Appendix A
Water Supply Information
Second Creek Water Supply Expansion Alternatives

Executive Summary

Purpose of Study

The purpose of this study is to identify and analyze the feasibility to expanding the available supply from the Second Creek system by the construction of a proposed reservoir, and compare it to the development of alternative water supply sources. Alternatives to the new reservoir would be a new withdrawal from either the Yadkin River near Salisbury or the Catawba River near Mooresville.

Previous studies performed by the City of Kannapolis indicate the proposed reservoir would increase the 50-year safe yield from Second Creek from 2.5 to 9.3 million gallons per day (MGD). The alternatives developed for this study will be based on providing a similar water supply. Also included in this study is an assessment on the capacity and operation of the existing Second Creek pump station and pipeline for continued service in the future.

Alternatives

The three alternatives have been considered for this study previously mentioned are described as follows: Alternative 1 is to construct a new reservoir just upstream of the Second Creek pump station. The purpose of this reservoir would be to increase the safe yield of the Second Creek supply. Previous studies indicate a lake of approximately 494 acres would be created and increase the Second Creek source to 9.3 MGD as shown on Figure 1. Alternatives 2 and 3 involve pumping raw water from the Yadkin or Catawba River respectively. Since the reservoir provides a 9.3 MGD supply, Alternatives 2 and 3 shall also be based on a 9.3 MGD supply so that an analysis of the alternatives is based on equal contributions. Proposed improvements to infrastructure involving pump stations and pipelines will be based on a capacity of 7 MGD to supplement the 2.5 MGD safe yield of the Second Creek facilities. The locations of Alternatives 2 and 3 are shown on Figure 1.
Permitting of Alternatives

**Alternative 1 – Second Creek Reservoir**

In order to implement the Second Creek reservoir alternative, sponsors would be required to meet the following permitting requirements:

- Obtain increased inter-basin transfer certificate from the Environmental Management Commission (EMC)
- Re-classification of the watershed by the EMC
- 401 Water Quality Certification/404 Dredge and Fill Permit
- Obtain a Dam Safety Permit

These permitting actions would likely result in the need to develop an Environmental Impact Statement (EIS) in conformance to the North Carolina Environmental Policy Act (NCEPA) process, and obtaining a Finding of No Significant Impact (FONSI) to permit the reservoir development. Reservoir creation results in significant impacts to the environment. Impacts normally include the inundation of wetland areas and the loss of habitat and water quality function of those areas.

This process involves a significant evaluation of all the potential impacts of the proposed reservoir and alternatives to the reservoir. In order to obtain the FONSI, mitigation plans must be developed to the satisfaction of the environmental regulators, and become a condition of the permit. The possibility exists that a proposed reservoir can go through the permitting process for many years and still not satisfy environmental regulators, or the mitigation requirements become too much of a burden to overcome.

**Alternative 2 (Yadkin River) and Alternative 3 (Catawba River)**

Implementation of Alternatives 2 and 3, which would withdraw water from the Yadkin and Catawba Rivers respectively, require that each alternative obtain permits from both state and federal agencies. State agency permits include approval of an inter-basin transfer from the EMC, and meeting state regulations for water main extensions requiring conformance with NCEPA requirements.

The reservoirs located on both the Yadkin River and the Catawba River are licensed by the Federal Energy Regulatory Commission (FERC) for the generation of hydroelectric power. New raw water intakes that withdraw more than 1 MGD from the reservoirs or requests to increase existing permitted withdrawals are considered “Industrial Uses” that require FERC approval to modify the current license. This process is generally a two-step process that first requires the applicant to obtain written approval from the license holder, and then prepare an Environmental Assessment (EA) and conduct an Agency Consultation Process.

The current FERC licenses for the Catawba and Yadkin Rivers will be up for renewal around 2008, and the re-license process has already been initiated. Discussions with the North Carolina Department of Environment and Natural Resources (NCDENR) Division of Water Resources revealed FERC may be reluctant to act on new request until that time. This
might create a significant delay to obtaining additional water through a new intake, and set direction towards utilization of existing intakes with available capacity in the short term.

**Capital Cost Estimates**

The cost estimates developed for this study are termed “order-of-magnitude” estimates by the American Association of Cost Engineers (AACE). An order-of-magnitude estimate is made without detailed engineering data. The intended use of these estimates is for long-range planning and not for project control purposes. Order-of-magnitude estimates are prepared with the use of previous estimates and historical data from comparable work, costing curves, and estimating guides and handbooks. The estimated capital cost of the proposed reservoir and the alternatives are provided in Table ES-1 below:

<table>
<thead>
<tr>
<th>Project Component</th>
<th>Alternative 1 Reservoir</th>
<th>Alternative 2 Yadkin River</th>
<th>Alternative 3 Catawba River</th>
</tr>
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<tr>
<td>Dam and Reservoir Construction</td>
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<td>N/A</td>
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<td>$6,000,000</td>
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<td>$9,744,000</td>
<td>$24,112,000</td>
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<td>$15,744,000</td>
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<td>Total Estimated Construction Cost w/ 25% Contingency</td>
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<td>$19,680,000</td>
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<td>$100,000</td>
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<tr>
<td>Home Acquisition</td>
<td>$3,000,000</td>
<td>$0</td>
<td>$0</td>
</tr>
<tr>
<td>Wetland Mitigation</td>
<td>$7,800,000</td>
<td>$0</td>
<td>$0</td>
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<td>Permitting</td>
<td>$2,000,000</td>
<td>$500,000</td>
<td>$500,000</td>
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<tr>
<td>Engineering Design and Construction Administration @ 15% of Construction Costs</td>
<td>$5,023,000</td>
<td>$2,362,000</td>
<td>$5,646,000</td>
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<tr>
<td>Total Cost Including Construction, Design, and Permitting</td>
<td>$63,341,000</td>
<td>$22,572,000</td>
<td>$43,886,000</td>
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1 Introduction

1.1 Purpose of Study

The purpose of this study is to identify and analyze the feasibility to expanding the available supply from the Second Creek system by the construction of a proposed reservoir, and compare it to the development of alternative water supply sources. Alternatives to the new reservoir would be a new withdrawal from either the Yadkin River near Salisbury or the Catawba River near Mooresville.

Previous studies performed by the City of Kannapolis indicate the proposed reservoir would increase the 50-year safe yield from Second Creek by 2.5 to 9.3 million gallons per day (MGD). The alternatives developed for this study will be based on providing a similar water supply.

Included in this study will be the identification of required infrastructure improvements with budget level cost estimates, identification of regulatory and legal considerations, and estimated schedule for each alternative. The expected outcome of this study is to identify the potential costs of the proposed reservoir for comparison to the cost of the alternatives.

