PRELIMINARY ENGINEERING REPORT

SECURING WATTS-BAR RESERVOIR WATER FOR CROSSVILLE

NOVEMBER 1999

PROVIDED BY:

LD&A

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PRELIMINARY ENGINEERING REPORT

SECURING WATTS-BAR RESERVOIR WATER FOR CROSSVILLE

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INTRODUCTION

I

SECTION I

INTRODUCTION

The City of Crossville is the water purveyor for a major part of Cumberland County. As utility district sprung up to serve rural customers in Cumberland County, they choose to purchase water from the City for resale.

Currently, the City owns and operates two water treatment plants. The City's oldest water treatment plant (Meadow Park) was constructed in the late 1930's. The Meadow Park plant has reached its useful life and will be replaced soon with a new larger facility. The new facility will have a rated capacity of 3.5 million gallons per day (MGD). The second City plant is the Lake Holiday facility. It was constructed in the 1960's. Even though, it is the newer plant, it is more than 30 years old and has reached the normal life expectancy of most mechanical and electrical equipment. The Lake Holiday has a rated capacity of 3.0 MGD.

Crossville and Cumberland County are located on the Cumberland Plateau. By the nature of the topography and geology, the water resources of the area are limited. Fortunately, the raw water sources (impoundments) for the two existing water treatment plants were constructed prior to current legislation and regulation. It is highly questionable if those facilities could be constructed in today's environment.

The City retained Lamar Dunn & Associates, Inc. to develop a water Master Plan for the City, which was published in April 1998. The U. S. Army Corps of Engineers, Nashville District published a Preliminary Engineering Report titled "Cumberland County Regional Water Supply Study". The City Master Plan confirmed previous work which indicated that the existing impoundment would not support the long-range water needs of the City and its utility district customers very far into the next century. The Master Plan indicated that the Meadow Park plant had reached its useful life and should be replaced with a new facility. It suggested that the new facility be designed such that it could be easily expanded. As for additional raw water, the Master Plan suggested that the Caney Fork River be investigated as a potential source. Preliminary discussions included a dam which would create an impoundment with a safe yield on the order of 20.0 MGD. The Corps of Engineers report acknowledged the LD&A Master Plan; but indicated that due to environmental concerns, the proposal might not be permitted. It was suggested by the corps that a "water harvesting" plan be developed. The Corps report explored many other options some of which LD&A rejected during the development of the Master Plan but were not mentioned. Two options discussed by the Corps, which would meet the long-range needs, was the possibility of getting raw water from either Watts Bar Reservoir or Center Hill Lake.

The City of Crossville authorized LD&A to develop a Preliminary Engineering study discussing the option of moving water from Watts Bar Reservoir to Crossville.

PROJECTED WATER NEEDS

II

SECTION II

PROJECTED WATER NEEDS

Over the past couple of years, there have been various discussions with the City Council about water demand and available resources. For clarification purposes, a brief discussion will be given to defining certain terms of their influence on determining needs.

When a treatment plant has a "rated capacity" of a certain amount, either in gallons per minutes (gpm) or million gallons per day (MGD), it refers to the instantaneous maximum rate that the plan can legally operate. For example, a treatment facility which has a 1.0 MGD rated capacity will operate at a maximum rate of 700 gpm. Normal operations of the plan requires that the filters be backwashed with "filtered water" and there are other uses of water within the plant. These uses can be on the order of 5% or more. Therefore, a plant may filter water at 700 gpm and pump water away at a rate of 700 gpm it may only distribute 950,000 gallons per day. The state requires that a pubic water supply begin planning for expansion when the production reaches 80% of rated capacity (in this 1.0 MGD example, when production reaches 800,000 gpd).

A treatment facility must meet the demand within the distribution system. The demand is not constant. It is dependent on weather, season, user habits, and many other parameters. A typical water treatment plant will record monthly the maximum (peak day) day production, the minimum and average productive of the month. Table II-1

TABLE II-1
WATER PRODUCTION
CITY OF CROSSVILLE WATER TREATMENT PLANTS

HOLIDAY PLANT								
	Max. 96	Min. 96	Max. 97	Min. 97	Max. 98	Min. 98	Max. 99	Min. 99
JANUARY	1782	486	1847	915	2500	1922	2064	730
FEBRUARY	1559	708	1410	739	2452	2048	1922	1135
MARCH	1323	660	1589	828	2242	1623	1632	985
APRIL	1429	536	2307	811	1606	974	1883	1119
MAY	1863	916	1703	1061	2366	1203	2102	1210
JUNE	1755	1016	1664	1155	2703	1157	2372	1300
JULY	1521	1220	161	1170	1953	1206	2316	1356
AUGUST	1776	1087	1652	1044	2033	1484		
SEPTEMBER	2221	985	1508	1117	2123	1573		
OCTOBER	2330	1537	1653	1015	1939	1121		
NOVEMBER	1646	806	2028	1053	1668	1206		
DECEMBER	1688	909	1983	1381	200	981		
MEADOW PARK PLANT								
	Max. 96	Min. 96	Max. 97	Min. 97	Max. 98	Min. 98	Max. 99	Min. 99
JANUARY	1424	1032	1585	674	1338	969	1511	1097
FEBRUARY	1446	1035	1404	865	1353	312	1449	1098
MARCH	1416	910	1482	712	1466	799	1494	1106
APRIL	1323	1007	1398	812	1460	733	1529	850
MAY	1381	704	1394	502	1440	840	1586	676
JUNE	1500	587	1049	624	1534	982	1548	
JULY	1298	775	1258	537	1378	756		
AUGUST	1441	688	1277	786	1494	924		
SEPTEMBER	1466	238	1317	792	1628	1029		
OCTOBER	1496	1063	1400	887	1540	833		
NOVEMBER	1555	1177	1307	841	1505	939		
DECEMBER	1479	582	1443	685	1540	799		

