

APPENDIX E

FINAL WATER NEEDS ANALYSIS

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Final Water Needs Analysis

Jackson County, Kentucky

for

Mangi Environmental Group, Inc.

May 7, 1999

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Jackson County, Kentucky

for

**Mangi Environmental Group, Inc.
701 W. Broad St., Ste 205
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May 7, 1999

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INTRODUCTION

This water needs analysis of Jackson County is a study to provide input for an Environmental Impact Statement for development of a water supply reservoir in Jackson County. This study included a review of the Long Range Water Supply Plan Phase I document.

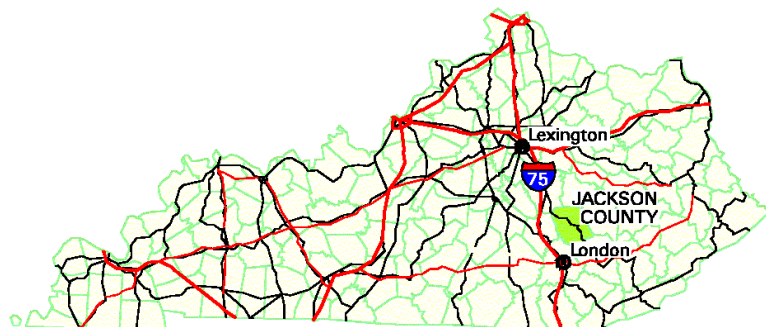
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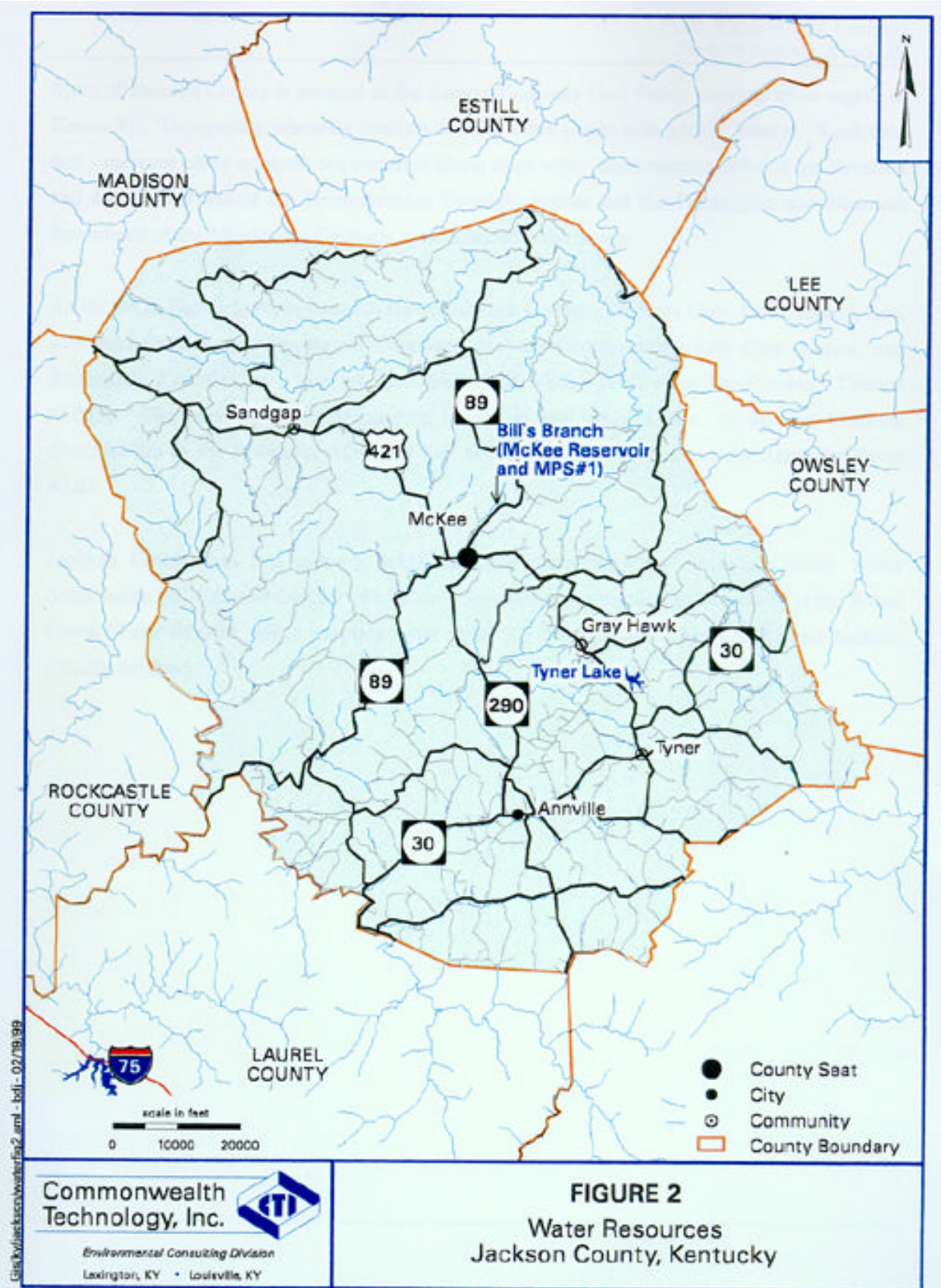
- the existing water supplies in Jackson County,
- the current and recent history of water demand in the county,
- the projections of future water demand in the county under various population growth and water use scenarios, and
- the assessment of regional need for water.

STUDY AREA

Jackson County is located in south central Kentucky as shown in Figure 1. It is rural and sparsely populated. The county area is 346 square miles, and the population density is 34.6 people per square mile. Figure 2 shows Jackson County in greater detail. Incorporated cities in Jackson County include McKee, the county seat, and Annville. Communities in Jackson County include Gray Hawk, Sandgap, and Tyner. Major roads include KY 30 that connects Jackson County to Laurel County and Owsley County and US 421 that connects Jackson County to Rockcastle and Madison Counties in the northwest and Clay County in the southeast. The divide for two major watersheds bisects Jackson County. The Kentucky River watershed lies in the northern portion of the county and the Cumberland River watershed lies in the southern portion.