1.2 Current Raw Water Supply System

The City of Kannapolis primary raw water supply is from Kannapolis Lake that has a limited watershed of approximately 10 square miles. However, Kannapolis Lake is supplemented with raw water transfers from the Coddle Creek Reservoir (Lake Howell) and Second Creek. The Second Creek supply is pumped by the city to Kannapolis Lake. According to city staff, the Second Creek pump station is capable of supplying up to 6 MGD; however, the 50-year safe yield of the watershed at the pump station location was determined to be 2.5 MGD in a separate study using 1999 and 2000 minimum pumping data. This same study determined that the 50-year safe yield of Kannapolis Lake is 5.44 MGD. Including the Second Creek transfer and excess water pumped greater than the 2.5 MGD Second Creek safe yield and a 2.3 MGD transfer from Lake Howell. The total 50 - year safe yield of the Kannapolis system is currently estimated to be 10.24 MGD.

1.3 Current System Water Demands and Future Needs

Recent master planning efforts undertaken by Cabarrus County indicate growth in the Kannapolis service area will increase water demands significantly from approximately 8 MGD for an average day (ADD) in 2000 to 14 MGD in 2030. Section 6 of State Water Supply Plan requires submittal of a plan to alleviate the available supply shortfall when the ADD is greater than 80 percent of available supply (80 percent criteria). Based on the analysis above, ADD is now at or just above the 80 percent criteria. Therefore, the safe yield of the Kannapolis Lake needs to be increased to meet future demands. To meet this demand, an additional supply source is required to increase the safe yield of Kannapolis Lake from 10 MGD to 17 MGD to meet the 80 percent criteria in 2050. Since the proposed Second Creek Reservoir increases the safe yield by 6.8 MGD, the development and analysis of the alternatives will be based on increasing the safe yield by 7 MGD.
1.4 Description of Alternatives

The three alternatives have been considered for this study previously mentioned are described as follows: Alternative 1 is to construct a new reservoir just upstream of the Second Creek pump station. The purpose of this reservoir would be to increase the safe yield of the Second Creek supply. Previous studies indicate a lake of approximately 494 acres would be created and increase the Second Creek source to 9.3 MGD as shown on Figure 1. Alternatives 2 and 3 involve pumping raw water from the Yadkin or Catawba River respectively. Since the reservoir provides a 9.3 MGD supply, Alternatives 2 and 3 shall also be based on a 9.3 MGD supply so that an analysis of the alternatives is based on equal contributions. Proposed improvements to infrastructure involving pump stations and pipelines will be based on a capacity of 7 MGD to supplement the 2.5 MGD safe yield of Second Creek. Alternative 2 is to construct a new raw water intake on the South Yadkin River to withdraw 7 MGD. Alternative 3 would do the same on the Catawba River, and is assumed to be located near Mooresville. The locations of Alternatives 2 and 3 are shown on Figure 1.
Figure 1: Alternatives 1, 2, and 3

- Statesville
- Lake Norman
- Mooresville
- Salisbury
- Kannapolis
- Irish Buffalo Creek
- Kannapolis Lake
- Yadkin River

Proposed Reservoir Alternative 1

Existing Second Creek Pumping Station

Proposed Route Alternative 2
30 Inch Pipeline

Approximate Location of New Intake and Pump Station

Proposed Route Alternative 3
30 Inch Pipeline

Approximate Location of New Intake and Pump Station

Second Creek Pipeline Discharge

Existing 30 Inch Second Creek Pipeline

300 Miles
2 Existing System Characterization

2.1 Description of Facilities

The Second Creek pump station (PS) is located at the confluence of Second Creek and Sloans Creek. Steel sheet pile dams across each creek create a pool to allow the withdrawal of water. The raw water is pumped through a 30-inch diameter raw water pipeline to the headwaters of Kannapolis Lake on Irish Buffalo Creek approximately one mile upstream of NC 1350.

This pipeline is located in a 70-foot wide easement across farm fields and through several wooded areas. A horizontal survey of the easement was completed in July 2001. Based on the results of this survey, the length of this pipeline is approximately 44,800 feet or 8.5 miles. According to city staff, the Second Creek system was constructed in the 1940s. For cast iron pipe of this age, a general guideline is to assume that it can only handle an internal pressure of 100 or 150 pounds per square inch (psi).

2.2 System Hydraulic Conditions

The Second Creek pump station contains a single horizontal pump located inside the pump station structure approximately 10 to 12 feet above the water surface level. This pump discharges to the 30-inch pipeline described previously. Surge protection is provided by a surge relief line located just downstream of the check valve located at the pump discharge. According to City staff; this system has a normal pumping capacity of approximately 6 MGD; pumping flows lower than this rate requires increasing system heads by partially closing valves located on the 30-inch pipeline to reduce the pump discharge rate.

The pump station has an intake screen that keeps significant sized debris from entering the pump and clogging it; however suspended sediments in the water are still withdrawn and pumped into the pipeline. To avoid settlement of suspended sediments in the bottom of the pipeline, the flow through the pipe should be have a velocity of 2 feet per second (fps) or greater. At the maximum capacity of 6 MGD, the velocity of the water flow is 1.9 fps. At this low velocity, sedimentation build up inside the pipeline is a continuous maintenance problem. In addition, intermittent operation of the pipeline enhances the settlement of suspended sediments that need cleaning out for each time the pumping operation starts up. Based on these operation conditions; the potential exists for the pipe walls to be experiencing a build up that reduces the pipe’s internal diameter and the capacity of the system.

A preliminary hydraulic analysis was conducted to develop a hydraulic grade line to evaluate the existing operating pressures of the pipeline. Due to the age of the pipeline, cast iron pipe manufactured 50 to 60 years ago has limited design operating pressures. This analysis is needed to determine how much additional pressure the pipeline can handle if flows are increased in the future.

This effort was completed by utilizing United States Geological Survey (USGS) quad maps to estimate the pipeline elevations and the horizontal survey of the 70-foot wide easement.
described above. The estimated high point of the pipeline is at NC 152 with an elevation of approximately 895 feet. The elevation of the centerline of the pump is approximately 665 feet, which provides a static head of 230 feet. At 6 MGD through the 30-inch pipeline with an assumed Hazen-Williams (H-W) C factor of 100, the friction head is approximately 31 feet. The total dynamic head (TDH) at the pump station is 261 feet or 113 psi maximum operating pressure. Operating pressures decrease downstream and reach near zero at the pipeline high point just south of NC 152.

If the “C” factor is much lower like 50, then the friction head increases to 110 feet, the TDH increases to 340 feet, and the operating pressure to 147 psi, assuming the pump can still pump 6 MGD at these higher heads. Minimum pressure in the pipeline is approximately 4 psi at the high point just south of NC 152.

