEY PLAN
GENERAL NOTES
1. REFERENCE DRAWING C-501 FOR CITY OF COLUMBIA STANDARD DETAILS.
2. REFERENCE DRAWING C-505 FOR PIPELINE TRENCH DETAILS
3. PIPELINE DESIGN SHOWN IS BASED ON STEEL PIPE.
4. EXISTING UTILITIES TO BE PROTECTED IN PLACE AT ALL PIPELINE CROSSINGS.
5. NO WORK TO TAKE PLACE WITHIN JURISDICTIONAL WATER FEATURES OR THE ASSOCIATED BUFFERS WITHOUT APPROVED TDEC ARAP AND USACE SECTION 404 PERMITS.
EXISTING UTILITIES PROFILE ELEVATIONS
(U) UNKNOWN
(GPR) FIELD MEASUREMENT - GPR
(S) FIELD MEASUREMENT - SURVEY
(PH) FIELD MEASUREMENT - POTHOLE
(R) RECORD DRAWING (DESIGN/AS-BUILT)
CONSTRUCTION NOTES
1 30" STEEL PIPE
4 30" 11.25 DEG BEND STEEL
6 30" 45 DEG BEND STEEL
39 RELOCATE EXIST WATER SERVICE AS REQUIRED
41 RESTORE PRIVATE DRIVEWAY IN KIND
SHEET KEY NOTES
A PRIVATE DRIVEWAY, CONTRACTOR SHALL MAINTAIN ACCESS FOR LANDOWNER AT ALL TIMES DURING CONSTRUCTION.
B MINIMUM REQUIRED PIPE DOVER WITHIN SCOUR PROTECTION LIMITS IS SHOWN IN PROFILE. IF BEDROCK ENCOUNTERED ABOVE BOTTOM OF PIPE ELEVATION SHOWN IN PROFILE, REFER TO DETAIL CWS-8 FOR PIPE COVER REQUIREMENTS.
EPSC NOTES
1 SILT FENCE
2 CONSTRUCTION ENTRANCE
3 STREAM BANK STABILIZATION
4 TEMPORARY STABILIZATION
5 PERMANENT STABILIZATION
6 INLET PROTECTION
7 OUTLET PROTECTION
Stantec
Consultant
Permit/Seal
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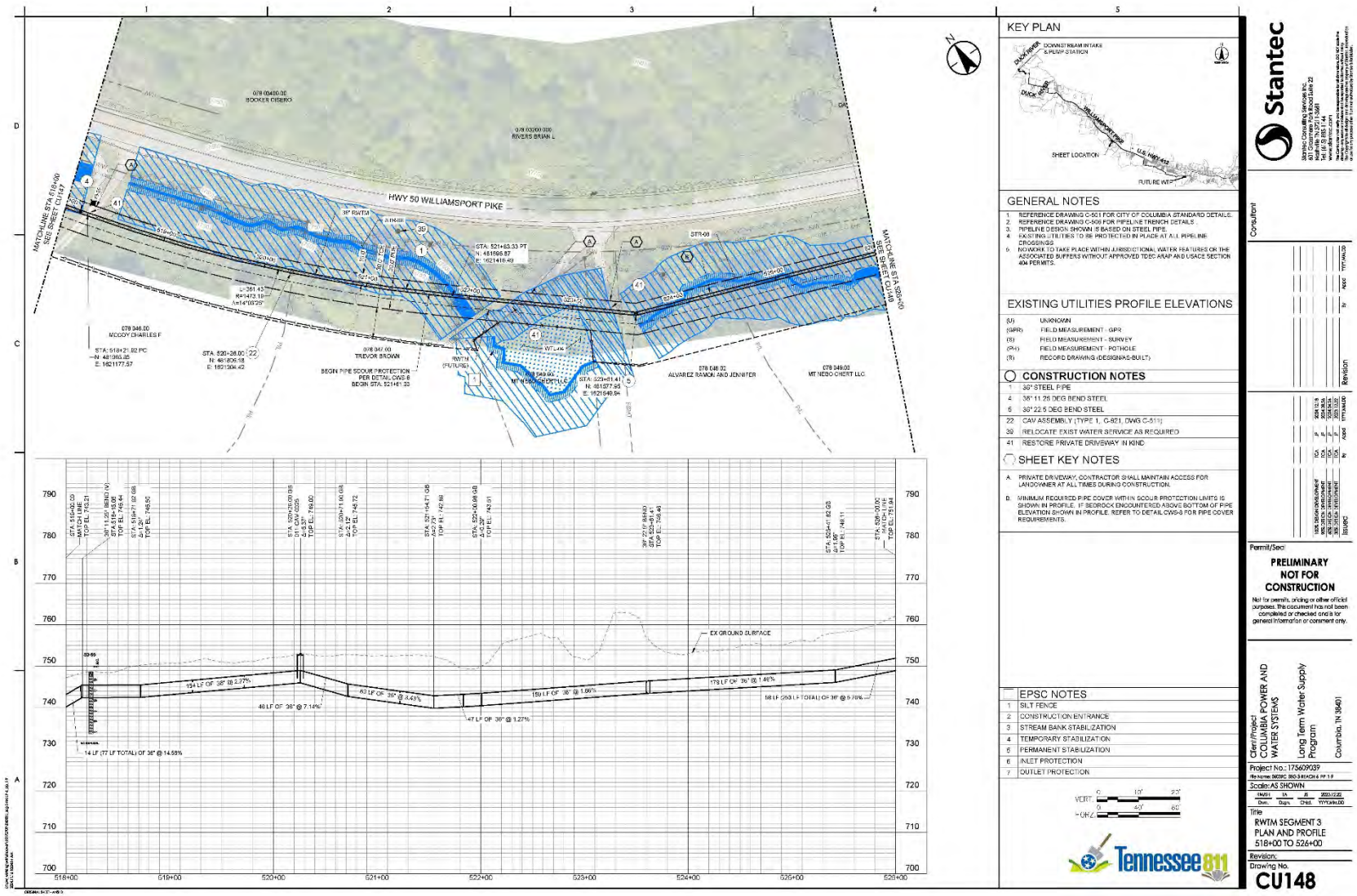
Client/Project
COLUMBIA POWER AND WATER SYSTEMS
Long Term Water Supply Program
Columbia, TN 38401
Project No.: 175609039
Scale: AS SHOWN
Title
RWTM SEGMENT 3
PLAN AND PROFILE
510+00 TO 518+00
Revision:
Drawing No.
CU147
Tennessee 811



KEY PLAN

GENERAL NOTES

1. REFERENCE DRAWING C-501 FOR CITY OF COLUMBIA STANDARD DETAILS.
2. REFERENCE DRAWING C-506 FOR PIPELINE TRENCH DETAILS.
3. PIPELINE DESIGN SHOWN IS BASED ON STEEL PIPE.
4. EXISTING UTILITIES TO BE PROTECTED IN PLACE AT ALL PIPELINE CROSSINGS.
5. NO WORK TO TAKE PLACE WITHIN JURISDICTIONAL WATER FEATURES OR THE ASSOCIATED BUFFERS WITHOUT APPROVED TDEC ARAP AND USACE SECTION 404 PERMITS.

EXISTING UTILITIES PROFILE ELEVATIONS

(U)	UNKNOWN
(GPR)	FIELD MEASUREMENT - GPR
(S)	FIELD MEASUREMENT - SURVEY
(PH)	FIELD MEASUREMENT - POTHOLE
(R)	RECORD DRAWING (DESIGN/AS-BUILT)

CONSTRUCTION NOTES

1	30" STEEL PIPE
4	36" 11.25 DEG BEND STEEL
5	30" 22.5 DEG BEND STEEL
22	CAV ASSEMBLY (TYPE 1, C-821, DWG C-511)
39	RELOCATE EXIST WATER SERVICE AS REQUIRED
41	RESTORE PRIVATE DRIVEWAY IN KIND

SHEET KEY NOTES

A. PRIVATE DRIVEWAY, CONTRACTOR SHALL MAINTAIN ACCESS FOR LANDOWNER AT ALL TIMES DURING CONSTRUCTION.

B. MINIMUM REQUIRED PIPE COVER WITHIN SCOUR PROTECTION LIMITS IS SHOWN IN PROFILE. IF BEDROCK ENCOUNTERED ABOVE BOTTOM OF PIPE ELEVATION SHOWN IN PROFILE, REFER TO DETAIL CWS-8 FOR PIPE COVER REQUIREMENTS.

EPSC NOTES

1	SILT FENCE
2	CONSTRUCTION ENTRANCE
3	STREAM BANK STABILIZATION
4	TEMPORARY STABILIZATION
5	PERMANENT STABILIZATION
6	INLET PROTECTION
7	OUTLET PROTECTION

VERT. 0 10' 20'
HORZ. 0 40' 80'

Tennessee 811

Stantec

Consultant

Issues	By	Appd	YYYY.MM.DD
30% DESIGN SUBMITTAL	TCA	JS	2024.12.16
60% DESIGN SUBMITTAL	TCA	JS	2025.04.25
90% DESIGN SUBMITTAL	TCA	JS	2025.06.20
100% DESIGN SUBMITTAL	TCA	JS	2025.08.15
PERMIT SUBMITTAL	TCA	JS	2025.12.22

Revision

Permit/Seal

PRELIMINARY NOT FOR CONSTRUCTION

Not for permits, pricing or other official purposes. This document has not been completed or checked and is for general information or comment only.

Client/Project
COLUMBIA POWER AND WATER SYSTEMS
Long Term Water Supply Program
Columbia, TN 38401

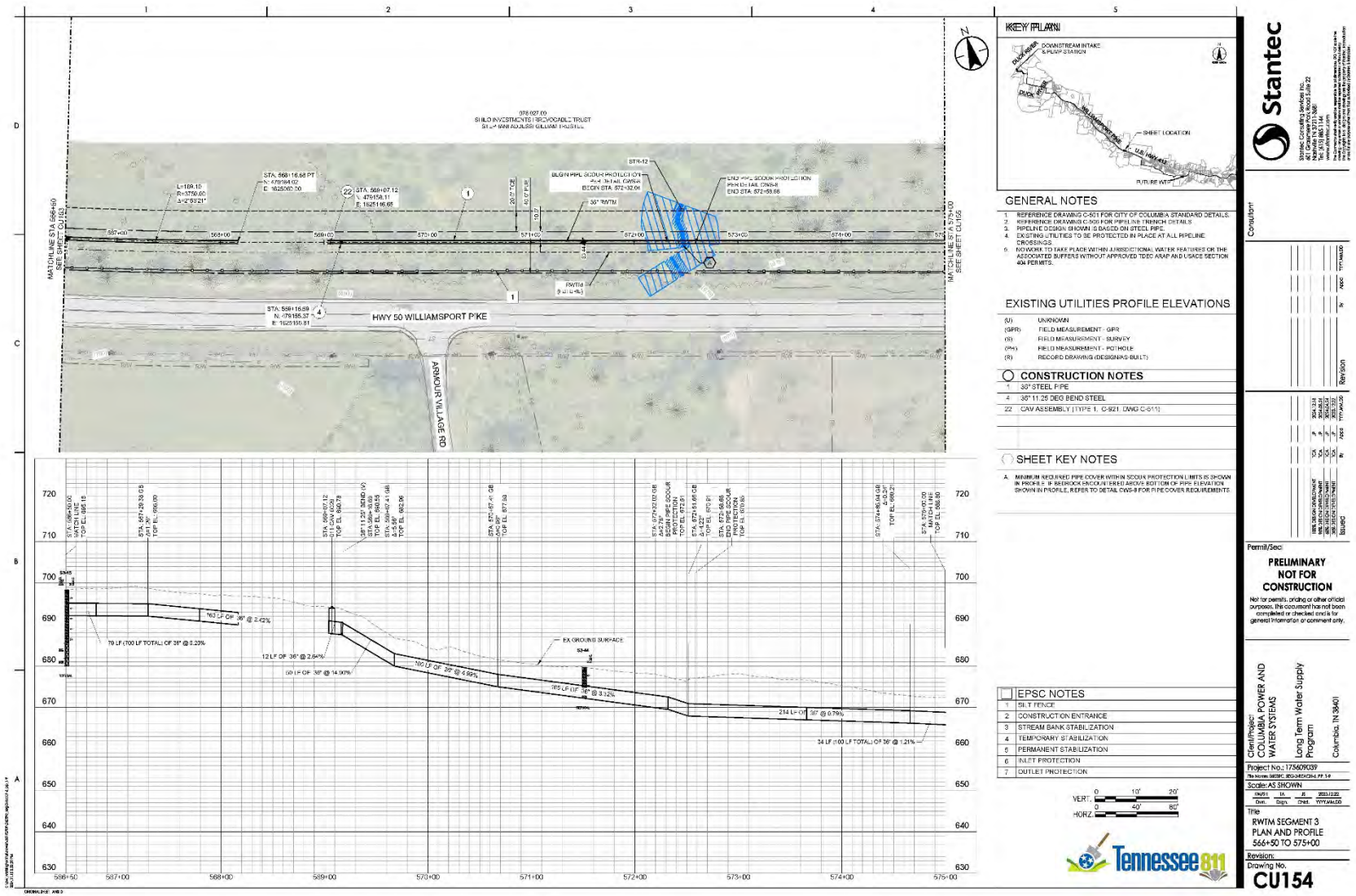
Project No.: 175609039
File Name: 5029C BIG SWEETWATER CREEK PP 1.0
Scale: AS SHOWN