1997	MEADOW PARK		HOLIDAY	
	MAXIMUM	AVERAGE	MAXIMUM	AVERAGE
JANUARY	1585	1212	1847	1254
				1097
	1394			
	[illegible]		1664	1465
	1258		1961	1505
	1277		1652	
			1508	1318
		1056	1653	
		1074	2028	
	1443			1646
1998				
	1338	1165	[illegible]	2188
		1138	2452	2290
		1179		1497
APRIL		1164	1606	1280
[illegible]	1440	1166		1738
JUN		1272		1882
JULY		1205		1677
		1269		1701
		1382	2123	1845
		1239		1557
		1315		1428
		1303		1422

shows maximum and minimum production for each of the Crossville plant from January 1996 through July 1999. Table II-2 shows the maximum day and average daily production for the years 1997 and 1998. Typically, the maximum day demand will range from 125% - 150% of the average. Therefore, in order to meet the needs of the customers, the infrastructure must be designed to meet the peak day demand.

Also, the actual volume of water sold and the amount produced is two different amounts. A municipal system will use "unmetered" water for fire fighting, street washing, main flushing, and other uses. Depending on the integrity of the distribution system, water losses caused by leaks may amount to 10% or more. Total unaccounted for water within a system may be in the range of 15 – 50 percent. The lower number is for an extremely good tight system; whereas, the higher number would represent a less well operated system.

So, a 1.0 MGD treatment facility may sell on the average at the point of time when expansions plans at to begin the following:

Plant rated capacity	1.0 MGD
Operation at 80% capacity	8 MGD
Plant use water	05 percent – 0.760 MGD
Distribution loss	.20 percent – 0.61 MGD
Water sales	0.61 MGD

Therefore, it is important to keep these various demands and uses clearly fixed as discussions are held.

LD&A has reviewed with the City projections of demand versus treatment capacity. Figures II-1, II-2, II-3, and II-4 are presented as a basis for sizing future facilities. It can be seen that at the end of the first quarter of the next century (2025) the total demand will be on the order of 14.5 – 16.8 MGD depending on which growth projections are chosen. Since the City currently has projected treatment capacity of 6.5 MGD, the shortfall over the next quarter century will be approximately 10 MGD.

