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Task Order YW06

Final
Savannah Assessment
Technical Memorandum

U.S. Army Corps of Engineers
Kansas City District

Northwest Missouri Regional Water Supply Transmission System Study
Phase V

August 2012

US Army Corps of Engineers
Kansas City District

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Missouri Department of Natural Resources

CDM Smith

Northwest Missouri Regional Water Supply
Transmission System Study
Phase V

Final
Savannah Assessment Technical Memorandum

August 2012

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Acronyms

CDM Smith	CDM Federal Programs Corporation
EPS	Extended Period Simulation
GNWWA	Great Northeast Wholesale Water Commission
HP	horsepower
kgal	thousand gallons
kwh	kilowatt-hours
MDNR	Missouri Department of Natural Resources
MGD	million gallons per day
O&M	Operation and Maintenance
PAS	Planning Assistance to State
PSI	pounds per square inch
PVC	polyvinyl chloride
PWSD	Public Water Supply District
SRF	State Revolving Fund
TM	Technical Memorandum
USACE	U.S. Army Corps of Engineers
WTP	Water Treatment Plant

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Section 1
Introduction

Water is a key driver in the success and stability of population trends. In northwest Missouri, many communities depend on access to the Missouri River and its alluvial aquifers or reservoirs for their water supply. Communities without access to these sources purchase water from wholesale suppliers or utilize inconsistent groundwater sources and a few large lakes for supply.

Under the Planning Assistance to States (PAS) cost share agreement between the U.S. Army Corps of Engineers (USACE) and the Missouri Department of Natural Resources (MDNR) Water Resources Center, CDM Federal Programs Corporation (CDM Smith) and Bartlett & West were requested to provide engineering and technical support services to the Kansas City District for Phase V of the Northwest Missouri Regional Water Supply Study. The objective of Phase V was to provide an evaluation of the Middle Fork water treatment plant (WTP).

This technical memorandum (TM) annotates the methodology used and results determined for user rates for the Great Northwest Wholesale Water Commission (GNWWC) based on information from the following documents:

- *City of Savannah, Missouri Drinking Water Facility Plan Water Treatment Plant Improvements (2010 Savannah Feasibility Study)* – Bartlett & West.
- *City of Savannah, Missouri Water Rate Analysis Report Addendum (Savannah Water Rate Analysis Addendum),* April 2, 2012 – Carl Brown Consulting, LLC.
- *Phase IV Final Feasibility Study Update,* May 12, 2011 – CDM and Bartlett & West.
- *Final Middle Fork Water Treatment Plant and Reservoir Condition Technical Memorandum,* June 2012 – CDM Smith and Bartlett & West
- *Phase IV Stage 1 Pipeline Preliminary Engineering Report* (*Stage 1 Report*), May 12, 2011 – CDM and Bartlett & West.

Portions of the previously noted reports (Appendix A) and attached calculations (Appendix B) were used to determine the estimated user rates for the following three scenarios:

Scenario 1: City of Savannah sells potable water to the Stage 1 GNWWC membership.

Scenario 2: GNWWC purchases the Savannah WTP well field, raw water pipeline and WTP to produce potable water to supply Savannah, Andrew County Public Water Supply District (PWSD) No. 3 (Andrew 3) and the Stage 1 GNWWC members identified in Section 1.1.

Scenario 3: GNWWC purchases potable water from Missouri-American.

These scenarios are being investigated due to changes in the GNWWC membership and desire of the membership to have the GNWWC supply 50-percent of the maximum day demand.

1.1 Demand Introduction

This TM assumes that 50-percent of the 2030 maximum day values from the *Stage 1 Report* would be supplied by either Missouri-American or the Savannah WTP. In addition, it was assumed that the Middle Fork Water Company (MFWC) current customers would continue to purchase water from the MFWC and those demands were not included in sizing the Savannah WTP expansion or the transmission system. See Table 1-1.

Table 1-1 Summary of Stage 1 Water System Demand

District/City[1]	Water Demands (MGD)			Water Supply
	2030 Max. Day [1]	50-Percent 2030 Max. Day	50-percent 2030 Average Day [4]	
Andrew County PWSD #1	1.17	0.59	0.29	
Andrew County PWSD #4	0.09	0.05	0.02	
City of Albany	0.50	0.25	0.13	
City of Barnard	0.05	0.03	0.01	
City of Bolckow	0.10	0.05	0.03	
City of Grant City	0.25	0.13	0.06	MFWC
City of King City	0.20	0.10	0.05	
City of Maysville	0.19	0.10	0.05	
City of Stanberry	0.23	0.12	0.06	MFWC
DeKalb County PWSD #1[2]	0.40	0.20	0.10	
Gentry County #1	0.25	0.13	0.06	
Gentry County #2	0.10	0.05	0.03	MFWC
Nodaway County #1[3]	0.60	0.30	0.15	
Savannah and Andrew County PWSD #3[4]		1.13	0.70	
Total Demand	4.13	3.20	1.03	
Total Demand w/o MFWC Customers		2.91	1.59	

(1) The cities and water districts are assumed demands for this assessment. These assumptions should be further refined if this project is pursued.
(2) Listed demand for DeKalb County PWSD #1 includes 25-percent of overall utility demand.
(3) Assumes only 0.3 million gallons per day (MGD) maximum day purchased, not full system demand.
(4) Currently not members of GNWWC, however both currently are supplied by the Savannah plant (demands from the *2010 Savannah Feasibility Study*)

The cities and water districts identified in Table 1-1 are assumed demands for this assessment. These assumptions should be further refined if this project is pursued.

1.2 Savannah WTP Description

The City of Savannah WTP currently serves the City of Savannah and Andrew PWSD #3. The plant was constructed in 2008 as discussed in Section 3 and shown on Figure 3-1. The plant is located about 3.5 miles southwest of Savannah along Highway T. The current treatment processes include iron removal, lime softening, media filtration, and chlorination before discharging water into the system. Section 3 of this report provides additional information regarding the WTP and possible expansion needs for the GNWWC use.

1.3 Modeled Distribution System Descriptions

There are three cost/purchase scenarios examined in Section 6, they necessitated only two modeled transmission system scenarios, one from the Missouri-American WTP near St. Joseph, Missouri and one from the Savannah WTP. The main difference between the two networks is the additional 4.9 miles of pipeline for the Missouri-American WTP scenario. The conceptual transmission system for the City of Savannah scenario is presented on Figure 1-1. The conceptual transmission system for the Missouri-American Water scenario is presented on Figure 1-2. Modeling efforts and details for the conceptual transmission systems are provided in Section 2. Changes in previous modeling include:

- The removal of Daviess County PWSD #1 and Maitland.
- The demand for Nodaway County PWSD #1 was moved south of its original location in Maryville.
- Grant City, Stanberry, and Gentry PWSD #2 would all continue to be served by the Middle Fork WTP and would not be included in the modeling effort.

Based on these changes to the system, new modeling and cost estimates were performed to determine the new cost of water per 1,000 gallons.

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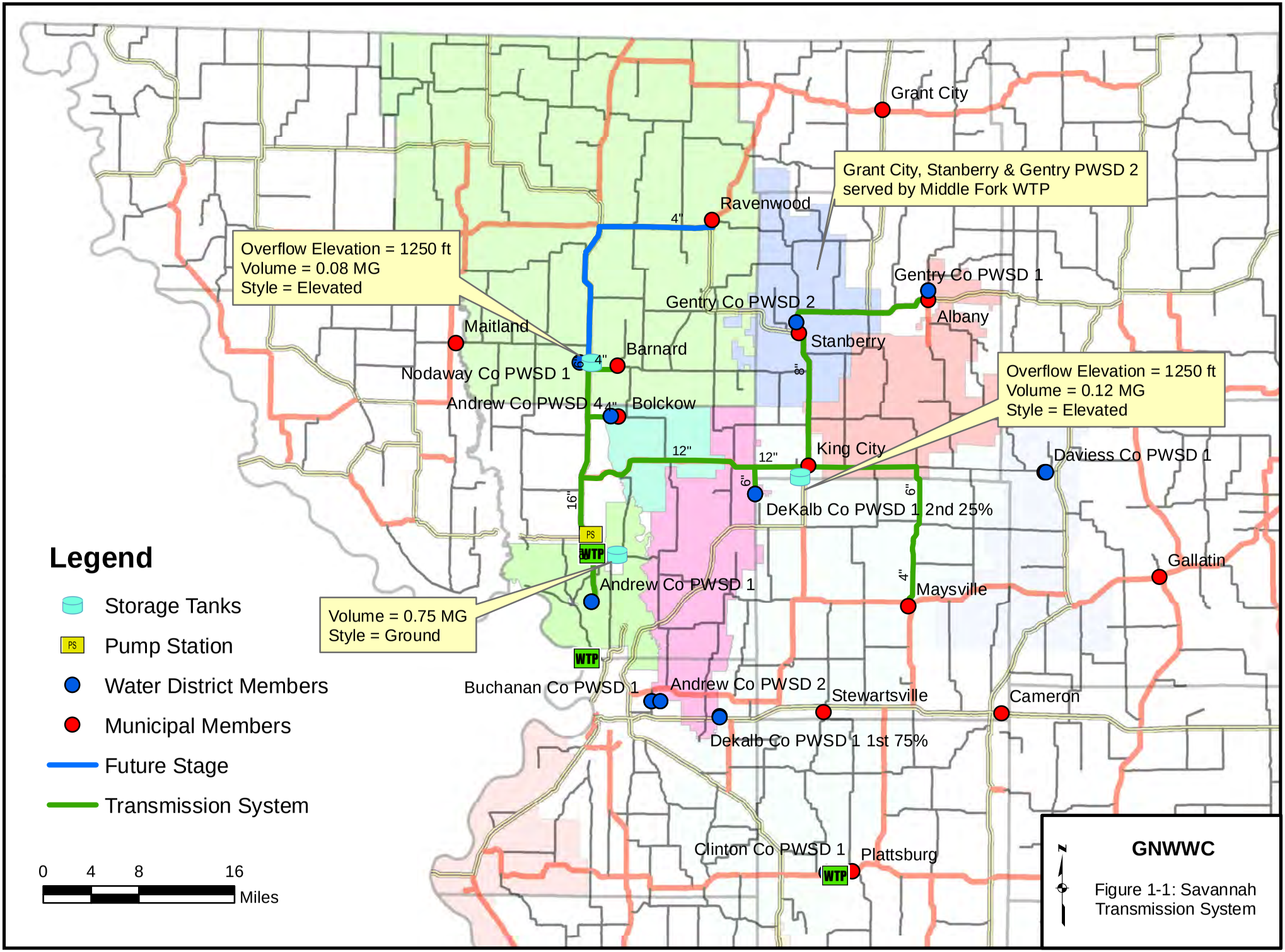
Grant City
Grant City, Stanberry & Gentry PWSD 2 served by Middle Fork WTP
Ravenwood
4"
Overflow Elevation = 1250 ft
Volume = 0.08 MG
Style = Elevated
Gentry Co PWSD 1
Gentry Co PWSD 2
Albany
Maitland
Stanberry
Barnard
4"
Nodaway Co PWSD 1
8"
Overflow Elevation = 1250 ft
Volume = 0.12 MG
Style = Elevated
Andrew Co PWSD 4
4"
Bolckow
12"
12"
King City
Daviess Co PWSD 1
6"
6"
16"
DeKalb Co PWSD 1 2nd 25%
PS
WTP
Gallatin
4"
Andrew Co PWSD 1
Maysville
Volume = 0.75 MG
Style = Ground
WTP
Buchanan Co PWSD 1
Andrew Co PWSD 2
Stewartsville
Cameron
Dekalb Co PWSD 1 1st 75%
Clinton Co PWSD 1
Plattsburg
WTP
Legend
Storage Tanks
Pump Station
Water District Members
Municipal Members
Future Stage
Transmission System
0
4
8
16
Miles
N
GNWWC
Figure 1-1: Savannah Transmission System