FIGURE 1 – LOCATION OF JACKSON COUNTY

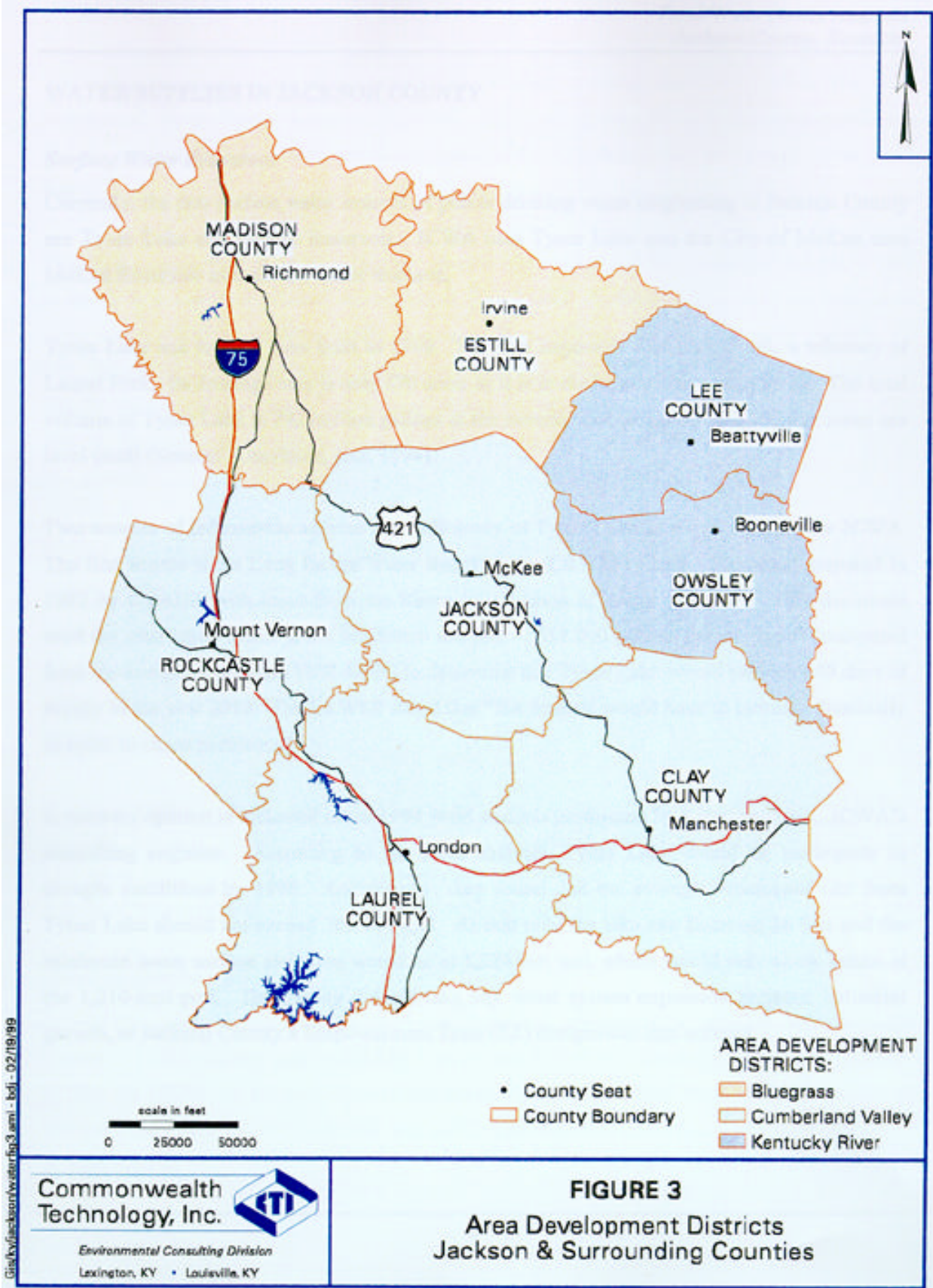




Most of Jackson County is situated in the Eastern Kentucky Coal Fields physiographic region of Kentucky. Topography primarily consists of steep sided slopes with narrow valleys. Sandstone and limestone cliffs or bluffs are common along ridge tops. Sedimentary rocks of the Breathitt and Lee formations of the Pennsylvanian Geologic system and the Pennington and Newman formations of the Mississippi Geologic system underlie the county.

As shown in Figure 3, seven counties border Jackson County. They are Clay, Estill, Laurel, Lee, Madison, Owsley, and Rockcastle Counties. Jackson County, along with Clay, Laurel, and Rockcastle Counties, is a part of the Cumberland Valley (CV) Area Development District (ADD). The other neighboring counties belong to two other ADDs. Estill and Madison Counties are in the Bluegrass ADD and Lee and Owsley Counties are in the Kentucky River ADD.

Jackson County has two primary public drinking water suppliers: Jackson County Water Association (JCWA) and the City of McKee. The other water supplier in the county is the Wood Creek Water District, which supplies water along KY 30 near the Laurel County and Jackson County border.



WATER SUPPLIES IN JACKSON COUNTY

Surface Water Resources

Currently, the two surface water sources of public drinking water originating in Jackson County are Tyner Lake and McKee Reservoir. JCWA uses Tyner Lake and the City of McKee uses McKee Reservoir as their raw water resource.

Tyner Lake and its dam were built in 1969. The dam impounds Flat Lick Creek, a tributary of Laurel Fork. Its drainage area is only 670 acres as it is in the headwaters of this creek. The total volume of Tyner Lake is 792 million gallons at the normal pool elevation of 1,250 feet mean sea level (msl) (Source: Kenvirons, Inc., 1994).

Two sources of information address the sufficiency of Tyner Lake as a water supply for JCWA. The first source is the Long Range Water Supply Plan (LRWSP) Phase I document prepared in 1992 by CVADD with input from the Kentucky Division of Water (KDOW). This document used the total lake volume and a maximum use rate of 611,000 gallons per day (gpd) (computed from the computer program IWR-Main) to determine that Tyner Lake would provide 649 days of supply in the year 2010. The LRWSP stated that “the demand would have to increase drastically in order to cause problems.”

A contrary opinion is indicated in the 1994 yield analysis performed by Kenvirons, Inc., JCWA’s consulting engineer. According to the yield analysis, Tyner Lake would be inadequate in drought conditions by 1998. Additionally, they found that the average withdrawal rate from Tyner Lake should not exceed 700,000 gpd. At that rate, the lake can fluctuate 26 feet and the minimum water surface elevation would be at 1,224 feet msl, which would only allow intake at the 1,210-foot port. Their study did not take any water system expansion projects, industrial growth, or Jackson County’s Empowerment Zone (EZ) designation into account.

According to monthly operating reports, the average monthly maximum gallon per day withdrawal from Tyner Lake is 874,000, which is above the rate recommended by Kenvirons, Inc. This data supports the assertions of the JCWA that they are at capacity of their lake.

The McKee Reservoir is on Bills Branch. Its drainage area is 685 acres, and the volume of the reservoir is 9.5 million gallons. According to the LRWSP, the McKee Reservoir and treatment plant are insufficient to meet water demand. The LRWSP used a maximum use rate of 188,000 gpd for calendar year 2010, computed from IWR-Main, to determine McKee's insufficiencies. According to monthly operating reports on file for calendar year 1998 with KDOW, the average monthly maximum gallon per day withdrawal from McKee Reservoir is 201,600.

Natural Resources Conservation Services (NRCS) has recently completed the dam for a new reservoir upstream of the current McKee Reservoir. Its name is MPS #1 (Multi-Purpose Structure) and it will be available for municipal water supply once the water is impounded. At the top of the dam, the area of the reservoir will be 34.6 acres, and the drainage area is 563 acres. The volume of water available for municipal water supply will be 66 million gallons, with a yield of 271,000 gallons per day.

JCWA is pumping, from Tyner Lake, over 200,000 gpd more than the use rate calculated in the LRWSP and over 100,000 gpd more than the rate recommended by Kenvirons. The City of McKee is pumping 13,000 gallons more per day than the use rate for long-range water supply planning. The NRCS reservoir will provide relief for the McKee reservoir.

Groundwater Resources

Several resources were used to determine the availability and quality of groundwater in Jackson County. These sources were published data by the USGS and Kentucky Geological Survey (KGS), the USDA soil survey, personal communication with Kentucky Rural Water Association, and personal communication with the Jackson County Health Department. Details are provided in Appendix A.