2.3 Future Service Life of Pipeline

Long-term water supply planning could result in the need to increase flows through the 30-inch pipeline up to 13 MGD. This would allow 6 MGD to continue to be pumped from Second Creek and an additional 7 MGD be pumped from the Yadkin River.

Separate regional water supply planning efforts underway could result in the need to ultimately be able to pump 26 MGD through the pipeline. This flow rate allows 6 MGD to continue pumping from Second Creek and a 20 MGD withdrawal from the Yadkin River.

Increasing the flow rate through the pipeline will result in significant increases in operating pressure, which will likely require replacement of part or all of the existing pipe. Listed in Table 1 are the potential flow scenarios and operating conditions.

<table>
<thead>
<tr>
<th>Flow Rate (MGD)</th>
<th>Flow Scenario</th>
<th>Year</th>
<th>Pipe Velocity (fps)</th>
<th>“C” Factor</th>
<th>Max Pressure (psi)</th>
<th>Min Pressure (psi)</th>
<th>Linear Feet of Pipe to Replace</th>
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<tr>
<td>6</td>
<td>Existing</td>
<td>2002</td>
<td>1.9</td>
<td>50</td>
<td>113.0</td>
<td>0.6</td>
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<tr>
<td>6</td>
<td>Existing</td>
<td>2002</td>
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<td>147.2</td>
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<tr>
<td>10</td>
<td>Future Reservoir</td>
<td>2010</td>
<td>3.2</td>
<td>100</td>
<td>133.8</td>
<td>2.3</td>
<td>~6,000</td>
</tr>
<tr>
<td>13</td>
<td>Future Regional</td>
<td>2010</td>
<td>4.0</td>
<td>100</td>
<td>150.3</td>
<td>3.2</td>
<td>~20,000</td>
</tr>
<tr>
<td>16</td>
<td>Future Regional</td>
<td>2020</td>
<td>5.1</td>
<td>100</td>
<td>179.3</td>
<td>4.8</td>
<td>~21,100</td>
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<tr>
<td>26</td>
<td>Future Regional</td>
<td>2035</td>
<td>8.3</td>
<td>100</td>
<td>289.7</td>
<td>11.2</td>
<td>~26,400</td>
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</tbody>
</table>

Depending on the current “C” factor of the existing pipeline, it should be anticipated that significant portions of the existing pipe would need to be replaced future flows greater than 10 MGD. This is most likely to occur under a regional water supply approach for flows in 2010 and beyond. However, at that time the pipe will be 60 to 70 years old and at the end of its expected service life.
2.4 Short-Term Testing and Improvements

If the long-term plan is to continue operating this system with a capacity of 6 MGD, there are several recommendations listed as follows:

- Due to the age of the cast iron pipeline, a field inspection of the pipe walls should be performed at several locations to identify potential corrosion problems and estimate the pipe structural condition. This inspection would be performed by removing a short section of the pipe or removing a coupon to inspect the internal and external pipe walls. In addition, closed-circuit television (CCTV) inspection of some sections should be performed where feasible.

- Field hydraulic testing should be performed to determine the current Hazen-Williams “C” factor and to determine its pressure limits.

- Review of the recently completed survey of the 70 - foot easement revealed the pipeline might not be inside the easement in several locations. Since the 70 - foot easement will be utilized to either replace this line or install a parallel line from another water supply source.

- Improve the intake screening system to prevent suspended solids from entering the pumps and the pipeline.

- Modify existing pump setup for the installation of a second pump to allow pump rates less than 6MGD to make pump station run times more continuous.
3 Infrastructure Improvements of Alternatives

Each of the three alternatives requires substantial infrastructure improvements. Pipelines are sized for a minimum velocity of 2 fps and max of 8 fps, based on new Ductile Iron Pipe (DIP). Maximum system pressure is 250 psi before a booster station is required. Listed below are descriptions of each of the alternatives:

3.1 Alternative 1 (Second Creek Reservoir)

This alternative would develop a water supply reservoir and would involve construction of a dam across Second Creek as shown in Figure 1. The current capacity of the Second Creek PS is 6MGD and must be upgraded to 10 MGD in order to pump the additional supply provided by the reservoir. The upgraded PS should be relocated to the reservoir to withdraw directly from the reservoir. Identifying the proposed site is beyond the scope of this study, however for the purposes of this analysis it is assumed one mile of new 30-inch pipeline would need to be constructed to connect to the existing 30-inch pipeline.

The proposed reservoir, with a normal pool elevation of 685 feet above mean sea level (msl), has an area of 500 acres and an operational storage capacity of 9,700 acre-feet. The impoundment extends westward into Sills Creek and Back Creek.

The proposed impounding structure for the reservoir is an earth dam across Second Creek approximately 4,400 feet downstream of the confluence of Sills Creek and Back Creek. The height of the proposed dam is in the range of 40 to 45 feet, extending from the base of the Second Creek channel (somewhere in the range of 660 and 665 feet msl) to a top of dam (crest) elevation in the range of 700 to 705 feet msl.

NC State Route 1737 currently crosses the proposed reservoir approximately 1800 feet upstream of the proposed dam and would be flooded by the reservoir. Under the current design concept, this two-lane roadway would be relocated along the crest of the proposed earth dam.

3.1.1 Available Geologic and Soils Information

No geotechnical information is currently available for the proposed dam site. Published information from the USGS indicates that the site lies within the Charlotte Belt, which is predominated by plutonic rocks with some large areas of metavolcanic rocks, but very few metasedimentary rocks. Rock units in the vicinity of the dam site include quartzite, and foliated to massive medium- to coarse-grained metamorphosed mafic complex and metamorphosed quartz diorite and tonalite.

Information from the Rowan County Soil Survey describes surface soil materials down to five feet as follows:

- Left Abutment Area – Hiwasee Clay Loam (ML/CL) weathered from felsic to mafic metamorphic to igneous rock, or old alluvium. Bedrock is characterized as being greater than 5 feet deep. Materials are said to be well drained and of moderate permeability. The water table is greater than 6 feet deep.
• Valley Area – Chewaka Loam (ML/CL), or recent alluvium. Bedrock is greater than 6 feet deep. Materials are said to be poorly drained with moderate permeability. The water table is generally located within 0.5 to 1 foot from the surface.

• Right Abutment Area – Pacolet Sandy Loam (ML/CL with SC/MC layers), Cecil Sandy Loam (ML/CL with SC/MC layers), and Uwharrie Loam (ML/CL) weathered from felsic or argillite and other fine grained bedrock materials. Bedrock said to be greater than 6 feet deep, but Saprolite (weathered bedrock) was identified at depths of 3.5 to 4 feet in the soil profiles. The materials are said to be well drained with moderate permeability. Water table is said to be greater than 6 feet deep.