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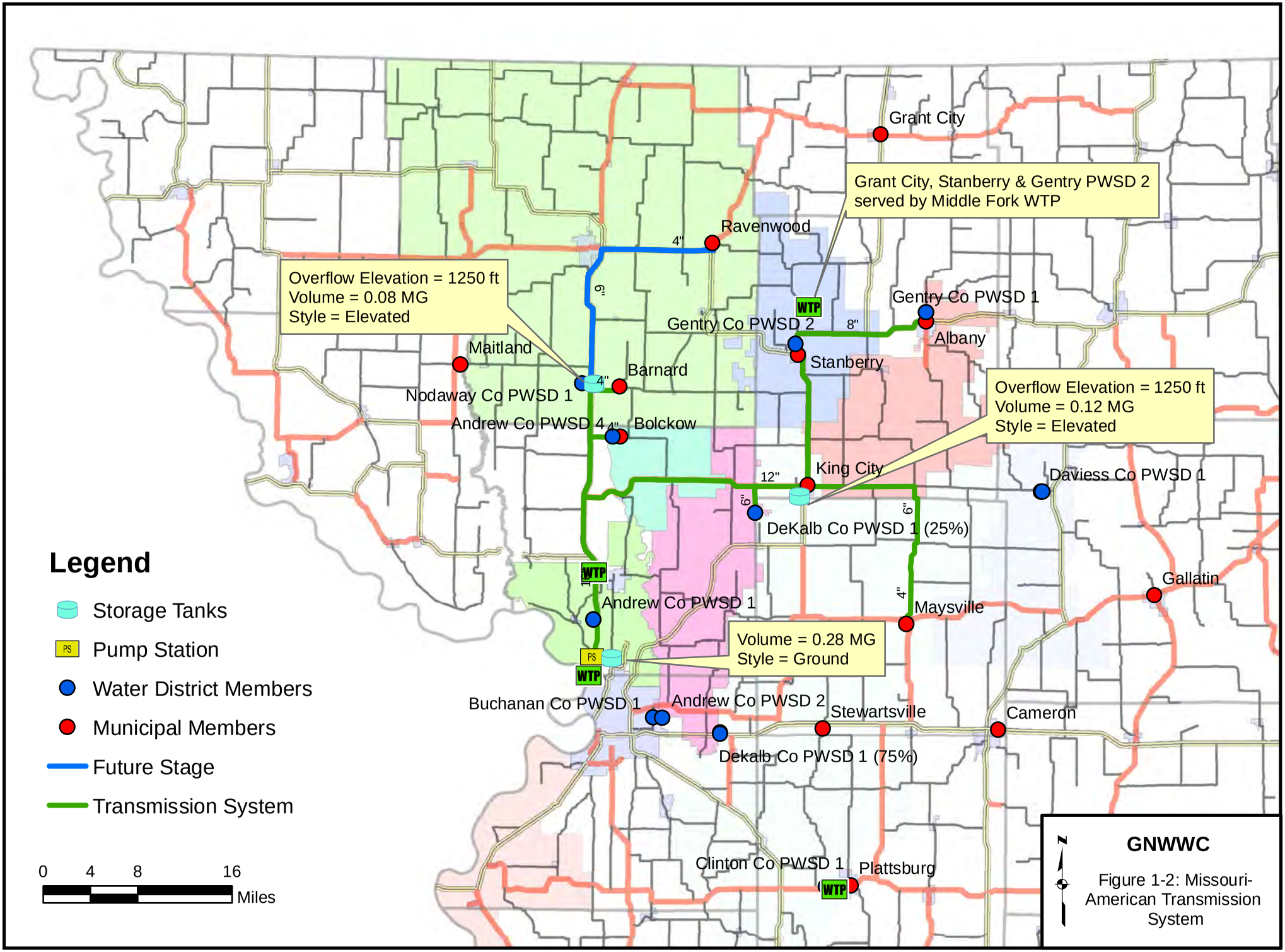
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Andrew Co PWSD 4
4"
Bolckow
Overflow Elevation = 1250 ft
Volume = 0.12 MG
Style = Elevated
King City
12"
Daviess Co PWSD 1
6"
6"
DeKalb Co PWSD 1 (25%)
12"
WTP
Gallatin
Andrew Co PWSD 1
4"
Maysville
Volume = 0.28 MG
Style = Ground
PS
WTP
Buchanan Co PWSD 1
Andrew Co PWSD 2
Stewartsville
Cameron
Dekalb Co PWSD 1 (75%)
Clinton Co PWSD 1
Plattsburg
WTP
Legend
Storage Tanks
PS
Pump Station
Water District Members
Municipal Members
Future Stage
Transmission System
0 4 8 16
Miles
GNWWC
Figure 1-2: Missouri-American Transmission System

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Section 2

Distribution System Modeling and Sizing Data

Two hydraulic models were developed based on separate supply locations, one at the Savannah WTP and another at the Missouri-American WTP. Assumptions for the model development are summarized below:

- Fifty-percent of the maximum day demand was used instead of the full maximum day demand.
- Gentry PWSD #2, Grant City and Stanberry water demands will be met through the existing MFWC and were not included in the model.
- The City of Maitland and Daviess PWSD #1 were removed from the model.
- DeKalb County PWSD #1 will have two connection points in the future system. It is assumed in the Phase IV Feasibility Study that the northern connection point will receive 25-percent of the demand.

EPANET 2.0 modeling software was used to perform a conceptual static hydraulic analysis on the overall system with the 50-percent maximum day demands. Further modeling is recommended as part of preliminary design activities to include:

- Extended Period Simulation (EPS) – An EPS simulation is recommended to evaluate transmission system operation of pumps, storage tank level fluctuations
- Water Quality – If only one supply source is intended to serve the master meters over long distances, water age should be evaluated to assess the water quality reaching the customers.
- Demands – Consider modeling other demand conditions rather than only 50-percent maximum day demands to verify pipe sizing.

The input parameters used to create the EPANET model and the output data are included in Appendix C. To create the overall system model, points were assigned for each utility to represent where they would receive water. These locations were selected by referencing the water distribution system maps provided by the individual utilities during the *Stage 1 Report* development.

2.1 Development Criteria and Pipeline Sizing

The hydraulic criteria used to develop the model are in Table 2-1. These criteria were chosen to minimize energy costs while optimizing storage and pumping facilities. A maximum pressure was selected to minimize the need for energy dissipation at delivery points. Most GNWWC members should be able to accept incoming water at this selected pressure without the need for throttling or higher pressure class pipelines. Some utilities may need to install booster pump stations to meet pressure requirements.

Table 2-1 Modeling Development Criteria

Model Constraint	Value
Allowable Friction Headloss Range	5.3 - 15.8 feet per mile
Target Pressure Range	40 - 150 PSI
Allowable Pressure Range	35 - 200 PSI
Maximum Transmission Velocity	3.5 feet per second
Transmission Storage Tank Volume	10% Transmission Flow
Plant Storage Tank Volume	15% of Transmission Flow
Maximum Horsepower per Pump	300 HP
Hazen-Williams Roughness Coefficient	140

PSI = pounds per square inch
HP = horsepower

Due to new regulations from MDNR, it is likely that a statute requiring every water transmission system to run at a minimum pressure of 35 psi will be created. In order to meet this anticipated MDNR statute the allowable pressure range in the model was changed from a minimum of 20 psi to 35 psi. This is the only criteria change from those used in the *Stage 1 Report*.

It was assumed that the pipeline material is polyvinyl chloride (PVC) for all pipes. A pipe roughness of 140 for the Hazen William's head loss equation was used for all the pipe sizes used throughout the model. Table 2-2 lists the pipeline sizing and lengths for the two different scenarios.

Table 2-2 Missouri-American and Savannah Pipeline Sizes and Lengths

Pipeline size	Savannah WTP Pipe Length	Missouri-American Pipe Length
4-inch	68,700	68,700
6-inch	83,600	83,600
8-inch	160,000	131,800
12-inch	158,700	158,700
16-inch	30,400	84,500
Total Feet	**501,400**	**527,300**
Total Miles	**95**	**100**

2.2 Pumping Facilities

The pump stations were sized to provide flow for peak daily demands in a 24-hour delivery period. Individual pumps were sized for 100 HP to allow low voltage (480 volt or less) equipment while keeping conductor sizes within a reasonable and economical range. A pump station is necessary at each WTP to serve the transmission system.

