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.

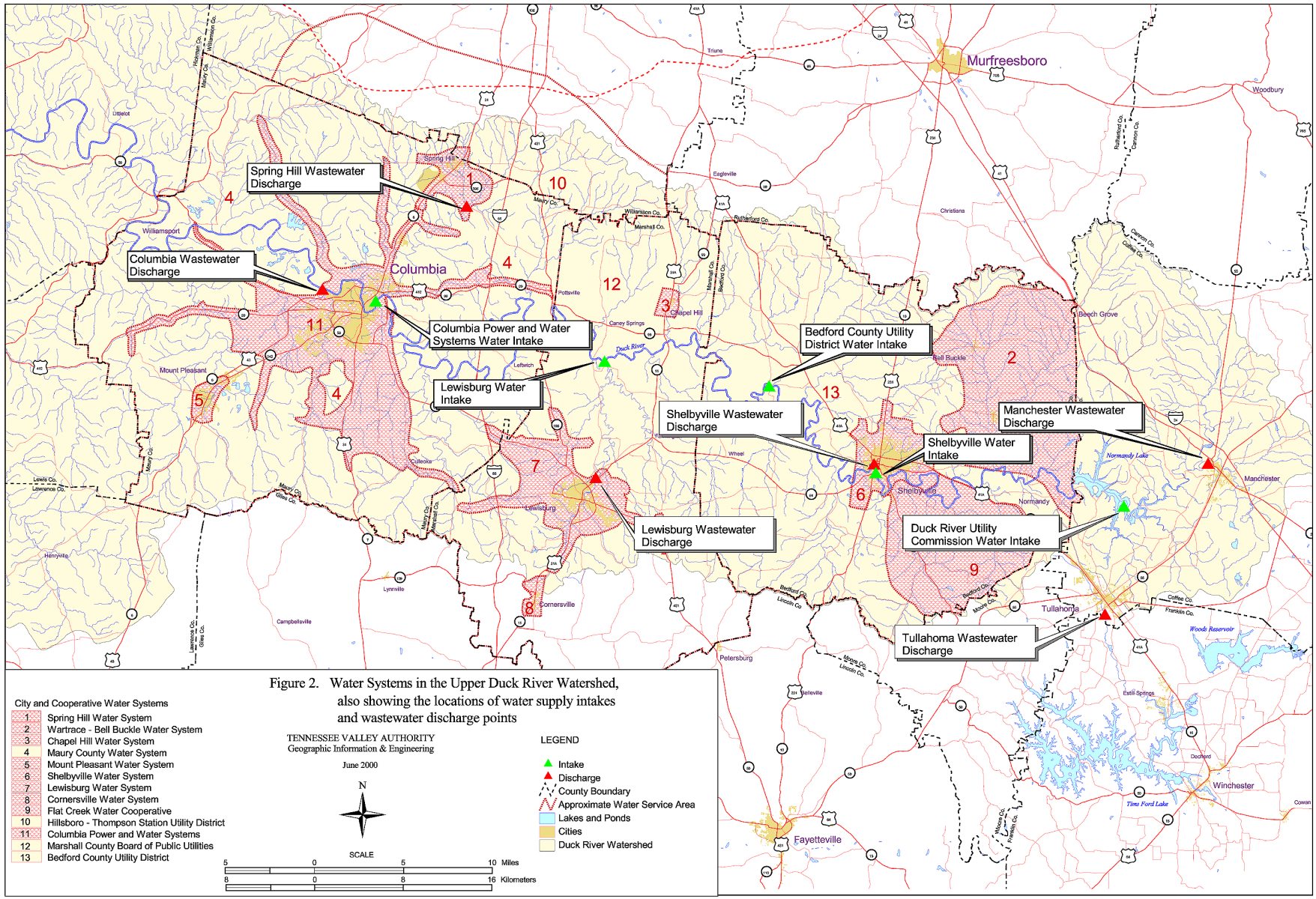

Figure 2. Water Systems in the Upper Duck River Watershed, also showing the locations of water supply intakes and wastewater discharge points

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.