3.1.2 Hydrological Conditions and Assumptions

The watershed for the proposed Second Creek Reservoir has an area of 34.1 square miles and a maximum length of 62,000 feet. The area is predominately farm and forested land. The watershed is drained into two tributaries, Sills Creek and Back Creek. Hillside slopes from the ridges to these tributaries are on the order of 20 percent.

The total storage capacity of the dam with a crest elevation in the range of 700 to 705 feet msl is estimated to be in the range of 30,000 to 35,000 acre-feet. Under North Carolina Administrative Code, Title 15A, Subchapter 2K, Dam Safety (NCAC 15A-2K), this storage capacity results in a classification as a “Large Dam”. The downstream conditions and hazard potential have not been surveyed. For purposes of this reconnaissance-level estimate, it is assumed that there may, now or in the future, be residences in the downstream floodplain of the dam which would further classify the dam as a High Hazard Potential (Class C) dam in accordance with NCAC 15A-2K.

For a Large, Class C dam, NCAC 15A-2K requires that the spillway system be designed for a design storm equal to three-fourths of the Probable Maximum Precipitation (¾ PMP). The estimated peak inflow rate for the ¾ PMP, from existing watershed information, is on the order of 76,000 cubic feet per second (cfs), or about 2,230 cfs per square mile. This peak estimate was based on a 6-hour PMP point rainfall of 29 inches (or ¾ PMP point rainfall of 22 inches) from Technical Paper No. 40, Rainfall Frequency Atlas for the United States, U.S. Department of Commerce, 1961, peak flow computations using procedures in Section 4, Hydrology, Soil Conservation Service National Engineering Handbook, 1972, and hydrological assumptions based on a review of the topographical maps and soils information for the drainage area.

For this reconnaissance estimate, it is assumed that the spillway system must pass the entire peak inflow rate for the ¾ PMP design storm, with at least 3 feet of freeboard in the dam. For estimating purposes, CH2M HILL has assumed an open channel spillway, with 3H:1V side-slopes extending through the ridge at the right abutment of the dam. This appears to be the best location for the spillway. This results in the need for an open channel spillway with a width of approximately 300 feet and a dam crest elevation of 705 feet msl to allow passage of the ¾ PMP with approximately 3 feet of freeboard.

The resulting spillway and crest height requirements are somewhat conservative since the reservoir has substantial storage capacity and actual spillway depth and flow during the design storm will likely be lower than 76,000 cfs once storage is taken into account. The conservative approach at this level of consideration, however, provides an allowance for future design refinements, such as providing a service spillway for everyday use and an
emergency spillway section for rare use, decreasing the spillway side-slopes if competent rock is encountered.

### 3.1.3 Assumptions for Dam and Spillway Construction

On the basis of the following information, assumptions on the design and construction of the dam and spillway have been made:

- The estimate includes only the construction cost for the dam and associated spillway. It does not include additional costs for engineering, design, permitting, impoundment area preparation, wetlands mitigation, road relocation, fish ladders, or other items. Those items are assumed to be in other cost items in the overall project estimate.

- The dam will be a homogeneous earth or earth-rock fill constructed of materials excavated from native materials. A chimney drain is not considered to be necessary given the normal pool depth of 25 feet and the accompanying 50 – foot wide crest necessary to accommodate a two-lane state highway.

- To the extent possible, excavated materials during foundation preparation and spillway construction will be used for dam construction. Borrow materials required to make up the difference will be derived from excavations in the reservoir area.

- The top of the dam will have an elevation of 705 feet msl to accommodate the hydrological assumptions above. The length of the dam at elevation 705 feet msl is 1225 feet.

- The downstream toe of the dam at the maximum section is approximate elevation 660 feet msl, the estimated base of the existing Second Creek channel.

- The crest of the dam will be 50 feet wide to accommodate a two-lane highway (26 feet) with 12 feet to each side for shoulders, guard rails, signs, monitoring devices, et cetera.

- The upstream and downstream slopes of the dam will be 3H:1V and 2.5H:1V, respectively.

- The base of the dam will be prepared by removing existing soil materials to a depth of 5 feet in the abutment areas and to depth of 10 feet in the valley area. A keyway, with a minimum width of 15 feet and a minimum depth of 5 feet will be constructed below the foundation cut along the centerline of the dam. Keyway and undercut areas will be back-filled with compacted embankment materials.

- A 2 - foot thick sand and gravel blanket drain will be installed beneath the downstream slope of the dam in the valley section of the dam.

- A concrete-encased 48 - inch reinforced concrete pipe will be placed through the dam in the vicinity of the existing Second Creek channel. This pipe will be connected to a 40 – foot high inlet structure with gates and to a concrete outlet structure.

- The spillway will be a 300 - foot wide channel with 3H:1V side-slopes through the narrow ridge in the right abutment. The outlet channel will extend around the dam to the downstream channel. The outlet channel downstream of the main cut will have a 300 - foot width, 3H:1V side-slopes, and a depth of 10 feet where it exits the cut and a depth of 6 feet where it extends down the slope.
• Approximately two-thirds of the spillway excavation will be rock excavation with these materials being removed and used in the dam. (No zoning configuration assumed since the exact volume of rock is unknown.)

• The last 400 feet of the outlet channel, which exits down a slope into the natural channel, will be paved with reinforced concrete with an average thickness of one foot. The remainder of the spillway will be in bedrock.

• A 20-foot wide strip of riprap, 2 feet thick, will be provided along the upstream slope of the dam in the vicinity Elevation 685 feet msl for wave action. (The exact configuration was not developed.)

• A 20-foot wide strip of riprap, 2 feet thick, will be provided along the downstream toe of the dam.

3.2 Alternative 2 (Yadkin River)

This alternative would construct a new 7 MGD raw water intake and pump station at a site on High Rock Lake (a site to be determined) near the confluence of the Yadkin River and South Yadkin River. The raw water would be pumped through a new 30-inch pipeline that would be constructed to the existing Second Creek PS and connect to the existing 30-inch pipeline that discharges to the headwaters of Kannapolis Lake. For the purposes of this study, the pipeline would be located in an existing overhead power line easement from the intake to the existing Second Creek PS for approximately 58,000 linear feet (11.0 miles) as shown on Figure 1. Final approval of this location would have to be obtained from the utility easement owner.

