BUILDING A WORLD OF DIFFERENCE®

BLACK & VEATCH

Facilities Master Plan Report

Prepared for

Winston-Salem/Forsyth County Utility Commission

Winston-Salem • Forsyth County
City/County Utilities
Water • Sewer • Solid Waste Disposal

Contact Information:

Contact Name:	Jeff Coggins, P.E., Kris Pennewell P.E.
Company Name:	Black & Veatch International Company
Address:	8520 Cliff Cameron Drive, Suite 210
City, State, Zip:	Charlotte, NC 28269
Phone:	(704) 548-8461
Fax:	(704) 548-8640
Email:	cogginsjd@bv.com, pennewellkj@bv.com

Submittal Date September 2007

BLACK & VEATCH
building a world of difference™

Table of Contents

Section 1 - Flow Projections 1

Legacy Development Guide 1
Forsyth County Population Projections 1
Historical Flow Data – System Total 2
Future Water Demands – Total System 2
Future Water Demands – R.W. Neilson Water Treatment Plant 6
Future Water Demands – R.A. Thomas Water Treatment Plant 7
Future Water Demands – Northwest Water Treatment Plant 8

Section 2 - Raw Water Supply Projects 10

Capital Improvements Plan Development 10
Capital Improvements Plan Development Process 10
Proposed Raw Water Supply Projects 11
Salem Lake Raw Water Supply Facilities – Phase 1 Improvements 12
Salem Lake Raw Water Supply Facilities – Phase 2 Improvements 13
Idols Raw Water Pumping Station – Phase 1 Improvements 14
Idols Raw Water Pumping Station – Phase 2 Improvements 15
Northwest Raw Water Pumping Station – RWP-304 Addition 17

Section 3 - Water Treatment Plant Projects 19

CIP Development 19
CIP Development Process 19
Proposed Water Treatment Plant Projects 20
R.A. Thomas Water Treatment Plant Improvements 21
R.W. Neilson Water Treatment Plant – Phase 2 Modernization 23
Implementation Schedule 24

Section 4 - Booster Pumping Station Projects 25

CIP Development 25
CIP Development Process 25
Proposed Booster Pumping Station Projects 26
Sides Road High Service Pumping Station – Standby Power and Electrical Improvements 27
Chitty High Service Pumping Station – Standby Power, Electrical and Pumping Improvements 28
15th Street Pumping Station – Standby Power and Electrical Improvements 29
Implementation Schedule 30

Section 5 - Elevated/Ground Storage Tank Projects 31

CIP Development 31
CIP Development Process 31
Elevated/Ground Storage Tank Projects 32
Wake Forest and Chitty Storage Tanks – Painting and Structural Repairs 32

Sides and 15th Street Ground Storage Tanks – Painting and Structural Repairs 33
Bowden Hammer Elevated Storage Tank – Painting and Structural Repairs 33
Need 33
Clemmons Elevated Storage Tank 34
Kernersville Elevated Storage Tank 34
Implementation Schedule 35

List of Figures

Figure 1-1 Forsyth County Population Projections 1
Figure 1-2 Historical Daily Pumped Flow 2
Figure 1-3 Total System Treatment Capacity Diagram 3
Figure 1-4 Firm System Treatment Capacity Diagram 3
Figure 1-5 Legacy Development Guide Future Demand Projections - System Total 4
Figure 1-6 Future Demand Projections Comparison – System Total 6
Figure 1-7 R.W. Neilson WTP Demand Projections 7
Figure 1-8 R.A. Thomas WTP Demand Projections 8
Figure 1-9 Northwest WTP Demand Projections 9

List of Tables

Table 1-1 Water Distribution Study Update Results 4
Table 1-2 CCUC Staff Demand Projections 5
Table 1-3 Neilson WTP Historical Demand Data 6
Table 1-4 R.A. Thomas WTP Historical Demand Data 7
Table 1-5 Northwest WTP Historical Demand Data 8
Table 2-1 Raw Water Supply Projects Implementation Schedule Summary 17
Table 3-1 Water Treatment Plant Projects Implementation Schedule Summary 24
Table 4-1 Booster Pumping Station Projects Implementation Schedule Summary 30
Table 5-1 Elevated/Ground Storage Tank Project Implementation Schedule Summary 35

Appendix A

System Wide Capital Improvements Projects Implementation Schedule

Section 1 - Flow Projections

Legacy Development Guide

The *Legacy Development Guide* was published in 2001 and serves as a general, long-range policy guide for decisions concerning the overall growth and development of the Forsyth County and its eight municipalities. The Legacy Development Guide is utilized the basis for the population projections and subsequent comparisons of the 2015 and 2025 water demand projections.

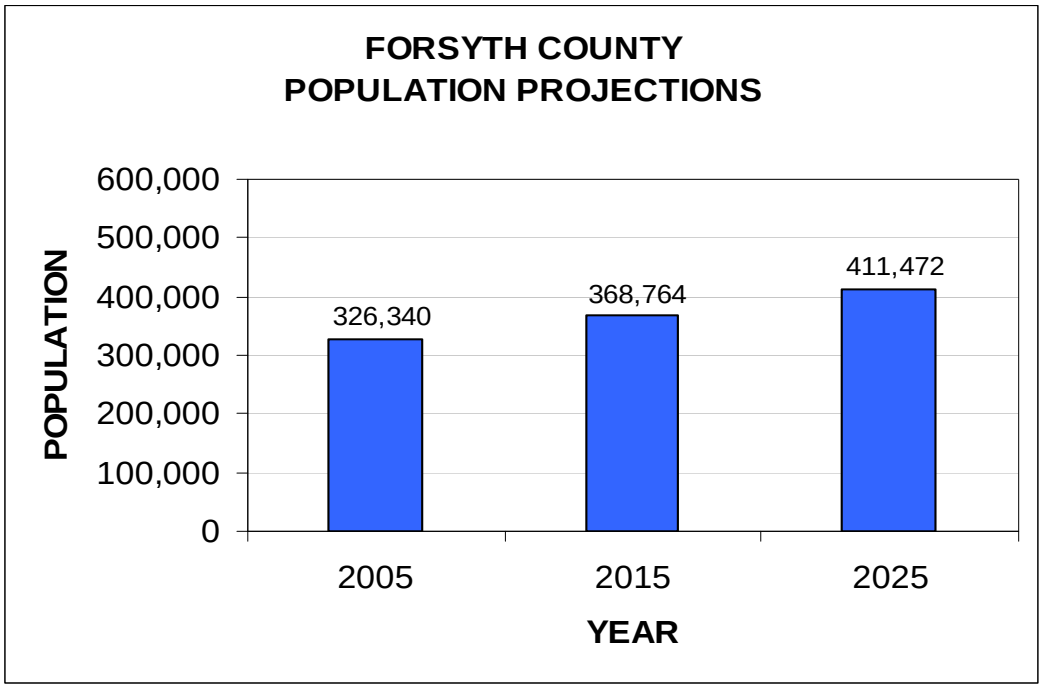
Forsyth County Population Projections

According to the North Carolina Office of State Budget and Management (OSBM), the population in Forsyth County will increase from 326,340 in July 2005 to an estimated 411,472 in July 2025. This estimate represents a 1.3 percent increase in population per year over the 20-year planning period.

The OSBM also publishes the historical population estimates in Forsyth County. The population in Forsyth County increased from 306,063 in April 2000 to 326,340 in July 2005. This equates to an actual population increase of 1.32 percent per year over the last 5 years.

By comparison, the population projections illustrated in Figure 1-1 established by the OSBM appear to be inline with the historical population increases observed in Forsyth County as well as the projections established in the *Legacy Development Guide*. An annual growth rate of 1.3 percent will be used as the basis for the population projections and subsequent demand projections contained in this Master Plan.