The methodology used to size the pump stations was performed in a step process: first the head was based on the pressure when the pump is on at the WTP, the pressure was converted to feet; then the horse power was determined by multiplying the flow by the head and then divided by efficiency. The quantity of pumps was determined by dividing the total HP by 300 (to limit the pump size) and rounding up to the nearest pump number. An additional pump was added for redundancy.

Table 2-3 lists the Savannah and Missouri-American WTP options, which required the same pump station and flow control structure. The pump station for both alternatives was sized to provide 1.9 MGD.

Table 2-3 Missouri-American and Savannah Pumping Facility Details

	Flow (gal/min)	Flow (MGD)	Head	Total HP	Number of Pumps
Pump Station	1,300	1.90	180	100	2

2.3 Water Storage Facilities

Water storage facilities are located where the combination of elevation and pipeline friction losses causes pipeline pressure upstream of the pump station to exceed 200 psi. Storage facilities were sized in the transmission system for pump station equalization and based on 10-percent of the total demand. The storage volume was split according to the ratio of demands in the north line versus the east line. The east line had higher demands so the tank in King City has a larger storage volume. Each GNWWC member will be responsible for their storage needs. Some storage capacity is available on the transmission system, but it is assumed that emergency storage and storage for fire flows will be provided by each member of the GNWWC. Recirculation systems may be needed to maintain disinfectant residuals for each storage tank. The tank specifications can be seen in Table 2-4.

Table 2-4 Missouri-American and Savannah Transmission System Model Tank Assumptions

Location	Height (feet)	HGL	Volume (kgal) [2]	Tank Type
King City	169	1250	120	Elevated
Near Barnard	141	1250	80	Elevated
Missouri-American [1]	--		280	Ground

(1) New tank needed for either scenario
(2) kgal – thousand gallons

2.4 Cost Reductions Related to System Changes

Reduction in the cost of the transmission system is due to several factors. One of the largest factors is the reduction in demand to the 50-percent maximum day demand. This led to smaller pipeline diameter sizes. The largest pipeline in the new system is 16-inch reduced from 24-inch in the previous Phase IV work.

Another factor lowering the cost opinion was the demand reduction, as this work does not include the demands from Daviess County PWSD #1 and Maitland (Maitland was not a part of Stage 1 but their demand was accounted for in the pipeline). Additionally, Grant City, Stanberry, and Gentry County PWSD #2 continued service through Middle Fork WTP; therefore, the transmission line does not carry their demands.

The demand location for Nodaway County PWSD #1 was moved south. This change moved the tank previously located near Maryville to a placement further south. A change which added pipeline occurred in order to connect Maysville to the transmission system as shown on Figures 1-1 and 1-2. Table 2-5 summarizes the cost change between the Phase IV system results and the revised systems results.

Table 2-5 Comparison of Phase IV Costs and Revised System Costs

Source	Original Phase IV System*	Revised System
Missouri-American	$57,780,000	$35,702,000
Savannah	$51,250,000	$31,482,000

*Includes the Daviess PWSD #1 Option in the total cost

Using the costs from Table 2-6, the ratio for the cost of the transmission system between Missouri-American and Savannah is 0.89 for the original Phase IV system. This ratio for the costs 0.88 for the revised system is similar to the results from the Phase IV system.

The debt service payment for the Savannah transmission system is $2,200,000 and for Missouri-American is $2,400,000. This assumes that the project is funded through a Missouri State Revolving Fund (SRF) at an assumed interest of 3-percent over 20 years or the U.S. Department of Agriculture (USDA) Rural Development loan at an assumed interest of 4.75-percent over 33 years.

Section 3

Water Treatment Plant Costs

The cost of expanding the Savannah WTP to serve the GNWWC Stage 1 Membership, Savannah, and Andrew 3 was based on Alternative 2 from the *2010 Savannah Feasibility Study*.

The City's original WTP was built around 1928. In 2008, the construction of the City's new 2 MGD WTP, clearwell, and lagoons located approximately 3.5 miles southwest Savannah was completed as shown in Figure 3-1. The project also included drilling a third well in the City's well field located in the Missouri River alluvium south of Amazonia, Missouri.

Currently the City uses chlorine gas as an oxidant for iron, a disinfectant, and for ammonia concentration removal at the WTP. The current disinfection system has three separate injection locations throughout the WTP.

3.1 Debt Service

The City of Savannah's existing debt service for their water system is estimated at $1,269,000 for the WTP and distribution system per the *Savannah Water Rate Analysis Addendum*. The debt service for the current Savannah WTP is estimated at $719,000 per the *2010 Savannah Feasibility Study*. The debt service attributed to the Savannah distribution system is estimated at $550,000. Additionally, based on the original revenue bonds taken out and the annual debt service payment, it is assumed that the City of Savannah has approximately $7 million in debt in the form of revenue bonds from the 2008 WTP upgrade.

Under the first scenario in this TM the GNWWC would purchase the Savannah WTP, if this purchase occurs the debt service associated with the WTP would become the responsibility of the GNWWC.

3.2 WTP Improvements to Serve GNWWC

The total system demands, including Savannah and Andrew 3 full demand and a partial demand from the GNW Commission, are 3.2 MGD. It is assumed that the MFWC will continue to supply its current customers per the *Final Middle Fork Water Treatment Plant and Reservoir Condition Technical Memorandum*. The remaining system demands will need to be supplied by the Savannah WTP. The existing Savannah WTP is rated at 2 MGD. Taking into consideration the system demands and current capacity available a 1.1 MGD expansion is necessary.

Based on the recommended improvements to expand the plant from the *2010 Savannah Feasibility Study* Alternative 2, the upgrades to increase the plant capacity to 3.1 MGD include two additional groundwater wells, additional raw water pipeline, one solids contact unit, two media filters, chemical feed improvements, and an ammonia feed facility. It is assumed that the aerator, lagoons, and re-carbonation basin have sufficient capacity for the proposed WTP expansion scope and costs are based on the data in the *2010 Savannah Feasibility Study*. In addition, $100,000 of miscellaneous repairs were included in the WTP upgrades to address deferred maintenance items based on communications with City of Savannah staff. Pertinent pages from the *2010 Savannah Feasibility Study* are included in Appendix A. The WTP cost opinion is presented in Table 3-1.

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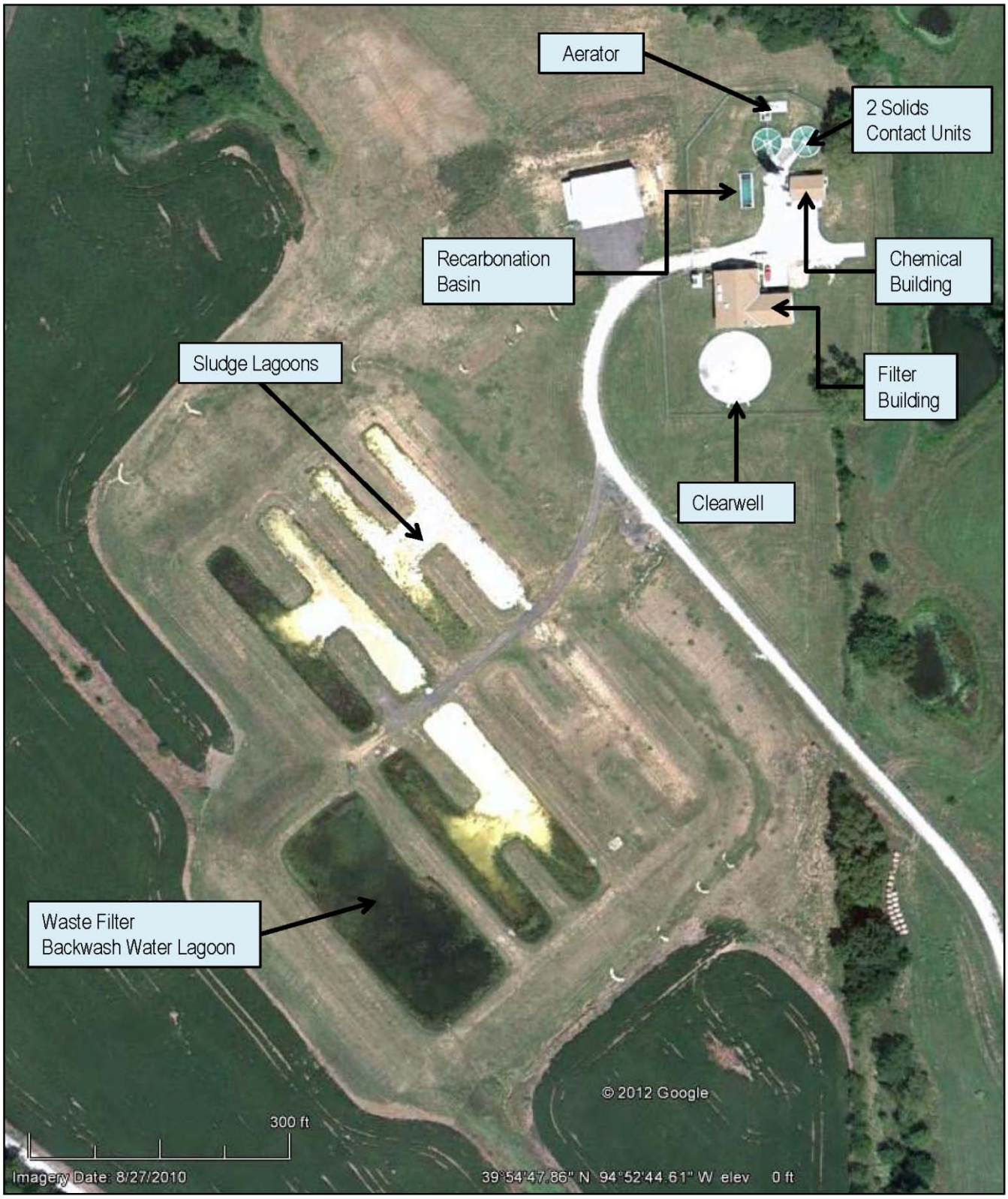

Figure 3-1 Existing Savannah Water Treatment Plant

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The ammonia feed facility was not recommended in the *2010 Savannah Feasibility Study*. However, by serving the GNWWC and increasing in water age before the water reaches the intended consumers it is recommended to change the residual disinfectant from free chlorine to chloramines. This is also consistent with the recommendations from the *Stage 1 Report*.