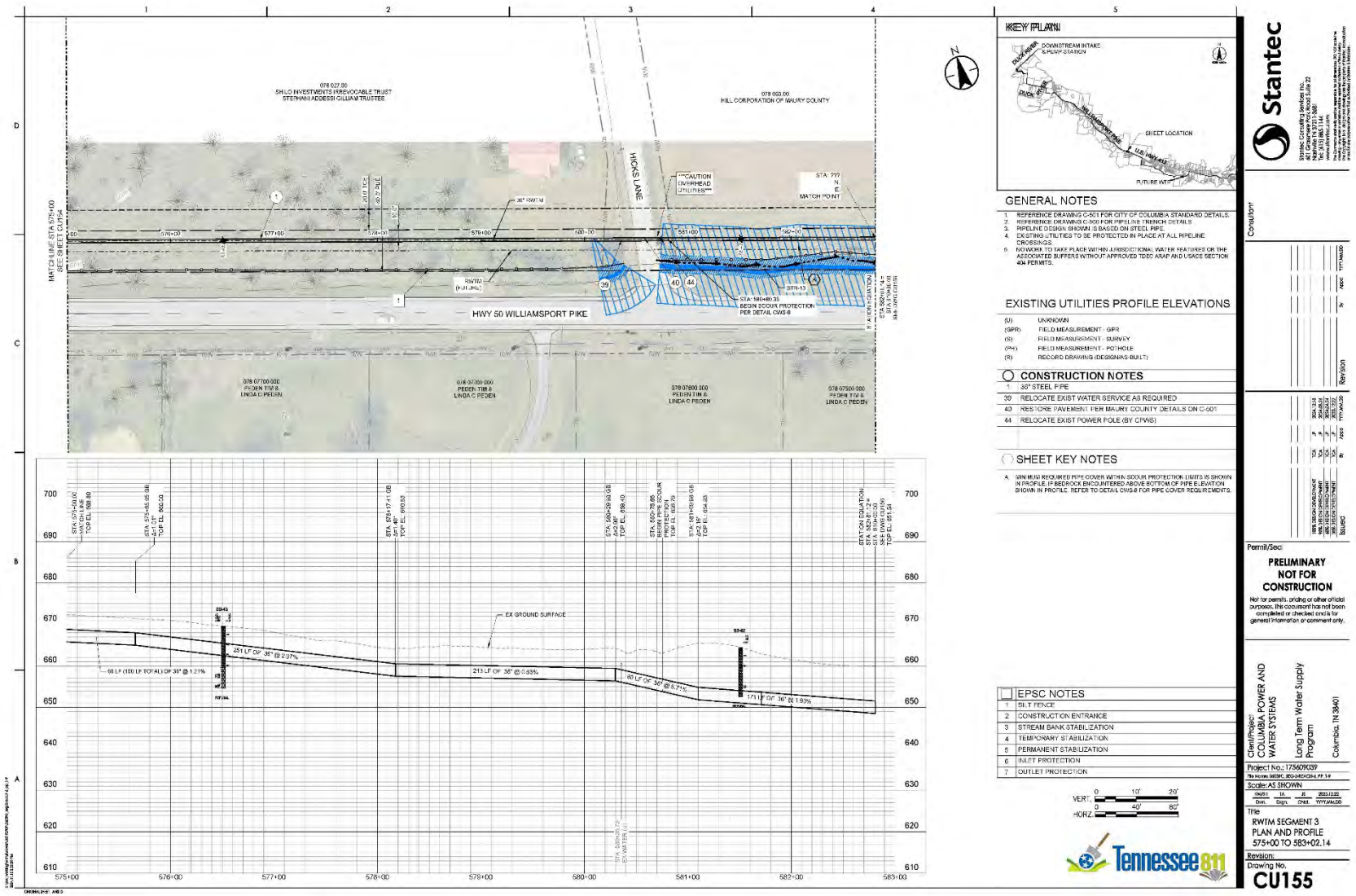
DM/DI	TA	JS	2025.12.22
Des.	Dsgn.	Chkd.	YYYY.MM.DD

Title
RWTM SEGMENT 3
PLAN AND PROFILE
518+00 TO 526+00

Revision

Drawing No.
CU148


KEY PLAN
GENERAL NOTES
EXISTING UTILITIES PROFILE ELEVATIONS
CONSTRUCTION NOTES
SHEET KEY NOTES
EPSC NOTES
HWY 50 WILLIAMSPORT PIKE
ARMOUR VILLAGE RD
EX GROUND SURFACE
Stantec
PRELIMINARY
NOT FOR
CONSTRUCTION
Client/Project
COLUMBIA POWER AND WATER SYSTEMS
Long Term Water Supply Program
Columbia, TN 38401
Project No.: 175609039
Scale: AS SHOWN
Title
RWTM SEGMENT 3
PLAN AND PROFILE
566+50 TO 575+00
Revision:
Drawing No.
CU154
Tennessee 811



KEY PLAN

GENERAL NOTES

1. REFERENCE DRAWING C-501 FOR CITY OF COLUMBIA STANDARD DETAILS.
2. REFERENCE DRAWING C-505 FOR PIPELINE TRENCH DETAILS
3. PIPELINE DESIGN SHOWN IS BASED ON STEEL PIPE.
4. EXISTING UTILITIES TO BE PROTECTED IN PLACE AT ALL PIPELINE CROSSINGS.
5. NO WORK TO TAKE PLACE WITHIN JURISDICTIONAL WATER FEATURES OR THE ASSOCIATED BUFFERS WITHOUT APPROVED TDEC ARAP AND USACE SECTION 404 PERMITS.

EXISTING UTILITIES PROFILE ELEVATIONS

(U)	UNKNOWN
(GPR)	FIELD MEASUREMENT - GPR
(S)	FIELD MEASUREMENT - SURVEY
(PH)	FIELD MEASUREMENT - POTHOLE
(R)	RECORD DRAWING (DESIGN/AS-BUILT)

CONSTRUCTION NOTES

1	30" STEEL PIPE
39	RELOCATE EXIST WATER SERVICE AS REQUIRED
40	RESTORE PAVEMENT PER MAURY COUNTY DETAILS ON C-501
44	RELOCATE EXIST POWER POLE (BY CPWS)

SHEET KEY NOTES

A. RIPRAP MUST REQUIRED PIPE COVER WITHIN SCOUR PROTECTION LIMITS AS SHOWN IN PROFILE. IF BEDROCK ENCOUNTERED ABOVE BOTTOM OF PIPE ELEVATION SHOWN IN PROFILE, REFER TO DETAIL CWS-8 FOR PIPE COVER REQUIREMENTS.

EPSC NOTES

1	SILT FENCE
2	CONSTRUCTION ENTRANCE
3	STREAM BANK STABILIZATION
4	TEMPORARY STABILIZATION
5	PERMANENT STABILIZATION
6	INLET PROTECTION
7	OUTLET PROTECTION

VERT. 0 10' 20'
HORZ. 0 40' 80'

Tennessee 811

Stantec
Consultant

Rev	Date	By	Description
1	3/24/2023	JP	ADDED TYP WALLS
A	3/24/2023	JP	ADDED TYP WALLS
B	5/24/2023	TCK	ADDED TYP WALLS

Permit/Seal

PRELIMINARY NOT FOR CONSTRUCTION

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Client/Project: COLUMBIA POWER AND WATER SYSTEMS — Long Term Water Supply Program — Columbia, TN 38401