Figure 1-1 Forsyth County Population Projections

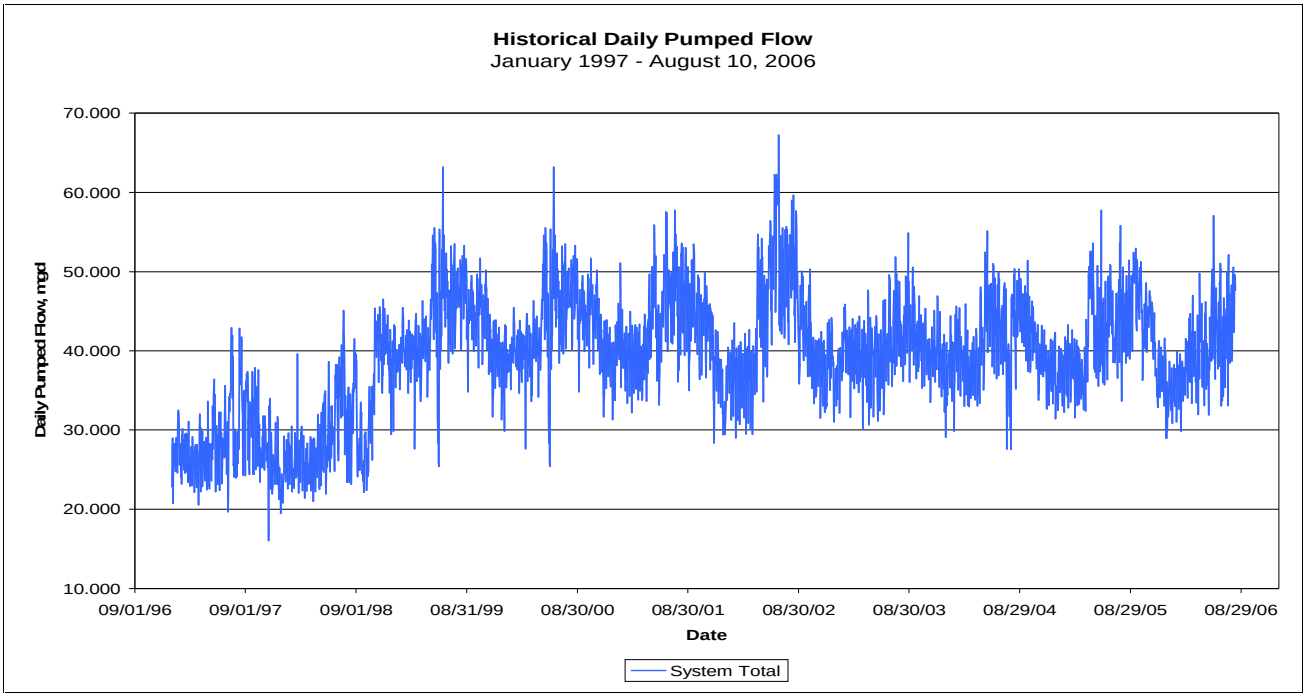


FLOW PROJECTIONS

Historical Flow Data – System Total

Historical plant flow data from the R.A. Thomas, R.W. Neilson, and Northwest water treatment plants was evaluated in order to establish historical trends and to project future flows. Daily pumped flow data from all three water treatment plants was evaluated for the period of January 1997 to August 31, 2006. Historical total system daily pumped flow is shown in the following Figure 1-2.

Figure 1-2 Historical Daily Pumped Flow



Analysis of the data indicates the following trends are occurring:

- Pumped flow varies dramatically depending on the time of year.
- Peak system demand is from May to August.
- Lowest system demand is from November to February.

Future Water Demands – Total System

Projections from the 2001 *Legacy Development Guide* will be used to predict the future water demands in years 2015 and 2025 for entire water treatment system. Once the demand projections are established, they will be compared against historical water demands, the future demand projections updated by Hazen & Sawyer in 2007 and CCUC staff projections.

Firm Water Treatment System Capacity

The concept of firm capacity is most typically discussed with regard to pumping station capacity. By definition, firm capacity is the capacity of a unit process with the largest unit out of service. One goal of the Utilities staff is to apply this same concept to the water treatment system to allow for enough flexibility in the system to make improvements or maintain any of the plants and continue to meet system demands. The original train at the Neilson WTP is the largest treatment train in the entire system with a capacity of 24-mgd. Assuming the original train at the Neilson WTP is out of service, the firm treatment capacity of the entire water treatment system is 67-mgd. In order to fully utilize the firm treatment capacity of the system,

changes in the distribution system are required to allow any water treatment plant in the system to deliver treated water to any zone in the system. The following Figure 1-3 and Figure 1-4 illustrate the firm treatment capacity concept for the entire water treatment system.

Figure 1-3 Total System Treatment Capacity Diagram

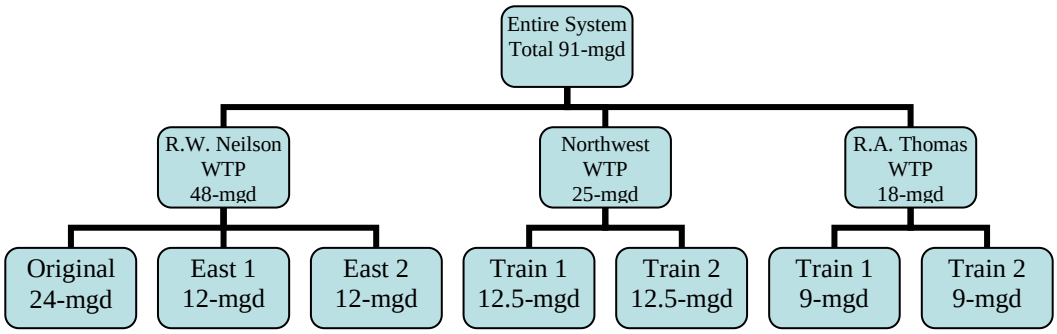
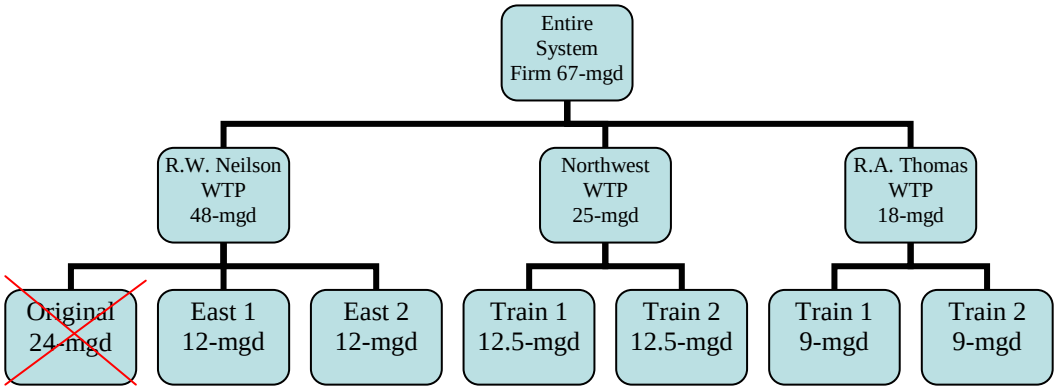


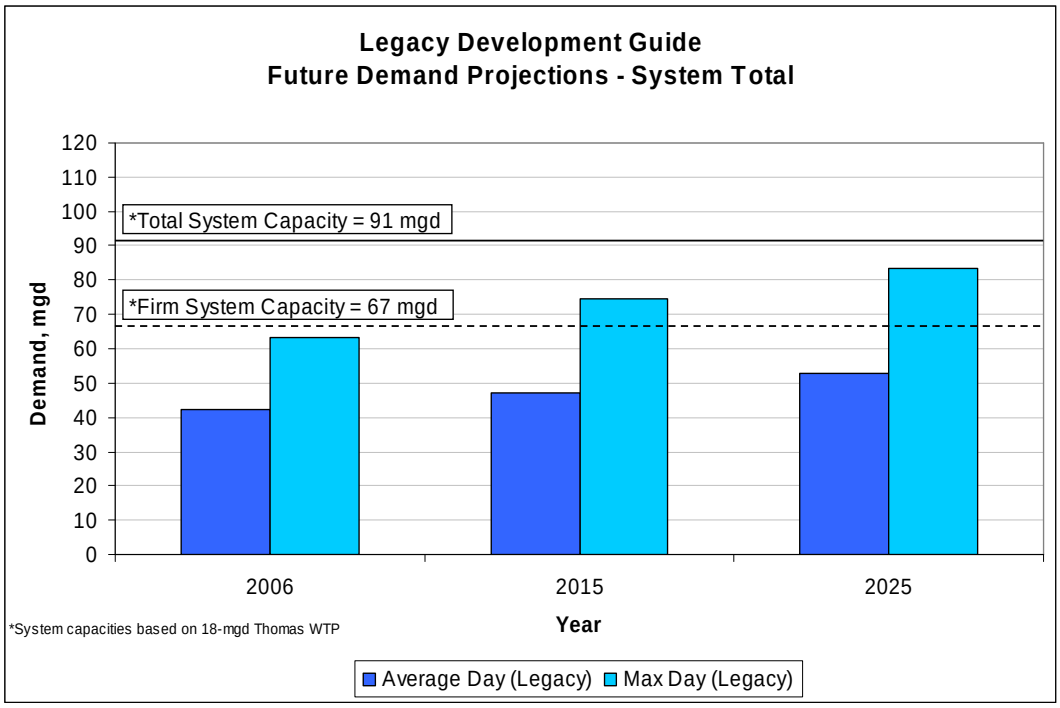
Figure 1-4 Firm System Treatment Capacity Diagram



Legacy Development Guide Projections

In order to project future demands for the entire water treatment system, an average annual growth rate must be established. The *Legacy Development Guide* estimates the average annual growth rate in Forsyth County to be 1.3 percent. This annual growth will be used as the basis for the demand projections presented herein. The annual average growth projection assumes the residential, commercial, and industrial distribution of the water demand will grow at an annual rate of 1.3 percent. Max day projections are based upon the Updated *Water Distribution Study* average day to maximum day ratio of 1.58. Future average and maximum day water demands for the CCUC water treatment system are projected as shown in the following Figure 1-5.