Table 3-1 Savannah WTP Expansion Cost Opinion

Item No.	Description	Unit	Quantity	2010 Unit Cost[(1)]	Total Cost Opinion
1	Groundwater Wells	EA	2	$ 115,000	$ 230,000
2	Raw Water Piping	LF	6,700	$ 20	$ 134,000
3	Solids Contact Unit	EA	1	$ 550,000	$ 550,000
4	Filters	EA	2	$ 200,000	$ 400,000
5	Chemical Feed Improvements	LS	1	$ 100,000	$ 100,000
6	Electrical	LS	1	$ 210,000	$ 210,000
7	Instrumentation and Controls	LS	1	$ 135,000	$ 135,000
8	Yard Piping	LS	1	$ 75,000	$ 75,000
9	Ammonia Feed Facility	LS	1	$ 70,000	$ 70,000
10	Miscellaneous Maintenance	LS	1	$ 100,000	$ 100,000
	Subtotal				$ 2,000,000
	Contingency, Overhead and Profit	35%			$ 700,000
	Total WTP Expansion Costs (2010 Dollars)				$ 2,700,000
	2012 Total WTP Expansion Cost Opinion	**1.03[(2)]**			**$ 2,800,000**

(1) Costs are from the *2010 Savannah Feasibility Study*

(2) The ratio of the KC CCI Value for 2010 to KC CCI June 2012 value was used to adjust the WTP Cost Opinion to a current dollar value.

If the $2.8 million is financed by the Missouri SRF at 3-percent interest over 20 years, or through USDA Rural Development at 4.75-percent interest over 33 years, the debt service payments would be approximately $200,000 per year. Figure 3-2 provides a conceptual drawing of the WTP expansion items for reference.

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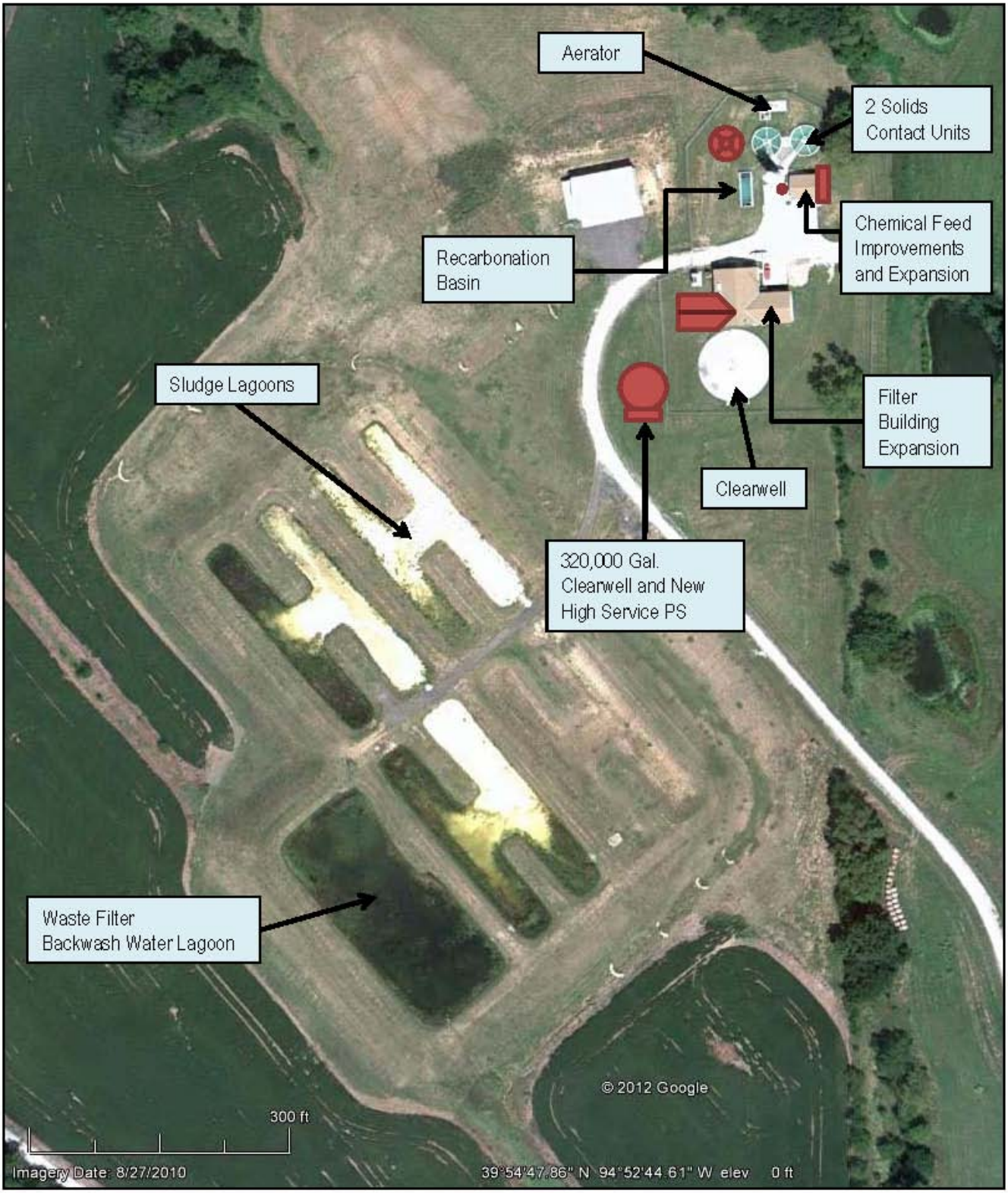

Figure 3-2 Savannah Water Treatment Plant Proposed Expansion

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Section 4

Operation and Maintenance Expenses

Total expenses to purchase or produce potable water and transmit water through the distribution system were based on the operation and maintenance (O&M) costs. This section presents the annual O&M cost assumptions for the two distribution system options (Savannah and Missouri-American) and the WTP.

4.1 Transmission System O&M Costs

O&M costs for the transmission system were based on the same methodology used in the *Stage 1 Report.* The costs were based on four components: staffing, energy (electricity) costs, storage repainting, and pipeline maintenance and repair. Costs for these four categories have been estimated and the total of these costs are represented as the estimated annual O&M cost for the transmission system in Table 6-1 in Section 6.

Staffing costs, for both Savannah and Missouri-American transmission systems, assume a staffing level of one part-time and three full-time employees, comprised of two administrative and two field employees. Estimated staffing costs include benefits and employer payroll contributions totaling $210,000.

Electrical costs, for both alignments, are mostly derived from pumping operations. Assuming pumping operations are active approximately 25-percent of the total hours available in a year, the system would have an annual electrical demand of approximately 327,000 kilowatt-hours (kwh). Assuming a rate cost of $0.12 per kwh, the resultant annual energy cost is approximately $40,000 per year.

Storage tank recoating is another significant maintenance cost on the conceptual system. It was assumed that the coating systems used require a full blast and recoat every 15 years. Recent recoating costs for similar size tanks indicate the present value cost of recoating is approximately $150,000 per tank. If this cost is annualized, the cost to recoat both of the system's storage tanks is budgeted at approximately $20,000 per year.

The final component of the estimated O&M costs is pipeline maintenance. For this component, it is assumed that one break will occur once per each 20 miles of pipeline each year. The present value repair cost represents the additional labor cost, equipment cost, and parts, and is estimated at $3,000 per repair. Based on the length of the pipelines, multiplying these two factors calculates an estimated cost of upkeep for both transmission systems at approximately $15,000 per year.

Combining these four factors provides the estimated annual O&M costs for the two transmission system options, excluding depreciation. It is assumed that cash investments set aside for depreciation will gain interest at a rate equal to inflation which should compensate for price inflation during the lifespan of the facilities. As such, the annual cost for O&M for both transmission systems is $285,000 per year.

4.2 Savannah Current WTP Expenses

Utilizing information from Scenario 6 Chart 3 of the *Savannah Water Rate Analysis Addendum,* the 2011-2012 WTP and City Distribution expenses are summarized in Table 4-1 below. For expenses that could be related to either the distribution system or the WTP, percentages were applied to determine how much of the expense was related to the distribution system and how much was generated by the WTP. The line item expense assumptions are provided in Appendix B. Non-variable expenses are items like postage and trash pickup that would not change based on the annual production. Variable expenses are items such as chemical use, maintenance personnel, and electricity where the expense is directly related to the hours of plant operation.

Table 4-1 2011-2012 Estimated WTP and Distribution O&M and Debt Service Expenses

Total Non-Variable Expenses for WTP	$36,000
Total WTP Debt Service	$719,000
Total Variable Expenses for WTP	$326,000
Total WTP Expenses	$1,081,000
Total Expenses Associated with Distribution	$842,000
TOTAL EXPENSES in 2011-12	$1,923,000

Based on the *2010 Savannah Feasibility Study*, it is assumed that the average daily water sale volume is 560,000 gallons and a total annual water sale would be 204.4 million gallons for Savannah and Andrew 3. Dividing the numbers in Table 4-1 by the annual water sales the cost per 1,000 gallons of water is shown in Table 4-2.