USGS studies done in 1962 suggest that adequate domestic groundwater supplies are available to single family residences throughout the county. The availability is greater in valley bottoms and lesser on slopes and ridges. The exact availability cannot be predicted and the quality can be highly variable. Coliform contamination in about one-third of the wells tested by the Jackson County Health Department in 1997 indicates a problem with existing wells improperly installed or located.

Although published data suggest groundwater to be sufficient for single family residences, water supplies in Eastern Kentucky have been generally found to be unreliable due to quality and quantity. Therefore, groundwater is not recommended as a long-term public drinking water source for Jackson County.

EXISTING SERVICE AREA

JCWA and the City of McKee reportedly provide water to approximately 70 percent of the county's population (Source: 1998 personal communication with Kenvirons, Inc.). The remaining residents rely on groundwater or cisterns for potable water. Figure 4 shows the service areas of the City of McKee, JCWA, and water suppliers in adjoining counties. The City of McKee service area is the incorporated limits of McKee; JCWA serves most of the remainder of the county. JCWA also sells water to portions of Rockcastle County Water District and Beattyville Water Works.

As of October 1998, JCWA is serving 3,466 residential customers. According to Kenvirons, Inc., this number has increased by about 200 customers per year over the past five years without any new waterline construction projects being undertaken. JCWA also serves around 200 commercial and public customers and provides service to 76 acres of industrial land contained within two industrial parks, Northern Jackson County Industrial Park and Jackson County Regional Industrial Park. Kenvirons, Inc. and JCWA are working on a project to add 40 miles of waterline in Jackson County, and that would still not have all residents connected to public water supply. This new line would add approximately 200 new customers, but is contingent on expanded treatment capacity and additional water supply.

Currently, the City of McKee is serving 583 residential users (including apartments) and 121 commercial and public customers. The City of McKee also provides service to the 10-acre McKee Industrial Park that is fully developed and has three industrial customers.

In the seven surrounding counties, there are 24 water utilities. The utilities' jurisdictional boundaries, shown in Figure 4, were provided by the ADDs. Any unserved areas in the seven surrounding counties are being addressed in their LRWSPs and by the utilities.

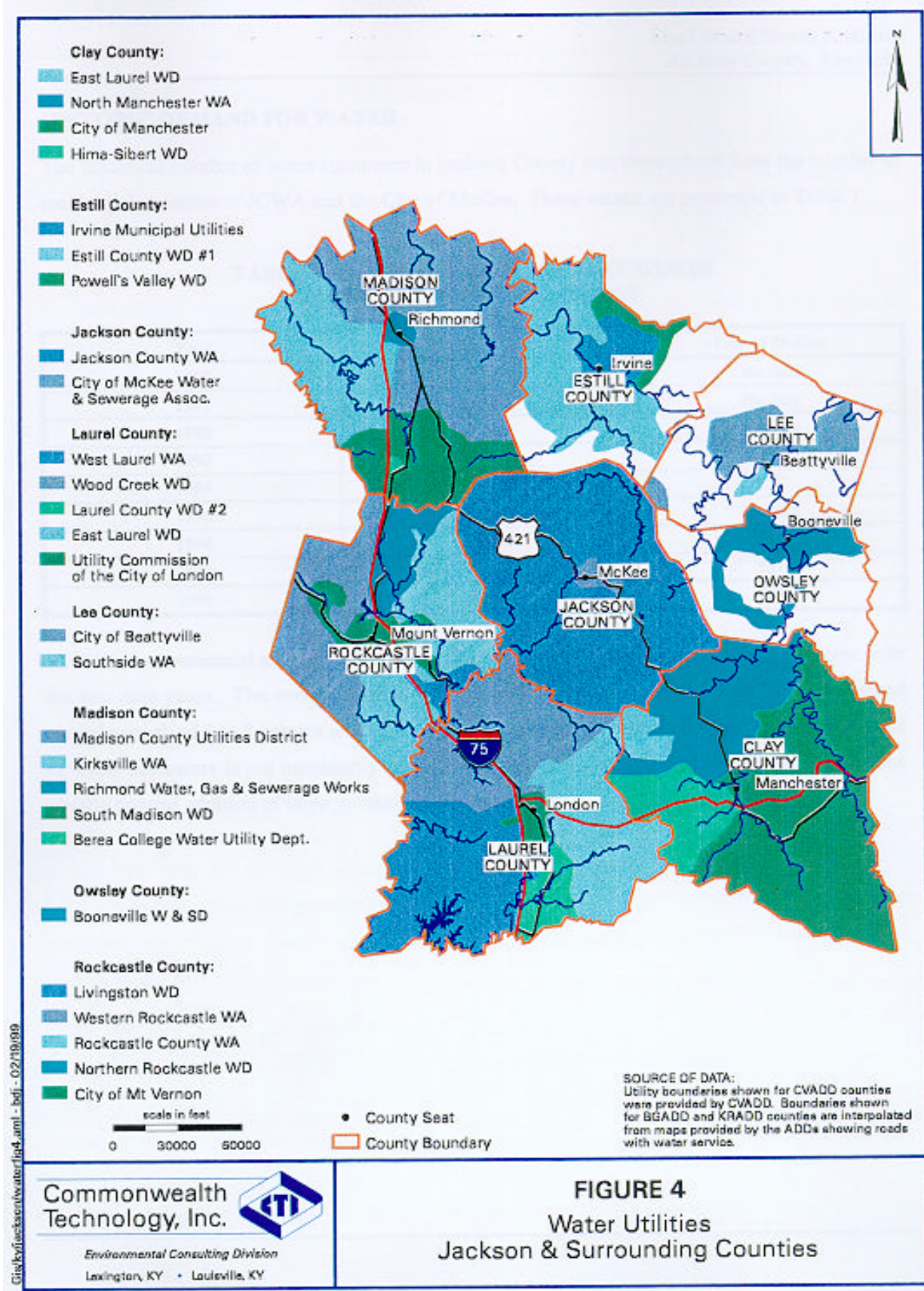


FIGURE 4
Water Utilities
Jackson & Surrounding Counties

HISTORIC DEMAND FOR WATER

The historical number of water customers in Jackson County was determined from the number of residential accounts of JCWA and the City of McKee. These values are presented in Table 1.

**TABLE 1 – RESIDENTIAL WATER ACCOUNTS
JACKSON COUNTY, KENTUCKY**

Year	JCWA	City of McKee
1990	1,989	No data
1991	2,188	No data
1992	2,394	No data
1993	2,509	No data
1994	2,678	252
1995	2,910	No data
1996	3,000	511
1997	3,356	551
1998	3,466	583

JCWA has experienced annual growth rates of new customers ranging from 3 to 12 percent over the last nine years. The average rate of new accounts is 7.2 percent. McKee has experienced annual growth of 6 to 8 percent since 1996. The average growth rate is 6.8 percent. Growth rate of water customers is not necessarily correlated with population growth. Water line extensions usually control addition of large numbers of new customers.

JACKSON COUNTY NEEDS ASSESSMENT

The water needs of Jackson County as a whole, including areas served by JCWA and McKee, are described in this section and quantified in the next section. Also considered are needs on a regional basis, as bordering counties may rely partially on a new raw water source in Jackson County to meet their water needs.