Figure 1-5 Legacy Development Guide Future Demand Projections - System Total



Water Distribution Study Projections

In January 2007, Hazen & Sawyer updated the demand projections in the 1998 *Water Distribution Study* by Pitometer and Associates. The update revised the study's original projected future water demands in years 2015 and 2025 for the entire water treatment system. Table 1-1 below summarizes the results of the *Water Distribution Study Update*.

Table 1-1 Water Distribution Study Update Results

Year	Original Study (1998)			Study Update (2007)			% Change	% Change
	Avg Day (mgd)	Max Day (mgd)	Peaking Factor	Avg Day (mgd)	Max Day (mgd)	Peaking Factor	Avg Day	Max Day
2015	56.6	88.3	1.56	47.6	75.5	1.58	-15.9	-14.5
2025	No data provided			57.6	91.2	1.58	-	-

As discussed in the report Hazen & Sawyer attributed this dramatic decrease in projected future water demands to the following trends in the system:

- Large customer usage decreased approximately 2% per year from 1995 to 2006.
- The average per capita water use by small users decreased from 342 gpd in 1995 to 257 gpd in 2006.

Taking into consideration the above trends, Hazen & Sawyer based the future water demand projections on the following assumptions.

- Large customer usage will decrease by 1 percent per year.
- Average per capita demand by small users will resume an annual increase of 3 gpd per year due to automatic sprinkler usage in new developments.
- The total number of meters will increase by 2,150 meters per year.
- The maximum day peaking factor equals 1.58.

CCUC Staff Projections

Utilizing Hazen & Sawyers report combined with CCUC's experience and knowledge of their system, alternative future water demand projections were developed by CCUC staff. Table 1-2 below summarizes the result of the CCUC staff projections and compares them to the *Water Distribution Study Update* by Hazen & Sawyer.

Table 1-2 CCUC Staff Demand Projections

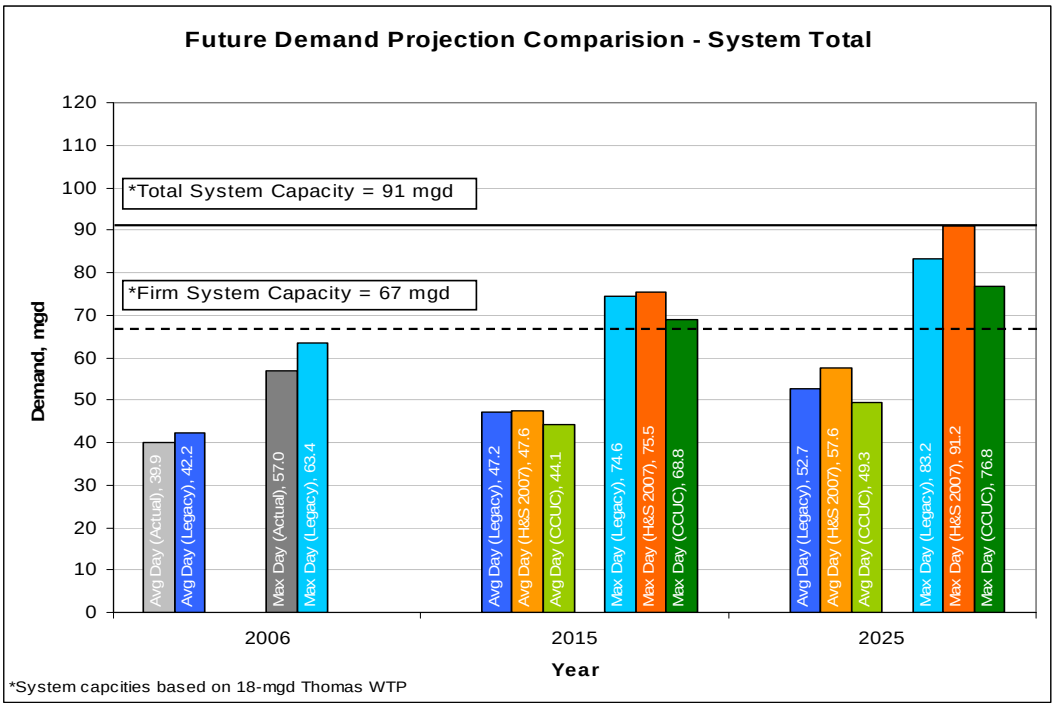
Year	Water Distribution Study Update (2007)			CCUC Staff Projections			% Change	% Change
	Avg Day (mgd)	Max Day (mgd)	Peaking Factor	Avg Day (mgd)	Max Day (mgd)	Peaking Factor	Avg Day	Max Day
2015	47.6	75.5	1.58	44.1	68.8	1.56	-7.4	-8.9
2025	57.6	91.2	1.58	49.3	76.8	1.56	-14.4	-15.8

CCUC's staff projections utilize the same assumptions as contained in the *Water Distribution Study Update* with the exception of the following:

- The average per capital water demand will remain constant in lieu of increasing at a rate of 3 gpd per year.
- The maximum day peaking factor equals 1.56 as compared to 1.58.

Figure 1-6 illustrates the average and maximum day demand projections from all sources in addition to the actual demands experienced by the system in 2006.

Figure 1-6 Future Demand Projections Comparison – System Total



Future Water Demands – R.W. Neilson Water Treatment Plant

Peaking Factor Determination

A review of the R.W. Neilson WTP historical average day and maximum day demands for the period January 1997 through December 2005 was conducted to establish a peaking factor for use in projecting maximum day demands. Table 1-3 shows historical annual average day, maximum day and the ratio of the maximum day to the annual average day (peaking factor).

Table 1-3 Neilson WTP Historical Demand Data

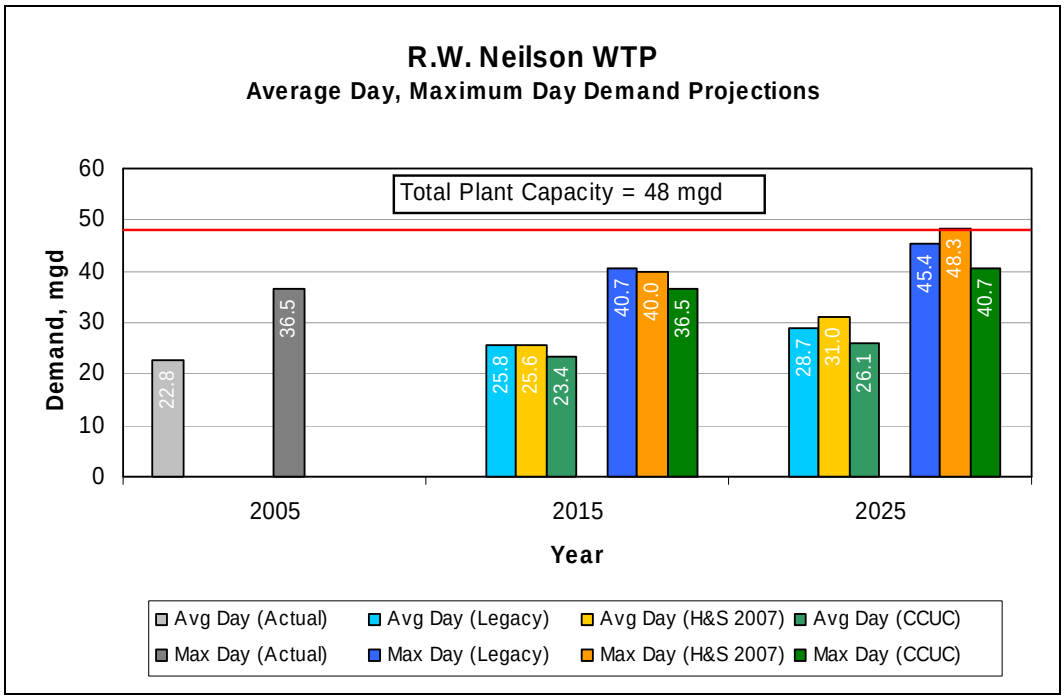
Year	Average Day (mgd)	Maximum Day (mgd)	Peaking Factor
1997	28.235	42.900	1.52
1998	28.718	45.100	1.57
1999	29.549	47.120	1.59
2000	29.455	48.950	1.66
2001	29.891	44.520	1.49
2002	29.917	49.630	1.66
2003	29.697	44.580	1.50
2004	28.542	45.440	1.59
2005	22.796	36.540	1.60

From Table 1-3, the average peaking factor over the evaluated period for the R.W. Neilson WTP is 1.58. Therefore, a peaking factor of 1.58 will be used to project maximum day demands for the years 2015 and 2025.

Demand Projections

Figure 1-7 illustrates the future demand projections from all sources for years 2015 and 2025 for the R.W. Neilson WTP.

Figure 1-7 R.W. Neilson WTP Demand Projections



Based on Figure 1-7 above, the treatment capacity of the Neilson WTP is sufficient to meet the maximum day demand projections from all sources through the year 2025.

Future Water Demands – R.A. Thomas Water Treatment Plant

Peaking Factor Determination

A review of the R.A. Thomas WTP historical average day and maximum day demands for the period January 2000 through December 2005 was conducted to establish a peaking factor for use in projecting maximum day demands. Table 1-4 shows historical annual average day, maximum day and the ratio of the maximum day to the annual average day (peaking factor).