Project No.: 175609039

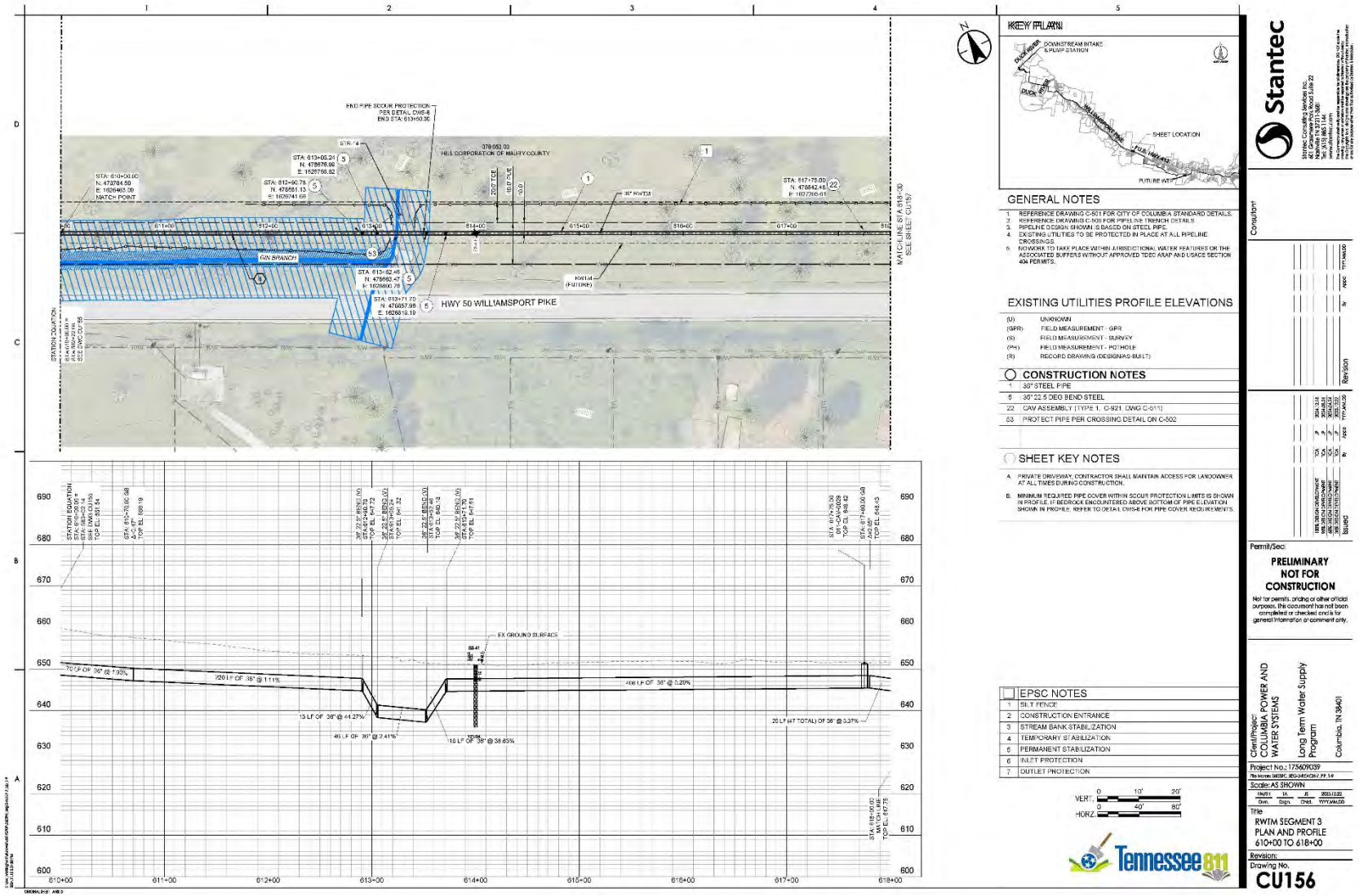
Scale: AS SHOWN

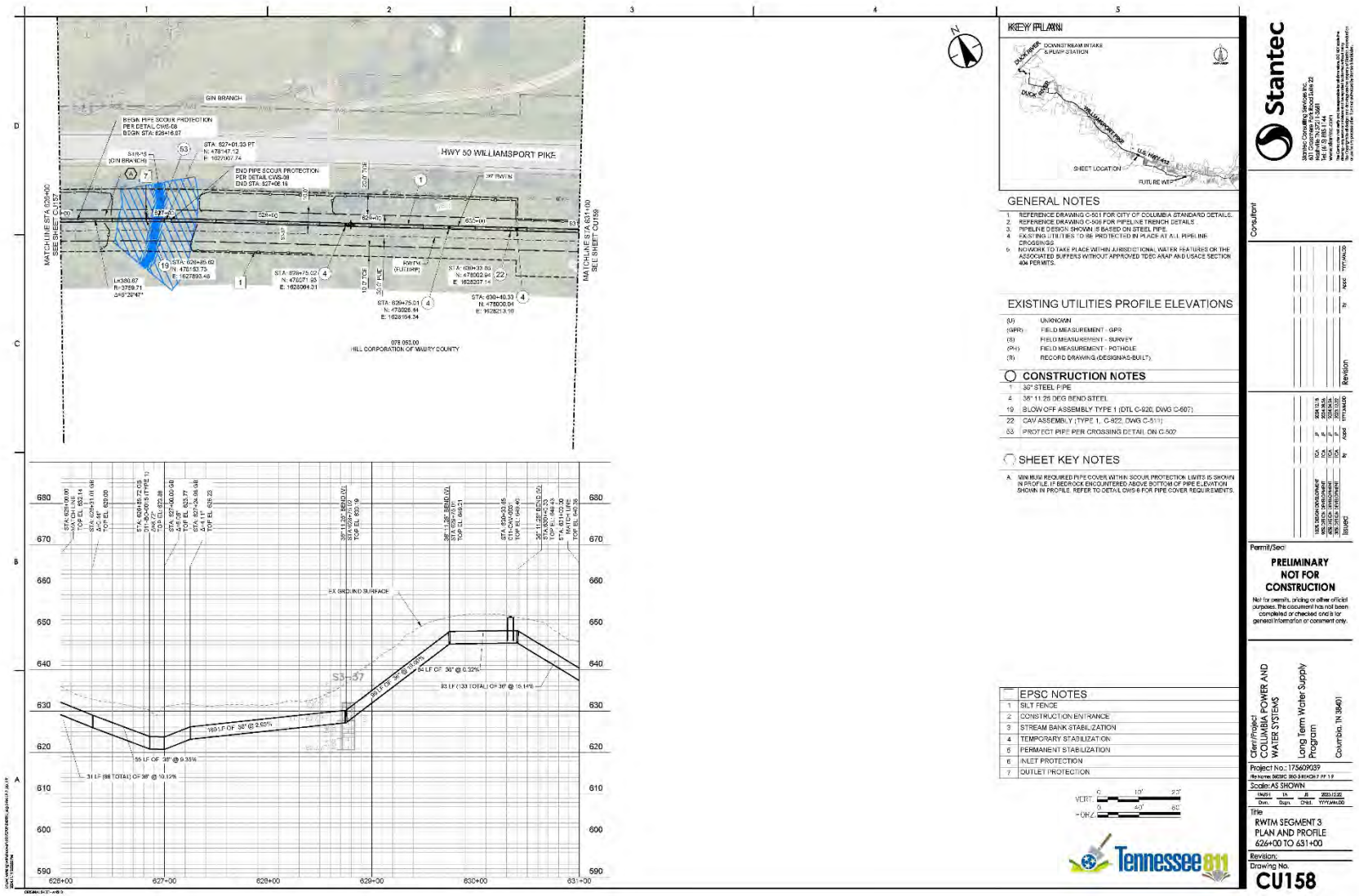
DM/SS	IA	JR	2023.12.22
Dsn.	Dsgn.	Chkd.	YYYY.MM.DD

Title: RWTM SEGMENT 3 PLAN AND PROFILE 575+00 TO 583+02.14

Revision:

Drawing No.: **CU155**


KEY PLAN
GENERAL NOTES
EXISTING UTILITIES PROFILE ELEVATIONS
CONSTRUCTION NOTES
SHEET KEY NOTES
EPSC NOTES
HWY 50 WILLIAMSPORT PIKE
GIN BRANCH
EX GROUND SURFACE
Stantec
PRELIMINARY
NOT FOR
CONSTRUCTION
Tennessee811
RWTM SEGMENT 3
PLAN AND PROFILE
610+00 TO 618+00
CU156



KEY PLAN

GENERAL NOTES

1. REFERENCE DRAWING C-501 FOR CITY OF COLUMBIA STANDARD DETAILS.
2. REFERENCE DRAWING C-505 FOR PIPELINE TRENCH DETAILS.
3. PIPELINE DESIGN SHOWN IS BASED ON STEEL PIPE.
4. EXISTING UTILITIES TO BE PROTECTED IN PLACE AT ALL PIPELINE CROSSINGS.
5. NO WORK TO TAKE PLACE WITHIN JURISDICTIONAL WATER FEATURES OR THE ASSOCIATED BUFFERS WITHOUT APPROVED TDEC ARAP AND USACE SECTION 404 PERMITS.

EXISTING UTILITIES PROFILE ELEVATIONS

(U)	UNKNOWN
(GPR)	FIELD MEASUREMENT - GPR
(S)	FIELD MEASUREMENT - SURVEY
(PH)	FIELD MEASUREMENT - POTHOLE
(R)	RECORD DRAWING/DESIGN(AS-BUILT)

CONSTRUCTION NOTES

1	30" STEEL PIPE
4	36" 11.25 DEG BEND STEEL
19	BLOW OFF ASSEMBLY TYPE 1 (DTL C-920, DWG C-507)
22	CAV ASSEMBLY (TYPE 1, C-922, DWG C-511)
53	PROTECT PIPE PER CROSSING DETAIL ON C-502

SHEET KEY NOTES

A. MINIMUM REQUIRED PIPE COVER WITHIN SCOUR PROTECTION LIMITS IS SHOWN IN PROFILE. IF BEDROCK ENCOUNTERED ABOVE BOTTOM OF PIPE ELEVATION SHOWN IN PROFILE, REFER TO DETAIL CWS-8 FOR PIPE COVER REQUIREMENTS.

EPSC NOTES

1	SILT FENCE
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6	INLET PROTECTION
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VERT. 0 10' 20'
HORZ. 0 40' 80'