As mentioned previously, there is question as to whether Tyner Lake is adequate for the current demand of JCWA. They are expecting a tap-on ban in the near future. McKee Reservoir also drains a small watershed, and it too is expected to have water supply problems. When NRCS's MPS #1 Reservoir is completed, though, some of McKee's supply problem should be alleviated. Another problem impacting McKee's water service is due to high volumes of line loss in their distribution system. The pipes in their system are asbestos cement and they typically experience a line loss of about 25 percent of total water produced. This loss is excessive. Kentucky Rural Water Association can provide guidance for reducing water loss by finding leaks, ensuring accurate metering, and other techniques.

Based on the yield analysis conducted by Kenvirons, Tyner Lake can be expected to yield 700,000 gpd. Current withdrawal is often greater than this, indicating that the water supply does not have excess capacity for current water needs. McKee's water supply yield from both reservoirs is 271,000 gpd. Currently, the water supplies being used by JCWA and the City of McKee can be expected to reliably yield 971,000 gpd.

In keeping with the USDA's Water 2000 project and Governor Paul Patton's Water 2020 program to ensure that everyone has access to a good drinking water source, JCWA will need to continue expanding its distribution system throughout the county, and additional water supply will be required.

REGIONAL NEEDS ASSESSMENT

Table 2 shows possible needs in surrounding counties for a new raw water source situated in Jackson County. This information was provided by the various ADDs, Rural Development personnel, and utility employees. Some of the smaller water associations and some districts are excluded from the discussion due to their geographical separation from Jackson County.

TABLE 2 – REGIONAL NEED FOR A NEW RAW WATER SOURCE IN JACKSON COUNTY, KENTUCKY

County	Water Utility	Would They Rely On Lake For Water Supply?	Comments
Clay	North Manchester Water Association	YES	They would like to get water from Jackson County.
Estill	Irvine Municipal Water & Estill County Water District	NO	They are not looking for a new source.
Laurel	Wood Creek Water District	NO	They have adequate supply.
Lee	Beattyville Water Works	NO	Although they currently buy 200,000 gallons per month from JCWA, they are planning to build their own reservoir. The preliminary engineering report is complete.
Madison	City of Richmond, Madison County Utilities Service, & Kirksville Water Association	NO	Richmond is too far north to be interested in a lake in Jackson County.
Madison	Berea College Water Utility Department & Southern Madison Water Association	MAYBE	They need additional supply. If the lake location is close to Madison County and if the cost of water is reasonable, then yes. Otherwise, Berea College will pursue plans to build a fifth reservoir.
Owsley	Booneville Water & Sewer District	YES	There would be lots of opportunities to expand their system. They also think the lake would be important as a reserve.
Rockcastle	Rockcastle County Water Association	YES	They currently rely on JCWA and would continue to do so.

Three utilities expressed an interest in a new raw water source in Jackson County, and Berea College Water Utility Department would consider relying on a new lake to supplement their water supply. Planning level (not precise) quantification of the out-of-county demand presented below is based on the following assumptions:

1. North Manchester Water Association – currently buys approximately 200,000 gallons of water per day from the City of Manchester. The City of Manchester produces about 1.8 million gallons per day (mgd) and had a shortage in 1998, according to a representative at the Manchester Chamber of Commerce. Both utilities are interested in an additional water source. Currently, a raw water pipeline to carry 13 mgd from Laurel Lake is being investigated. This pipeline will be designed to serve the needs of Clay, Leslie, and Jackson Counties for 30 years. Clay County is projected to need 5 mgd in the year 2030, with approximately 550,000 gallons per day (11%), allocated to North Manchester. This represents 37.9 percent of the Jackson County year 2030 need, therefore, 37.9 percent was added to the Jackson County projections to account for projected water needs of North Manchester Water Association. (See note at the end of this section).
2. Berea College currently has four water supply reservoirs. A fifth reservoir was assumed to add 20 percent to their capacity. Berea College provides water to a population of 11,400, 20 percent of which is 2,288 people. This represents 17.8 percent of Jackson County population, so 17.8 percent was added to the Jackson County water need to account for projected water need for Berea.
3. Booneville withdraws water from the South Fork of the Kentucky River. The LRWSP for Owsley County found this supply to be inadequate during drought conditions. They have indicated that a back-up supply (such as from Jackson County) would be beneficial during a drought, and allow them to possibly expand their distribution system. Additional water need of 10 percent was assumed, which equates to 3.2 percent of the projected Jackson County need in the year 2000. Other utilities which draw water from the Kentucky River may also benefit from a backup supply.
4. Rockcastle County Water Association purchased 1.7 million gallons in 1995 from JCWA. According to Doug Moore of United States Department of Agriculture-Rural

Development (USDA-RD) London office, Rockcastle County Water Association needs are not expected to greatly increase. 1.7 million gallons is approximately 1 percent of the current Jackson County water demand.

The sum of these demands is 59.9 percent, therefore the rounded value of 60 percent was added to the Jackson County water need, starting in year 2000.

Note: Recent discussions between representatives of Jackson and Clay Counties indicate the possibility of Clay County utilizing a potential Jackson County reservoir to fulfill their entire 5.0 mgd shortfall projected for the year 2030. (Jackson County Lake Committee, April 1999) This desire does not, at this time, warrant consideration as a requirement. But it does indicate additional study for any subsequent Environmental Impact Statement.

NEEDS QUANTIFICATION AND ANALYSIS

In order to quantify water needs from now until the year 2050, two types of criteria are needed. The first is water consumption rates, and the second is population projections. Both of these criteria are subject to many factors that can either increase or decrease their rates. Some factors affecting water use and population include economic situation, improved technology, improved transportation systems, and job availability. As a result of the variance in water use and population, ranges of plausible criteria were used to determine water needs in Jackson County.

Residential Use

One per capita use rate was computed for the water needs analysis: 67 gallons per person per day. Calculations are shown in Appendix B.

This value was computed from data compiled from the Kentucky Public Service Commission’s (PSC) Annual Report Statistics Summaries for 1994 through 1997. These reports contain water consumption data for every water district, water association, and privately-owned water supplier in the state. For reference, Table 3 provides residential use rates of Jackson County and other nearby utilities.

**TABLE 3 – RESIDENTIAL WATER USE COMPARISON
 GALLONS PER PERSON PER DAY**

Utility	Use Rate	Comments
JCWA	54	average 1989 to 1997
McKee	30	average 1996 to 1998 (low value may be due to reporting differences)
Berea	49	based on 1997 water use of Berea sewer customers
Morehead	55	based on 1996 water use of Morehead Utility Plant Board
Rowan Co	58	based on 1996 water use of Rowan Water, Inc.
Bath Co	57	based on 1996 water use of Bath County Water District
Somerset	61	average 1992,1994, 1996, 1998 water use of Somerset Water Service
PSC	67	average of all reporting to the Public Service Commission, 1994 to 1997

Commercial Use

Due to wide variations in commercial use (Table 4), three per capita commercial use rates were selected:

- Low: 25 gallons per person per day, the average JCWA commercial use rate, 1989 through 1997.
- Moderate: 30 gallons per person per day, a moderate increase from the historical JCWA commercial use rate.
- High: 50 gallons per person per day, approximately the average commercial use rate reported to the PSC by private water companies, which serve moderate to large population centers in Kentucky.