Table 1-4 R.A. Thomas WTP Historical Demand Data

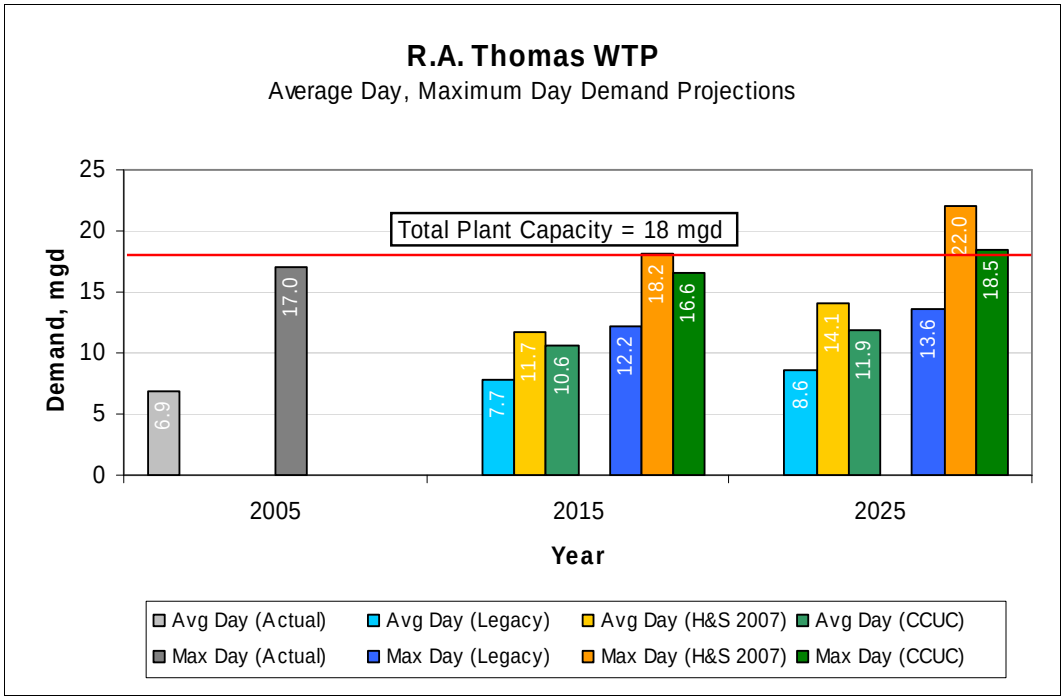
Year	Average Day (mgd)	Maximum Day (mgd)	Peaking Factor
2000	13.467	16.693	1.26
2001	12.835	17.402	1.36
2002	12.870	17.582	1.37
2003	10.590	15.756	1.49
2004	8.210	12.911	1.57
2005	6.852	16.997	2.48

Since the commissioning of the new Northwest WTP in 2004 and considering the poor condition of the Thomas WTP, Utilities operations staff has greatly reduced the water production from the Thomas WTP. It is anticipated that with the new Thomas WTP online, the average peaking factor for the Thomas WTP will be similar to the peaking factor currently observed at the Neilson WTP. Therefore a peaking factor of 1.58 will be used to project maximum day demands for the years 2015 and 2025.

Demand Projections

Figure 1-8 the future demand projections from all sources for years 2015 and 2025 for the R.A. Thomas WTP.

Figure 1-8 R.A. Thomas WTP Demand Projections



Based on Figure 1-8 above, the new 18-mgd Thomas WTP will have sufficient treatment capacity to meet both the *Legacy Development Guide* and CCUC projected maximum day demands through the year 2025. The *Water Distribution Study Update* maximum day demand projections exceed the treatment capacity of the plant in year 2015.

Future Water Demands – Northwest Water Treatment Plant

Peaking Factor Determination

A review of the Northwest WTP historical average day and maximum day demands for the period August 2004 through August 2006 was conducted to establish a peaking factor for use in projecting maximum day demands. Table 1-5 shows historical annual average day, maximum day and the ratio of the maximum day to the annual average day (peaking factor).

Table 1-5 Northwest WTP Historical Demand Data

Year	Average Day (mgd)	Maximum Day (mgd)	Peaking Factor
2004	9.433	16.120	1.71

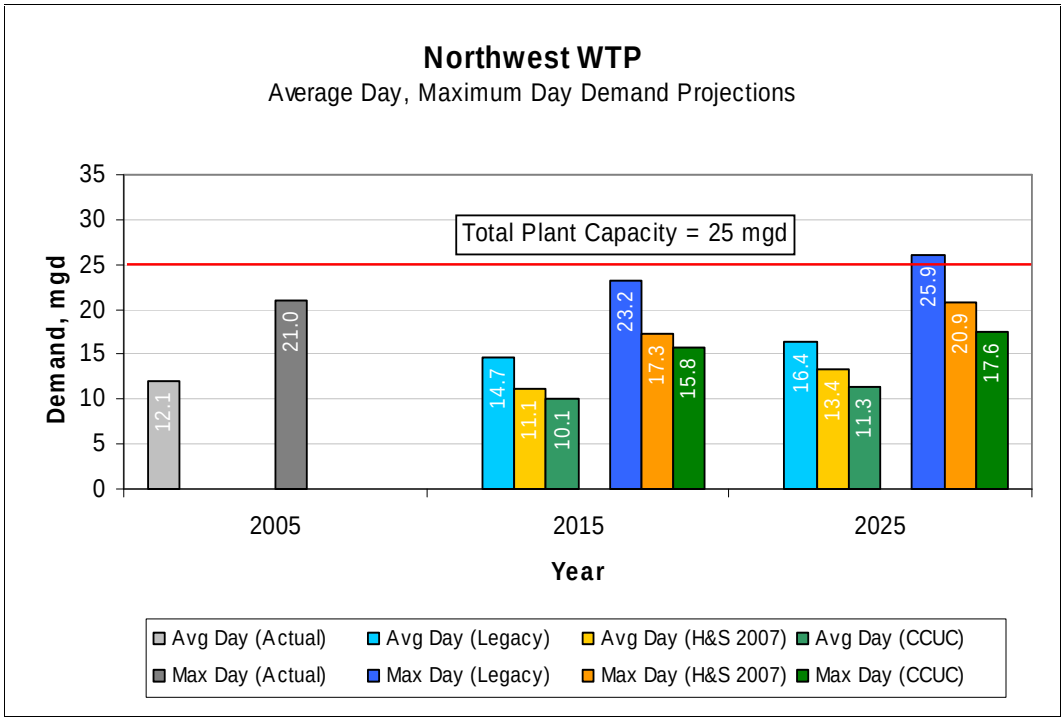
Year	Average Day (mgd)	Maximum Day (mgd)	Peaking Factor
2005	12.058	21.000	1.74
2006	13.170	19.420	1.47

It is difficult to establish a peaking factor based upon only 3 years of operating data. Several factors such as initial startup, new role in the system and high rate testing may have skewed the average and maximum day demands away from the normal demands that will typically be experienced at the facility. Because of the operational flexibility of the Northwest WTP, it can more easily adapt to changes in the distribution system as compared to the Neilson or Thomas WTPs. Based upon how CCUC will operate the plant, it is reasonable to assume that the Northwest WTP will experience a similar average peaking factor as the other plants in the system. For this reason, a peaking factor of 1.58 will be used to project maximum day demands for the years 2015 and 2025.

Demand Projections

Figure 1-9 illustrates the future demand projections from all sources for years 2015 and 2025 for the Northwest WTP.

Figure 1-9 Northwest WTP Demand Projections



Based on Figure 1-9 above, the Northwest WTP will have sufficient treatment capacity to meet both the *Water Distribution Study Update* and CCUC projected maximum day demands through the year 2025. The *Legacy Development Guide* maximum day demand projections exceed the treatment capacity of the plant in year 2025.

Section 2 - Raw Water Supply Projects

Capital Improvements Plan Development

A goal of this Facilities Master Plan is the development of a Capital Improvements Plan (CIP) to include proposed CIP projects for the raw water supply facilities in the CCUC system. The CIP projects recommended herein are for the 10-year planning period from 2007 to 2017.

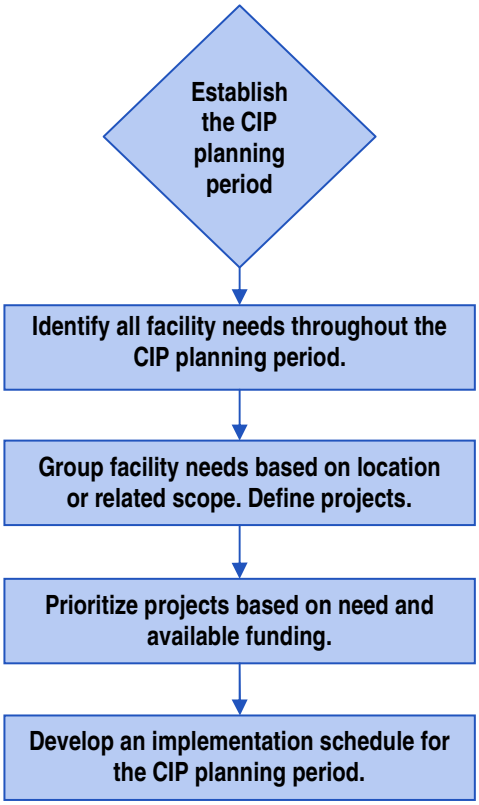
Selection of the raw water supply projects proposed herein were based upon meetings with CCUC administration, operations, and maintenance staff as well as observations by Black & Veatch from current and past projects.