3.3 Alternative 3 (Catawba River)

This alternative would construct a new 7 MGD raw water intake and pump station at a site on Lake Norman (a site to be determined) near Mooresville. The raw water would be pumped through a new 30-inch pipeline that would be constructed to the headwaters of Kannapolis Lake. For the purposes of this study, the pipeline would generally follow SR 150 from Lake Norman across Interstate 77 and go around the north side of Mooresville to the intersection with SR 152. From this point the pipeline would follow SR 152 to just west of Five Points and turn south into the existing 70-foot wide Second Creek pipeline easement and terminate adjacent to the Second Creek pipeline discharge point as shown on Figure 1. Total length of the pipeline route is approximately 88,000 linear feet (16.7 miles).
4 Regulatory Permitting Considerations

4.1 Alternative 1 (Second Creek Reservoir)

In order to implement the Second Creek reservoir alternative; sponsors would be required to complete an Environmental Impact Statement (EIS) following North Carolina Environmental Policy Act (NCEPA) process. Secure a 401 Water Quality Certification/404 Dredge and Fill Permit; and obtain a Dam Safety Permit. In addition, the Second Creek watershed could require request reclassification by the Environmental Management Commission. This would require preliminary contacts with the Divisions of Water Quality and Environmental Health, a formal reclassification request, a water supply suitability study, and rule-making action by the EMC including a public hearing. Local governments within the watershed would also be required to implement water supply protection requirements depending on the water supply classification deemed appropriate for the new reservoir and watershed.

In the past decade, the proposed development of new surface water reservoirs has been the subject of heavy scrutiny by environmental regulators. Reservoir creation results in insignificant impacts to the environment. Impacts normally include the inundation of wetland areas and the loss of habitat and water quality function of those areas. The development of a reservoir will like require the preparation of an Environmental Impact Statement (EIS) in accordance to the National Environmental Policy Act (NEPA). The EIS process and obtaining a Finding of No Significant Impact (FONSI) to permit the project is usually a very lengthy and expensive process.

This process involves a significant evaluation of all the potential impacts of the proposed reservoir and alternatives to the reservoir. In order to obtain the FONSI, mitigation plans must be developed to the satisfaction of the environmental regulators, and become a condition of the permit. The possibility exists that a proposed reservoir can go through the permitting process for many years and still not satisfy environmental regulators or the mitigation requirements become too much of a burden to overcome.

4.1.1 Environmental Considerations

The full range of potential impacts to the environment would be identified during the development of an EIS. However, permanent impacts to wetlands would result by construction of the reservoir. Locations of wetlands were identified from the National Wetlands Inventory database. A detailed field investigation would be required during the EIS process to delineate wetlands in accordance with the USACE protocol. Listed below are some initial environmental impacts of the proposed reservoir:

1. Inundation of 500 acres for the reservoir would result in loss of approximately 104 acres of existing wetlands and other natural habitat.

2. The 500 acre reservoir would result in a loss of agricultural and rural lands and could impact cultural/historical properties as well.

3. Existing property owners that are located in the area of the proposed reservoir would have to be relocated.
4.1.2 Dam Safety Design Standards

The North Carolina Department of the Environment and Natural Resources (NCDENR) has jurisdiction over dam safety. In accordance with the Dam Safety Law of 1967 (NCAC 143-215.25A), an application for dam construction must be filed and approved by the Division of Land Resources prior to construction of a dam. Administrative rules for meeting the design, construction, permitting, maintenance, minimum stream flows, and other requirements of the Dam Control Law are contained in North Carolina Administrative Code, Title 15A, Subchapter 2K, Dam Safety. Under the administrative rules, dams are classified by size and hazard classification. Size refers to the height and storage capacity. Hazard classification refers to the potential losses should the dam fail and does not reflect the condition of the dam.

Since the proposed dam and reservoir would impound 30,000 to 35,000 acre-feet, it would be classified as a Large Dam based on DENR administrative rules. Large Dams impound 7,500 to 50,000 acre-feet, or are 50 and 100 feet high.

Residences are located, or could be located, within the floodplain downstream of either dam site and there is likely a potential for loss of life if the dam were to fail - resulting in a High Hazard (Class C) classification for either dam site. This requires that the dam and outlet works be designed to safely pass a Spillway Design Flood equivalent to at least the ¾ PMP.

4.2 Alternatives 2 (Yadkin River) and 3 (Catawba River)

Construction of a new raw water intake and pipeline from either the Yadkin River or the Catawba River would require permits from both the state and federal government.

4.2.1 State Regulations on Inter-Basin Transfers of Water

The proposed withdrawal of water from either the Yadkin or the Catawba River would result in an inter-basin transfer of water to the Rocky River basin. North Carolina Statute G. S. 143-215.22G & G. S. 143.215.22I and North Carolina Administrative Code Section T15A: 02G. 0400, adopted in January of 1994 and modified in 1997 and 1998 regulate surface water transfers in the state. An inter-basin transfer (IBT) certificate is required from the North Carolina Environmental Management Commission (EMC) for new transfers of 2 million gallons per day (MGD) or more (maximum daily demand [MDD]) or once the amount of water transferred from one sub-basin to another reaches the full capacity of the transfer facilities that were existing or under construction as of July 1, 1993 (referred to as the grandfathered capacity).

Prior to EMC consideration of an IBT, the NCEPA process must be completed including an Environmental Assessment and FONSI or completion of an EIS. Following the NCEPA process, the EMC will accept a petition for an IBT Certificate and begin the process for reviewing and approving the IBT.

4.2.2 State Regulations for Water Main Extensions

State regulations (15A NCAC 01C.0100 – 0.0500) establishes procedures and regulations for the extension of water mains, sanitary sewer, and other utility infrastructure expansions and new facilities that must conform to the North Carolina Environmental Policy Act (NCEPA). The regulations require the development of environmental documents for water and wastewater treatment facilities and expansions. In addition, water main extensions must
comply if they are greater than 5 miles in length, and sewer mains greater than 3 miles in length; unless site specific adverse environmental consequences are identified.

4.2.3 Federal Regulations
The reservoirs located on both the Yadkin River and the Catawba River are licensed by the Federal Energy Regulatory Commission (FERC) for the generation of hydroelectric power. These licenses were granted to Alcoa Power Generating Inc. (AGPI) for the Yadkin River, and Duke Power for the Catawba River. The FERC license holder is required to operate and manage the reservoir in accordance to the terms of its license and FERC rules and regulations to avoid compromising the reservoir’s environmental and recreational values or the needs of the license holder to generate hydroelectric power.

New raw water intakes that withdraw more than 1 MGD from the reservoirs or requests to increase existing permitted withdrawals are considered “Industrial Uses” that require FERC approval to modify the current license. This process is generally a two-step process that first requires the applicant obtain written approval from the license holder, and then prepare an Environmental Assessment (EA) and conduct an Agency Consultation Process. Since an IBT certificate must also be obtained from the state, there should be a significant overlap in most of the documentation required for each. However, the FERC EA will require identification of the proposed intake type and location; which will require completion of preliminary engineering of the intake design and pumping facilities if located near the shoreline.