FIGURE II-1

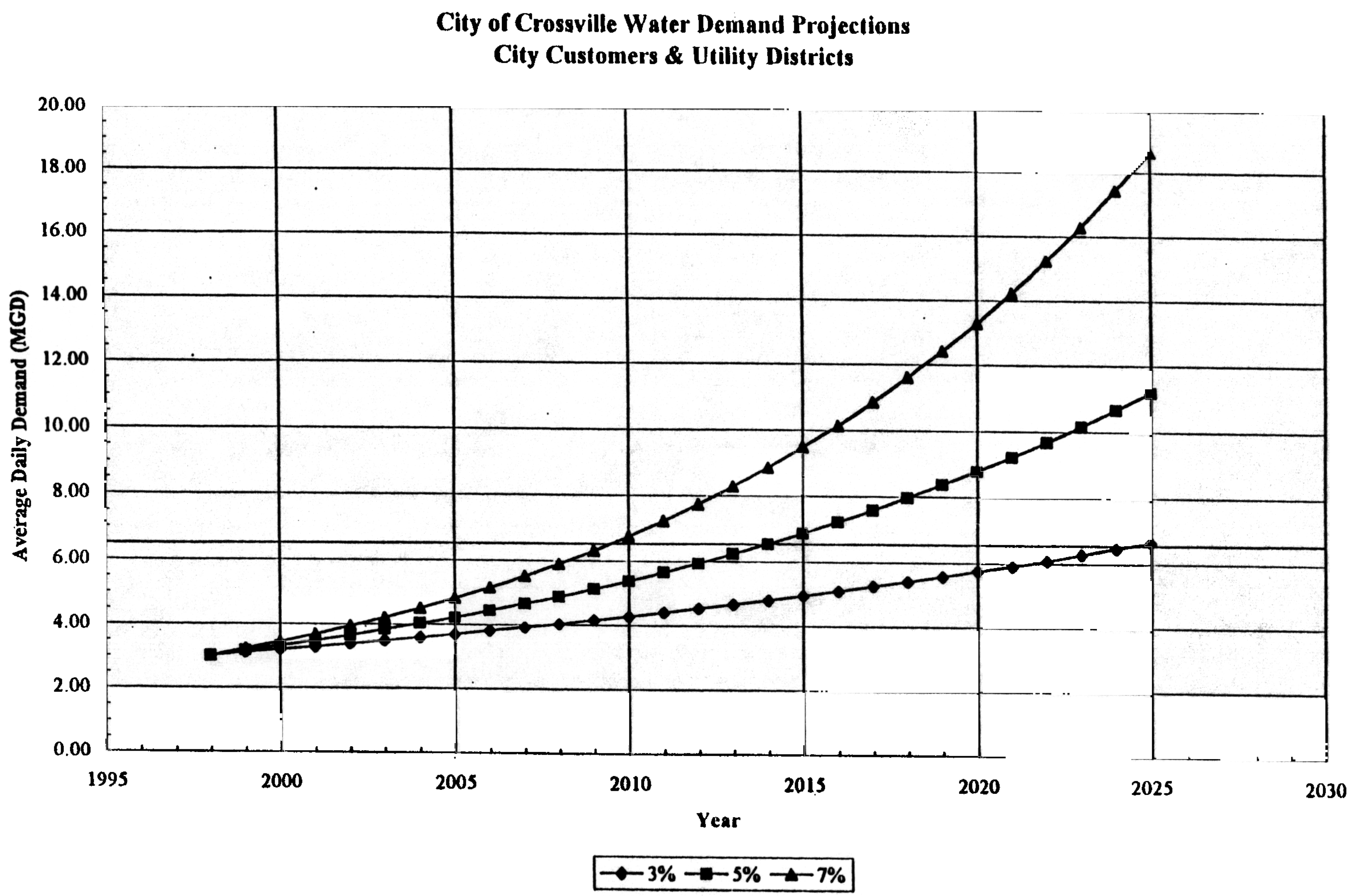

City of Crossville Water Demand Projections
City Customers & Utility Districts
Average Daily Demand (MGD)
20.00
18.00
16.00
14.00
12.00
10.00
8.00
6.00
4.00
2.00
0.00
1995
2000
2005
2010
2015
2020
2025
2030
Year
3%
5%
7%

FIGURE II-2

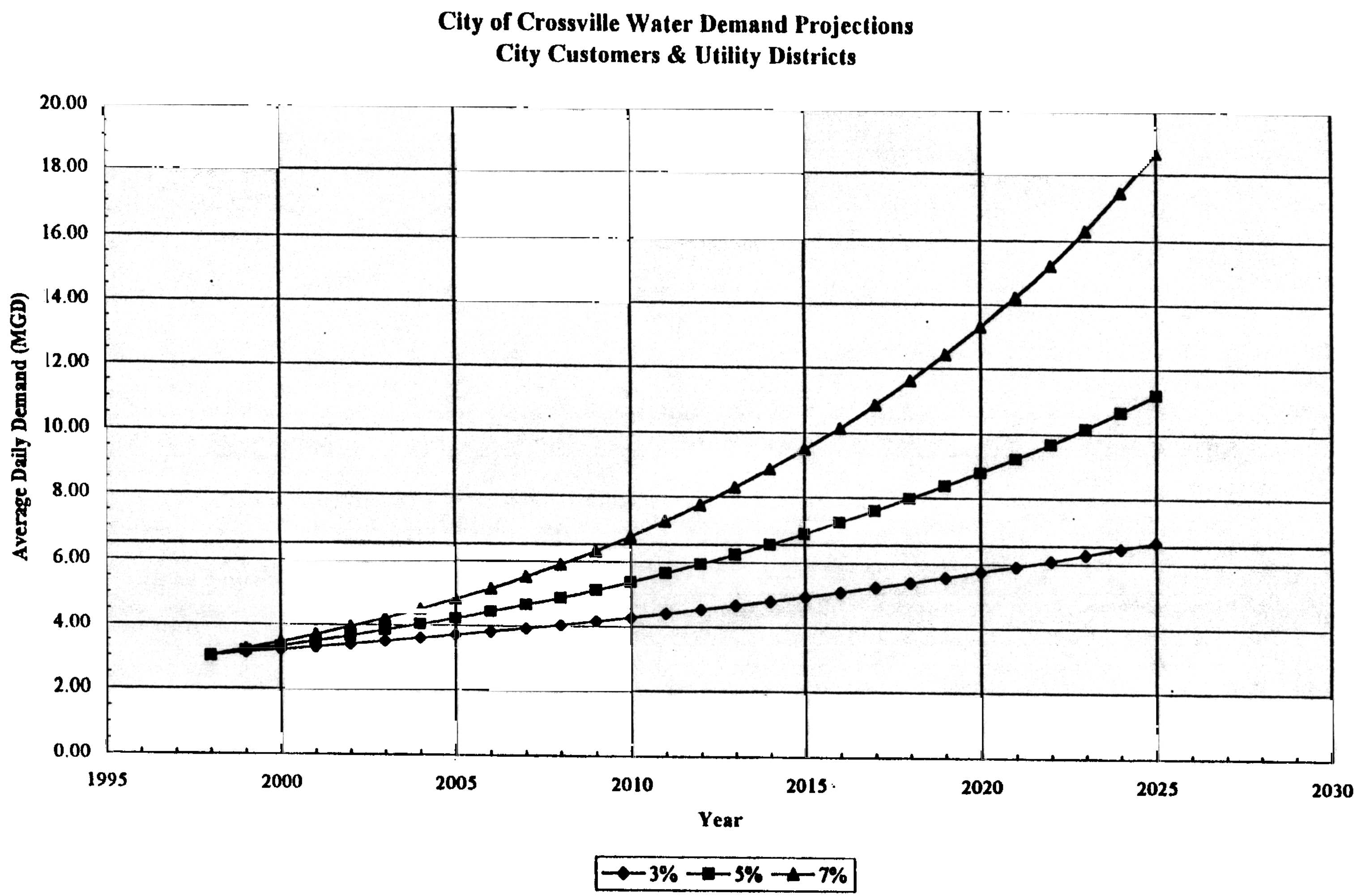

City of Crossville Water Demand Projections
City Customers & Utility Districts
Average Daily Demand (MGD)
20.00
18.00
16.00
14.00
12.00
10.00
8.00
6.00
4.00
2.00
0.00
1995
2000
2005
2010
2015
2020
2025
2030
Year
3%
5%
7%