CIP projects were selected and prioritized based upon one or more of the following criteria:

- Ability to meet future regulatory requirements.
- System reliability.
- Ability to properly maintain equipment.
- Equipment age.
- Safety.
- Operational flexibility.
- Water treatment quality.

Capital Improvements Plan Development Process

Several steps were considered in the development of the proposed CIP projects. The following flow chart illustrates the CIP development process.



RAW WATER SUPPLY PROJECTS

Proposed Raw Water Supply Projects

Five raw water supply CIPs are proposed for the 10-year planning period and are listed as follows:

- Salem Lake Raw Water Supply Facilities – Phase 1 Improvements.
- Salem Lake Raw Water Supply Facilities – Phase 2 Improvements.
- Idols Raw Water Pumping Station – Phase 1 Improvements.
- Idols Raw Water Pumping Station – Phase 2 Improvements.
- Northwest Raw Water Pumping Station – RWP-304 Addition.

Additionally, annual funding for miscellaneous items such as analytical instrumentation, chemical feed equipment and piping, heavy maintenance, protective lining and coating systems, plumbing, and HVAC systems should be considered during the annual CIP planning period

The following subsections discuss the need, scope, and conceptual level total project cost (in 2007 dollars) for the proposed projects. Appendix A, located at the end of this report, provides a proposed implementation schedule for the entire CIP projects presented herein.

RAW WATER SUPPLY PROJECTS

The original intake structure has been abandoned due to excessive siltation of the effluent channels.

Salem Lake Raw Water Supply Facilities – Phase 1 Improvements

Need

The Salem Lake Intake Facility has been utilized since the early 1900s as a primary raw water supply source for the R.A. Thomas Water Treatment Plant. Since the initial construction, minimal capital improvements have been performed. The original intake structure and effluent channel have been abandoned due to excessive silt accumulation. A detailed evaluation of the dam, intake facilities and raw water pipeline should be conducted to determine the condition of the facility and its ability to reliably supply water in the future.

Scope

The following evaluations and design are proposed as part of this project:

- ***A detailed structural evaluation of the dam and intake facility –*** After 75 year of continuous operation, the structural integrity of the dam and intake facility should be evaluated.
- ***Intake evaluation –*** The existing and original intake will be evaluated to determine the condition of the intakes and the feasibility of retrofitting to accommodate intake screening. Alternative intake screening technologies will be considered as part of this evaluation.
- ***Raw water pipeline evaluation –*** Over the last year, Operation's staff have observed a decrease in the capacity of the 48-inch raw water pipeline from the Salem Lake Intake to the R.A. Thomas Water Treatment Plant. The pipeline will be inspected to determine the cause of the decrease in capacity and a physical and hydraulic evaluation of the pipeline will be conducted to determine its ability to reliably deliver adequate capacity to the R.A. Thomas Water Treatment Plant.

The Salem Lake Intake Facility has been in operation for over 75 years

- ***Intake screening –*** Based upon the results of the intake screening alternative analysis, new intake screens will be added. No intake screening is currently installed.

Opinion of Cost

The conceptual level total project cost is $9.1 million including 15% engineering, construction and 25% contingency. A detailed cost estimate will be determined during the preliminary and detailed design phases of the project.

Project Highlights

- Structural integrity of the intake facility and dam will be known.
- Raw water pipeline capacity and reliability will be established.
- Intake screening will ensure continued reliability to send high quality raw water to the R.A. Thomas Water Treatment Plant

Salem Lake Raw Water Supply Facilities – Phase 2 Improvements

Need

The existing 48-inch raw water transmission main from the Salem Lake Raw Water Intake to the R.A. Thomas WTP was installed in the mid 1920s. Over the last year, Operation's staff has observed a decrease in the capacity of the 48-inch raw water pipeline from the Salem Lake Intake to the R.A. Thomas Water Treatment Plant. Concern over the age of the pipeline and decreasing capacity necessitate capital investment in this critical raw water supply pipeline.

Scope

Approximately 9,360 feet of 48-inch raw water transmission main will be rehabilitated or replaced pending the outcome of the raw water pipeline evaluation completed as a part of the Salem Lake Raw Water Supply Facilities – Phase 1 Improvements

Opinion of Cost

The conceptual level total project cost is $7.5 million including 15% engineering, construction and 25% contingency. The conceptual level estimate assumes installation of a new 48-inch pipeline and the existing 48-inch pipeline abandoned in place. A detailed cost estimate will be determined during the preliminary and detailed design phases of the project.

Project Highlights

- Raw water pipeline capacity and reliability will be restored.

Existing starters will likely be replaced with reduced voltage solid state starters

Idols Raw Water Pumping Station – Phase 1 Improvements

Need

The Idols Raw Water Pumping Station is the backbone of the raw water supply for both the R.W. Neilson and R.A. Thomas Water Treatment Plants. Built in the mid 70s, it has served these facilities reliably for over 30 years with no major capital improvement projects. The majority of the equipment in the station has reached the upper limit of its expected life. Due to its significance in the system, capital improvements are needed to ensure its continued reliability. These improvements will be conducted in two phases in order to maximize available funding and speed implementation.

Scope

The Phase 1 Improvements project is currently in the evaluation and design phase. Components of the evaluation and design scope include:

- ***Electrical master plan –*** A comprehensive electrical master plan for the facility will be developed to include a determination of the system components for the final pumping station configuration including improvements to the power utility feed system, onsite standby power generation, switchgear, motor starters, and motors for the three existing raw water pumps.
- ***Pump evaluation –*** In-situ raw water pump performance testing will be conducted to confirm the existing pump curves and to properly size RWP-1 and RWP-2 motors.
- ***RWP-1 and RWP-2 motor/starter replacement –*** The original (1970s) synchronous motors and starters for pumps RWP-1 and RWP-2 will be replaced. Starters will likely be reduced-voltage, solid state. Motors will likely be low speed, induction motors.
- ***Plumbing improvements –*** The existing maintenance intensive pump seal water system will be replaced with a new potable water seal water system. The existing plumbing will be replaced and new potable water plumbing will be installed.
- ***CCTV and access control improvements –*** The existing CCTV security system will be expanded to include additional cameras inside the pumping station. An access control system will be added to all the building entrances.
- ***Instrumentation improvements*** – The existing instrumentation will be replaced and new instrumentation will be installed. A communications line will be installed between the pumping station and the Neilson WTP to allow for remote monitoring and starting of the raw water pumps.

Opinion of Cost

The conceptual level total project cost is $2.5 million including 15% engineering, construction and 25% contingency. A detailed cost estimate will be determined during the preliminary and detailed design phases of the project.

Project Highlights

- Determination of the improvements required and the associated capital costs.
- Increased reliability.
- Enhanced security and remote operator control and monitoring.

Idols Raw Water Pumping Station – Phase 2 Improvements

Need

The goal of the Phase 2 Improvements project is to further enhance reliability beyond the immediate improvements provided during Phase 1. The long-term recommendations from the electrical master plan completed under Phase 1 will be implemented. In addition, detailed evaluations of the raw water supply facilities including the dam, intake, and presettling basins must be conducted to provide a plan for long term reliability of these critical components.

Scope

The recommended scope of this project is as follows:

- ***Dam evaluation –*** The structural integrity of the dam is critical to maintaining a continuous raw water supply to the facility. A structural evaluation of the dam will be conducted.
- ***Intake evaluation –*** The existing raw water intake will be evaluated to determine the condition of the existing equipment and the ability of the intake to provide a continuous raw water supply.
- ***Presettling basin solids removal evaluation –*** Settled solids in the presettling basins is removed by a labor intensive process of hosing out the basins. Disposal of the solids is through gravity drains back into the Yadkin River. Over the years, sediment has deposited behind the dam and has dramatically reduced the ability to gravity drain the solids out of the presettling basins during a basin cleaning. An evaluation will be conducted to determine the most efficient way to remove settled solids in the presettling basins.

Settled solids removal in the presettling basins has become labor intensive.

- ***RWP-3 motor/starter replacement –*** The original (1970s) synchronous motor and starter for pump RWP-3 will be replaced. Starters will likely be reduced-voltage, solid state. Motors will likely be low speed, induction motors.
- ***Standby power generation –*** An electrical equipment platform including 4160-volt generators, switchgear, 480-volt generator with automatic transfer switch, fuel storage tank and transformer will be constructed. The facilities design and operation will be based upon the electrical equipment platform installed at the Northwest Raw Water Pumping Station. The existing diesel locomotive engine and right angle drive will be removed from service.