**TABLE 4 – COMMERCIAL WATER USE COMPARISON
 GALLONS PER PERSON PER DAY**

Utility	Use Rate	Comments
JCWA	25	average 1989 to 1997
Berea	18	based on 1997 water use of Berea sewer customers
Morehead	52	based on 1996 water use of Morehead Utility Plant Board
Rowan Co	5	based on 1996 water use of Rowan Water, Inc.
Bath Co	5	based on 1996 water use of Bath County Water District
Somerset	66	average 1992,1994, 1996, 1998 water use of Somerset Water Service
PSC avg	21	average of all reporting to the Public Service Commission, 1994 to 1997
PSC high	48	average of all private water companies reporting to the PSC, 1994 to 1997

Industrial Use

Jackson County has three industrial parks. Their total acreage, developed acreage, and water providers are shown in Table 5. The McKee Industrial Park is served by the City of McKee and has all ten acres completely developed. There are three customers in the park and their water accounts are a part of the commercial classification used by the City of McKee. Both the Northern Jackson County Industrial Park and the Jackson County Regional Industrial Park are partially developed and are both served by JCWA. The Industrial Authority of Jackson County is planning to purchase an additional 55 acres for the Jackson County Regional Industrial Park, and additional industrial land (approximately 100 acres) is anticipated to be needed by 2050, according to a representative of the Jackson County Empowerment Zone.

**TABLE 5 – INDUSTRIAL PARKS
JACKSON COUNTY, KENTUCKY**

INDUSTRIAL USE			
Industrial Park Name	Total Size Acres	Currently Developed Acres	Water Provided By
Jackson County Northern Industrial Park	62.87	23	JCWA
Jackson County Regional Industrial Park	104	53.4	JCWA
McKee Industrial Park	10	10	City of McKee
Additional Acreage Projected ¹	155	0	JCWA

¹As projected by EZ for development by 2050.

Table 6 shows the current water usage per acre per day over the past six years for the combined developed park acreage in the JCWA service area. Based on industrial water usage computed by JCWA, the highest industrial rate was in 1992 at 122 gallons per acre per day (gpapd) and the average rate was 98 gpapd. These rates are reflective of low water use industries for many industrial parks, but this is probably due to the types of industries that typically locate in areas of minimal infrastructure.

**TABLE 6 – CURRENT WATER USE BY INDUSTRIAL PARKS
JACKSON COUNTY, KENTUCKY**

Year	Acres Developed	Industrial Use (gpy)	Rate (gpapd)
1992	76.4	3,401,500	122
1993	76.4	2,040,000	73
1994	76.4	2,846,400	102
1995	76.4	2,846,400	102
1996	76.4	2,366,900	85
1997	76.4	2,852,400	102
		AVERAGE RATE:	98

gpy = gallons per year

gpapd = gallons per acre per day

Table 7 shows a comparison of water use rates for three utilities in Kentucky that have experienced significant economic development.

**TABLE 7 – INDUSTRIAL WATER USE COMPARISON
 GALLONS PER ACRE PER DAY**

Utility	Use Rate	Comments
JCWA	98	average 1989 to 1997
Winchester Municipal Utilities	875	Current use rate for industries served by Winchester Municipal Utilities
Louisville-Jefferson Metropolitan Sewer District	1000	Guideline for sewer design for Louisville and Jefferson County Metropolitan Sewer District
Somerset	2914	average 1990, 1992, 1994, 1996, 1998 industrial water use of Somerset Water Service

Three industrial water use rates were used to predict future water use for Jackson County:

- Low: 100 gallons per acre per day, approximately the JCWA historical average.
- Moderate: 200 gallons per acre per day, twice the historical average of the JCWA, and reflects the limitations of wastewater treatment in the county.
- High: 1000 gallons per acre per day, the value cited in the Louisville and Jefferson County Metropolitan Sewer District (MSD) Design Manual.

Table 8 shows the projected industrial water use through 2050. There are 90.47 acres remaining for industrial development in Jackson County. Industrial water use is projected to increase through 2050 as additional industries move into Jackson County or as current industries expand their operations. Jackson County’s EZ designation could cause rapid industrial growth by the year 2005. Accordingly, it was assumed that a 85.47 additional acres of industrial park land would be developed by 2005, and an additional 20 acres would be developed every five years between 2005 and 2035 as residual effects of the EZ designation. The remaining 30 acres were evenly distributed over the remaining portion of the planning period.

**TABLE 8 – PROJECTED INDUSTRIAL WATER USE THROUGH 2050
 JACKSON COUNTY, KENTUCKY**

Year	Acres Developed	Industrial Use (gallons per year)		
		low	moderate	High
2000	96.87	9,687	19,374	96,870
2005	171.87	17,187	34,374	171,870
2010	191.87	19,187	38,374	191,870
2015	211.87	21,187	42,374	211,870
2020	231.87	23,187	46,374	231,870
2025	251.87	25,187	50,374	251,870
2030	271.87	27,187	54,374	271,870
2035	291.87	29,187	58,374	291,870
2040	301.87	30,187	60,374	301,870
2045	311.87	31,187	62,374	311,870
2050	321.87	32,187	64,374	321,870

gpy = gallons per year

Population Projections

For this report, three estimates of future population in Jackson County were used: low, moderate, and high growth. Population projections were made for the year 2000, and every fifth year to the year 2050.

Low population projections were developed from US Census Data (the 1990 Census and 1997 estimate of total people in Jackson County). Projections were provided by the Kentucky Population Research Center at the University of Louisville for the years 2000, 2010, and 2020. The Kentucky Population Research Center is the official resource for population projections in Kentucky. For the years 2005 and 2015, linear interpolation was used. The exponential growth rate of the census projection from 1990 to 2020 was determined to be approximately 0.5 percent per year and was used to project population to 2050. More information is provided on the Kentucky Population Research Center in Appendix C.

The moderate population projection started at the 1997 population estimate (12,829) and then allowing the population to grow exponentially at a rate of 1 percent per year. An alternative starting point for projections (year 2000 population) was considered because the 1990 Census may have underestimated the number of people in Jackson County (11,955), and may have underestimated the number of people per household (2.71). A modified value was determined from electrical meter records. Jackson Energy, who supplies electricity to all of Jackson County,

has on record 5,329 residential accounts. This number does not include separate Electro-Thermal Storage (ETS) accounts, but does include 1,198 addresses with more than one account. Most of these 1,198 addresses are residences with more than one electric meter, but some may be households sharing a mailbox. We assumed that 80 percent of the 1,198 were households with more than one meter, suggesting 4,371 households in Jackson County with electrical service. This value is less than the Census estimate of 1990 households (4,381), and was not used.

High population projections started at the 1997 population estimate (12,829) and used an exponential growth rate of 1.3 percent, the growth rate of Pulaski County from 1960 through 1990. Pulaski County is a nearby county (county seat is Somerset) which has experienced significant economic development in the last few decades. Jackson County could experience a similar growth rate if EZ initiatives provide significantly increased job opportunities.

Low, moderate, and high population projections are shown in Table 9. For planning purposes, it was assumed that 85 percent of the Jackson County population will be served by a public water supply by 2000. This is the maximum coverage cited by a representative of the Kentucky Rural Water Association. Current estimate of coverage according to a JCWA official is 70 percent.