FIGURE II-3

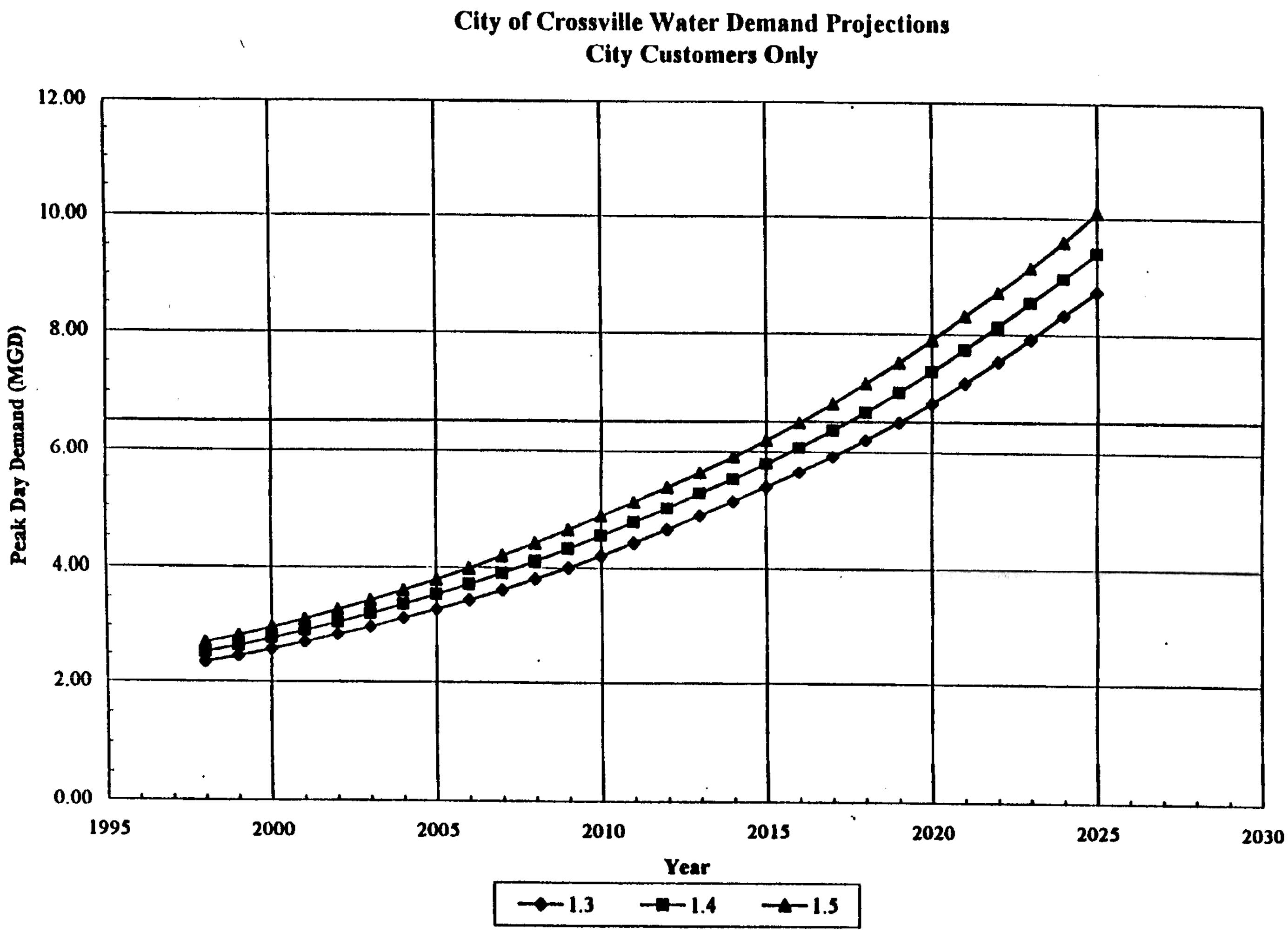
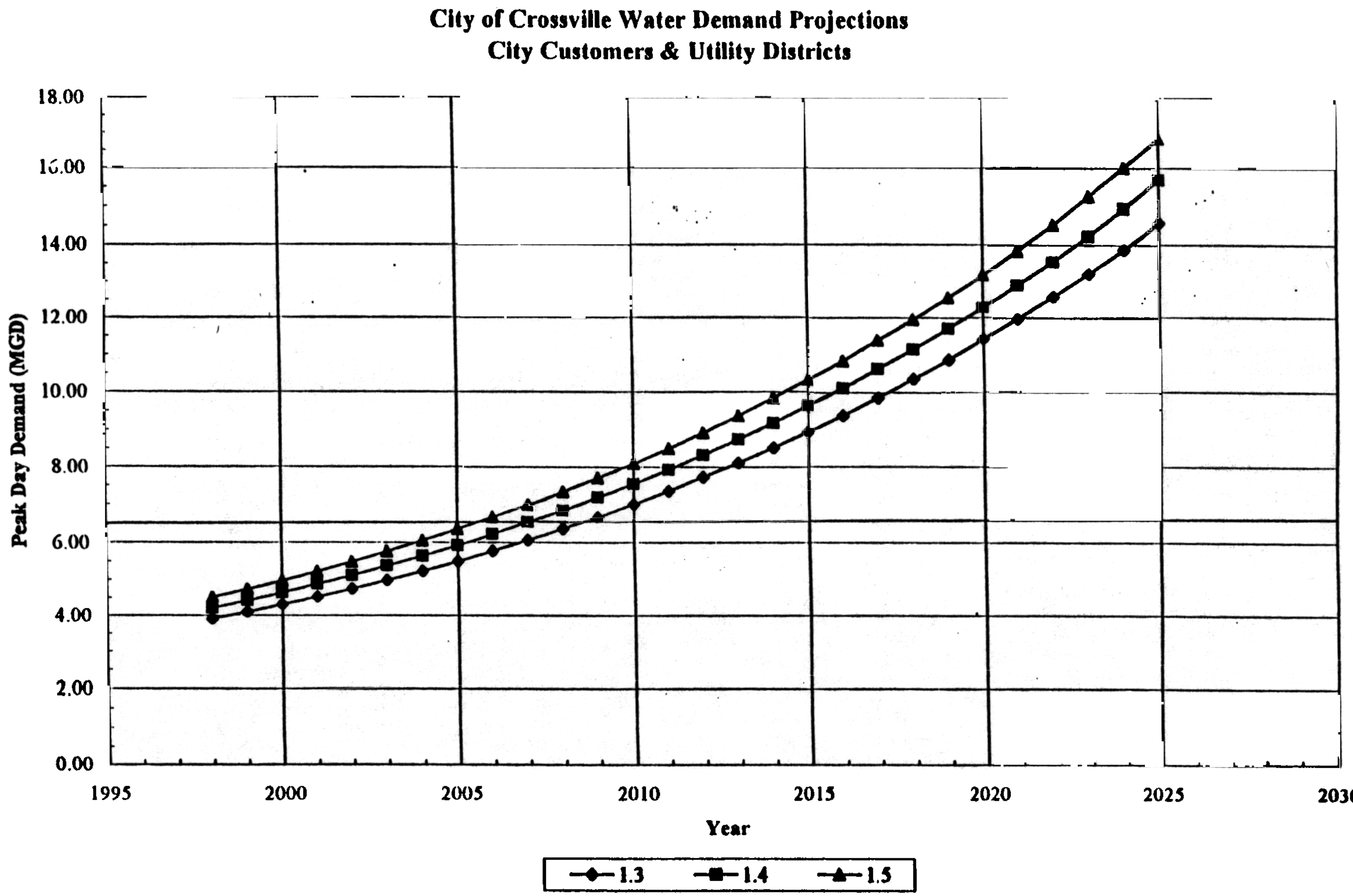