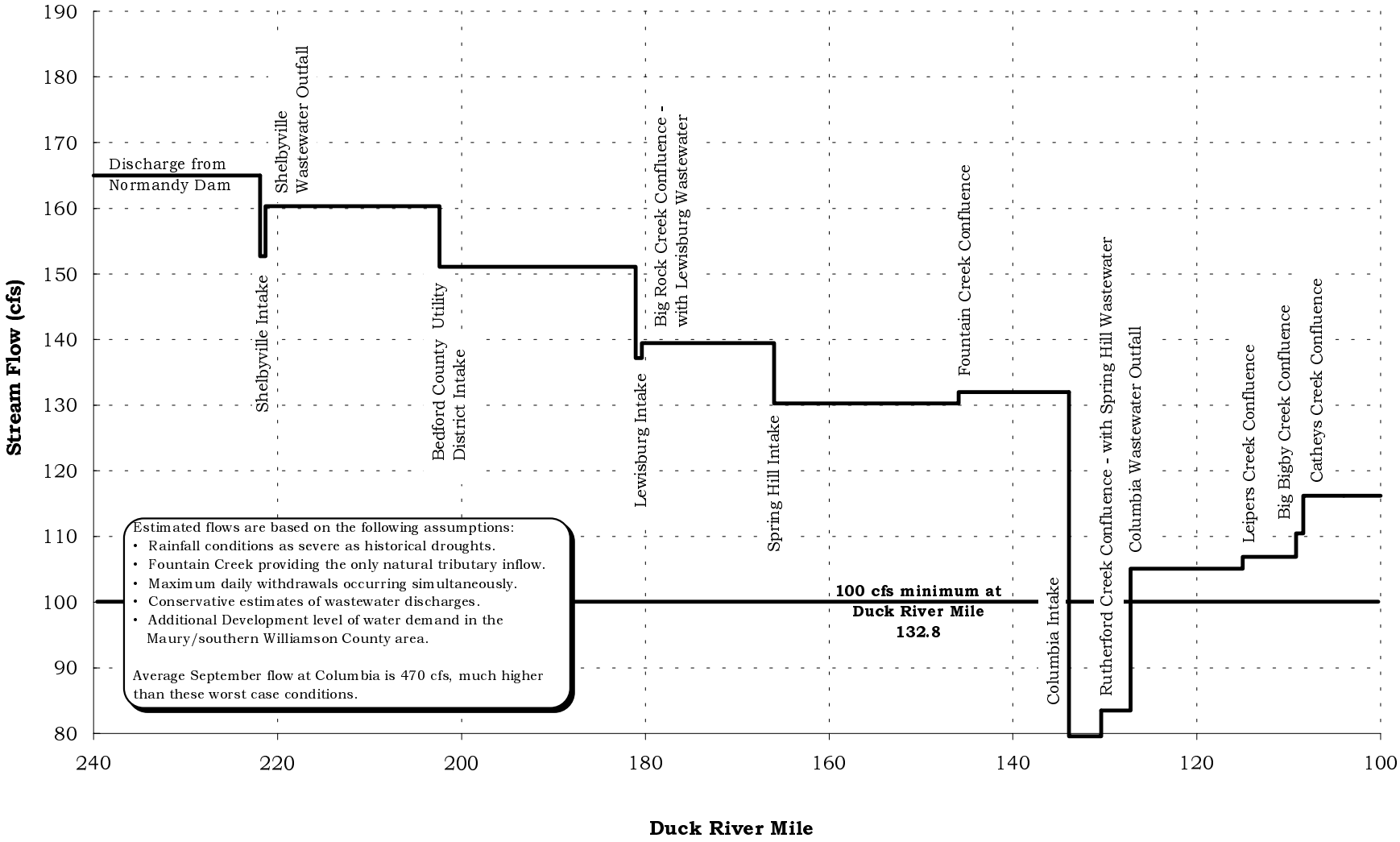

Figure 3. The potential effects of anticipated water supply withdrawals and wasterwater discharges on flows in the Duck River during possible drought conditions in 2050.

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.