Tennessee 811

Stantec

Consultant

Revision	By	Appd	YYYY.MM.DD
ISSUED FOR CONSTRUCTION	TCA	TCA	2024.12.06
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ISSUED FOR CONSTRUCTION	JF	JF	2023.12.22
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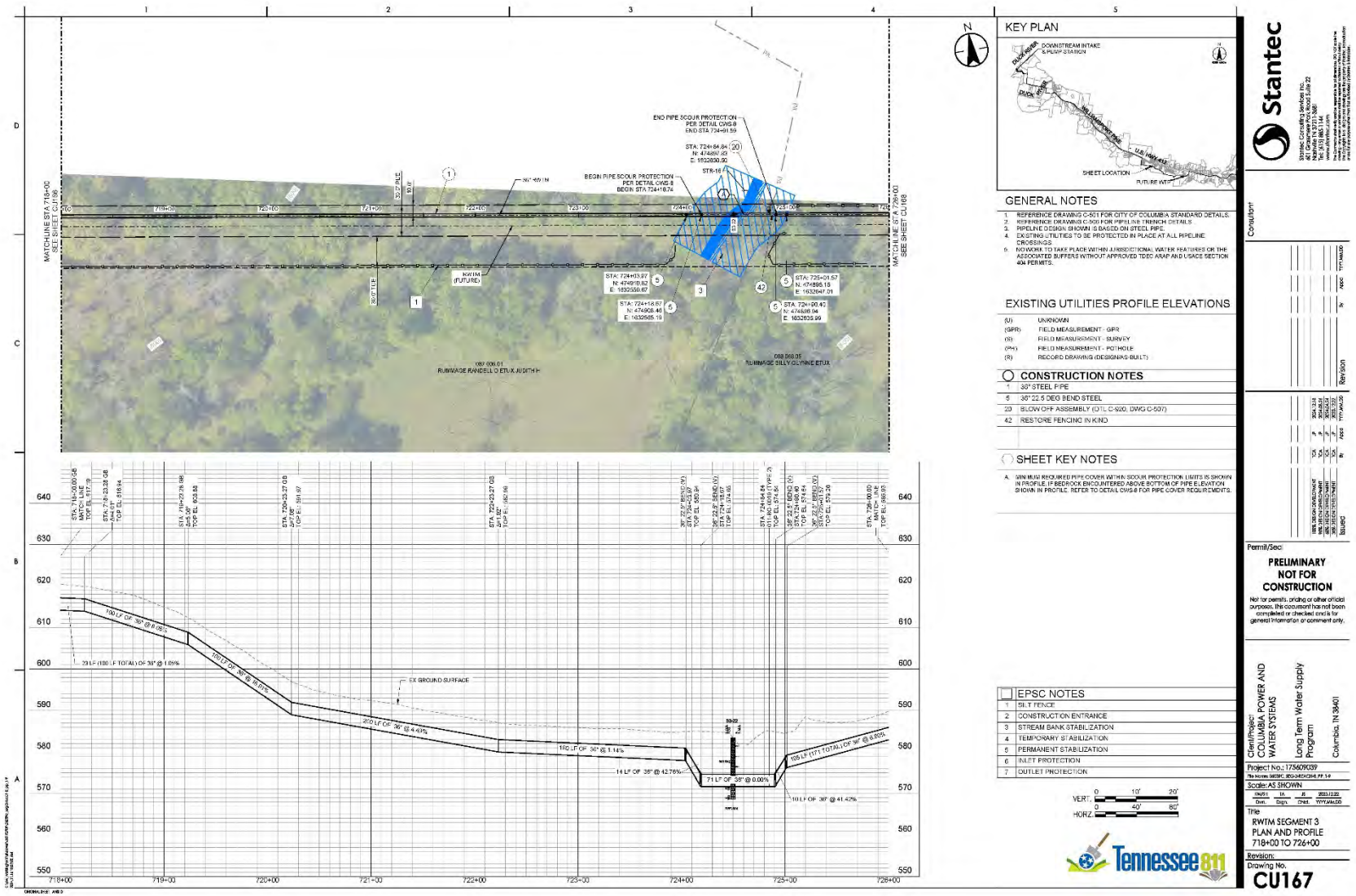
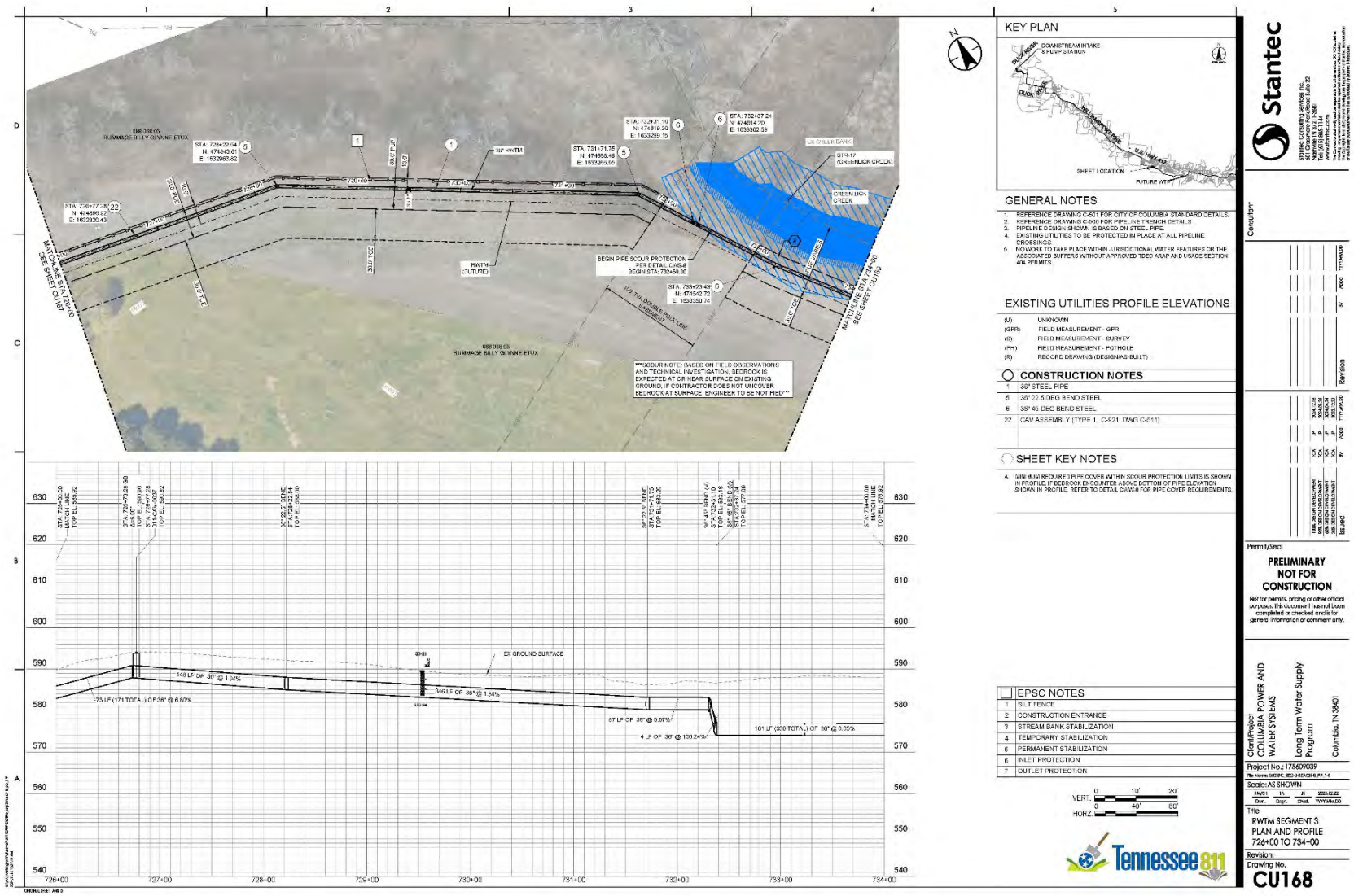
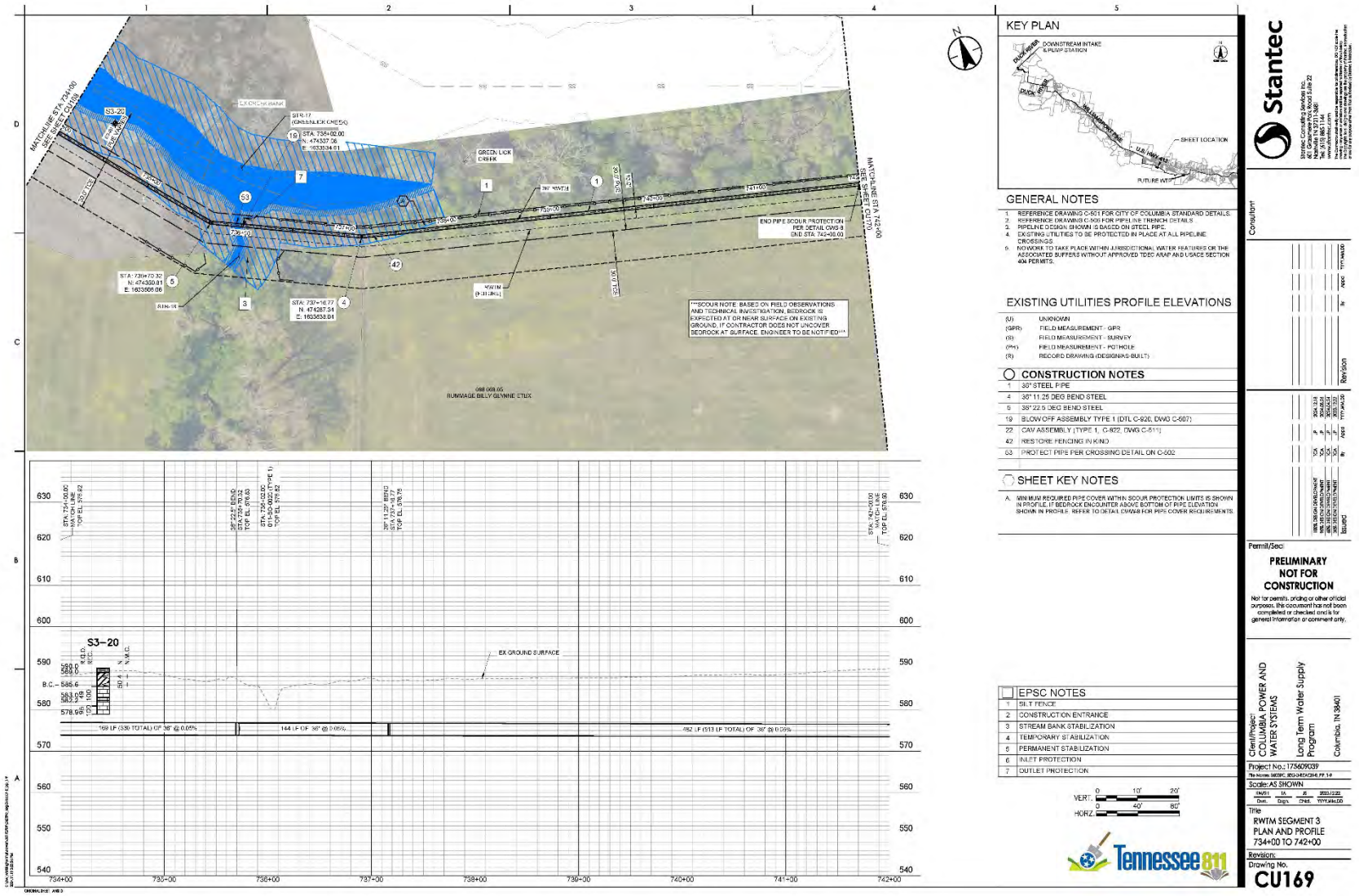
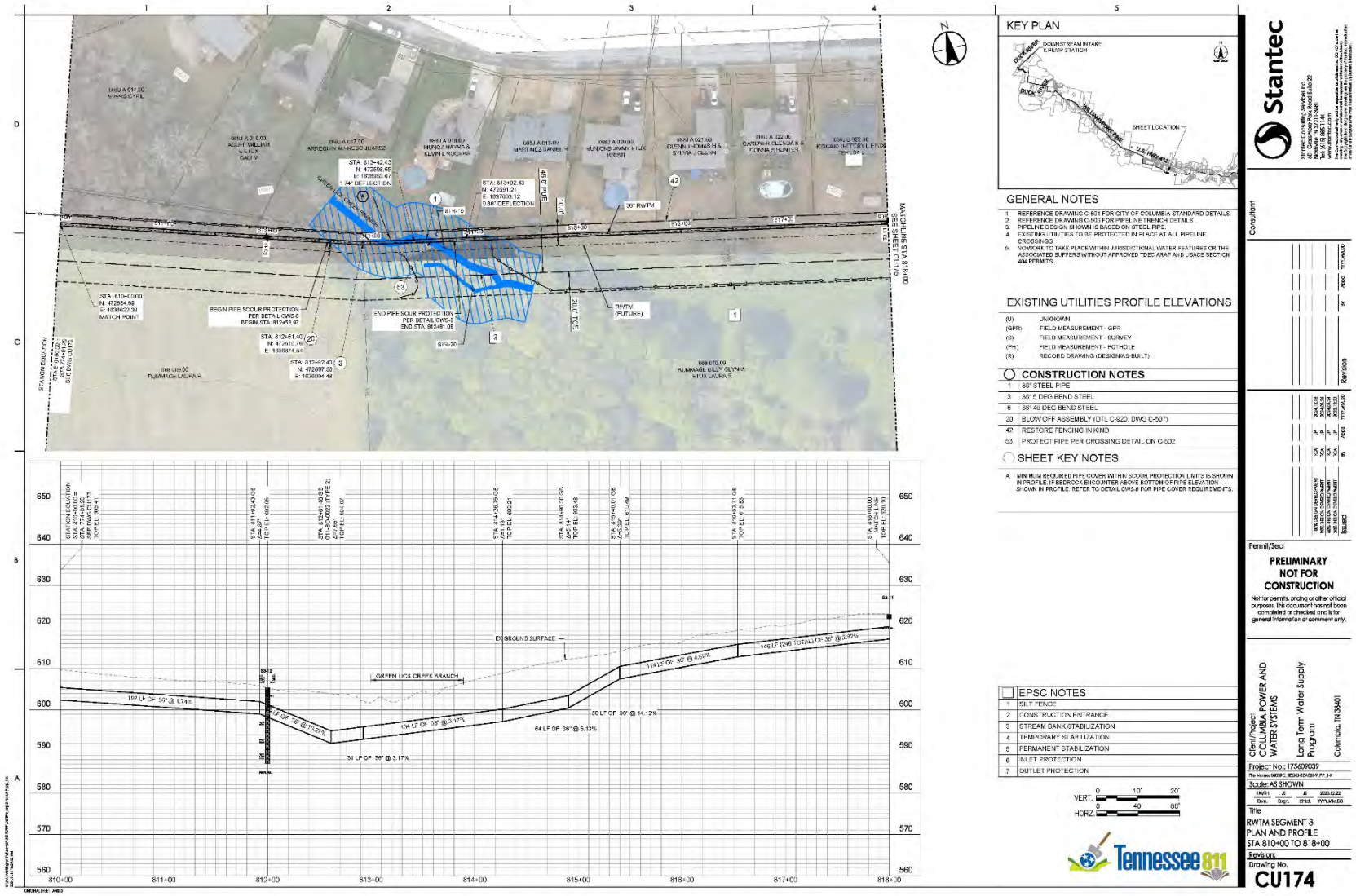
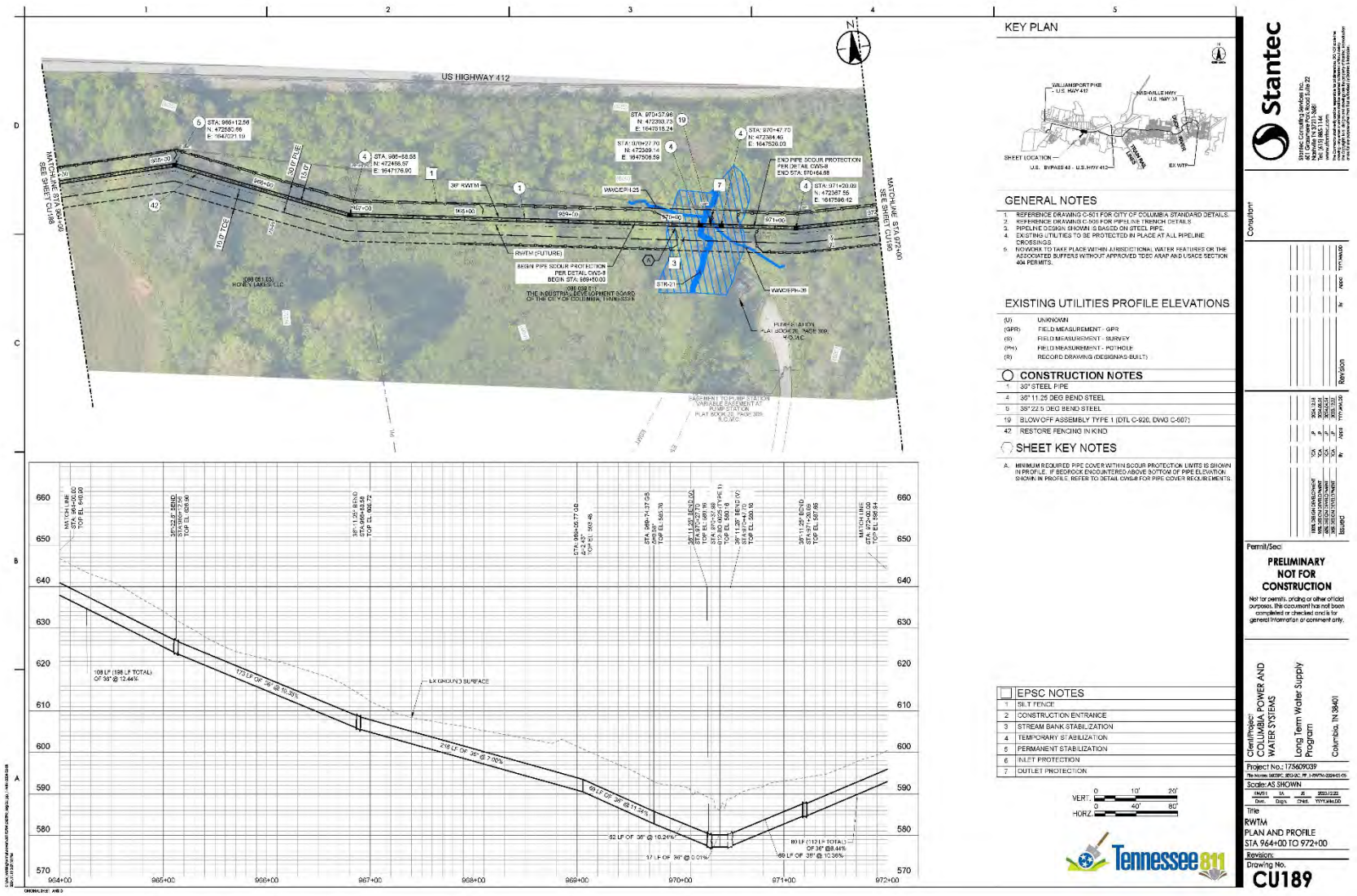