The current FERC licenses for the Catawba and Yadkin Rivers will be up for renewal around 2008, and the re-license process has already been initiated. Discussions with the NCDENR Division of Water Resources revealed FERC may be reluctant to act on new request until that time. This might create a significant delay to obtaining additional water through a new intake; and set direction towards utilization of existing intakes with available capacity in the short term.
5 Estimates of Probable Cost

The order-of-magnitude estimates in this technical memorandum (TM) are prepared with the use of costing curves, previous estimates and historical data from comparable work, and estimating guides and handbooks. Anticipated construction cost are then converted to capital costs to identify the potential total cost of each alternative. An industry standard contingency factor of 25 percent is applied to each alternative’s base cost.

5.1 Definitions of “Order-of-Magnitude” Estimates

The cost estimates contained in this TM are termed “order-of-magnitude” estimates by the American Association of Cost Engineers (AACE). An order-of-magnitude estimate is made without detailed engineering data. The intended use of these estimates is for long-range planning and not for project control purposes. Order-of-magnitude estimates are prepared with the use of previous estimates and historical data from comparable work, costing curves, and estimating guides and handbooks. They have an expected accuracy of plus 50 percent and minus 30 percent of the estimated cost. These percentages should be viewed as statistical confidence limits and should not be confused with the contingencies.

The cost estimates shown, and any resulting conclusions on project financial feasibility or funding requirements, have been prepared from available information at the time of the estimate for guidance in project evaluation or implementation. Final project costs and resulting feasibility will depend on actual labor and material costs, competitive market conditions, actual site conditions, final project scope, implementation schedule, continuity of personnel and engineering, and other variable factors. As a result, final project costs will vary from the estimates presented here. Because of these factors and to help ensure proper project evaluation and adequate funding, project feasibility, benefit/cost ratios, risks, and funding needs must be carefully reviewed prior to making specific financial decisions or establishing project budgets.

For an order-of-magnitude estimate, CH2M HILL standard practice is to apply a 25 to 30 percent contingency. While the estimate is grounded in an understanding of the basic project, additional information beyond what is presently available will affect the preliminary design and project cost.

Assumptions of particular note used in developing these estimates include the following:

5.2 Dam Construction

There is currently uncertainty as to the suitability of bedrock/soil in the proposed spillway cut to accommodate design flow velocities. If the existing materials are unsuitable, the entire spillway section may have to be paved to the design depth. This single item could increase the base estimate from 15 to 20 percent. Due to the current site uncertainties, the upper end of this range has been used in the order-of-magnitude project costs.
Additional Considerations:

- There is a potential for some savings with a roller compacted concrete (RCC) dam, provided that the road can be relocated off the dam and the volume of the RCC dam could be decreased to about 30 percent of the volume of the proposed earth dam. Another major benefit of an RCC dam, at least at this level of consideration, is that the spillway could be made an integral part of the RCC dam, deleting the need and uncertain final design requirements for a large channel spillway in the right abutment.

- The suitability of the site for a RCC dam, and design requirements for either an RCC dam or an earth dam with a channel spillway, cannot be determined for sure until the subsurface conditions, especially those in relation to the location and condition of bedrock at the site, have been determined. The next logical step in the evaluation process would be, at least, an initial field investigation targeting specific data points necessary to identify the path forward. The initial investigation could then be followed up later by a more detailed analysis targeting specific data needs of the selected type of dam, roadway relocation, et cetera.

5.3 Raw Water Intakes/Pump Stations and Transmission Mains

The construction costs for raw water intakes, transmission pipelines, and pump stations were developed using the costs of WSSCC Master Plan similar type planning projects. For pipelines, a “length” contingency has been added to account for minor variations in the pipeline route that could make the final route longer. This was achieved by adding a 15 percent contingency to the estimate. Pipeline costs are then presented in a cost per mile average for the different pipe diameters. Listed below is a summary of the construction costs used:

- 7 and 10 MGD raw water PS and Intakes = $6 Million each
- 30-inch pipeline for Alternatives 1 and 2 averages $168 per linear foot because the rural nature of the pipeline route. Alternative 1 at 5,280 linear feet is $887,000. Alternative 2 at 58,000 linear feet is $9,744,000.
- 30-inch pipeline for Alternative 3 averages $274 per linear foot because of the urbanized area around Mooresville. At 88,000 linear feet, the cost would be $24,112,000.

The pipeline construction costs include appropriate allowances for easement acquisitions, tunneling under road ways, and construction cost contingencies.

5.4 Site Acquisitions

The City has purchased some of the property that would be inundated by the reservoir. For the purposes of this study, it was assumed that half of the land area under elevation 700 feet, which is 366 acres, would still need to be purchased. Research of similar-type properties for sale in September 2002 near the proposed reservoir indicated the average cost was approximately $10,000 per acre. This cost is approximately $3,660,000.

Site acquisitions are also required for the proposed raw water intake and pump station for Alternatives 2 and 3. For the purposes of this study, it is assumed a one-acre site is required.
The proposed pump station site on the Yadkin River (High Rock Lake) is assumed to be $30,000 per acre, and Catawba River (Lake Norman) is $100,000 per acre.

5.5 Home Purchases

For the reservoir, it was assumed approximately 20 homes would have to be purchased. Research of similar-type properties for sale in September 2002 near the proposed reservoir indicated the average cost was approximately $150,000 per home. This cost is approximately $3,000,000.

5.6 Wetlands Mitigation

Permanent impacts to wetlands are limited to the reservoir. Locations of wetlands were based on the National Wetlands Inventory database. A detailed field investigation would be required during the Environmental Impact Statement (EIS) process to delineate wetlands in accordance with the United States Army Corps of Engineers (USACE) protocol. For this study, the extent of wetlands needing mitigation was estimated based on an average ratio of 2.6 acres per acre impacted. The cost for restoration was assumed to be an average of $30,000 per acre mitigated (based on North Carolina Department of Transportation (NCDOT) project costs). The reservoir would require the mitigation of approximately 260 acres for a cost of $7,800,000.

Table 2 provides a summary of cost estimates for both of the proposed alternative sites (based on increasing existing Second Creek water supply to 10 MGD). A detailed breakdown of the costs for each alternative is provided in Appendix A.