New backup power generation facilities will resemble facilities provided at the Northwest Raw Water Pumping Station

- ***Miscellaneous improvements*** – Miscellaneous improvements include the resurfacing of RWP-1, -2, -3 volutes, replacement of the power feed to the building, repairing the wall leaks in the basement, replacement of the vacuum priming system, and replacement of three surge relief valves.

Opinion of Cost

The conceptual level total project cost is $6.3 million including 15% engineering, construction and 25% contingency. A detailed cost estimate will be determined during the preliminary and detailed design phases of the project.

Project Highlights

- Increased reliability during power outages
- Enhanced flexibility.
- The ability of the raw water intake to provide a continuous raw water supply in the future will be evaluated and quantified. The condition of the intake equipment will be known.
- The ability of the dam to provide a continuous raw water supply in the future will be evaluated and quantified.
- A plan for enhanced solids removal from the presettling basins will be developed.

Northwest Raw Water Pumping Station – RWP-304 Addition

Need

A catastrophic failure of RWP-303 occurred shortly after initial startup of the Northwest Raw Water Pumping Station in January 2004. The pump was removed from service and sent back to the manufacturer for repair. The pump was reinstalled in June 2005 and operated for approximately one year prior to another catastrophic failure. Despite several meetings with the pump manufacturer, the cause of the failures has not been determined. Utility administration, operations, and maintenance staff have lost confidence that this pump will ever be able to reliably pump raw water to the Northwest Water Treatment Plant.

Scope

The scope of the project includes the following:

- ***RWP-304 Addition*** – A new 25-mgd pumping unit, starter, valves, piping, accessories, and controls will be added to the existing station. The station layout and piping was originally designed to accommodate the future addition of RWP-304

Location of RWP-304 planned in original station design

Opinion of Cost

The conceptual level total project cost is $1.4 million including 15% engineering, construction and 25% contingency. A detailed cost estimate will be determined during the preliminary and detailed design phases of the project.

Project Highlights

- Provides a plan for long term reliability

Implementation Schedule

A summary schedule for the implementation of the Raw Water Supply capital improvements projects is provided in Table 2-1 below. A detailed system wide capital improvements projects implementation schedule is provided in Appendix A.

Table 2-1 Raw Water Supply Projects Implementation Schedule Summary

Project Name	Project Cost	Project Start	Project End	Duration (months) Design & Bid/Const
Idols Raw Water Pumping Station, Phase 1 Improvements	$2,500,000	1/2007	9/2009	14/18
Idols Raw Water Pumping Station, Phase 2 Improvements	$6,300,000	4/2014	1/2017	16/18
Salem Lake Raw Water Supply Facilities, Phase 1 Improvements	$9,100,000	3/2010	3/2013	18/18
Salem Lake Raw Water Supply Facilities, Phase 2 Improvements	$7,500,000	1/2014	4/2016	9/18

RAW WATER SUPPLY PROJECTS

Project Name	Project Cost	Project Start	Project End	Duration (months) Design & Bid/Const
Northwest Raw Water Pumping Station, RWP-304 Addition	$1,400,000	7/2007	11/2007	4/15

Section 3 - Water Treatment Plant Projects

CIP Development

A goal of this Facilities Master Plan is the development of a Capital Improvements Plan (CIP) to include proposed CIP projects for the water treatment plants in the CCUC system. The CIP projects recommended herein are for the 10-year planning period from 2007 to 2017.

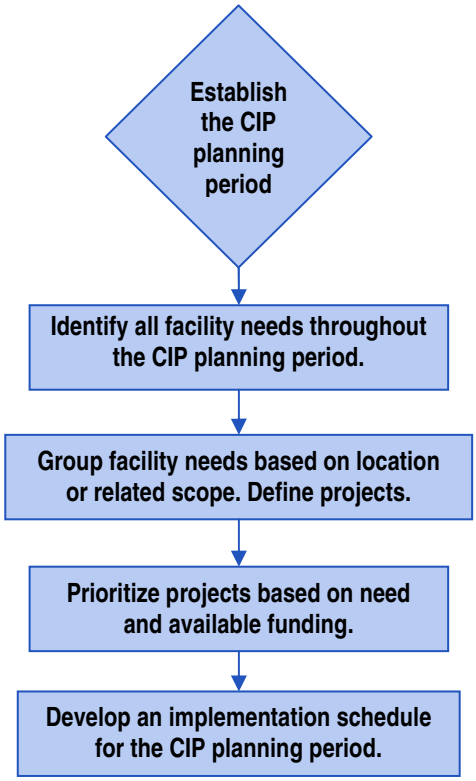
Selection of the water treatment plant projects proposed herein were based upon meetings with CCUC administration, operations, and maintenance staff as well as observations by Black & Veatch from current and past projects.

CIP projects were selected and prioritized based upon one or more of the following criteria:

- Ability to meet future regulatory requirements.
- System reliability.
- Ability to properly maintain equipment.
- Equipment age.
- Safety.
- Operational flexibility.
- Water treatment quality.

CIP Development Process

Several steps were considered in the development of the proposed CIP projects. The following flow chart illustrates the CIP development process.



WATER TREATMENT PLANT PROJECTS

Proposed Water Treatment Plant Projects

Two water treatment plant CIP projects are proposed for the 10-year planning period and are listed as follows:

- R.A. Thomas Water Treatment Plant Improvements.
- R.W. Neilson Water Treatment Plant – Phase 2 Modernization.

Additionally, annual funding for miscellaneous items such as analytical instrumentation, chemical feed equipment and piping, heavy maintenance, protective lining and coating systems, plumbing, and HVAC systems should be considered during the annual CIP planning period.

The following subsections discuss the need, scope, and conceptual level total project cost (in 2007 dollars) for the proposed projects. Appendix A, located at the end of this report, provides a proposed implementation schedule for the entire CIP projects presented herein.

R.A. Thomas Water Treatment Plant Improvements

Need

The R.A. Thomas Water Treatment Plant is the oldest of three treatment plants in the CCUC water treatment system. As a consequence, the Thomas WTP has the oldest treatment infrastructure in the system. Little effort has been made in recent years to improve or replace this aging infrastructure. With the operating and maintenance costs on the rise, concerns about meeting current and future treatment goals, and long-term reliability of the facilities in question, the CCUC has decided that major facilities improvements to the plant are necessary.

The R.A. Thomas Water Treatment Plant is the oldest of the treatment plants in the CCUC system.

Scope

The plant improvements project is currently in the preliminary design phase and includes the following scope:

- Demolition of the existing plant including the chemical building, north and south treatment trains, administration building, finished water pumping station and clearwells.
- New plant entrance
- New operations building including chemical feed and storage systems
- New basin/filter complex
- New raw water metering, rate control and blending facilities
- New storm drainage system
- New finished water pumping station
- New wash water equalization basin
- New wash water clarification system
- Rehabilitate and modernize the existing residuals pumping station
- Modify/expand residuals storage lagoons
- New finished water reservoirs

Opinion of Cost

The design memorandum level construction cost opinion for this project is $56 million. Detailed cost estimates will be provided during the detailed design phases of the project.

WATER TREATMENT PLANT PROJECTS

Project Highlights

- Both Salem Lake and Yadkin River raw water supply sources will be maintained.
- Ability to meet existing and future treatment regulations.
- Enhanced operations flexibility.
- Improved reliability.
- Ability to maintain equipment.

R.W. Neilson Water Treatment Plant – Phase 2 Modernization

Need

The Neilson Water Treatment Plant is the largest plant in the system with a treatment capacity of 48-mgd. Two major expansions have occurred since the construction of the original 24-mgd plant in the mid 1960's. Despite several small miscellaneous improvements projects, significant capital investment is required to replace aging infrastructure, improve treatment to meet current and future regulatory requirements, and to ensure the continued reliability in the distribution system provided by this critical facility.

The R.W. Neilson WTP is the largest WTP in the CCUC system.

Scope

It is anticipated that the scope of this project will include the following items:

- Modify rapid mix, flocculation, and sedimentation basins
- Overhaul all filters including controls, valves, media, underdrains, and air scour.
- Evaluate wash water supply system and implement improvements.
- Evaluate filter backwash water supply and waste system and implement improvements.
- Evaluate residuals storage and storm drainage systems and implement improvements.
- Eliminate recirculation of lagoon effluent to raw water reservoirs and permit a new NPDES discharge.
- Provide remote control and monitoring of raw water booster pumping station serving R.A. Thomas WTP.
- New standby power generators and distribution switchgear.
- New electrical utility feed
- Replace substations (3) with pad mount transformers.
- Replace 480V MCC providing power for pumps FWP-1, FWP-2 and FWP-3
- Replace 4160V MCLU providing power for pumps FWP-4 and FWP-5
- Replace FWP-6 and FWP-7 diesel drive with electric motor and new motor starters.

Opinion of Cost

The conceptual level total project cost is $44 million including 15% engineering, construction and 25% contingency. A detailed cost estimate will be determined during the preliminary and detailed design phases of the project.