KEY PLAN
GENERAL NOTES
1. REFERENCE DRAWING C-501 FOR CITY OF COLUMBIA STANDARD DETAILS.
2. REFERENCE DRAWING C-505 FOR PIPELINE TRENCH DETAILS
3. PIPELINE DESIGN SHOWN IS BASED ON STEEL PIPE.
4. EXISTING UTILITIES TO BE PROTECTED IN PLACE AT ALL PIPELINE CROSSINGS.
5. NO WORK TO TAKE PLACE WITHIN JURISDICTIONAL WATER FEATURES OR THE ASSOCIATED BUFFERS WITHOUT APPROVED TDEC ARAP AND USACE SECTION 404 PERMITS.
EXISTING UTILITIES PROFILE ELEVATIONS
(U) UNKNOWN
(GPR) FIELD MEASUREMENT - GPR
(S) FIELD MEASUREMENT - SURVEY
(PH) FIELD MEASUREMENT - POTHOLE
(R) RECORD DRAWING (DESIGN/AS-BUILT)
CONSTRUCTION NOTES
1 30" STEEL PIPE
5 30" 22.5 DEG BEND STEEL
20 BLOW OFF ASSEMBLY (DTL C-520, DWG C-507)
42 RESTORE FENCING IN KIND
SHEET KEY NOTES
A MINIMUM REQUIRED PIPE COVER WITHIN SCOUR PROTECTION LIMITS IS SHOWN IN PROFILE. IF BEDROCK ENCOUNTERED ABOVE BOTTOM OF PIPE ELEVATION SHOWN IN PROFILE, REFER TO DETAIL CWS-8 FOR PIPE COVER REQUIREMENTS.
EPSC NOTES
1 SILT FENCE
2 CONSTRUCTION ENTRANCE
3 STREAM BANK STABILIZATION
4 TEMPORARY STABILIZATION
5 PERMANENT STABILIZATION
6 INLET PROTECTION
7 OUTLET PROTECTION
Stantec
Consultant
Revision
Permit/Seal
PRELIMINARY
NOT FOR CONSTRUCTION
Client/Project
COLUMBIA POWER AND WATER SYSTEMS
Long Term Water Supply Program
Columbia, TN 38401
Project No.: 175609039
Scale: AS SHOWN
Title
RWTM SEGMENT 3
PLAN AND PROFILE
718+00 TO 726+00
Revision:
Drawing No.
CU167
Tennessee 811


KEY PLAN
GENERAL NOTES
EXISTING UTILITIES PROFILE ELEVATIONS
CONSTRUCTION NOTES
SHEET KEY NOTES
EPSC NOTES
Stantec
PRELIMINARY
NOT FOR
CONSTRUCTION
Client/Project:
COLUMBIA POWER AND WATER SYSTEMS
Long Term Water Supply Program
Columbia, TN 38401
Project No.: 175609039
Scale: AS SHOWN
Title
RWTM SEGMENT 3
PLAN AND PROFILE
726+00 TO 734+00
Revision:
Drawing No.
CU168
Tennessee 811


KEY PLAN
GENERAL NOTES
EXISTING UTILITIES PROFILE ELEVATIONS
CONSTRUCTION NOTES
SHEET KEY NOTES
EPSC NOTES
S3-20
EX GROUND SURFACE
Stantec
PRELIMINARY
NOT FOR
CONSTRUCTION
Project No.: 175609039
Scale: AS SHOWN
RWTM SEGMENT 3
PLAN AND PROFILE
734+00 TO 742+00
Drawing No.
CU169


KEY PLAN
GENERAL NOTES
1. REFERENCE DRAWING C-501 FOR CITY OF COLUMBIA STANDARD DETAILS.
2. REFERENCE DRAWING C-505 FOR PIPELINE TRENCH DETAILS
3. PIPELINE DESIGN SHOWN IS BASED ON STEEL PIPE.
4. EXISTING UTILITIES TO BE PROTECTED IN PLACE AT ALL PIPELINE CROSSINGS.
5. NO WORK TO TAKE PLACE WITHIN JURISDICTIONAL WATER FEATURES OR THE ASSOCIATED BUFFERS WITHOUT APPROVED TDEC ARAP AND USACE SECTION 404 PERMITS.
EXISTING UTILITIES PROFILE ELEVATIONS
(U) UNKNOWN
(GPR) FIELD MEASUREMENT - GPR
(S) FIELD MEASUREMENT - SURVEY
(PH) FIELD MEASUREMENT - POTHOLE
(R) RECORD DRAWING (DESIGNAS-BUILT)
CONSTRUCTION NOTES
1 30" STEEL PIPE
3 30" 6 DEG BEND STEEL
5 30" 45 DEG BEND STEEL
20 BLOW OFF ASSEMBLY (OTL C-920; DWG C-507)
42 RESTORE FENCING IN KIND
53 PROTECT PIPE PER CROSSING DETAIL ON C-502
SHEET KEY NOTES
A. MIN MUSI REQUIRED PIPE COVER WITHIN SCOUR PROTECTION LIMITS IS SHOWN IN PROFILE. IF BEDROCK ENCOUNTER ABOVE BOTTOM OF PIPE ELEVATION SHOWN IN PROFILE, REFER TO DETAIL DWG-8 FOR PIPE COVER REQUIREMENTS.
EPSC NOTES
1 SILT FENCE
2 CONSTRUCTION ENTRANCE
3 STREAM BANK STABILIZATION
4 TEMPORARY STABILIZATION
5 PERMANENT STABILIZATION
6 INLET PROTECTION
7 OUTLET PROTECTION
EX GROUND SURFACE
GREEN LICK CREEK BRANCH
Stantec
Consultant
PRELIMINARY
NOT FOR
CONSTRUCTION
Client/Project
COLUMBIA POWER AND WATER SYSTEMS
Long Term Water Supply Program
Columbia, TN 38401
Project No.: 175609039
Scale: AS SHOWN
Title
RWTM SEGMENT 3
PLAN AND PROFILE
STA 810+00 TO 818+00
Revision:
Drawing No.
CU174
Tennessee 811



KEY PLAN

GENERAL NOTES

1. REFERENCE DRAWING C-501 FOR CITY OF COLUMBIA STANDARD DETAILS.
2. REFERENCE DRAWING C-505 FOR PIPELINE TRENCH DETAILS
3. PIPELINE DESIGN SHOWN IS BASED ON STEEL PIPE.
4. EXISTING UTILITIES TO BE PROTECTED IN PLACE AT ALL PIPELINE CROSSINGS.
5. NO WORK TO TAKE PLACE WITHIN JURISDICTIONAL WATER FEATURES OR THE ASSOCIATED BUFFERS WITHOUT APPROVED TDEC ARAP AND USACE SECTION 404 PERMITS.

EXISTING UTILITIES PROFILE ELEVATIONS

(U)	UNKNOWN
(GPR)	FIELD MEASUREMENT - GPR
(S)	FIELD MEASUREMENT - SURVEY
(PH)	FIELD MEASUREMENT - POTHOLE
(R)	RECORD DRAWING (DESIGN/AS-BUILT)

CONSTRUCTION NOTES

1	36" STEEL PIPE
4	36" 11.25 DEG BEND STEEL
5	36" 22.5 DEG BEND STEEL
19	BLOW OFF ASSEMBLY TYPE 1 (DTL C-920, DWG C-607)
42	RESTORE FENCING IN KIND

SHEET KEY NOTES

A. MINIMUM REQUIRED PIPE COVER WITHIN SCOUR PROTECTION LIMITS IS SHOWN IN PROFILE. IF BEDROCK ENCOUNTERED ABOVE BOTTOM OF PIPE ELEVATION SHOWN IN PROFILE, REFER TO DETAIL CW5-9 FOR PIPE COVER REQUIREMENTS.

EPSC NOTES

1	SILT FENCE
2	CONSTRUCTION ENTRANCE
3	STREAM BANK STABILIZATION
4	TEMPORARY STABILIZATION
5	PERMANENT STABILIZATION
6	INLET PROTECTION
7	OUTLET PROTECTION

VERT. 0 10' 20'
HORZ. 0 40' 80'

Tennessee 811

Stantec
Stantec Consulting Services Inc
401 Commerce Street, Suite 222
Nashville TN 37219-3681
Tel: (615) 255-1651
www.stantec.com

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Consultant

Revision	By	Appd	YYYY.MM.DD
Issued			
1RA SIGN DRAWDOWN	TCA	JR	2021.12.22
1RA SIGN DRAWDOWN	TCA	JR	2021.12.22
40% SIGN DRAWDOWN	TCA	JR	2021.12.22
90% SIGN DRAWDOWN	TCA	JR	2022.03.25
Issued	By	Appd	YYYY.MM.DD

Permit/Seal

PRELIMINARY NOT FOR CONSTRUCTION

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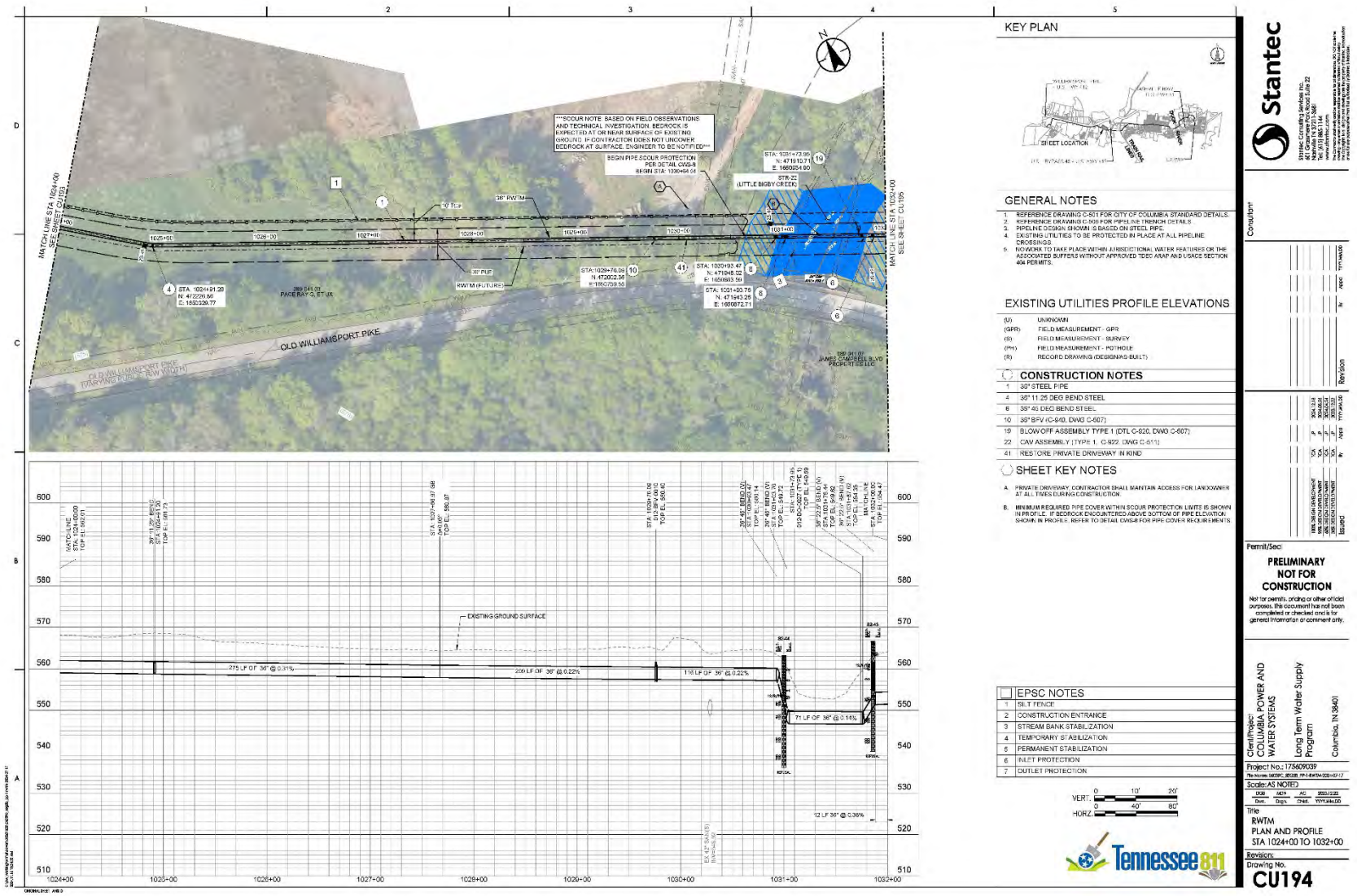
Client/Project
COLUMBIA POWER AND WATER SYSTEMS
Long Term Water Supply Program
Columbia, TN 38401