**TABLE 2**
Summary of Opinion of Probable Costs
Second Creek Water Supply Expansion Alternatives

<table>
<thead>
<tr>
<th>Project Component</th>
<th>Alternative 1</th>
<th>Alternative 2</th>
<th>Alternative 3</th>
</tr>
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<tbody>
<tr>
<td>Dam and Reservoir Construction</td>
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<td>N/A</td>
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<td>Raw Water Intake and PS Construction Cost Construction</td>
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<td>$6,000,000</td>
<td>$6,000,000</td>
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<tr>
<td>Pipeline Construction Cost</td>
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<td>Home Acquisition</td>
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<tr>
<td>Wetland Mitigation</td>
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<td>Permitting</td>
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<td><strong>$22,572,000</strong></td>
<td><strong>$43,886,000</strong></td>
</tr>
</tbody>
</table>
References

Rowan County Soil Survey

Section 6 of *State Water Supply Plan*

USGS published info regarding Charlotte Belt rock formations


*Section 4, Hydrology, Soil Conservation Service National Engineering Handbook, 1972*
WATER AND WASTEWATER
MASTER PLAN

WSAOC

Water & Sewer Authority
Of Cabarrus County

BLACK & VEATCH
International Company

Black & Veatch International
2002

PN 96873
4.3 Options for Additional Water Supply

4.3.1 Expansion of Existing Reservoirs

Possible modifications to increase the storage capacity of the existing reservoirs were considered. Dam safety considerations and development are believed to limit the potential for expansion at the older dams. The dam on Coddle Creek at Lake Howell is the only reservoir with potential for expansion, since the normal pool is set at El. 650 feet, and Cabarrus County owns property to El. 660 ft. However, structural issues encountered during construction of the original dam may limit the feasibility and practicality of raising the normal reservoir pool.

4.3.2 Interconnection and Optimization of Existing Raw Water Sources

Limited opportunities exist to further strengthen the County’s raw water supply by interconnecting existing sources. The Kannapolis raw water system has the most flexibility, since it can direct water from three separate drainage basins into Kannapolis Lake. However, the system is constrained by the usable volume of Kannapolis Lake; less than one billion gallons.

The other significant sources of raw water are located in Concord. Because the Hillgrove WTP can obtain raw water from each of the three reservoirs, they can be operated in a coordinated manner. In comparison, the large storage volume at Lake Howell and the infrastructure that allows raw water to be moved to the Kannapolis system and to the Hillgrove WTP provide a potential opportunity to increase the current system yield. Lake Howell’s usable storage volume is nearly 5.4 billion gallons with inflow from its 47 square mile drainage basin. If another surface stream could be tapped to provide additional inflow to Lake Howell, the system reliability and safe yield could be increased. Two possible sources of additional inflow in proximity to Lake Howell are Irish Buffalo Creek and Rocky River. Mass balance modeling could be used as a tool to evaluate how often this approach could be utilized and to quantify the potential additional system yield from either option.

4.3.2.1 Second Creek Intake Optimization

The City of Kannapolis has traditionally withdrawn 6 mgd from its Second Creek intake and pumping station near the confluence of Back Creek and Sills Creek. However, low natural stream flows, intake configuration, hydraulic characteristics of the installed pumping facilities, and other factors may combine to limit the reliable pumping capacity from the intake. Because of the substantial drainage area, relative to the other surface water sources in Cabarrus County, it is necessary to ensure that the full capacity of the
intake is able to be withdrawn from Second Creek. The documented capacity of the intake is at least 6 mgd.

Under North Carolinas Regulation of Surface Water Act, the allowable withdrawal form Second Creek without an IBT certificate is the greater of the Second Creek Pump Station capacity (6.0) or 25 percent more flow than was withdrawn in the year prior to July 1, 1993. Kannapolis was no withdrawing much from Second Creek at the time so the pumping capacity of 6 mgd governs. Kannapolis should maximize pumping from Second Creek.

In the current configuration, the water is withdrawn for storage in Lake Kannapolis. It would be advantageous to be able to pump flows to Lake Howell as well, if that reservoir is not full when Lake Kannapolis is full. Any operating mode involving Lake Howell will require additional infrastructure. Additional analysis is needed to determine whether the additional reliability is cost-effective, when costs of new infrastructure are considered.

4.3.2.2 Rocky River Supplemental Withdrawal

Possible factors limiting the use of Rocky River are water quality concerns associated with potential discharges upstream in the vicinity of Mooresville. The other possible issue is the potential to reduce the flow needed for dilution of the Rocky River Regional Wastewater Treatment Plant discharge downstream. The segments of Rocky River of most interest may need to be reclassified, before they can be tapped for drinking water use.

4.3.2.3 Irish Buffalo Creek Supplemental Withdrawal

The possible limiting factors on use of Irish Buffalo Creek include low availability of inflow due to the impoundment of flows in Kannapolis Lake upstream, and the related potential for ecological impacts resulting from an additional withdrawal. However, the capability to withdraw from Irish Buffalo Creek and input to Lake Howell provides linkage among all of the County’s major raw water sources. If the Second Creek withdrawal is maximized to at least 6 to 7.5 mgd, excess flows into Kannapolis Lake could be released for transfer to Lake Howell.

4.3.3 Construction of New Reservoirs

Construction of new surface water impoundments is greatly affected by the federal and state permitting process. The National Environmental Policy Act (NEPA) requires that projects that may result in significant impacts to the environment must be evaluated and justified in a rigorous manner. The damming of a free flowing stream results in a change in the natural environment and can result in numerous impacts to the
aquatic habitat of plant and animal species. Of equal or greater significance, is the impact of inundation of wetland areas and the loss of habitat and water quality function of those areas. Due to these potential effects, obtaining the necessary permits for construction of any reservoir project is often a very time-consuming and resource-intensive process. Although some projects with minimal environmental impacts, or other extenuating circumstances, have received permits for construction, a number of recent projects in the Mid-Atlantic region have not received permits. Failure to receive a permit in a timely manner, if at all, is an especially serious issue in a developing community that is planning on a reservoir as a reliable long-term source of water supply.

4.3.3.1 **Impoundment of Back and Sills Creeks**

Development of a new reservoir was considered as an alternative in the Rowan County Water and Wastewater Feasibility Study (Hobbs, Upchurch, and Associates. June 1998). The option proposed to construct a new reservoir near the confluence of Back Creek and Sills Creek in Rowan County. The City of Kannapolis operates the Second Creek pumping station downstream of this site. Some property has been acquired, in anticipation of a possible reservoir. The drainage area attributed to Back and Sills Creeks is about 37 square miles of the 55.6 square miles draining to the Second Creek intake. It has been estimated previously that the reservoir could increase the Kannapolis system yield by 2 to 3 mgd. The most significant benefit of the reservoir could be its ability to regulate and improve the reliability of the Second Creek withdrawal just downstream. Two modes of operation are possible during periods of low flow. The water impounded at Back and Sills Creeks could be released to improve flows at the intake. Alternatively, a pipeline could be constructed from the reservoir to connect directly to the existing 30-inch raw water pipeline as an auxiliary source.