**TABLE 9 – POPULATION PROJECTIONS
 JACKSON COUNTY, KENTUCKY**

	Low	Moderate	High
1997	12,829	12,829	12,829
2000	13,189	13,218	13,336
2005	13,618	13,892	14,226
2010	14,046	14,601	15,175
2015	14,333	15,345	16,187
2020	14,619	16,128	17,267
2025	14,911	16,951	18,419
2030	15,209	17,816	19,647
2035	15,513	18,724	20,958
2040	15,823	19,679	22,356
2045	16,140	20,683	23,848
2050	16,462	21,738	25,439

Note: Only 85 percent of Jackson County population is projected to be served by a water public water system.

Projected Water Demands

Water demand scenarios were computed by multiplying each population growth projection by 0.85 to represent population served, then multiplying by the sum of the residential and commercial per person use rates. This product was then added to the industrial water demand, and the resulting sum was increased by 60 percent (the regional demand) to achieve the total water demand. The total water needed was computed by dividing the water demand by 0.85 to account for 15 percent line loss and unaccounted water.

The scenarios shown in Table 10 were used to compute water needs.

**TABLE 10 – PROJECTION SCENARIOS
 JACKSON COUNTY, KENTUCKY**

	Low	Moderate	High
Population Growth	0.5 %	1 %	1.3%
Residential gallons/person/day	67	67	67
Commercial: gallons/person/day	25	30	50
Industrial: gallons/acre/day	100	200	1000
Regional Need	60 %	60 %	60 %

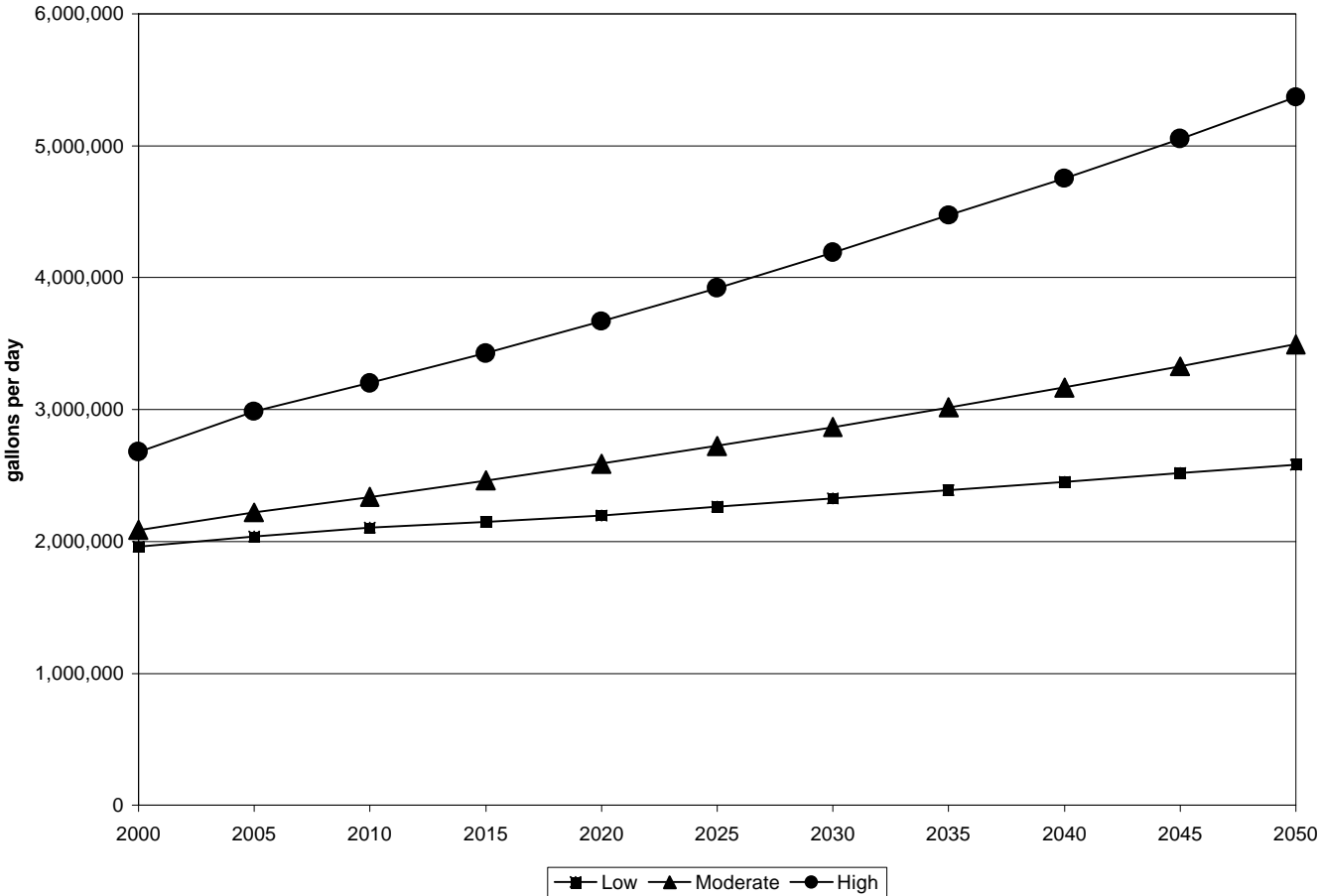
Water needs projections are summarized in Table 11, and shown in Figure 5. Computation details are provided in Appendix D.

**TABLE 11 – SUMMARY OF WATER DEMAND (MILLION GALLONS PER DAY)
 JACKSON COUNTY AND REGIONAL NEEDS**

Year	Low	Moderate	High
2000	2.0	2.1	2.7
2050	2.6	3.5	5.4

*1997 demand for Jackson County was 878,136 gpd.

**FIGURE 2 – WATER NEEDS PROJECTIONS
JACKSON COUNTY AND REGIONAL NEEDS**



CONCLUSIONS/RECOMMENDATIONS

1. The LRWSP for Jackson County should be supplemented with the findings of this report.
2. The combined yield of Tyner Lake and the McKee reservoirs is 971,000 gallons per day; this is less than the low projected water need of Jackson County in the year 2000 (1,200,000 gallons per day).
3. JCWA is currently withdrawing more than the recommended yield from Tyner Lake.
4. Regional need projections amounted to approximately 60 percent of the Jackson County water need. Water suppliers in the Bluegrass region (north of Jackson County), which rely on the Kentucky River, are currently faced with projected water supply deficits under severe drought conditions.
5. It is recommended that the high projection of water need, 5.4 million gallons per day, be used when considering reservoirs to meet water needs in Jackson County. This is recommended because reservoir land impacts and environmental permitting efforts are extensive, and other regional needs may develop in the future.
6. For other water supply alternatives, which can be more easily implemented, it is recommended that the moderate water need of 3.5 million gallons per day be used,

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APPENDICES

APPENDIX A – GROUNDWATER RESOURCES IN JACKSON COUNTY

The Breathitt formation (USGS, HA-38) overlies most of the eastern quarter of the county and consists of interbedded shale, siltstone, and sandstone. Most wells completed in this eastern quarter of the county are completed in sandstones of the Breathitt formation. Most wells drilled in valley bottoms will produce a sufficient supply for a modern domestic supply. About half of the wells drilled into the Breathitt formation along slopes and ridge tops will produce a modern domestic supply. Most of these wells will produce moderately hard water with noticeable amounts of iron.