City of Crossville Water Demand Projections
City Customers Only
12.00
10.00
8.00
6.00
4.00
2.00
0.00
Peak Day Demand (MGD)
1995
2000
2005
2010
2015
2020
2025
2030
Year
1.3
1.4
1.5

FIGURE II-4


City of Crossville Water Demand Projections
City Customers & Utility Districts
18.00
16.00
14.00
12.00
10.00
8.00
6.00
4.00
2.00
0.00
Peak Day Demand (MGD)
1995
2000
2005
2010
2015
2020
2025
2030
Year
1.3
1.4
1.5

ALTERNATIVES FOR MOVING WATTS-BAR WATER TO CROSSVILLE

III

SECTION III

ALTERNATIVES FOR MOVING WATTS-BAR WATER TO CROSSVILLE

A determination should be made whether raw water or finished (treated) water is to be transported. It is generally more economical to pump finished water; but not a necessity. If finished water is transported, potential users along the way could become customers. In the option of Watts-Bar water being used, additional pipe would be required to move raw water since the City's treatment facilities are on the opposite side of the distribution system than Watts-Bar.

Two locations on Watts-Bar were selected as potential site to acquire water (either raw or finished). They were Rockwood and Spring City. Also two separate locations for the delivery point was selected. They were the Cook Road tank and the other being the proposed Homestead Tank.

Tables III-1 and III-2 show the data developed as a result of the investigation. Factors affecting the cost are: 1) construction, 2) energy, 3) financing, and 4) operations. The energy cost is shown as a function of 1,000 gallons pumped. The construction and financing cost would be fixed cost while the energy and operations cost are variable.

Based on the investigation, it is suggested that water be brought into the distribution system on the grade line of the Cook Road Tank.