Project No.: 175609039
File Name: 985RC_RPT-RWTM-2024-03-05
Scale: AS SHOWN

DM/SS	IA	JR	2021/12/22
Dsn.	Dsgn.	Chkd.	YYYY.MM.DD

Title
RWTM
PLAN AND PROFILE
STA 964+00 TO 972+00

Revision:
Drawing No.
CU189


SCOUR NOTE: BASED ON FIELD OBSERVATIONS AND TECHNICAL INVESTIGATION, BEDROCK IS EXPECTED AT OR NEAR SURFACE OF EXISTING GROUND. IF CONTRACTOR DOES NOT UNCOVER BEDROCK AT SURFACE, ENGINEER TO BE NOTIFIED
BEGIN PIPE SCOUR PROTECTION PER DETAIL CWG-8
BEGIN STA: 1030+94.04
STR 22 (LITTLE BIGBY CREEK)
MATCH LINE STA 1024+00 SEE SHEET CU193
MATCH LINE STA 1032+00 SEE SHEET CU195
OLD WILLIAMSPORT PIKE
JAMES CAMPBELL BLVD PROPERTIES LLC
EXISTING GROUND SURFACE
275 LF OF 36" @ 0.31%
209 LF OF 36" @ 0.22%
116 LF OF 36" @ 0.22%
71 LF OF 36" @ 0.14%
12 LF 36" @ 0.38%
KEY PLAN
STREET LOCATION
GENERAL NOTES
1. REFERENCE DRAWING C-501 FOR CITY OF COLUMBIA STANDARD DETAILS.
2. REFERENCE DRAWING C-505 FOR PIPELINE TRENCH DETAILS
3. PIPELINE DESIGN SHOWN IS BASED ON STEEL PIPE.
4. EXISTING UTILITIES TO BE PROTECTED IN PLACE AT ALL PIPELINE CROSSINGS.
5. NO WORK TO TAKE PLACE WITHIN JURISDICTIONAL WATER FEATURES OR THE ASSOCIATED BUFFERS WITHOUT APPROVED TDEC ARAP AND USACE SECTION 404 PERMITS.
EXISTING UTILITIES PROFILE ELEVATIONS
(U) UNKNOWN
(GPR) FIELD MEASUREMENT - GPR
(S) FIELD MEASUREMENT - SURVEY
(PH) FIELD MEASUREMENT - POTHOLE
(R) RECORD DRAWING (DESIGN/AS-BUILT)
CONSTRUCTION NOTES
1 36" STEEL PIPE
4 36" 11.25 DEG BEND STEEL
6 36" 45 DEG BEND STEEL
10 36" BFV (C-640, DWG C-607)
19 BLOW OFF ASSEMBLY TYPE 1 (DTL C-920, DWG C-607)
22 CAV ASSEMBLY (TYPE 1, C-922, DWG C-611)
41 RESTORE PRIVATE DRIVEWAY IN KIND
SHEET KEY NOTES
A. PRIVATE DRIVEWAY. CONTRACTOR SHALL MAINTAIN ACCESS FOR LANDOWNER AT ALL TIMES DURING CONSTRUCTION.
B. MINIMUM REQUIRED PIPE COVER WITHIN SCOUR PROTECTION LIMITS IS SHOWN IN PROFILE. IF BEDROCK ENCOUNTERED ABOVE BOTTOM OF PIPE ELEVATION SHOWN IN PROFILE, REFER TO DETAIL CWG-8 FOR PIPE COVER REQUIREMENTS.
EPSC NOTES
1 SILT FENCE
2 CONSTRUCTION ENTRANCE
3 STREAM BANK STABILIZATION
4 TEMPORARY STABILIZATION
5 PERMANENT STABILIZATION
6 INLET PROTECTION
7 OUTLET PROTECTION
VERT. 0 10' 20'
HORZ. 0 40' 80'
Tennessee 811
Stantec
Consultant
Permit/Seal
PRELIMINARY NOT FOR CONSTRUCTION
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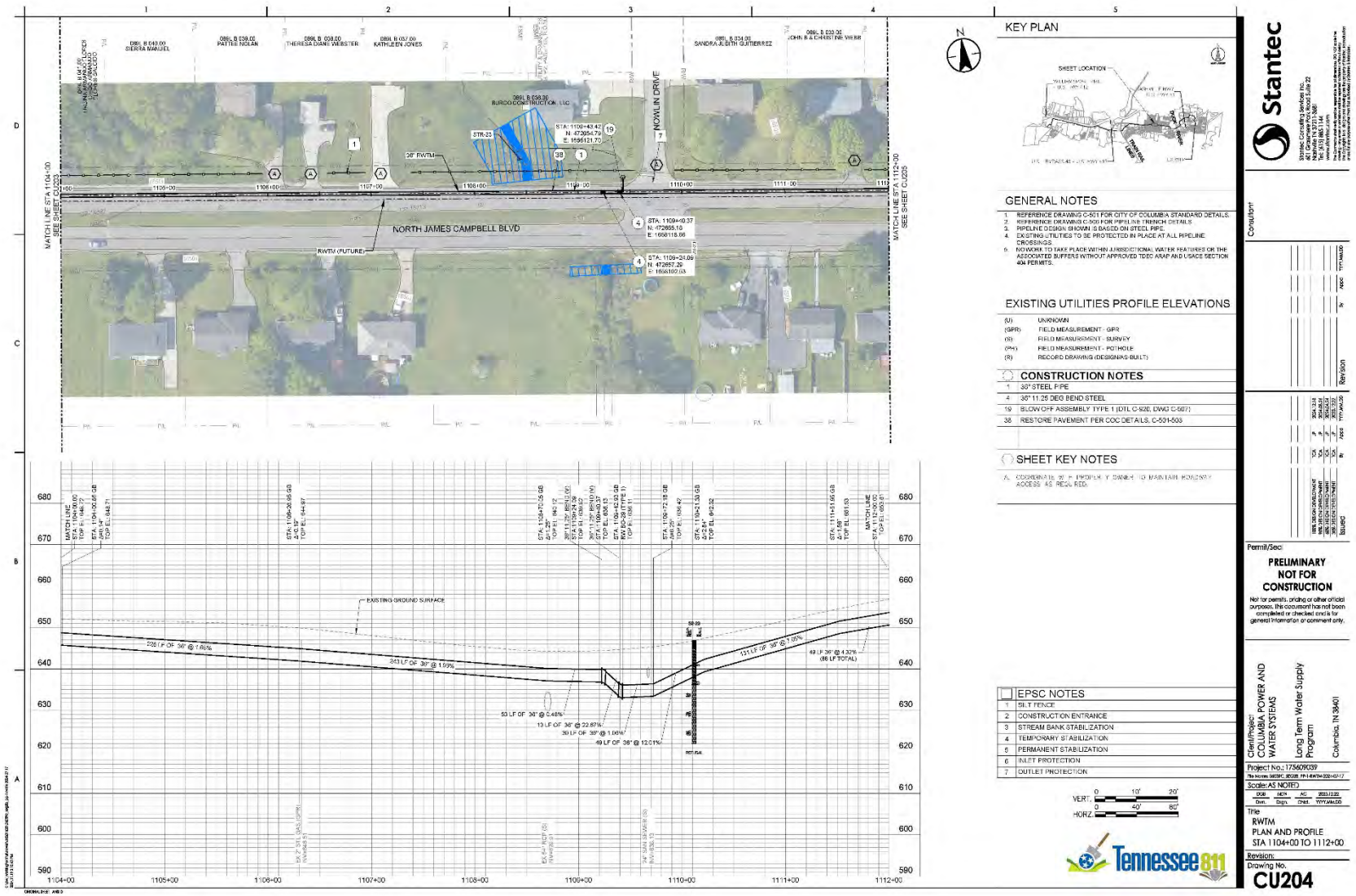
Client/Project
COLUMBIA POWER AND WATER SYSTEMS
Long Term Water Supply Program
Columbia, TN 38401
Project No.: 175609039
Scale: AS NOTED
Title
RWTM
PLAN AND PROFILE
STA 1024+00 TO 1032+00
Revision:
Drawing No.
CU194



KEY PLAN

GENERAL NOTES

1. REFERENCE DRAWING C-501 FOR CITY OF COLUMBIA STANDARD DETAILS.
2. REFERENCE DRAWING C-505 FOR PIPELINE TRENCH DETAILS
3. PIPELINE DESIGN SHOWN IS BASED ON STEEL PIPE.
4. EXISTING UTILITIES TO BE PROTECTED IN PLACE AT ALL PIPELINE CROSSINGS.
5. NO WORK TO TAKE PLACE WITHIN JURISDICTIONAL WATER FEATURES OR THE ASSOCIATED BUFFERS WITHOUT APPROVED TDEC ARAP AND USACE SECTION 404 PERMITS.

EXISTING UTILITIES PROFILE ELEVATIONS

(U)	UNKNOWN
(GPR)	FIELD MEASUREMENT - GPR
(S)	FIELD MEASUREMENT - SURVEY
(PH)	FIELD MEASUREMENT - POTHOLE
(R)	RECORD DRAWING (DESIGN/AS-BUILT)

CONSTRUCTION NOTES

1	36" STEEL PIPE
4	36" 11.25 DEG BEND STEEL
19	BLOW OFF ASSEMBLY TYPE 1 (DTL C-520, DWG C-507)
38	RESTORE PAVEMENT PER COC DETAILS, C-501-503

SHEET KEY NOTES

A. COORDINATE W/ PROPERTY OWNER TO MAINTAIN ROADWAY ACCESS AS REQ'D.

EPSC NOTES

1	SILT FENCE
2	CONSTRUCTION ENTRANCE
3	STREAM BANK STABILIZATION
4	TEMPORARY STABILIZATION
5	PERMANENT STABILIZATION
6	INLET PROTECTION
7	OUTLET PROTECTION

VERT. 0 10' 20'
HORZ. 0 40' 80'

Tennessee 811

Stantec
Consultant

Permit/Sec

PRELIMINARY NOT FOR CONSTRUCTION

Not for permit, pricing or other official purposes. This document has not been completed or checked and is for general information or comment only.