Table 4-2 2011-12 O&M and Debt Service Expenses per kgal of Water Sold

Total WTP Expenses per kgal Sales	$5.30
Total Distribution Expenses per kgal Sales	$4.10
Total 2011-12 s per kgal	$9.40

4.3 Savannah WTP Projected Expenses

The expenses in Table 4-2 are a base unit cost and do not consider minimum charges nor do they consider varying water rates to wholesale and retail customers. This data will be used to evaluate the impacts to the City of Savannah for the additional water sales. The actual Savannah water rates are listed in Section 6. The projected O&M expenses are shown in Table 4-3.

Table 4-3 Projected WTP O&M Expenses and Debt Service

	2011-12 Estimated WTP Expenses	Projected O&M Expenses
Total Non-Variable Costs	$36,000	$36,000
Total Variable Costs for WTP	$326,000	$957,000 (1)
Total Debt Service	$719,000	$700,000 (2)
Total WTP Expenses	$1,081,000	$1,693,000

(1) Projected Variable Cost is equal to the 2011-12 Est. WTP Value multiply by the ratio of projected water sales to estimated water sales volumes (204,400 kgal/583,000 kgal). Also added 10-percent of chemical costs to account for additional ammonia feed at the WTP.

(2) Projected Debt Service assumes purchase of the WTP, wellfield and raw waterline for $7 million and expanding the WTP for $2.8 million (Table 3-1) financed by the Missouri State Revolving Loan Fund at 3-percent interest over 20 years.

The projected debt service assumes that the existing WTP, wellfield and raw waterline may be purchased for $7 million and that the WTP purchase may be combined with the expansion loan for a total of $9.8 million financed by the Missouri State Revolving Fund with a 3-percent interest rate over 20 year repayment term. If financed through the USDA Rural Development at 4.75-percent interest over 33 years, the annual debt service payment would be $600,000.

In addition, the variable costs were multiplied by the ratio of projected water sales, 583,000 kgal, divided by the 2011-12 estimated Savannah and Andrew 3 annual water sales of 204,400 kgal.

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Section 5

Annual Renewal and Replacement Expenses

This section presents the estimated annual renewal and replacement expenses for the distribution system and the WTP.

5.1 Transmission Renewal and Replacement Expenses

Transmission system replacement expenses are essential to managing a water system and are an important component in determining rates. Based on the methodology used in the *Stage 1 Report*, this TM uses the following assumption: full replacement of each component at the end of its lifespan at the inflated initial construction cost, minus 40-percent for one-time project incidentals. The expenses, such as easement acquisition and some design costs are not paid again during a replacement project. Projected lifespan is assumed at 20 years for pump stations, 40 years for water storage facilities, and 60 years for pipeline. It is assumed that cash investments set aside for depreciation will gain interest at a rate equal to inflation which should compensate for price inflation during the lifespan of the facilities.

Using these assumption for the Missouri-American alignment (Figure 1-2), annualized replacement expenses are approximately $17,000 for pump station replacement, $22,000 for storage tank replacement, $11,000 for clearwell replacement and $259,000 for pipeline replacement, for a total of $309,000 per year in replacement expenses. Using the same assumptions for the Savannah alignment (Figure 1-1) the annualized replacement expenses are estimated at $17,000 for the pump station replacement, $22,000 for storage tank replacement, $11,000 for clearwell replacement and $225,000 for the pipeline. The total annual replacement expenses for the Savannah alignment are estimated at $275,000. Frequently investments can be chosen which exceed the rate of price inflation. Utilizing this methodology can reduce the amount of cash needed to fund depreciation.

5.2 WTP Renewal and Replacement Expenses

The Savannah WTP renewal and replacement expenses are inherent in maintaining a water supply system. These expenses are an essential piece of information needed to determine adequate water user rates. The WTP renewal and replacement expenses used in this TM were based on the Summary of Life Cycle Costs and Comparison of Alternatives table found on Page 12 of the *2010 Savannah Feasibility Study*. The renewal and replacement expenses are a combination of expenses for the currently existing facilities and the expanded facilities. These expenses are only associated with the two scenarios that utilize the Savannah WTP. These expense estimates were performed using 2012 dollars. The expenses for the existing facilities are estimated at $94,000 per year based on the *2010 Savannah Feasibility Study* and adjusted to 2012 dollars. The renewal and replacement expenses for the improvements are estimated at $47,000. The improvement expenses were determined based on the 50-percent increase in capacity of the improved WTP. Total renewal and replacement for both existing and future improvements is $141,000.

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Section 6
User Rates

Using the information presented in the previous sections, the calculated expense for supplying water and a general user rate for the three different scenarios described below are summarized in Table 6-1. The detailed calculations are included in Appendix B.

Scenario 1: The City of Savannah sells potable water to the Stage 1 GNWWC membership.

Scenario 2: The GNWWC purchases the Savannah WTP well field and raw water pipeline to produce potable water to supply Savannah, Andrew County PWSD No. 3 and the Stage 1 GNWWC Commission members identified in Section 1.1.

Scenario 3: The GNWWC purchases potable water from Missouri-American.

Table 6-1 Scenario Cost Comparison

	Savannah Potable Water Purchase	GNNWC Production	Missouri-American Water Purchase
Annual Water Purchased/ Produced Volume, kgal (1)	356,000	583,000	356,000
Annual Water Sales Volume, kgal (2)	324,000	530,000	324,000
Missouri-American Water Purchase Cost (3)	--	--	$798,000
WTP Costs			
Savannah WTP Debt Service	$560,000 (4)	$700,000 (5)	--
Savannah WTP O&M (Variable and Non-Variable Costs) (6)	$606,000	$993,000 (7)	--
WTP Renewal and Replacement Costs (8)	$86,000	$141,000	
Annual GNWWC Transmission System Debt Service	$2,200,000	$2,200,000	$2,400,000
GNWWC Transmission System Annual Costs			
Annual Renewal and Replacement	$275,000	$275,000	$309,000
O&M	$285,000	$285,000	$285,000
Annual Expenses	**$4,012,000**	**$4,594,000**	**$3,792,000**
Cost per kgal Sold (9)	**$12.40**	**$8.70**	**$11.70**

(1) 50-percent of 2030 Ave. Day Stage 1 Pipeline demands plus 10-percent increase for water loss in the transmission system
(2) 50-percent of 2030 Ave. Day Stage 1 Pipeline demands
(3) Water purchase costs from Missouri-American published rates as of April 1 2012
(4) Savannah WTP Debt Service for Savannah Potable Water includes: 50-percent of existing debt service from original WTP ($719,000 Section 3.1) and 100-percent of the WTP expansion ($200,000 Section 3.2)
(5) Reference Section 4 Table 4-3 of this TM, Projected O&M total debt service
(6) Variable and Non-variable costs for Savannah Potable Water calculated as a ratio of GNWWC capacity to the total WTP capacity
(7) Reference Section 4 Table 4-3 of this TM, Projected O&M variable and total non-variable costs
(8) WTP Renewal and Replacement costs calculated as a ratio of GNWWC capacity to the total WTP capacity
(9) All costs per kgal sold are presented to three significant digits

The following assumptions and additional information were also used in developing Table 6-1.

- The existing annual debt service for the Savannah WTP and raw water line was assumed to be $699,000 in 2010 with an anticipated $10,000 increase each year for 15 years based on *2010 Savannah Feasibility Study*.
- Savannah existing O&M expenses were based on data from *Savannah Water Rate Analysis Addendum* and assumptions were made to assign the expenses to the distribution system or to the WTP.
- Water purchase costs were based on the average annual demand presented in Section 1, with an estimated 10-percent water loss.
- The current residential rates were not used. The expenses for the City's Distribution System would not be appropriate to apply to GNWWC. There are also additional expenses to expand the WTP that are not considered in the water purchase rates. See Section 6.1 for additional information on the citizens of Savannah and their rate impacts.
- The estimated annual water purchase cost from Missouri-American is based on a monthly minimum charge and bulk water sale rate (reducing cost scale per thousand gallons sold per month) as shown on Table 6-2.

Table 6-2 Current Missouri-American Water Purchase Costs

Charge Description	1,000 Gallons/ Month	Water Purchase Rates[2] ($/kgal)	Cost per Month for Water Purchase[3] ($)	Average Cost per kgal
Monthly Minimum Charge [1]	--	$1,293.43	$1,300	
For the first	100	$4.9217	$500	
For the next	1900	$3.8222	$7,300	
For the next	3000	$3.1847	$9,600	
For everything over 5MG/Month	29,583	$2.1721	$47,800	
Total Monthly Cost to Purchase Water from Missouri-American			$66,500	
Total Annual Water Cost			$798,000	$2.50

(1) 12-inch meter size was chosen for the monthly charge.

(2) Water Purchase Rates per Missouri-American as of April 1, 2012

(3) Costs from Missouri-American rounded to the nearest one hundred

Based on the information presented in Table 6-1, the least cost alternative is the purchase of the Savannah WTP and the combined sale of water to Savannah, Andrew 3, and the GNWWC Membership. If the City is unwilling to sell the WTP, well field, and raw waterline, then it is less costly for the Commission to purchase water from Missouri-American unless Savannah re-finances their existing debt.

These results are based on a large number of assumptions regarding financing terms, agreement between the City of Savannah and GNWWC to how the split of expenses and capacity of the WTP is handled, etc. The user rates are presented for reference only and are NOT recommended to be the final water sale rate of any of the parties involved without further analysis and more accurate information

provided. Significant work and negotiations must be made within the GNWWC and with the City of Savannah before these may be considered "final" numbers.

The Stage 1 PER calculated the cost of purchasing water from Missouri-American at $8.83 per 1,000 gallons. The key assumption differences between that cost and the one presented here are due to the following:

- The reduction in water sales volume does not linearly reduce the cost of construction, resulting in a net increase in the cost of water per 1,000 gallons.
- Reduction in pipeline length in Nodaway County.
- The assumption that MFWC continues to serve a portion of the GNWWC membership in the north eastern portion of the Commission territory.

This is also consistent with the findings of the Stage 1 PER that indicated that if the GNWWC purchased potable water from either Savannah or Missouri-American, Missouri-American was the least cost alternative. However, the original *2007 Phase 1 Report* by MDNR recommended the GNWWC purchase water from multiple sources throughout the region. It should be noted that an agreement with one party now, does not dismiss the thought of additional agreements with other potable water supplies later after the first construction project is in service.