TABLE III-1
Hydraulic and Power Cost Data for 24 Inch Pipeline Option
Homestead Tank

C=120

Q, MGD	Q, gpm	Q, cfs	D, in	L, ft	Hs, ft	Hf, ft	TDH, ft	Pm, HP	Pm, KW	Cost, $/Hr	Cost, $/1000 gal
0	0.00	0.00	24	108368	1337	0	1337.00	0.00	0.00	0.00	0.000
2	1388.89	3.09	24	108368	1337	20.041	1357.04	755.08	563.49	33.81	0.406
4	2777.78	6.19	24	108368	1337	72.246	1409.25	1568.25	1170.34	70.22	0.421
6	4166.67	9.28	24	108368	1337	152.96	1489.96	2487.12	1856.06	111.36	0.445
8	5555.56	12.38	24	108368	1337	260.45	1597.45	3555.38	2653.27	159.20	0.478
10	6944.44	15.47	24	108368	1337	393.56	1730.56	4814.54	3592.94	215.58	0.517

Cook Road Reservoir

C=120

Q, MGD	Q, gpm	Q, cfs	D, in	L, ft	Hs, ft	Hf, ft	TDH, ft	Pm, HP	Pm, KW	Cost, $/Hr	Cost, $/1000 gal
0	0.00	0.00	24	114020	1258.8	0	1258.80	0.00	0.00	0.00	0.000
2	1388.89	3.09	24	114020	1258.8	21.086	1279.89	712.15	531.45	31.89	0.383
4	2777.78	6.19	24	114020	1258.8	76.015	1334.81	1485.42	1108.53	66.51	0.399
6	4166.67	9.28	24	114020	1258.8	160.94	1419.74	2369.90	1768.58	106.11	0.424
8	5555.56	12.38	24	114020	1258.8	274.03	1532.83	3411.57	2545.95	152.76	0.458
10	6944.44	15.47	24	114020	1258.8	414.08	1672.88	4654.09	3473.20	208.39	0.500

TABLE III-2
Hydraulic and Power Cost Data for 30 Inch Pipeline Option

Homestead Tank

C=120

Q, MGD	Q, gpm	Q, cfs	D, in	L, ft	Hs, ft	Hf, ft	TDH , ft	Pm, HP	Pm, KW	Cost, $/Hr	Cost, $/1000 gal
0	0.00	0.00	30	108368	1337	0	1337.00	0.00	0.00	0.00	0.000
2	1388.89	3.09	30	108368	1337	6.760198	1343.76	747.69	557.98	33.48	0.402
4	2777.78	6.19	30	108368	1337	24.37053	1361.37	1514.98	1130.58	67.83	0.407
6	4166.67	9.28	30	108368	1337	51.5981	1388.60	2317.91	1729.79	103.79	0.415
8	5555.56	12.38	30	108368	1337	87.85579	1424.86	3171.25	2366.60	142.00	0.426
10	6944.44	15.47	30	108368	1337	132.7559	1469.76	4088.98	3051.48	183.09	0.439
12	4166.67	9.28	30	108368	1337	51.59818	2777.20	9271.66	6919.15	415.15	0.830
14	4861.11	10.83	30	108368	1337	68.62544	2811.25	10949.57	8171.32	490.28	0.840
16	5555.56	12.38	30	108368	1337	87.85592	2849.71	12685.01	9466.42	567.99	0.852
18	6250.00	13.93	30	108368	1337	109.2453	2892.49	15289.56	11410.12	684.61	0.913
20	6944.44	15.47	30	108368	1337	132.7558	2939.51	16355.90	12205.89	732.35	0.879

Cook Road Reservoir

C=120

Q, MGD	Q, gpm	Q, cfs	D, in	L, ft	Hs, ft	Hf, ft	TDH , ft	Pm, HP	Pm, KW	Cost, $/Hr	Cost, $/1000 gal
0	0.00	0.00	30	114020	1258.8	0	1258.80	0.00	0.00	0.00	0.000
2	1388.89	3.09	30	114020	1258.8	7.11278	1265.91	704.37	525.65	31.54	0.378
4	2777.78	6.19	30	114020	1258.8	25.64159	1284.44	1429.37	1066.69	64.00	0.384
6	4166.67	9.28	30	114020	1258.8	54.28924	1313.09	2191.87	1635.72	98.14	0.393
8	5555.56	12.38	30	114020	1258.8	92.43797	1351.24	3007.40	2244.33	134.66	0.404
10	6944.44	15.47	30	114020	1258.8	139.6799	1398.48	3890.68	2903.49	174.21	0.418
12	8333.33	18.57	30	114020	1258.8	195.7128	1454.51	4855.88	3623.79	217.43	0.435
13	9027.78	20.12	30	114020	1258.8	226.9494	1485.75	5373.51	4010.09	240.61	0.444
14	9722.22	21.66	30	114020	1258.8	260.298	1519.10	5916.75	4415.49	264.93	0.454
15	10416.67	23.21	30	114020	1258.8	295.735	1554.54	6487.26	4841.24	290.47	0.465
16	11111.11	24.76	30	114020	1258.8	333.239	1592.04	7086.69	5288.57	317.31	0.476
17	11805.56	26.30	30	114020	1258.8	372.7901	1631.59	7716.66	5758.70	345.52	0.488
18	12500.00	27.85	30	114020	1258.8	414.3698	1673.17	8378.80	6252.84	375.17	0.500

It is estimated that three in-line booster stations would be required to lift the water from Watts-Bar to the City, plus a station at the lake. If treated water is pumped, the first pumping station would be a part of the plant. Then, three others would be required. The distance for the pipeline would be approximately 110,000 feet, depending on exact location of being. This route would be approximately 21 miles. The static head (elevation difference) is approximately 1,260 feet. This static head is equivalent to more than 540 pounds per square inch (psi) pressure. Therefore, it is not practical to pump the water by a single pumping station; thus, the reason for three stations along the route. Most normally used materials for water system construction has an upper operating pressure of 250 psi. Therefore, in order to stay in that range, a minimum of three booster arrangements would be proposed. It is also proposed that each booster station facility include a storage reservoir in order to "break" the line pressure such that the full 540 psi pressure could not be exerted on the pipe system.