The thicker sandstone beds of the Lee formation (USGS, HA-38) are present in the western three-quarters of the county. These wells tend to have a greater recharge rate and almost all wells drilled in the valley bottoms will produce sufficient water for a modern domestic supply. At least three-fourths of the wells drilled on slopes and ridge tops will produce a minimum domestic supply. Wells that are drilled through the full 500-foot thickness of the Lee formation may produce a sufficient municipal or industrial supply. The water tends to be soft to moderately hard with noticeable amounts of iron.

The Kentucky Geological Survey (KGS) reports that there have been 157 domestic water supply wells registered in Jackson County since 1988. These registered wells have an average depth of 116 feet.

The Kentucky Farm Bureau analyzed 20 domestic water supply wells in Jackson County. Farmers delivered water samples to the Farm Bureau offices, then Farm Bureau delivered the samples to an analytical laboratory. The location of the wells was not reported. The average depth was 86 feet, with a range of 15 to 165 feet, 13 were drilled wells and 4 were dug wells. The wells were not selected randomly but were part of a Kentucky Farm Bureau service program. The results of the analysis show only one sample above drinking water standards. (Note: standards apply to public water supplies). No distinction is made between dug and drilled wells in reporting of the data. Dug wells are generally very shallow and can be more susceptible to the infiltration of contaminants.

The Jackson County Health Department tested nine well water samples for fecal coliform in 1997 and three were contaminated. One sample tested for total coliform was also contaminated. To date, 12 tests have been conducted during 1998, and 5 samples were contaminated with fecal

coliform. Fecal coliform contamination can be prevented by proper installation and location of wells.

Kentucky regulations for water well construction practices and standards (401 KAR 6:310) provide minimum standards for location, construction, and modification of water wells. It states in the section called water samples:

“Upon completion and disinfection of a new well or modification of an existing well, the driller shall be responsible for having the well tested for fecal coliform if the well is for potable use. The driller shall also give the owner information prepared by the cabinet explaining the importance of water well sampling, procedures for sampling, and how the water can be tested to assure a safe supply of water.”

The regulations further give specific instructions for locating wells away from potential sources of contamination.

APPENDIX B – WATER RATE CALCULATIONS

TABLE B-1 – COMPUTATION OF PER CAPITA USE RATE FOR JACKSON COUNTY WATER ASSOCIATION

JCWA water use data from Kenvirons, Inc., 1998. "Potable Water Projections for Jackson County"										
Year	Residential		Commercial			Industrial		Other*	Line Loss	Total
	Customers	Total gpy	Gal/Person/Day**	Customers	Total Gallons	Gal/Person/Day**	Total Gallons	Total Gallons		Average Gpd
1989	1,972	98,001,600	50	114	14,741,100	8	1,259,600	31,496,000	10.90%	398,625
1990	1,989	112,354,200	57	86	10,113,300	5	2,297,100	37,530,500	10.98%	444,644
1991	2,188	112,088,100	52	132	16,437,100	8	1,589,800	27,669,200	8.71%	432,285
1992	2,394	123,061,800	52	138	17,197,500	7	3,401,500	54,485,276	15.20%	542,866
1993	2,509	132,986,800	54	148	17,487,900	7	2,040,000	57,951,845	17.00%	576,621
1994	2,678	149,054,114	56	157	18,839,800	7	2,846,400	38,672,741	10.40%	573,734
1995	2,910	157,519,766	55	159	18,839,800	7	2,846,400	54,531,602	9.85%	640,377
1996	3,000	161,205,100	54	186	19,439,700	7	2,366,900	63,911,000	10.76%	676,501
1997	3,356	163,059,000	49	212	22,975,100	7	2,852,400	82,105,300	14.79%	742,443
average	2,455	130,783,935	54	140	16,637,025	7	2,330,963	45,781,021	11.73%	535,707

* Other includes line loss

** Based on 2.71 people per household, and assuming a residential customer is a household. From the 1990 census.

Legend: gpy = gallons per year
 gpcpd = gallons per capita per day
 gpd = gallons per day

TABLE B-2 – COMPUTATION OF PER CAPITA USE RATE FOR THE CITY OF MCKEE

City of McKee water use data from facsimile provided by Beulah Venable at City of McKee; the info was a monthly summary.							
	Residential			Comm., Public, Other*		Line Losses**	Total
	Users	Total Gallons	Gal/Person/Day	Total Gallons	Gal/Person/Day		Average gpd
1996	511	13,728,756	27	17,757,480	35	25.00%	1,049,541
1997	551	16,339,164	30	24,990,948	46	25.00%	1,377,670
1998	583	17,497,356	30	23,491,620	41	25.00%	1,366,299
average	548	15,855,092	29	22,080,016	41	25.00%	1,264,504

* Computed from Commercial + Tax Exempt categories (includes industrial)

** Estimated by Utility

*** Based on 2.71 people per household, and assuming a residential customer is a household. From the 1990 census.

Legend: gpd = gallons per day

TABLE B-3 – COMPUTATION OF PER CAPITA USE RATE FOR KENTUCKY PSC STATISTICS

PSC Use Data from www.psc.state.ky.us													
Water Districts													
Year	Number Reporting	Residential			Commercial			Industrial		Other*		Line Losses**	
		Customers	Total gpy	Gal/Person/Day***	Customers	Total gpy	Gal/Person/Day	Customers	Total gpy	Customers	Total gpy		Total gpy
1994	143	305,856	20,000,679,032	69	13,852	4,858,417,550	17	272	1,161,725,847	449	7,580,121,940	13.53%	4,546,207,773
1995	138	321,258	20,710,439,105	68	12,725	4,850,720,425	16	621	1,159,469,730	435	7,555,512,590	14.27%	4,891,205,442
1996	142	335,777	21,375,912,525	67	13,889	4,878,930,175	15	265	1,236,553,178	478	7,780,961,922	13.97%	4,927,548,394
1997	136	348,542	21,765,995,910	66	15,424	5,141,771,068	16	274	1,286,842,082	484	7,312,688,869	14.17%	5,031,384,117
Water Associations													
Year	Number Reporting	Residential			Commercial			Industrial		Other*		Line Losses**	
		Customers	Total gpy	Gal/Person/Day***	Customers	Total gpy	Gal/Person/Day	Customers	Total gpy	Customers	Total gpy		Total gpy
1994	29	42,833	2,499,841,966	61	1,168	226,428,842	6	13	9,665,100	20	117,746,350	19.66%	560,524,483
1995	28	45,196	2,626,610,982	61	1,136	234,200,532	5	13	9,778,600	21	120,540,837	15.25%	456,147,470
1996	26	47,870	2,719,350,069	60	1,227	264,002,765	6	13	7,692,700	24	140,517,800	14.65%	458,774,028
1997	24	51,608	2,836,138,227	58	1,616	267,426,111	5	13	9,100,300	25	162,635,742	14.55%	476,556,205
Privately-Owned Water Companies													
Year	Number Reporting	Residential			Commercial			Industrial		Other*		Line Losses**	
		Customers	Total gpy	Gal/Person/Day***	Customers	Total gpy	Gal/Person/Day	Customers	Total gpy	Customers	Total gpy		Total gpy
1994	28	92,388	6,380,498,597	73	8,814	4,460,972,547	51	76	1,108,573,272	1,622	2,561,321,868	7.18%	1,041,916,099
1995	23	94,318	6,421,599,845	72	8,393	4,335,921,945	48	45	1,666,938,735	1,674	2,580,701,637	8.81%	1,277,904,786
1996	21	96,006	6,587,014,374	72	8,935	4,390,897,136	48	73	1,195,595,439	1,744	2,466,690,948	7.00%	1,024,813,853
1997	19	97,401	6,325,520,730	68	9,051	4,287,440,034	46	72	1,282,787,452	1,784	2,039,070,100	9.77%	1,361,431,749
ALL PSC DATA AVERAGED													
Year	Number Reporting	Residential			Commercial			Industrial		Other*		Line Losses**	
		Customers	Total gpy	Gal/Person/Day***	Customers	Total gpy	Gal/Person/Day	Customers	Total gpy	Customers	Total gpy		Total gpy
1994	200	441,077	28,881,019,595	69	23,834	9,545,818,939	29	361	2,279,964,219	2,091	10,259,190,158	13.53%	6,148,648,355
1995	189	460,772	29,758,649,932	68	22,254	9,420,842,902	28	679	2,836,187,065	2,130	10,256,755,064	13.75%	6,625,257,698
1996	189	479,653	30,682,276,968	67	24,051	9,533,830,076	27	351	2,439,841,317	2,246	10,388,170,670	13.29%	6,411,136,276
1997	179	497,551	30,927,654,867	66	26,091	9,696,637,213	26	359	2,578,729,834	2,293	9,514,394,711	13.75%	6,869,372,071
average	186	479,325	30,456,193,922	67	24,132	9,550,436,730	27	463	2,618,252,739	2,223	10,053,106,815	13.60%	6,635,255,348