6.1 Potential Cost Implications for the Citizens of Savannah

The current water rates charged to the citizens of Savannah are $21.16 for the minimum charge and $12.51 per 1,000 gallons thereafter.

For comparison, Table 6-3 provides the estimated current WTP expenses and distribution expenses per year for three scenarios: existing conditions, Savannah maintains ownership and sells water, Savannah sells the WTP to GNWWC and becomes a full member.

Table 6-3 Cost Impacts to the Citizens of Savannah Presented as a Cost per 1,000 Gallons

	Existing Conditions	Scenario 1 – Savannah Sells Water	Scenario 2 – GNWWC Sells Water
Total WTP Expenses per kgal Sales	$5.30	$3.50(1)	$8.70
Total Distribution Expenses per kgal Sales	$4.10	$4.10	$4.10
Total 2011-12 $ per kgal	$9.40	$7.60	$12.80

(1) This assumes 50% of the existing debt and a ratio of combined Savannah and Andrew 3 water demands against the Commission demands for the variable and non-variable costs and the replacement savings is paid by Savannah and Andrew 2.

In this case, the best alternative for the City of Savannah is to sell the water and maintain ownership of the plant. The cost for Scenario 2 assumes that all Commission members, regardless of location, pay the same base rate. This translates to the citizens of Savannah paying for a portion of the distribution system that they will not receive any benefit from due to the infrastructure needed to provide water to them is already in place. This is another point that both parties need to consider before moving forward.

These calculations were performed to create rates for comparison, not actual user rates. The contracted water rate for Andrew 3 was not taken into consideration as part of these calculations.

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Appendix A

Referenced Document Pages

Appendix B

Calculations and Cost Opinions

Appendix C

Modeling Results

Appendix A

Referenced Document Pages

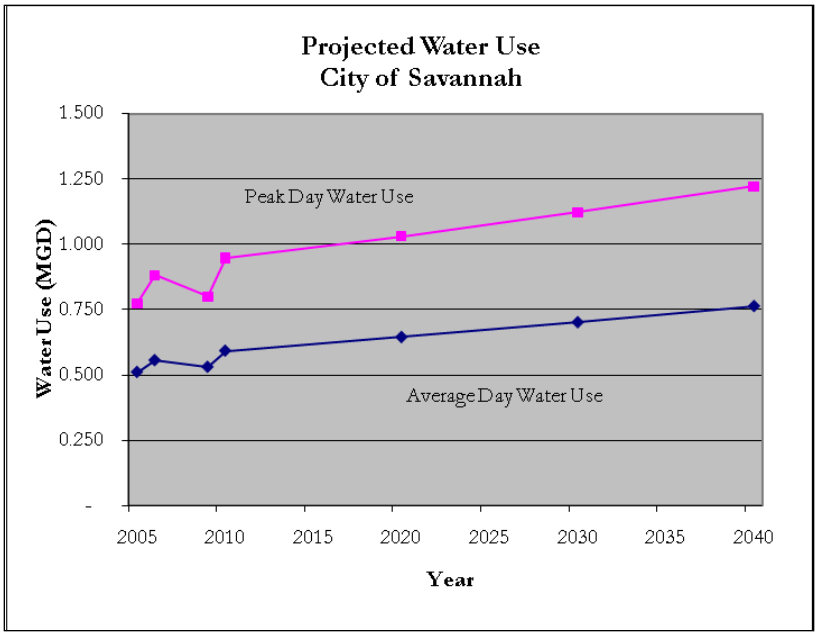
Year	Average Day Use *	Peak Day Use **	Ratio of Peak to Avg. Day Use
2004	412,816	620,000	1.50
2005	510,444	774,000	1.52
2006	556,016	881,000	1.58
2007	575,315	1,003,000	1.74
2008	533,205		
2009	530,174	800,000	1.51
2010	552,165	793,000	1.44

**Total water use and the peak to average day ratio includes both Savannah municipal water use and water sold to Public Water Supply District No.3 (PWSD No 3) of Andrew County.*
*** Peak Day in 2007 is high due to a leak in the system, no data is available for 2008.*

While the City meters water use at each household within town, this information was not readily available to compare with metered use at the water treatment plant. However the per capita-day water use is consistent with other towns the size of Savannah. As such, we would anticipate the unaccounted for water use, as a percent of the total demand to be approximately 10%. Unaccounted for water use reflects water loss due to backwashing, fighting fires, flushing mains and hydrants, system leaks and repairs, and unmetered parks, swimming pools, or other public facilities. There are 2,061 household meters within the City and the City is currently implementing a program to replace each meter with a wireless read system to further track and reduce water loss.

Water Use Projections

The following table and graph are provided showing the current and future water use projections for the City of Savannah and Andrew County PWS District No 3. As indicated, water use projections are determined using the estimates of population growth presented earlier in this study, a water use rate of 95 gallons per capita-day and a peaking factor of 1.60. Water use projections similar to population projections are for the 30-year study period.



In addition to the three wells, the improvements of Alternate No. 3 include construction of new raw water pipeline, additional clearwell capacity, and a new 3.0 MGD treatment train; including solids contact basins, multi-media rapid rate filters, waste residuals handling and associated chemical feed equipment.

- Well Field/Raw Water Line – Approximately $1,680,000 of improvements, including construction of three new 1,200 gpm wells and approximately 5 miles of 18" diameter raw water transmission pipeline.

- WTP Improvements – Approximately $5,180,000 of improvements, including construction of two new 1.5 MGD treatment trains, each consisting of a solids contact basin, rapid rate filters, and chemical feed equipment. Also included are additional waste lagoons as required to handle the increased treatment residuals.

Project Criteria
Project design criteria as proposed are as per requirements for distribution systems, MoDNR Publication 417 -Design Guide for Community Water Systems and the 10 State Standards – Recommended Standards for Water Works. The project design period is 30 years with population and water use projections to the year 2040.

VI. Project Financing and Water Rates

City's Current Indebtedness and Budget
As part of the improvements in 2005 and 2006, the City issued 20-year revenue bonds for approximately 8 million in loans to construct the water system improvements. In 2009-2010, the debt service payment on the principle and interest of the bonds was $699,000 or about 45% of the City budget of approximately 1.5 million. The debt service is slated to increase by approximately $10,000 per year for the next 15 years before finally decreasing for eight years before the final two payments.

A summary of the current City water budget and an estimate of associated revenues from both bulk and metered sales are provided below.

VII. Project Budget with O & M Costs

Life Cycle Costs and Comparison of Alternatives

For each of the proposed alternates or level of expansion, capital costs were estimated and life cycle costs were developed. These life cycle costs are summarized below and include a comparison of the debt service, annual operating and maintenance (O & M) expenses, along with funds for long-term replacement and reserves. Annual operating costs include both the fixed and variable costs, the latter comprised of mostly chemical and electrical expenses.

Summary of Life Cycle Costs and Comparison of Alternatives	Current Budget	Alternate 1	Alternate 2	Alternate 3
Water Use and Plant Capacity				
Estimated Annual Water Use (X 1000gal)	197,465	410,692	410,692	866,942
City Annual Sales (X 1000gal)	167,845	174,572	174,572	174,572
Bulk Annual Sales (X 1000gal)	29,620	236,119	236,119	692,369
System Capacity	1.0 MGD	2.0 MGD	3.8 MGD	5.0 MGD
Capital Cost Summary				
Well Field/Raw Water Line	$0	$260,000	$490,000	$1,680,000
WTP Improvements	$0	$120,000	$4,060,000	$5,180,000
Total New Capital Costs	**$0**	**$380,000**	**$4,550,000**	**$6,860,000**
Annual Expenses & Production Costs				
Annual Debt Service				
New Improvements Debt Service	$0	$30,094	$360,336	$543,276
Current Annual Debt Service (P & I)	$699,000	$799,000	$799,000	$799,000
Total Annual Debt Service	$699,000	$829,094	$1,159,336	$1,342,276
Admin Costs				
City Annual Retail/Admin Costs	$220,800	$220,800	$220,800	$220,800
Annual Operating Costs				
Fixed Operating Costs	$337,200	$437,200	$660,000	$760,000
Variable Operating Costs, ($0.93/kgal)	$183,000	$382,000	$382,000	$806,000
Subtotal	$520,200	$819,200	$1,042,000	$1,566,000
Rehab/Reserve, Existiing Facilities	$92,000	$92,000	$92,000	$92,000
Rehab/Reserves, New Improvements	$0	$15,047	$180,168	$271,638
Annual Operating Costs	$612,200	$926,247	$1,314,168	$1,929,638
Total Annual Expenses	**$1,532,000**	**$1,976,141**	**$2,694,304**	**$3,492,713**
Unit Price Cost Comparison				
Cost of Debt Service ($/kgal)	$3.54	$2.02	$2.82	$1.55
Cost of Operation ($/kgal)	$3.10	$2.26	$3.20	$2.23
*Total Production Cost ($/kgal)	$6.64	$4.27	$6.02	$3.77
* Excludes City Admin Costs				

The production costs as tabulated above include both the debt service and operating costs divided by the projected annual water sales. It does not include the City administration and billing costs. The unit price cost comparison of production costs is intended as a tool to evaluate the economic feasibility of the different alternatives.

Savannah, MO, Water Rates Scenario 6

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Chart 3 - Operating Costs and Net Income

This chart depicts expenses during the test year, this year and for the next 10 years.

(First year costs and net incomes are actual, subsequent years are projected.)