Figure II-1 generally shows the two alternate routes.

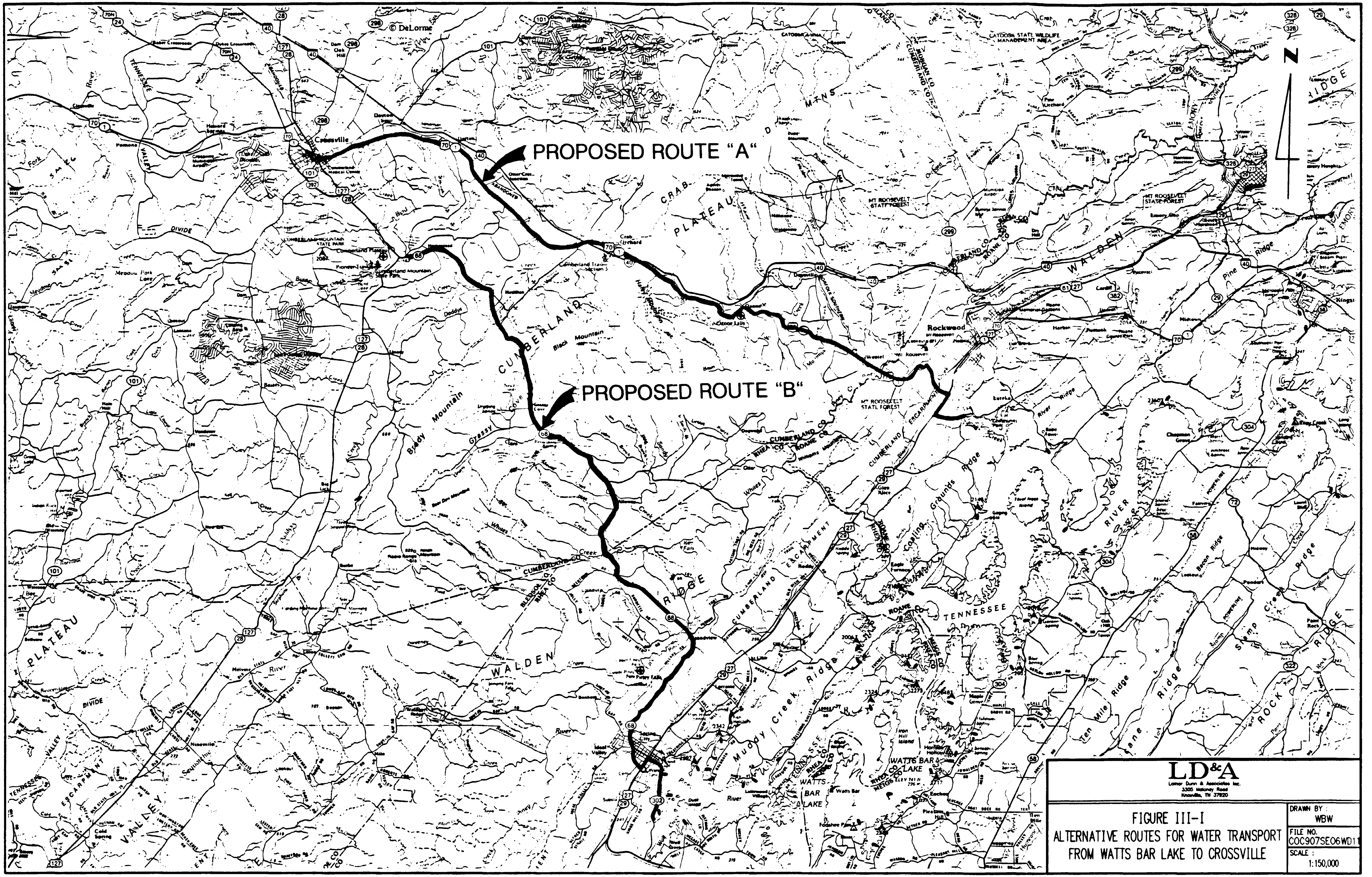


FIGURE III-I
ALTERNATIVE ROUTES FOR WATER TRANSPORT
FROM WATTS BAR LAKE TO CROSSVILLE

COC90701.DWG 1:1

PROJECT COST ESTIMATES

IV

SECTION IV

PROJECT COST ESTIMATES

As can be seen from Section III, two different pipe sizes were investigated as well as two different routes. The following cost estimates (Tables IV-1 and IV-2) are shown for moving water from Rockwood to the Cook Road pressure system.