Client/Project: COLUMBIA POWER AND WATER SYSTEMS — Long Term Water Supply Program — Columbia, TN 38401

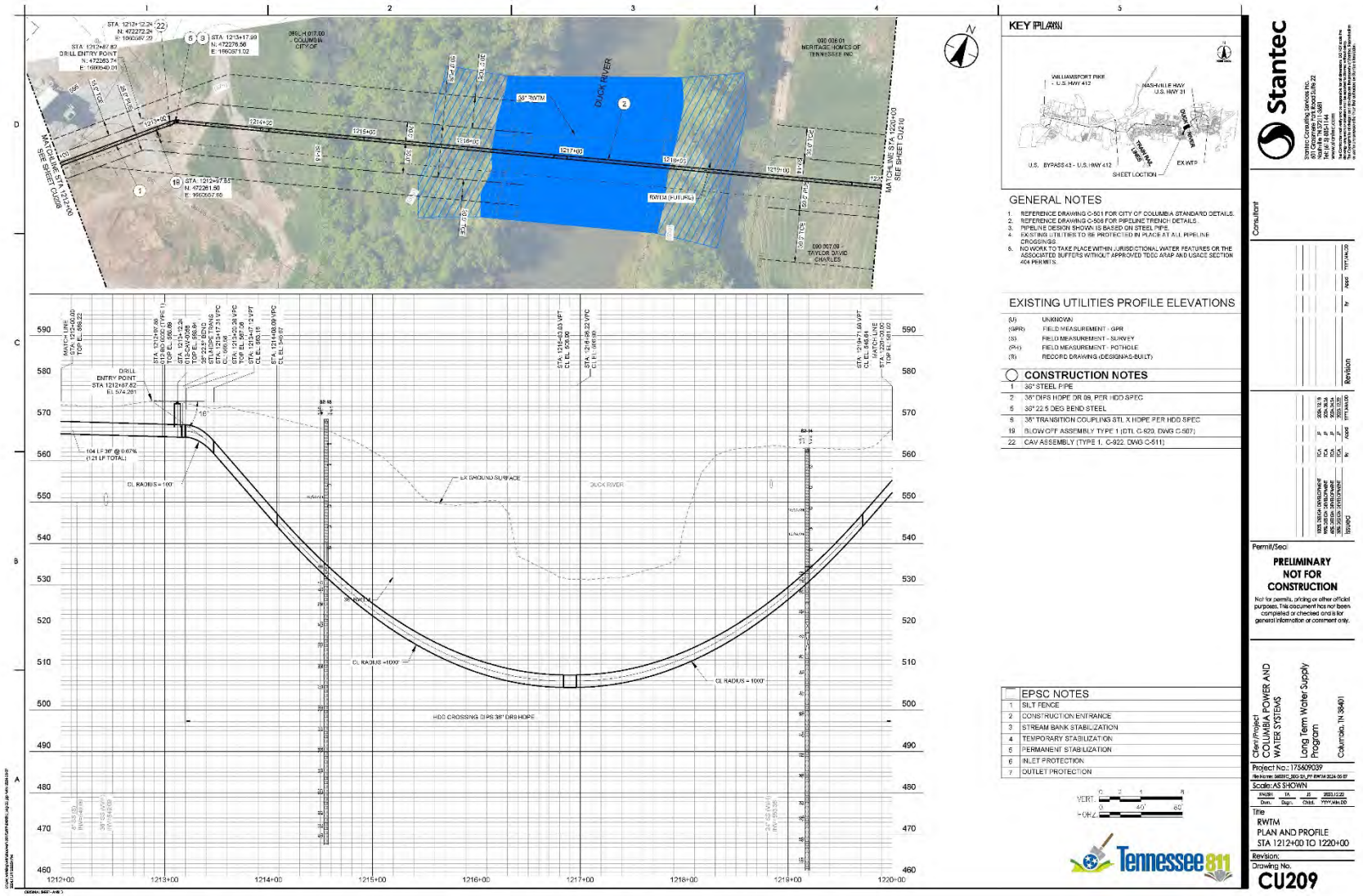
Project No.: 175609039

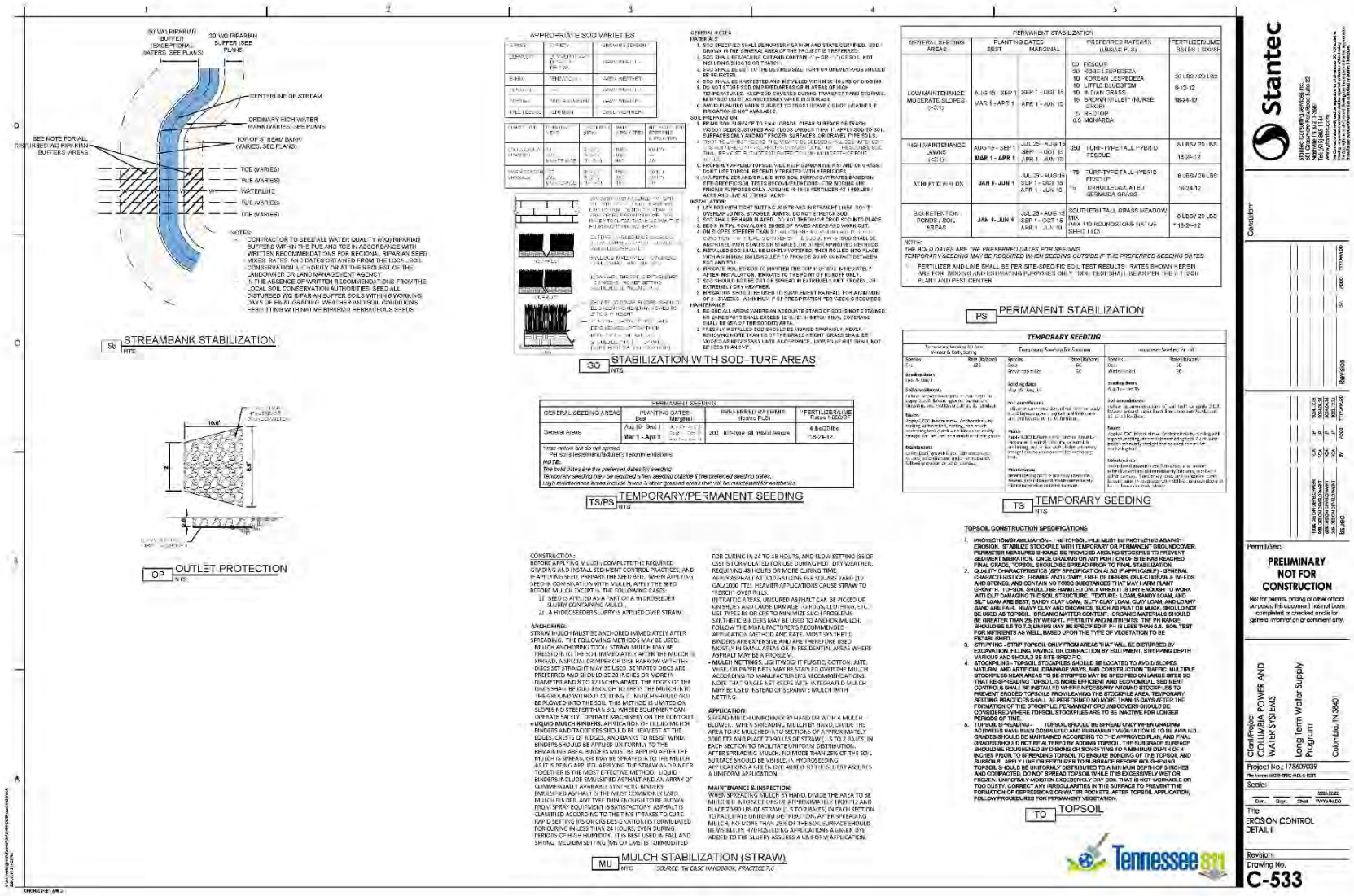
Scale: AS NOTED

Title: RWTM PLAN AND PROFILE STA 1104+00 TO 1112+00

Revision:

Drawing No. **CU204**


KEY PLAN
GENERAL NOTES
1. REFERENCE DRAWING C-501 FOR CITY OF COLUMBIA STANDARD DETAILS.
2. REFERENCE DRAWING C-506 FOR PIPELINE TRENCH DETAILS.
3. PIPELINE DESIGN SHOWN IS BASED ON STEEL PIPE.
4. EXISTING UTILITIES TO BE PROTECTED IN PLACE AT ALL PIPELINE CROSSINGS.
5. NO WORK TO TAKE PLACE WITHIN JURISDICTIONAL WATER FEATURES OR THE ASSOCIATED BUFFERS WITHOUT APPROVED TDEC ARAP AND USACE SECTION 404 PERMITS.
EXISTING UTILITIES PROFILE ELEVATIONS
(U) UNKNOWN
(GPR) FIELD MEASUREMENT - GPR
(S) FIELD MEASUREMENT - SURVEY
(PH) FIELD MEASUREMENT - POTHOLE
(R) RECORD DRAWING (DESIGN AS-BUILT)
CONSTRUCTION NOTES
1 36" STEEL PIPE
2 36" DIPS HDPE DR 09, PER HDD SPEC
5 36" 22.5 DEG BEND STEEL
6 36" TRANSITION COUPLING STL X HDPE PER HDD SPEC
19 BLOW OFF ASSEMBLY TYPE 1 (DTL C-920, DWG C-907)
22 CAV ASSEMBLY (TYPE 1, C-922, DWG C-511)
EPSC NOTES
1 SILT FENCE
2 CONSTRUCTION ENTRANCE
3 STREAM BANK STABILIZATION
4 TEMPORARY STABILIZATION
5 PERMANENT STABILIZATION
6 INLET PROTECTION
7 OUTLET PROTECTION
DUCK RIVER
EX GROUND SURFACE
HDD CROSSING DIPS 36" DR9 HDPE
Stantec
Consultant
Permit/Seal
PRELIMINARY
NOT FOR CONSTRUCTION
Not for permit, pricing or other official purposes. This document has not been completed or checked and is for general information or comment only.
Client/Project
COLUMBIA POWER AND WATER SYSTEMS
Long Term Water Supply Program
Columbia, TN 38401
Project No.: 175609039
Scale: AS SHOWN
Title
RWTM
PLAN AND PROFILE
STA 1212+00 TO 1220+00
Revision
Drawing No.
CU209
Tennessee 811


STREAMBANK STABILIZATION
STABILIZATION WITH SOD -TURF AREAS
PERMANENT STABILIZATION
TEMPORARY/PERMANENT SEEDING
TEMPORARY SEEDING
OUTLET PROTECTION
MULCH STABILIZATION (STRAW)
TOPSOIL
Stantec
PRELIMINARY NOT FOR CONSTRUCTION
EROSION CONTROL DETAIL II
C-533

APPENDIX

NRS24.226

Permit Rationale

Columbia Power and Water Systems
201 Pickens Lane
Columbia, Tennessee 38401

April 8, 2025

Permit Writer: Robert Baker

Summary

Permittee:	Columbia Power and Water Systems
Contact:	Jonathan Hardin 931-375-7646
Activity Location:	Streams and wetlands in Maury County at multiple points of impact.
Authorized Activity:	The alterations considered for authorization are stream crossings of raw water transmission pipe of 27 waterbodies (includes multiple crossings of some waterbodies), including six perennial streams, 16 intermittent streams, four wetlands, and construction of a raw water intake. The purpose of the work is for public water supply development.

Permit Status

Permit Type:	ARAP
Effective Date:	April 18, 2025
Expiration Date:	April 17, 2030

Status of Affected Waters

Ecoregion Outer Nashville Basin 71h, Maury County
Hydrologic Unit Code - Lower Duck River 06040003

STR-01 Duck River from Lick Creek to Big Bigby Creek. Ecoregion 71h & 71f Hickman County Maury County DRM 99.7

The affected waters have been determined to have available habitat parameters and water withdrawal parameters.

The affected waters are Exceptional Tennessee Waters, the basis for inclusion is USFWS Critical Habitat for Fluted Kidneyshell (Ptychobranchus subtentum) and Slabside Pearlymussel (Pleuronaia dolabelloides) from Ky Lake to Flat Ck (216 RM) Rm 133 to 179 also USFWS Critical Habitat for Purple Bean and Cumberlandian Combshell. Federal endangered Clubshell, Pygmy Madtom, Birdwing Pearlymussel, Oyster Mussel. State

threatened Coppercheek Darter and Water Stitchwort in reach. Portions in Natchez Trace Parkway NP, Hugh Link Farm SAA and Tennessee National Wildlife Refuge.