*Other includes water produced for resale.

** Line loss was tallied by PSC and is a percent total water produced each year.

*** Based on 2.6 average # of people/household statewide. From 1990 Census Data.

Legend: gpy = gallons per year
 gpcpy = gallons per capita per year
 gpcpd = gallons per capita per day

APPENDIX C – ABOUT KENTUCKY POPULATION RESEARCH

About Kentucky Population Research...

Kentucky Population Research (KPR) is the applied demographic research program of the University of Louisville's Urban Studies Institute providing technical assistance to the Kentucky State Data Center. As Kentucky's representative in the Federal-State Cooperative Program for Population Estimates and Projections, KPR, in conjunction with the U.S. Bureau of the Census, is the state's official source of population estimates and forecasts. In addition, we maintain extensive data holdings including 1980 and 1990 census data, Current Population Surveys (CPS), Kentucky vital statistics, and Bureau of Economic Analysis (BEA) data. These resources provide the basis for a variety of demographic services to accommodate the informational needs of state and local governments and businesses.

Michael Price serves as the Kentucky State Demographer and directs the KPR program. Technical/research assistance is provided by Thomas Sawyer and Martye Scobee. For questions about what data and services are available, contact the Kentucky State Data Center at 502-852-7990.

Source: <http://athena.louisville.edu/cbpa/kpr/>

APPENDIX D – WATER NEEDS COMPUTATION

APPENDIX D – JACKSON COUNTY WATER NEEDS

Units: Gallons per day

Low								
Year	KPR 1999	% Pop. Served	Residential	Commercial	Industrial	Total JC Demand	County Effects	Total Need
	Population	0.85	gpcd	gpcd	gpcd		Included	Line Loss Incl.
			67	25	100		0.6	0.15
2000	13,189	11,211	751,114	280,266	9,687	1,041,067	1,665,707	1,959,655
2005	13,618	11,575	775,517	289,372	17,187	1,082,076	1,731,321	2,036,848
2010	14,046	11,939	799,920	298,478	19,187	1,117,584	1,788,135	2,103,688
2015	14,333	12,183	816,236	304,566	21,187	1,141,989	1,827,182	2,149,625
2020	14,619	12,426	832,552	310,654	23,187	1,166,393	1,866,228	2,195,563
2025	15,070	12,809	858,232	320,236	25,187	1,203,655	1,925,848	2,265,704
2030	15,462	13,143	880,579	328,574	27,187	1,236,341	1,978,145	2,327,230
2035	15,865	13,485	903,508	337,130	29,187	1,269,825	2,031,720	2,390,259
2040	16,278	13,836	927,034	345,908	30,187	1,303,129	2,085,007	2,452,949
2045	16,702	14,197	951,173	354,915	31,187	1,337,275	2,139,640	2,517,223
2050	17,137	14,566	975,940	364,157	32,187	1,372,283	2,195,653	2,583,121
Moderate								
Year	KPR 1999	% Pop. Served	Residential	Commercial	Industrial	Total JC Demand	County Effects	Total Need
	Population	0.85	gpcd	gpcd	gpcd		Included	Line Loss Incl.
			67	30	200		0.6	0.15
2000	13,218	11,235	752,750	337,052	19,374	1,109,176	1,774,682	2,087,861
2005	13,892	11,808	791,148	354,245	34,374	1,179,767	1,887,627	2,220,738
2010	14,601	12,411	831,504	372,315	38,374	1,242,193	1,987,509	2,338,246
2015	15,345	13,044	873,919	391,307	42,374	1,307,600	2,092,160	2,461,365
2020	16,128	13,709	918,498	411,268	46,374	1,376,140	2,201,823	2,590,380
2025	16,951	14,408	965,350	432,246	50,374	1,447,971	2,316,753	2,725,592
2030	17,816	15,143	1,014,593	454,295	54,374	1,523,262	2,437,220	2,867,317
2035	18,724	15,916	1,066,347	477,469	58,374	1,602,190	2,563,505	3,015,888
2040	19,679	16,727	1,120,742	501,825	60,374	1,682,941	2,692,705	3,167,888
2045	20,683	17,581	1,177,911	527,423	62,374	1,767,708	2,828,333	3,327,450
2050	21,738	18,478	1,237,996	554,327	64,374	1,856,697	2,970,715	3,494,959
High								
Year	KPR 1999	% Pop. Served	Residential	Commercial	Industrial	Total JC Demand	County Effects	Total Need
	Population	0.85	gpcd	gpcd	gpcd		Included	Line Loss Incl.
			67	50	1,000		0.6	0.15
2005	14,226	12,092	810,144	604,585	171,870	1,586,599	2,538,558	2,986,539
2010	15,175	12,898	864,190	644,918	191,870	1,700,978	2,721,565	3,201,841
2015	16,187	13,759	921,842	687,942	211,870	1,821,654	2,914,646	3,428,996
2020	17,267	14,677	983,340	733,836	231,870	1,949,046	3,118,474	3,668,793
2025	18,419	15,656	1,048,941	782,792	251,870	2,083,603	3,333,764	3,922,075
2030	19,647	16,700	1,118,918	835,013	271,870	2,225,801	3,561,282	4,189,744
2035	20,958	17,814	1,193,563	890,719	291,870	2,376,152	3,801,843	4,472,757
2040	22,356	19,003	1,273,188	950,141	301,870	2,525,199	4,040,318	4,753,316
2045	23,848	20,271	1,358,126	1,013,527	311,870	2,683,522	4,293,635	5,051,336
2050	25,439	21,623	1,448,729	1,081,141	321,870	2,851,740	4,562,784	5,367,981

Legend: gpcd: gallons per capita per day

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