TABLE IV-1

COST ESTIMATE FOR 24 INCH PIPE OPTIONS

CONSTRUCTION:

Item	Description	Estimated Qty.	Units	Unit Price	Total Price
1.	24" Pipe Line	110,000	LF	$ 90.00	$ 9,900,000.00
2.	Booster Stations	3	EA	$ 1,200,000.00	$ 3,600,000.00
				Sub-Total	$ 13,500,000.00
				Contingency	$ 2,750,000.00
	Total Estimated Construction Cost Less Initial Pumping Station				$ 16,250,000.00

OTHER PROJECT COST:

Engineering	
Permitting	$ 100,000.00
Design	$ 500,000.00
General Engineering During Construction	$ 200,,000.00
Inspection	$ 250,000.00
Administrative and Legal	$ 75,000.00
Land and Rights-of-way	$ 200,000.00
Interests During Construction	$ 300,000.00
Project Contingency	$ 500,000.00
Sub-Total	$ 2,125,000.00
Total Estimated Project Cost	**$ 18,375,000.00**

TABLE IV-2

COST ESTIMATE FOR 30 INCH PIPE OPTIONS

CONSTRUCTION:

Item	Description	Estimated Qty.	Units	Unit Price		Total Price	
1.	24" Pipe Line	110,000	LF	$	100.00	$	11,000,000.00
2.	Booster Stations	3	EA	$	1,200,000.00	$	3,600,000.00
					Sub-Total	$	15,500,000.00
					Contingency	$	2,750,000.00
	Total Estimated Construction Cost Less Initial Pumping Station					$	18,250,000.00

OTHER PROJECT COST:

Engineering		
Permitting	$	100,000.00
Design	$	500,000.00
General Engineering During Construction	$	200,,000.00
Inspection	$	250,000.00
Administrative and Legal	$	75,000.00
Land and Rights-of-way	$	200,000.00
Interests During Construction	$	350,000.00
Project Contingency	$	500,000.00
Sub-Total	$	2,175,000.00
Total Estimated Project Cost	**$**	**20,425,000.00**

PROJECT FINANCE

V

SECTION V

PROJECT FINANCE

The estimated project cost (capital) for the 24 inch option is approximately $18.5 million. The 30 inch option has an estimated cost of $20.5 million. Based on data in Section II-2, additional water will probably be needed within less than 10 years. It is estimated that a two year construction program should be considered and a one year period for design and regulatory approval to construct. Therefore, with 5 – 7 years design should be authorized if this option were to be pursued by the City.

The debt service for $18.5 and 20.5 million at various interest rates are shown in Table V-1. For the purposes of estimating the rate impact of this program, it will be assumed that one billion of gallons water would be sold per year at the outset of construction. Table V-1 also shows the debt service per 1,000 gallons of water sold at the outset.

DEBT SERVICE COSTS ONLY

Cost Parameters	Interest Rate with 20 Year Term				
	1.5%	3%	4%	5%	6%
Annual Principal and Interest 24" option	1,077,546	1,243,490	1,361,262	1,484,488	1,612,914
Cost Per 1,000 Gallons*	$1.08	$1.24	$1.36	$1.48	$1.61
Annual Principle and Interest 30" option	1,194,038	1,377,922	1,508,426	1,644,973	1,787,283
Cost Per 1,000 Gallons*	$1.20	$1.38	$1.51	$1.64	$1.79
*Estimate sales of one billion gallons					

From Section III, the power costs are shown per 1,000 gallons pumped from Watts-Bar. In order to spread that cost over all the customers, it would be a ratio of the total sold.

CONCLUSIONS AND RECOMMENDATIONS

VI

SECTION VI

CONCLUSIONS AND RECOMMENDATIONS

Conclusions

The City of Crossville is the central potable water purveyor for most of Cumberland County. Projections are that if growth continues as it has been in recent history for the next decade, the existing water resources will no longer be adequate to meet the demand. And, if the utility districts were to find alternate source, the City would exhaust its available water before the end of the second decade. Therefore, it is prudent for the City to give serious thought to the long-range water matters.

The Master Plan of 1998 identified several short-range projects which were needed. Most of those are being addressed. The Meadow Park Water Treatment Plant is being replaced. A new storage reservoir has been designed at Homestead. A new line has been designed along U.S. 127 N and an application filed with the EDA to fund the line and a new storage reservoir near the interstate. Design is essentially complete on a major transmission line from the new water plant to the Lantana Tank and on the Homestead Tank. Other than the long-range matter, the City has acted on each of the recommendations.

The Master Plan indicated that a raw water source might be developed on the Caney Fork. An estimated cost for that project was shown in the Master Plan to be approximately $17 million dollars. The potential environmental challenges were mentioned. The U.S. Army Corp of Engineers identified several potential options in a report dated December 1998. They express concern over an impoundment on the Caney Fork and suggested alternatively a water harvesting option. They also mentioned both the Watts-Bar reservoir and the Center Hill reservoir as options. Their estimate for Center Hill and Watts-Bar was $38.44 million and $27.62 million respectively.

If the Caney Fork were pursued, there would be a long drawn out permitting process before construction could begin, if ever. In the above mentioned $17.0 million for the Caney Fork there is not sufficient funding estimated to cover the environmental costs. It is questionable if the necessary environmental permits could be secured before the current water resources are exhausted. This document does not address the cost of treating water at either Watt-Bar end of the pipe or at Crossville. Either way, construction would be required unless treated water was purchased from Rockwood.

Recommendations

If the City desires to compare the cost of this option against others, by either cost or expected difficulty of securing permits, those other options should be given a more in-depth investigation then has been performed to date.

It would also be recommended at preliminary discussions be had with Rockwood as to the possibility of purchasing wholesale water until the demand for the transmission line reaches 2 – 4 MGD. It would be more economical to purchase water in those amounts than it would to build treatment facilities.

If the Watts-Bar option is pursued, the 30 inch pipe should be given serious consideration in that it can deliver approximately twice the volume of water for a small increment in capital cost.