4.3.3.2 **Dutch Buffalo Creek**

Dutch Buffalo Creek in the vicinity of Mount Pleasant has a fairly significant drainage area. Development has occurred such that siting of a dam could be difficult, but not impossible. The location and size of the dam would determine the potential safe yield of this alternative. The benefit of the option is that it would strengthen the Mount Pleasant supply, and it would tap a new drainage area in the county. The disadvantages are that the location of the reservoir would not easily link to the existing sources of supply.

4.3.4 **Cabarrus County Yadkin River Supply**

A logical source of a large quantity of raw water for Cabarrus County is the Yadkin River. This would provide an alternative to purchasing treated water from the
Cities of Albemarle or Salisbury. A Cabarrus County Yadkin source would require a new intake on the Yadkin River and a WTP in either Rowan or Stanly County. Alternatively, a raw water pumping facility could deliver water to existing or new reservoirs in Cabarrus County or directly to a new WTP in Cabarrus County. The transfer of raw water instead of treated water would minimize secondary and cumulative impacts from unplanned growth along the Highway 49 corridor. The interbasin transfer of water remains as an issue due to the different sub-basins of the Yadkin River involved. The potential for connections to the treated water pipeline would be a factor during the review of the IBT petition.

4.3.5 Cabarrus County Catawba River Supply

The Catawba River is an alternative source of a large quantity of raw water proximate to, but not bordering, Cabarrus County. This alternative would provide an option to purchasing treated water from Charlotte Mecklenburg Utilities or from Union County, both of whom use the Catawba River (or Lake Norman) as the source for their water treatment plants. Using the Catawba River as a source of raw water would require a new intake and a water treatment plant. A raw water pumping facility could deliver water to Lake Howell for storage or directly to a WTP in Cabarrus County. A major issue would be the transfer of a significant quantity of water outside of the Catawba River basin, since the Rocky River Regional Wastewater Treatment facility discharges to the Rocky River basin, which is a sub-basin of the Yadkin River. Existing, grandfathered transfers out of the Catawba River basin, including from Charlotte Mecklenburg Utilities, will likely result in a more difficult process to successfully obtain an IBT certificate.

4.3.6 Treated Water from Outside Cabarrus County

4.3.6.1 City of Salisbury/Rowan County

The City of Salisbury has indicated that approximately 3.1 mgd of treated water could be made available to Kannapolis to benefit Rowan County residents. An agreement between Salisbury and Kannapolis has been executed for this water. The availability of this supply would be contingent upon construction of a pipeline and provision of supply to serve China Grove and Landis. Approximately 7 miles of additional pipe would be required from Landis to Kannapolis. Because Kannapolis' wastewater is returned to a different sub-basin of the Yadkin River than it would be taken from, an Interbasin Transfer certificate would be required for flows greater than 2 mgd to Kannapolis. If the Salisbury agreement with China Grove and Landis moves forward quickly, this could be a near term improvement.
4.3.6.2 Charlotte-Mecklenburg Utilities

Obtaining treated water from CMU has the potential to be a short- and long-term option. The North Mecklenburg Water Treatment Plant is well situated to provide treated water supply to a developing area of Concord and for further transfer to Kannapolis. Highway 73 is the general service area boundary between Concord and Kannapolis, and a single connection to CMU at this location could serve both communities. In addition, a more direct connection from Coddle Creek WTP to the Kannapolis distribution system could be provided. Charlotte-Mecklenburg Utilities has indicated that 10 mgd could be made available in the short-term, and additional water could be available in the future. The long-term transfer of water between the Catawba and Yadkin River basins would require an interbasin transfer certificate.

4.3.6.3 Union County

Union County operates one water treatment plant, which withdraws from the Catawba River in South Carolina. Union County also receives water from Anson County and an expansion of the WTP would be required in the future. Upgraded piping into northern Union County and Cabarrus County would be required. An interbasin transfer would occur due to transfer among sub-basins of the Yadkin River. This option has potential for the long-term, and should be further considered for the 2010 to 2020 planning horizon.

4.3.6.4 Albemarle

Obtaining water from the City of Albemarle has potential to be a long-term option. Albemarle currently operates two WTPs, which are supplied water from impoundments on the Yadkin River. Pumping facilities and pipeline along Highway 49 would be required to deliver water to the eastern side of the County. Albemarle has excess capacity at this time but plant expansions would be required to meet future demands in Cabarrus County. The City of Concord has begun negotiations with the City of Albemarle to reach a long term agreement to receive water. An inter-basin transfer would occur due to transfer among sub-basins of the Yadkin River.

4.3.7 Reclaimed Water Use

Current state regulations do not allow augmentation of water supply reservoirs with reclaimed wastewater. Allowable potential water reuse applications are described in the following sections of this report. The investigation presents a brief discussion on reclaimed water use regulations; identifies potential categories of reclaimed water customers; summarizes facility additions/improvements necessary for implementation with associated costs; and details the potential benefits of water reuse to the County. The
potential benefit of using reclaimed water for irrigation will vary by member government, dependent on the potential customer base and quality of water needed. Economic incentives may be available from state and federal sources to implement demonstration projects and to begin planning of a comprehensive reclaimed water system.

4.4 Demand Management Options

In recent years, water utilities facing the challenges of diminishing untapped water resources have implemented demand management programs as an alternative to developing new water supplies. Furthermore, water resource management during historic drought events, such as the drought affecting the Cabarrus County region over the past months, has prompted serious consideration of a variety of conservation options. Successful demand management programs are part of an integrated resource planning (IRP) approach. The IRP process broadens the scope of conventional water planning to include both supply and demand management. Along those lines, many regulatory procedures, such as application for interbasin transfers, require documentation of a proposed demand management program.

Demand management can be classified into two categories: structural and behavioral. Structural conservation measures achieve water use reduction by implementing large-scale system changes, such as water saving fixture programs. Behavioral conservation focuses on realizing demand reduction by identifying inefficient water usage and suggesting more efficient operations like irrigation scheduling based on precipitation rather than fixed application rates. Successful implementation of either type of program has been shown to reduce demand by as much as 30 percent. Clearly, conservation practices are an integral part of a progressive water-planning program.

4.4.1 Conservation Practices

As noted, water management practices often include supply development techniques as well as conservation practices. These conservation practices focus on achieving demand reduction through management (i.e., fixture replacement programs, rate policies, etc.) and public education. A comprehensive conservation program also includes a component to address loss reduction through leak detection/repair, evaporation suppression and the like. EPA published guidelines for water conservation plan development in response to the 1996 amendments to the Safe Drinking Water Act. These guidelines represent a three-tiered approach by scaling the scope of the procedure based on the size of the water system. In *Handbook of Water Use and Conservation* (Amy