Project Highlights

- Ability to meet existing and future treatment goals.
- Enhanced operations flexibility.
- Improved reliability

Implementation Schedule

A summary schedule for the implementation of the Water Treatment Plant capital improvements projects is provided in Table 3-1 below. A detailed system wide capital improvements projects implementation schedule is provided in Appendix A.

Table 3-1 Water Treatment Plant Projects Implementation Schedule Summary

Project Name	Project Cost	Project Start	Project End	Duration (months) Design/Const
R.A. Thomas Water Treatment Plant Improvements	**$56,000,000**	**9/2006**	**4/2011**	**21/ 34**
R.W. Neilson Water Treatment Plant, Phase 2 Modernization	**$44,000,000**	**1//2011**	**7/2015**	**18/36**

Section 4 - Booster Pumping Station Projects

CIP Development

A goal of this Facilities Master Plan is the development of a Capital Improvements Plan (CIP) to include proposed CIP projects for the booster pumping stations in the CCUC system. The CIP projects recommended herein are for the 10-year planning period from 2007 to 2017.

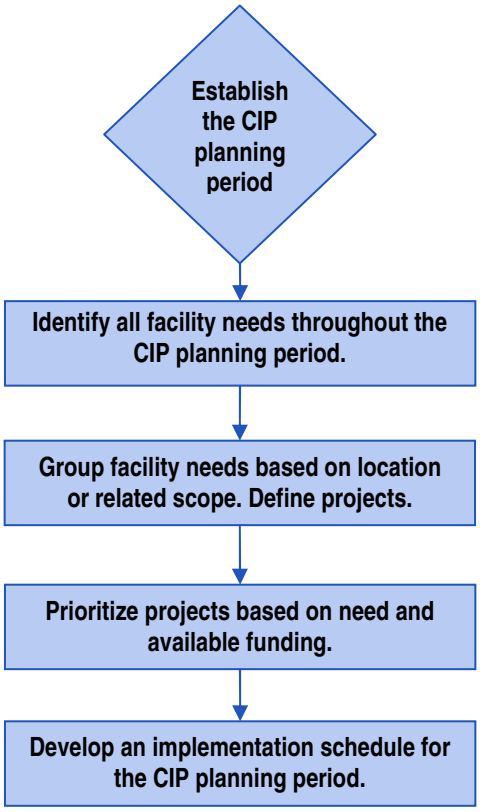
Selection of the booster pumping station projects proposed herein were based upon meetings with CCUC administration, operations, and maintenance staff as well as observations by Black & Veatch from current and past projects.

CIP projects were selected and prioritized based upon one or more of the following criteria:

- Ability to meet future regulatory requirements.
- System reliability.
- Ability to properly maintain equipment.
- Equipment age.
- Safety.
- Operational flexibility.
- Water treatment quality.

CIP Development Process

Several steps were considered in the development of the proposed CIP projects. The following flow chart illustrates the CIP development process.



BOOSTER PUMPING STATION PROJECTS

Proposed Booster Pumping Station Projects

Three booster pumping station CIP projects are proposed for the 10-year planning period and are listed as follows:

- Sides Road High Service Pumping Station – Standby Power and Electrical Improvements
- Chitty High Service Pumping Station – Station Standby Power, Electrical and Pumping Improvements
- 15th Street Pumping Station – Standby Power and Electrical Improvements

Additionally, annual funding for miscellaneous items such as analytical instrumentation, chemical feed equipment and piping, heavy maintenance, protective lining and coating systems, plumbing, and HVAC systems should be considered during the annual CIP planning period.

The following subsections discuss the need, scope, and conceptual level total project cost (in 2007 dollars) for the proposed projects. Appendix A, located at the end of this report, provides a proposed implementation schedule for the entire CIP projects presented herein.

Sides Road High Service Pumping Station – Standby Power and Electrical Improvements

Need

The Sides Road High Service Pumping Station is one of two high service pumping stations in the distribution system. The electrical power systems and emergency backup pumping systems are approximately 25-years old and have reached the end of their anticipated useful life. Confidence in the ability of the pumping station to continue to meet the system demands is dwindling as this equipment continues to age. Maintenance on the equipment has become difficult due to the age of the equipment and the lack of readily available replacement parts.

Scope

It is anticipated that the scope of this project will include the following items:

- ***4160-volt standby power generation.*** A standby power generation system will be provided including new 4160-volt generators, automatic transfer switch, switchgear, and fuel storage tank.
- ***120/208-volt standby power generation.*** The existing 120/208-volt generator will be replaced with a new 120/208-volt generator and automatic transfer switch.
- ***4160-volt motor control center replacement.*** The 25 year old motor control center will be replaced. New starters will likely be reduced voltage solid state.

Standby power generation system will provide emergency power for the entire station.

- ***No. 2 diesel engine replacement.*** The diesel powered engine providing emergency backup for the No. 2 pump will be removed and salvaged. Emergency standby power will now be provided by the new 4160-volt generators.
- ***Isolation valve replacement.*** The isolation valves in the yard and inside the pumping station are failing and do not provide adequate isolation for maintenance. All isolation valves will be replaced with new valves and actuators.

Opinion of Cost

The conceptual level total project cost is $4.0 million including 15% engineering, construction and 25% contingency. A detailed cost estimate will be determined during the preliminary and detailed design phases of the project.

BOOSTER PUMPING STATION PROJECTS

Chitty High Service Pumping Station – Standby Power, Electrical and Pumping Improvements

The 45 year old MCC is beyond its anticipated useful life.

Need

The Chitty High Service Pumping Station is comprised of two pumping stations. The oldest station, built in 1961, has operated for over 45 years with little capital investment. The equipment has aged beyond its useful life. The lack of available replacement part has rendered the equipment difficult to maintain. The entire pumping station is in need of major rehabilitation if it is to be relied upon to meet the current and future distribution system demands. The 1986 pumping station is the newest of the stations located at the Chitty Pumping Station. After 20 years of continuous service, a small capital investment is needed to replace some aging equipment and maintain the reliability of the station.

Scope

1961 Pumping Station

- ***Electrical substation replacement.*** The existing substation will be replaced.
- ***Standby power generation.*** New standby power generating equipment will be provided for both the 1961 and 1986 pumping stations. New equipment will include 4160-volt switchgear, 4160-volt generators, 480-volt generators, fuel storage tank and transformer.
- ***Diesel engine replacement.*** The existing diesel driven pumps will be removed from service. Emergency backup power for the entire pumping station will be provided by the new standby power generation system.
- ***120/208-volt automatic transfer switch.*** A new 120/208-volt generator and automatic transfer switch will be provided.
- ***480-volt motor control center replacement.*** The 45 year old motor control center will be replaced with a new 4160-volt motor control center. New starters will likely be reduced voltage solid state.
- ***Pump evaluation and replacement.*** Due to changes in the distribution system since the facility was built, the pumps have experienced abnormal wear due to cavitation. A pump evaluation on both the high and low level pumps will be performed to determine the cause of the abnormal wear and to help select new pumps appropriate for the current distribution system conditions. It is anticipated that all the exiting pumps will be replaced.

The existing pumps are subject to excessive wear due to cavitation.

- ***Isolation valve replacement.*** The existing isolation valves and pump control valves inside the pumping station are failing and do not provide adequate isolation for maintenance. All interior isolation valves and pump control valves including actuators will be replaced.

1986 Pumping Station

Scope

- ***Diesel engine replacement.*** The existing diesel engine providing emergency backup power to the high level no. 1 pump will abandoned in place or removed and salvaged.
- ***4160-volt motor control center replacement.*** The 20 year old motor control center will be replaced. New starters will likely be reduced voltage solid state.
- ***Isolation valve replacement.*** The existing isolation valves inside the pumping station are failing and do not provide adequate isolation for maintenance. All interior isolation valves including actuators will be replaced.
- ***Motor replacement.*** The two existing 2,000 hp motors will be replaced.

Opinion of Cost

The conceptual level total project cost is $6.5 million including 15% engineering, construction and 25% contingency. A detailed cost estimate will be determined during the preliminary and detailed design phases of the project.

15th Street Pumping Station – Standby Power and Electrical Improvements

Scope

- ***480-volt standby power generation.*** A new standby power generation system will be provided including new 480-volt generators, automatic transfer switch, switchgear, fuel storage tank and electrical transformer.
- ***480-volt motor control center replacement.*** A new 480-volt motor control center will be installed to replace the existing combination starters.
- ***Diesel engine replacement.*** The existing standalone diesel engine driven pump will be abandoned in place or removed and salvaged.

Opinion of Cost

The conceptual level total project cost is $950,000 including 15% engineering, construction and 25% contingency. A detailed cost estimate will be determined during the preliminary and detailed design phases of the project.

BOOSTER PUMPING STATION PROJECTS

Implementation Schedule

A summary schedule for the implementation of the Booster Pumping Station capital improvements projects is provided in Table 4-1 below. A detailed system wide capital improvements projects implementation schedule is provided in Appendix A.