Assessment Date January 29, 2025

Designated Use	Use Support	Causes	Sources
livestock watering & wildlife	fully supporting		
irrigation	fully supporting		
recreation	not supporting	Escherichia coli	Choose an item.
fish and aquatic life	fully supporting		
industrial water supply	fully supporting		
domestic water supply	fully supporting		

STR 1, Duck River from Big Bigby Creek to Roberts Bend Branch (just upstream of Monsanto Lake). Ecoregion 71h Maury County DRM 113.2 - TN06040003024_1000

The affected waters are Exceptional Tennessee Waters, the basis for inclusion is USFWS Critical Habitat for Fluted Kidneyshell (Ptychobranchus subtentum) and Slabside Pearlymussel (Pleuronaia dolabelloides) from Ky Lake to Flat Ck (216 RM) Rm 133 to 179 also USFWS Critical Habitat for Purple Bean and Cumberlandian Combshell. Federal endangered Clubshell, Pygmy Madtom, Birdwing Pearlymussel, Oyster Mussel. State threatened Coppercheek Darter and Water Stitchwort in reach. Portions in Natchez Trace Parkway NP, Hugh Link Farm SAA and Tennessee National Wildlife Refuge.

Assessment Date September 13, 2021

The affected waters have been determined to have available habitat parameters.

Designated Use	Use Support	Causes	Sources
livestock watering & wildlife	fully supporting		
irrigation	fully supporting		
recreation	not supporting	Escherichia coli	Grazing in Riparian or Shoreline Zones
recreation	not supporting	Nutrients	Grazing in Riparian or Shoreline Zones
fish and aquatic life	not supporting	Escherichia coli	Grazing in Riparian or Shoreline Zones
fish and aquatic life	not supporting	Nutrients	Grazing in Riparian or Shoreline Zones
industrial water supply	fully supporting		
domestic water supply	fully supporting		

STR-01, Duck River from Little Bigby Creek to end of cataloging unit at Iron Bridge Road (upstream of Bear Creek). Ecoregion 71h Maury County DRM 132.1

The affected waters are Exceptional Tennessee Waters, the basis for inclusion is USFWS Critical Habitat for Fluted Kidneyshell (Ptychobranchus subtentum) and Slabside Pearlymussel (Pleuronaia dolabelloides) from Ky Lake to Flat Ck (216 RM) Rm 133 to 179 also USFWS Critical Habitat for Purple Bean and Cumberlandian Combshell. Federal endangered Clubshell, Pygmy Madtom, Birdwing Pearlymussel, Oyster Mussel. State threatened Coppercheek Darter and Water Stitchwort in reach. Portions in Natchez Trace Parkway NP, Hugh Link Farm SAA and Tennessee National Wildlife Refuge.

Assessment Date September 13, 2021

The affected waters have been determined to have available habitat parameters.

Designated Use	Use Support	Causes	Sources
livestock watering & wildlife	fully supporting		
irrigation	fully supporting		
recreation	not assessed		
fish and aquatic life	fully supporting		
industrial water supply	fully supporting		
domestic water supply	fully supporting		

STR-02, WTL-01, WTL-02. Misc. Tribs to Duck River from Big Bigby Creek to Knob Creek. Ecoregion 71h Maury County TN06040003024_0999

The affected waters have been determined to have available habitat parameters.

Designated Use	Use Support	Causes	Sources
livestock watering & wildlife	not assessed		
irrigation	not assessed		
recreation	not assessed		
fish and aquatic life	not assessed		
industrial water supply	not assessed		
domestic water supply	not assessed		

STR-03 - STR-11, WTL-03, WTL-04. Poplar Creek from Duck River to headwaters. Ecoregion

71h Maury County TN06040003024_0300

The affected waters have been determined to have available habitat parameters.

Designated Use	Use Support	Causes	Sources
livestock watering & wildlife	not assessed		
irrigation	not assessed		
recreation	not assessed		
fish and aquatic life	not assessed		

STR-12 – STR-20. Greenlick Creek from Duck River to headwaters. Ecoregion 71h Maury County TN06040003024_0200

The affected waters have been determined to have available habitat parameters.

Designated Use	Use Support	Causes	Sources
livestock watering & wildlife	not assessed		
irrigation	not assessed		
recreation	not assessed		
fish and aquatic life	not assessed		

STR-21. Misc. Tribs to Little Bigby Creek from Little Bigby Creek to headwaters Ecoregion 71h Maury County TN06040003027_0999

The affected waters have been determined to have available habitat parameters.

Designated Use	Use Support	Causes	Sources
livestock watering & wildlife	not assessed		
irrigation	not assessed		
recreation	not assessed		
fish and aquatic life	not assessed		

STR-22. Little Bigby Creek from Duck River to headwaters. Ecoregion 71h & 71f Maury County TN06040003027_1000

Assessment Date: September 13, 2021

The affected waters have been determined to have unavailable habitat parameters.

Designated Use	Use Support	Causes	Sources
livestock watering & wildlife	fully supporting		
irrigation	fully supporting		
recreation	not assessed		
fish and aquatic life	not supporting	Alteration in Stream-side or Littoral Vegetative covers	Grazing in Riparian or Shoreline Zones
fish and aquatic life	not supporting	Alteration in Stream-side or Littoral Vegetative covers	Municipal (Urbanized High Density Area)
industrial water supply	fully supporting		
domestic water supply	fully supporting		

Authorized Alterations

The authorized alterations include construction of approximately 87,500 linear feet (16.8 miles) of raw water transmission main (RWTM) pipeline that will involve stream crossings of 27 waterbodies (includes multiple crossings of some waterbodies), including 6 perennial streams, 16 intermittent streams, and 4 wetlands.

The RWTM is approximately 87,500 linear feet and extends from the authorized river intake pump station near DRM 100 to the existing WTP. Beginning at the pump station, the RWTM heads south and then east along Greenfield Bend Road. The pipeline will cross the Duck River via microtunneling near DRM 113.2, continuing east until it intersects State Highway 50 (Williamsport Pike). The pipeline generally parallels Williamsport Pike for approximately 5.5 miles, staying outside of the roadway ROW.

The authorized project will impact a total of 23 jurisdictional streams (includes multiple crossing of the same stream) and 4 wetlands. To help reduce potential impacts, waterbodies, streams, and rivers will be crossed as quickly and safely as practicable. Additionally, efforts will be made to plan work during dry conditions for intermittent and ephemeral waterbodies, where practicable. CPWS states that they intend to reduce turbidity through best management practices (BMPs) outlined in the Project's Erosion and Sediment Control Plan (ESCP) (Permit Details). Adherence to the construction procedures throughout construction will help allow uninterrupted stream flow in streams that are flowing at the time of the pipeline crossing installation.

The pipeline will be installed across waterbodies using dry crossing or trenchless construction methods. Upland swales, ditches, and other such non-jurisdictional conveyances may be crossed using either an open cut technique if water is flowing at the

time of crossing or by BMPs if there is no flow at the time of crossing. Waterbodies within the construction workspace but not crossed by the pipeline will be avoided or temporarily crossed using temporary pipe culverts. Authorized waterbody crossing methods for each waterbody crossed by the authorized pipeline are provided in the Project's ESCP (Permit Details).

Trenchless Duck River crossing site-specific plans are included in the Microtunneling and HDD Work Plan (Permit Details)

Temporary culvert crossings may be constructed across waterbodies during clearing and grading activities for construction equipment. These temporary crossings and associated in-stream support will be removed as part of the restoration process.

In general, construction equipment and vehicle refueling and lubricating will take place in upland areas located more than 100-feet from the edge of a waterbody (or wetland). In addition, fuels, lubricating oils, petroleum products, and other hazardous materials will not be stored within 100-feet an aquatic resource. However, instances may arise where equipment refueling and lubrication near or in a waterbody are necessary. For example, stationary equipment, such as a hydrostatic test water pump, may need to operate continuously on the bank of a waterbody. The Project's ESCP and Stormwater Pollution Prevention Plan address the handling of fuel and other hazardous materials in or near a waterbody (Permit Details).

If trench dewatering is necessary in or near a waterbody, the removed trench water will be discharged into an energy dissipation/sediment filtration device, such as a geotextile filter bag or straw bale structure located in a well-vegetated upland area away from the water's edge to prevent heavily silt-laden water from flowing into the waterbody in accordance with the Project's ESCP and applicable permits. Monitoring will be conducted to help ensure that flow from the structure is infiltrating into the underlying soil.

CPWS plans to execute dry crossings at John Branch, Gin Branch, Greenlick Creek and Little Bigby Creek in late spring and summer when stream flow will generally be at seasonal lows due to the dry season. CPWS proposes to utilize the trenchless methods at two locations crossing the Duck River at DRM 113.2 and DRM 132.1.

Alternatives Analysis and Selection of Least Impactful Practicable Alternative

The stated purpose of the authorized alterations to state water resources is to provide a raw water pipeline for CPWS's Long Term Water Supply Program. The applicant has submitted an analysis of potentially practicable alternatives to the authorized activity and provided the following discussion of those alternatives:

CPWS conducted an alternative analysis in conjunction with CWA Section 404(b)(1) guidelines to determine if alternatives to construct and install the Project are practicable based on environmental considerations, construction costs, technical feasibility, human safety, and logistics. CPWS investigated alignment alternatives (Appendix C Permit Details), documented evaluation criteria, and selected the preferred pipeline alignment alternatives for the RWTM

pipeline.

An intake siting and evaluation study (Appendix C, C.1Permit Details) was completed to evaluate, rank, and determine the preferred location for the new downstream intake and intake configurations. In addition, River Intake Technical Memo (Appendix C, C.2 Permit Details) was prepared analyzing intake structures for the preferred location. Alternative routings of the RWTM were also analyzed and prepared (Appendix C, C.3Permit Details).

For proposed waterbody crossing methods, CPWS considered alternatives including wet open cut and dry open cut trenching crossing methods, as well as trenchless crossing methods including HDD. After extensive consideration, CPWS incorporated site designs that have led to a preferred alternative with reduced environmental impacts in comparison to others considered. The proposed Project will utilize a combination of rock saw in areas with limestone near streams, open-cut crossing for dry streambeds, and dry open cut crossing methods at the waterbody crossings with flow, except for the planned Microtunneling and HDD construction methods near RM 113.2 and RM 132.1, respectively.

As part of the development process for the Project, CPWS evaluated pipeline routing and pump station site options based on regional topography, potential adverse environmental impacts, population density, environmental justice communities, existing land use, and construction safety and feasibility considerations.

10.2 Rock Trencher Alternative

Rock trencher alternative was considered for the installation of the RWTM in areas where limestone or other hard rock is present. This alternative was not selected as the only excavation method for several reasons. Rock trenchers are less precise and efficient in hard rock, often requiring a larger overall construction footprint and extended periods of ground disturbance. Continuous trenching may lead to excessive soil displacement, increasing the risk of erosion and sedimentation, and broader ecological harm. In addition, rock trenching would require more extensive restoration efforts post-construction. As rock trenching is more costly and time consuming than rock sawing or blasting, further extending the project timeframe. Overall, rock trenching does not align with the projects overall environmental protection goals and was not determined to be the preferred methodology for installation of the RWTM.

10.3 Trenchless Crossing for All Waterbodies Alternative

Trenchless crossings for the streams were considered but determined not to be the preferred alternative for several reasons. While trenchless methods, such as HDD or jack and bore, can reduce direct impacts to streambeds, they are significantly more costly and often not feasible across the majority of stream types within the project area, particularly in locations with challenging geotechnical conditions. The complexity and risk of failure associated with trenchless methods, especially in areas with variable soil and rock formations, make it impractical for widespread use. Additionally, trenchless techniques typically require extensive staging areas and longer construction timeframes, further increasing the overall environmental impacts. Open trench or dry ditch crossings, when executed with sediment and erosion control measures, offer a more practicable and less costly alternative. Therefore, trenchless crossings for all streams are

not the preferred alternative, as they do not align with the project's cost-efficiency and environmental protection goals.

Based on the available information, the Division has determined that there is no practicable alternative consistent with the overall purpose of the authorized activity that would have less adverse impact on resource values.

Existing Conditions/Authorized Loss of Resource Values

The applicant has described best management practices (BMPs) for all steam and wetland crossings. These applied BMPs are determined to be temporary or de minimis in impact to resource values.

The Division has determined that the activity will not result in an appreciable permanent loss of resource values.

Antidegradation

In accordance with the Tennessee Antidegradation Statement (Rule 0400-40-03-.06), the Division has determined that the authorized activities will not result in an appreciable permanent loss of resource values, and therefore will result in no more than de minimis degradation of waters with available parameters and Exceptional Tennessee Waters without mitigation.

The Division has determined that the authorized activities will result in no significant degradation in a waterbody with unavailable parameters for habitat.

For more information, please reference Tennessee's Antidegradation Statement which is found in Chapter 0400-40-03 of the Rules of the Tennessee Department of Environment and Conservation.