	Infla./De-flation (–) Factor	Year Starting 10/1/10	Year Starting 10/1/11	Year Starting 10/1/12	Year Starting 10/1/13	Year Starting 10/1/14	Year Starting 10/1/15	Year Starting 10/1/16	Year Starting 10/1/17	Year Starting 10/1/18	Year Starting 10/1/19	Year Starting 10/1/20
(Note: Some future costs will experience inflation. Those costs that go up as use goes up are also increased by the growth rate in users and the percentage by which that cost is variable as reported in Chart 4.)												
Administration Salaries, Benefits, etc.	3.0%	$45,337	$46,697	$48,098	$49,541	$51,027	$52,558	$54,135	$55,759	$57,432	$59,155	$60,929
Maintenance Salaries, Benefits, etc.	3.0%	$136,011	$140,091	$144,294	$148,623	$153,082	$157,674	$162,404	$167,276	$172,295	$177,464	$182,787
Sales Tax	0.0%	$9,066	$12,273	$15,448	$15,795	$16,157	$16,528	$16,907	$17,295	$17,692	$18,097	$18,512
Credit Card Expense	3.0%	$3,629	$3,738	$3,850	$3,966	$4,084	$4,207	$4,333	$4,463	$4,597	$4,735	$4,877
Training	5.0%	$897	$942	$989	$1,038	$1,090	$1,145	$1,202	$1,262	$1,325	$1,392	$1,461
Uniforms	3.0%	$0	$1,200	$1,236	$1,273	$1,311	$1,351	$1,391	$1,433	$1,476	$1,520	$1,566
Postage	5.0%	$4,114	$4,320	$4,536	$4,762	$5,001	$5,251	$5,513	$5,789	$6,078	$6,382	$6,701
Telephone	5.0%	$3,248	$3,410	$3,581	$3,760	$3,948	$4,145	$4,353	$4,570	$4,799	$5,039	$5,291
Service Agreements	3.0%	$839	$864	$890	$917	$944	$973	$1,002	$1,032	$1,063	$1,095	$1,128
Chemicals and Fertilizer	5.0%	$90,467	$94,990	$99,740	$83,554	$87,732	$92,118	$96,724	$101,560	$106,638	$111,970	$117,569
Fuel and Oil	5.0%	$6,652	$6,985	$7,334	$7,701	$8,086	$8,490	$8,914	$9,360	$9,828	$10,319	$10,835
Oil and Asphalt	5.0%	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
Rock and Chat	3.0%	$2,924	$4,000	$4,120	$3,559	$3,666	$3,776	$3,889	$4,006	$4,126	$4,250	$4,377
Repairs and Maintenance	5.0%	$19,929	$20,925	$21,972	$23,070	$24,224	$25,435	$26,707	$28,042	$29,444	$30,916	$32,462
Supplies	5.0%	$2,226	$2,337	$2,454	$2,577	$2,706	$2,841	$2,983	$3,132	$3,289	$3,453	$3,626
Lagoon Cleaning	5.0%	$25,000	$25,000	$26,250	$21,711	$22,797	$23,937	$25,134	$26,390	$27,710	$29,095	$30,550
Professional Services	3.0%	$11,551	$6,000	$6,180	$6,365	$6,556	$6,753	$6,956	$7,164	$7,379	$7,601	$7,829
Printing and Publications	3.0%	$1,059	$1,091	$1,123	$1,157	$1,192	$1,228	$1,265	$1,302	$1,342	$1,382	$1,423
Commercial Insurance	5.0%	$6,267	$6,580	$6,909	$7,255	$7,618	$7,998	$8,398	$8,818	$9,259	$9,722	$10,208
Utilities	3.0%	$79,936	$82,334	$84,804	$68,640	$70,699	$72,820	$75,005	$77,255	$79,572	$81,960	$84,418
Lab Supplies and Equipment	5.0%	$2,985	$3,134	$3,291	$2,757	$2,895	$3,039	$3,191	$3,351	$3,519	$3,695	$3,879
Dues and Permits	5.0%	$3,002	$3,152	$3,310	$3,475	$3,649	$3,831	$4,023	$4,224	$4,435	$4,657	$4,890
Missouri Primacy Fee	0.0%	$6,500	$6,500	$6,506	$6,516	$6,528	$6,540	$6,553	$6,565	$6,578	$6,590	$6,603
Testing Service	5.0%	$123	$129	$136	$142	$150	$157	$165	$173	$182	$191	$200
Trash Disposal	5.0%	$620	$651	$684	$718	$754	$791	$831	$872	$916	$962	$1,010
Water Commission Membership	2.0%	$6,357	$6,484	$6,620	$6,762	$6,911	$7,062	$7,217	$7,376	$7,537	$7,703	$7,872
Equipment and Vehicles (Moved to R&R)	5.0%	$4,369	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
Transfer to Other Funds	5.0%	$129,612	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
Loan Payments - Water Metering System	0.0%	$48,162	$95,904	$96,204	$95,319	$95,319	$48,087	$0	$0	$0	$0	$0
Annual Payment to Replacement Fund (Dedicated)	0.0%	$69,005	$69,005	$69,005	$67,340	$67,340	$67,340	$67,340	$67,340	$67,340	$67,340	$67,340
User Charge Analysis Services	5.0%	$0	$5,587	$0	$0	$6,160	$0	$0	$6,791	$0	$0	$7,487
Loan Payments, Except Water Metering System	0.0%	CIP	CIP	CIP	CIP	CIP	CIP	CIP	CIP	CIP	CIP	CIP
8-year Line of Credit Loan Payments	0.0%	$0	$0	$108,305	$108,305	$108,305	$108,305	$108,305	$108,305	$108,305	$108,305	$0
Total Operating Costs		$719,887	$654,325	$777,869	$746,599	$769,929	$734,382	$704,840	$730,908	$744,156	$764,989	$685,832
Net Income (or Loss)		$920,284	$1,724,533	$1,296,381	$1,238,891	$1,259,356	$1,339,276	$1,414,021	$1,434,206	$1,468,433	$1,496,115	$1,624,913
Working Capital Goal: 30%	In Dollars, That is:	$215,966	$196,298	$233,361	$223,980	$230,979	$220,314	$211,452	$219,272	$223,247	$229,497	$205,750

Savannah, MO, Water Rates Scenario 6
Chart 6 - Capital Improvement Program

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This chart depicts the capital improvements needed for the next 10 years and how they will be paid for. Costs reflect inflation.

CIP Spending Plan	Year Starting 10/1/10	This Year Year Starting 10/1/11	Next Year Year Starting 10/1/12	3rd Year Year Starting 10/1/13	4th Year Year Starting 10/1/14	5th Year Year Starting 10/1/15	6th Year Year Starting 10/1/16	7th Year Year Starting 10/1/17	8th Year Year Starting 10/1/18	9th Year Year Starting 10/1/19	10th Year Year Starting 10/1/20
Capital Improvements to be Paid With Debt											
11 Blocks of 2" Line	$0	$0	$0	$0	$36,558	$0	$0	$0	$0	$0	$0
4 Blocks of 8" Line	$0	$0	$0	$0	$86,052	$0	$0	$0	$0	$0	$0
200 Hydrants	$0	$0	$0	$0	$224,973	$0	$0	$0	$0	$0	$0
New Well	$0	$0	$0	$0	$0	$0	$0	$0	$0	$136,857	$0
Total Capital Improvements to be Paid With Debt	$0	$0	$0	$0	$347,583	$0	$0	$0	$0	$136,857	$0
Capital Improvements to be Paid With Cash											
11 Blocks of 2" Line	$0	$0	$0	$0	$36,558	$0	$0	$0	$0	$0	$0
4 Blocks of 8" Line	$0	$0	$0	$0	$86,052	$0	$0	$0	$0	$0	$0
200 Hydrants	$0	$0	$0	$0	$224,973	$0	$0	$0	$0	$0	$0
New Well	$0	$0	$0	$0	$0	$0	$0	$0	$0	$136,857	$0
Total Cap Imprvmts to be Paid With Cash	$0	$0	$0	$0	$347,583	$0	$0	$0	$0	$136,857	$0
Total CIP Planned Spending	$0	$0	$0	$0	$695,166	$0	$0	$0	$0	$273,714	$0
CIP Funding Plan											
CIP Reserves Carryover Plus Transfers in	$753,546	$1,268,375	$1,253,890	$1,232,970	$1,227,299	$1,300,166	$1,310,121	$1,330,622	$1,373,258	$1,419,874	$1,658,528
CIP Reserves Interest Earned (or Paid)	$0	-$19,033	-$217	-$612	-$1,002	-$1,991	-$4,510	-$3,831	-$3,648	-$2,800	$197
New Connection Fees Transferred From Net Current Assets to CIP Reserves	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
Grants	$0	$0	$0	$0	$347,583	$0	$0	$0	$0	$136,857	$0
Loan Originated in 4th Year					$347,583	$0	$0	$0	$0	$0	$0
Loan Originated in 9th Year										$136,857	$0
Total CIP Fund Sources	$753,546	$1,249,342	$1,253,673	$1,232,358	$1,921,462	$1,298,175	$1,305,610	$1,326,791	$1,369,610	$1,690,788	$1,658,725
New Debt Payment Plan	Payments for future loans assume 100 percent financing for projects, term of:					20	years and	2.50%	interest		
Loan(s) Originated Before Test Year	$1,229,373	$1,254,770	$1,268,975	$1,257,416	$1,276,071	$1,388,641	$1,379,078	$1,395,696	$1,417,304	$1,384,911	$1,391,611
Loan Originated in 4th Year						$22,296	$22,296	$22,296	$22,296	$22,296	$22,296
Loan Originated in 9th Year											$8,779
Total Debt Payments	$1,229,373	$1,254,770	$1,268,975	$1,257,416	$1,276,071	$1,410,937	$1,401,374	$1,417,992	$1,439,600	$1,407,207	$1,422,686
CIP Spending Plus Debt Payments	$1,229,373	$1,254,770	$1,268,975	$1,257,416	$1,971,237	$1,410,937	$1,401,374	$1,417,992	$1,439,600	$1,680,921	$1,422,686
CIP Reserves Balance	-$475,826	-$5,428	-$15,302	-$25,058	-$49,774	-$112,762	-$95,764	-$91,201	-$69,991	$9,867	$236,039

Notes: Near-future capital improvements should be relatively minor. Based upon the affordability index of rates, the City should qualify for a much higher grant rate (in fact, 100%), but simply because grant funds are so limited, it was assumed the new projects will be funded at the rate of 50% loan and 50% grant.