Table 4-1 Booster Pumping Station Projects Implementation Schedule Summary

Project Name	Project Cost	Project Start	Project End	Duration (months) Design/Const
Sides Road High Service Pumping Station, Standby Power and Electrical Improvements	**$4,000,000**	**1/2012**	**4/2014**	**9/18**
Chitty High Service Pumping Station, Standby Power, Electrical, and Pumping Improvements	**$6,500,000**	**5/2008**	**8/2010**	**9/18**
15th Street Pumping Station, Standby Power and Electrical Improvements	**$950,000**	**9/2009**	**10/2011**	**9/16**

Section 5 - Elevated/Ground Storage Tank Projects

CIP Development

A goal of this Facilities Master Plan is the development of a Capital Improvements Plan (CIP) to include proposed CIP projects for the elevated/ground storage tanks in the CCUC system. The CIP projects recommended herein are for the 10-year planning period from 2007 to 2017.

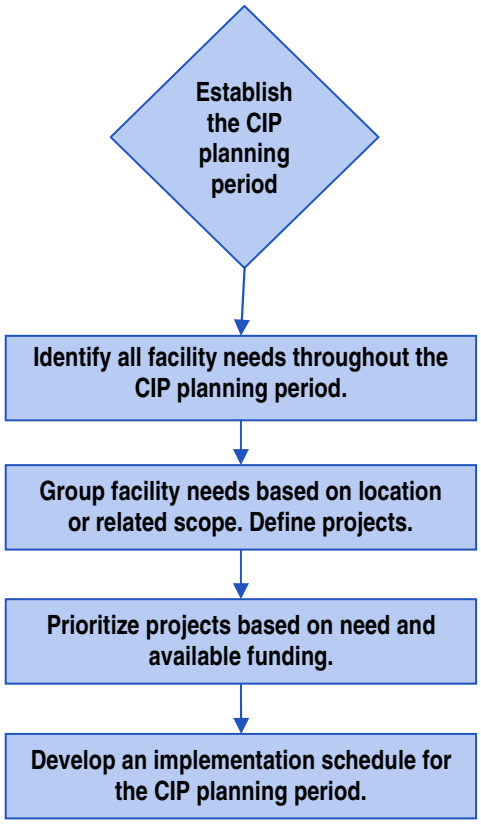
Selection of the elevated/ground storage tanks projects proposed herein were based upon meetings with CCUC administration, operations, and maintenance staff as well as observations by Black & Veatch from current and past projects.

CIP projects were selected and prioritized based upon one or more of the following criteria:

- Ability to meet future regulatory requirements.
- System reliability.
- Ability to properly maintain equipment.
- Equipment age.
- Safety.
- Operational flexibility.
- Water treatment quality.

CIP Development Process

Several steps were considered in the development of the proposed CIP projects. The following flow chart illustrates the CIP development process.



Elevated/Ground Storage Tank Projects

Five elevated/ground storage tank CIPs are proposed for the 10-year planning period and are listed as follows:

- Wake Forest and Chitty Storage Tanks – Painting and Structural Repairs
- Sides and 15th Street Ground Storage Tanks – Painting and Structural Repairs
- Bowden Hammer Elevated Storage Tank– Painting and Structural Repairs
- Clemmons Elevated Storage Tank
- Kernersville Elevated Storage Tank

The following subsections discuss the need, scope, and construction cost (in 2007 dollars) of the proposed projects. Appendix A, located at the end of this report, provides a proposed implementation schedule for the entire CIP projects presented herein.

Wake Forest and Chitty Storage Tanks – Painting and Structural Repairs

Need

Years of exposure to the elements had resulted in failing protective coatings and structural damage.

Scope

Chitty Ground Storage Tank

- ***Painting***. A new exterior coating system will be applied.
- ***Structural Repairs***. Exterior structural damage will be repaired.

Wake Forest Elevated Storage Tank

- ***Painting***. New interior and exterior coating systems will be applied.
- ***Structural Repairs***. Interior and exterior structural damage will be repaired.

Opinion of Cost

Funding in the amount of $1,175,000 is currently budgeted in the CIP to complete this project.

Sides and 15th Street Ground Storage Tanks – Painting and Structural Repairs

Need

25 years of service and exposure to the elements had resulted in failing protective coatings and structural damage.

Scope

Sides Ground Storage Tank

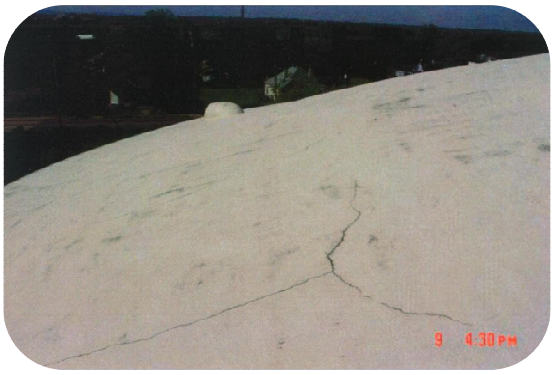
- ***Painting***. New interior and exterior coating systems will be applied
- ***Structural Repairs***. Interior and exterior structural damage will be repaired.

15th Street Elevated Storage Tank

- ***Painting***. New interior and exterior coating systems will be applied.
- ***Structural Repairs***. Interior and exterior structural damage will be repaired.

Opinion of Cost

Funding in the amount of $1,381,000 is currently budgeted in the CIP to complete this project.



Cracks in the concrete dome require structural repair

Bowden Hammer Elevated Storage Tank – Painting and Structural Repairs

Need

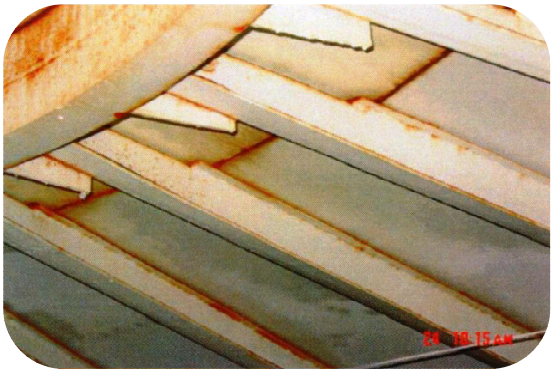
Years of service and exposure to the elements had resulted in failing protective coatings and structural damage.

Scope

- ***Painting***. New interior and exterior coating systems will be applied
- ***Structural Repairs***. Interior and exterior structural damage will be repaired.

Opinion of Cost

Funding in the amount of $585,000 is currently budgeted in the CIP to complete this project.



Rust formation on the interior of the roof requires removal and a new coating system applied

ELEVATED/GROUND STORAGE TANK PROJECTS

Clemmons Elevated Storage Tank

Need

A Water Distribution System Study was completed by The Pitometer Associates in 1998. Based on this report the 980 Level does not have enough storage. Pumps at the R.W. Neilson Water Treatment Plant presently supply the 980 Level. A single elevated tank in Clemmons provides only 300,000 gallons of storage. Pitometer's report estimates approximately 1.49 million gallons total of elevated storage will be required to meet the maximum day plus fire flow demand in 2015.

The existing elevated storage tank in Clemmons provides only 300,000 gallons of the total 1,490,000 gallons required by 2015.

Scope

- ***Elevated storage tank.*** Additional storage will be provided with a new 1.5 million gallon elevated storage tank in Clemmons.

Opinion of Cost

Funding in the amount of $1.1 million is currently budgeted in the CIP to complete this project.

Kernersville Elevated Storage Tank

Need

A Water Distribution System Study was completed by The Pitometer Associates in 1998. Based on this report, the 1060 Level does not have enough floating storage. With a capacity of 1.0 million gallons, the 9th street tank is the only storage tank in the 1060 Level. This capacity equates to only 3 percent of the maximum day demand in 2015.

Scope

- ***Elevated storage tank.*** Additional storage will be provided with a new 1.0 million gallon elevated storage tank in Kernersville.

Opinion of Cost

Funding in the amount of $1.5 million is currently budgeted in the CIP to complete this project.

ELEVATED/GROUND STORAGE TANK PROJECTS

Implementation Schedule

A summary schedule for the implementation of the Elevated/Ground Storage Tank capital improvements projects is provided in Table 5-1 below. A detailed system wide capital improvements projects implementation schedule is provided in Appendix A.

Table 5-1 Elevated/Ground Storage Tank Project Implementation Schedule Summary

Project Name	Project Cost	Project Start	Project End	Duration (months) Design/Const
Wake Forest and Chitty Storage Tanks, Painting and Structural Repairs	**$1,175,000**	**3/2007**	**3/2008**	**12**
Kernersville Elevated Storage Tank	**$1,100,000**	**7/2009**	**1/2011**	**6/12**
Sides and 15th Street Storage Tanks, Painting and Structural Repairs	**$1,381,000**	**1/2010**	**1/2011**	**12**
Bowden Hammer Elevated Storage Tank, Painting and Structural Repairs	**$585,000**	**1/2010**	**1/2011**	**12**
Clemmons Elevated Storage Tank	**$1,500,000**	**1/2013**	**7/2014**	**6/12**

APPENDIX A