Appendix B

Calculations and Cost Opinions

A **Calculation Form (Excel)**

Client:	USACE KC District	**Job #**	51115-85333	**Calc. By:**	TAP
Project:	Phase V Savannah Assessment	**Checked By:**	S. Stewart	**Date:**	06/27/12
Detail:	Cost Comparison	**Date:**	06/29/12	**Calc. No.:**	--
		Reviewed By:	J. Plevniak	**Revision#:**	1
		Date:	07/05/12	**Date:**	

Calculation Brief Title: Determine the water use rates based on cost per kgal water from three scenarios for the Stage 1 Pipeline.

1.0 Purpose/Objective

Determine the water use rates based on cost per kgal water from three scenarios for the Stage 1 Pipeline.

2.0 Procedure

1 Determine water demand based on *Ref. 3*
2 Determine current water capacity versus water demand *Ref. 2 and Ref. 3*
3 Summarize water rate from Missouri-American (*Ref. 1*)
4 Summarize OPCC data from Bartlett & West (*Ref. 5*)
5 Determine O&M, Debt Service, Replacement Costs, and Staffing Costs (*Ref. 2, Ref. 4, and Ref. 5*)

3.0 References/Data Sources

1 2012 Water Rates from Missouri American date April 1, 2012.
2 *2010 Savannah Feasibility Study*
3 *Stage 1 Report*
4 *Savannah Water Rate Analysis Addendum*
5 OPCCs provided by Bartlett & West on 06-27-2012 for each alternative including contingency, land acquisition, engineering & legal

4.0 Assumptions and Limitations

1 Final numbers rounded to the nearest thousand
2 Specific assumptions are summarized throughout the document.

5.0 Calculations

Calculations provided on following sheets:

SHEET TITLE	DESCRIPTION
Sheet 1: Savannah Assessment Final Table Calculations	Calculation Results for Average Day Demands
Sheet 2: Savannah Alternative Background Calculations	Calculation of proposed improvement costs associated with Savannah WTP Improvements
Sheet 3: Missouri American Alternative Background Calculations	Calculation of proposed improvement costs associated with purchasing water from Missouri American
Sheet 4: Savannah Assessment Water Purchase Cost Calculations	Calculation of average Missouri-American Bulk water rate
Sheet 5: Savannah and GNWWC Assessment WTP Calculations and Data	Calculation of Current Savannah and GNNWC Water Needs
Sheet 5: Savannah Assessment WTP Calculations and Data	Calculation of Savannah WTP Expansion Cost Table
Sheet 6: Savannah Assessment WTP Upgrade Cost Calculations	Calculation of Savannah water supply costs
Sheet 7: Savannah Assessment Annual Cost Calculations	Savannah Expense Breakout and Expense Calculations
Sheet 8: Savannah Assessment Cost to Produce Water Calculations	Calculation of estimated and Projected O&M costs
Sheet 9: Savannah Assessment Water System Demands Calculations	Calculations to determine overall system capacity and water needs
Sheet 10: Water System Demands	Calculations to determine GNNWC and Savannah anticipated 2030 average annual water sales

6.0 Acronyms

D -	Distribution System
EA -	Each
GPCD -	Gallon per capita per day
gpm	Gallons per minute
HP	Horsepower
HR	Hour
KC CCI	Kansas City Construction Cost Index
kgal -	Thousand Gallons
KW	Kilowatt
KWH	Kilowatt Hour
LS -	Lump Sum
MGD -	Million Gallons per Day
O&M -	Operation and Maintenance
WTP -	Water Treatment Plant

CDM Smith

PROJECT: Phase V Savannah Assessment
JOB NO.: 51115-85333
CLIENT: USACE KC District

COMPUTED BY : TAP
DATE : 6/22/2012
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Description:

Sheet 1: Savannah Assessment Final Table Calculations

Table 6.1

Line		Column 1 **Savannah Potable Water Purchase**	Column 2 **GNNWC Production**	Column 3 **Missouri-American Water Purchase**
1	**Annual Water Purchased/Produced Volume, kgal** [1]	356,000	583,000	356,000
2	**Annual Water Sales Volume, kgal** [2]	324,000	530,000	324,000
3	**Missouri American Water Purchase Cost** [3]	--	--	$798,000
4	**Savannah WTP Debt Service** [4]	$560,000	$700,000	--
5	**Savannah WTP O&M (Variable and Non-Variable Costs)** [5]	$606,000	$993,000	--
6	**WTP Renewal and Replacement Costs** [6]	$86,000	$141,000	
7	**Annual GNWWC Distribution System Debt Service**	$2,200,000	$2,200,000	$2,400,000
8	**GNWWC Distribution System Annual Costs**			
9	*Est. Ann. Renewal and Replacement*	$275,000	$275,000	$309,000
10	*Est. O&M*	$285,000	$285,000	$285,000
11	**Annual Expenses**	**$4,012,000**	**$4,594,000**	**$3,792,000**
12	**Cost per kgal Sold**	**$12.40**	**$8.67**	**$11.70**

kgal - thousand gallons

Line - Column	**Link Source**
Line 2 - Column 1, 2, & 3	Sheet 10: Water System Demands
Line 3 - Column 3	Sheet 4: Savannah Assessment Water Purchase Cost Calculations
Line 4 - Column 1	Sheet 7: Savannah Assessment Annual Cost Calculations
Line 4 - Column 2, Line 5 - Column 1 & 2	Sheet 8: Savannah Assessment Cost to Produce Water Calculations
Line 6 - Column 1 & 2	Sheet 2: Savannah Alternative Background Calculations
Line 7, 9 & 10 - Column 3	Sheet 3: Missouri American Alternative Background Calculations

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Sheet 2: Savannah Alternative Background Calculations

Distribution Replacement Costs

OPCC Break Down - Provided by Bartlett & West

		Annualized Replacement Costs	(Assumed Values) Proposed Life Span (yrs.)
Transmission Lines	$22,500,000	$225,000	60
Clearwell	$710,000	$11,000	40
Elevated Water Storage Tanks	$1,420,000	$22,000	40
Pump Stations	$552,000	$17,000	20
Total	$25,182,000	$275,000	

Replacement Cost = 2013 OPCC Value * (1-0.4) [Proposed Life Span; 40% of initial OPCC is assumed as a one time expense]
Proposed lifespan (Ref. 4): 20 years for pump stations, 40 years for storage facilities, 60 years for pipelines

WTP Replacement Costs

	2010	2012
WTP Existing	$92,000	$94,000
WTP Expansion	$46,000	$47,000
	$138,000	$141,000

(2012 adjustment by KC CCI Value for 2010 and June 2012 to generate multiplier)
(2 MGD Capacity Based on Summary of Life Cycle Costs Table on Page 12 of *2010 Savannah Feasibility Study*)
(Incremented as a % capacity, 50% increase in capacity would result in a 50% increase in Replacement Costs.)

O&M Costs

O&M Cost Summary per year	
Staffing	$210,000
Electrical	$40,000
Storage Tanks	$20,000
Piping	$15,000
Total O&M	$285,000

Staffing Assumptions: 1 full time and 1 part time ADMIN and 2 full time field service employees, Employee cost is $60,000 per employee per year
$210,000

Electrical: Assume PS operates 25% of the time on an annual basis per Phase II O&M assumptions

HP	KW	KW*HR	Cost / KWH	Annual Cost
200	150	328500	0.12	$40,000

(OPCC report from Bartlett & West)

200 HP, two pumps — KWH rounded: 329,000

Storage Tanks: Assumed $150K every 15 years for repainting and maintenance
$10,000 per tank
No. of Tanks 2 (OPCC report from B&West)

Pipelines: Assume 1 break every 20 miles and $3000 to fix each break
Total Pipeline Mileage 95 miles — w/o Davies 1 transmission main (OPCC report from B&West)
Total Breaks Per Year 5
Total Line O&M $15,000

Pipeline size	Pipe length	$/ft	Cost
4"	68,700	$20	$ 1,374,000
6"	83,600	$28	$ 2,340,800
8"	160,000	$40	$ 6,400,000
12"	158,700	$62	$ 9,839,400
16"	30,400	$83	$ 2,523,200
Feet	**501,400**		$ 22,477,400
mile	**95**		

OPCC

Construction Land & Engineering	$25,182,000	$8,820,000		
Legal & Financial	$1,260,000			
Contingency & Inflation	$5,040,000			
Total OPCC	$31,482,000	$2,200,000.00	$44,000,000.00	20 years at 3%
		$2,000,000.00	$66,000,000.00	33 years at 4.75%

Assumed cost of replacement of Ammonia feed accounted for in WTP Replacement costs

CDM Smith

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Sheet 3: Missouri American Alternative Background Calculations

Distribution Replacement Costs

OPCC Break Down - Provided by Bartlett & West

		Annualized Replacement Costs	(Assumed Values) Proposed Life Span (yrs.)
Transmission Lines	$25,870,000	$259,000	60
Water Storage Tanks	$1,420,000	$22,000	40
Clearwell	$710,000	$11,000	40
Pump Stations	$552,000	$17,000	20
Total	$28,552,000	$309,000	

Replacement Cost = 2013 OPCC Value * (1-0.4) [Proposed Life Span; 40% of initial OPCC is assumed as a one time expense]
Proposed lifespan (Ref. 4): 20 years for pump stations, 40 years for storage facilities, 60 years for pipelines

O&M Costs

O&M Cost Summary per year

Summary:	Staffing	$210,000
	Electrical	$40,000
	Storage Tanks	$20,000
	Piping	$15,000
	Total O&M	$285,000

Staffing Assumptions: 1 full time and 1 part time ADMIN and 2 full time field service employees, Employee cost is $60,000 per employee per year
$210,000

Electrical

Assume PS operates 25% of the time				
HP	KW	KW*HR	Cost / KWH	Annual Cost
200	150	328500	0.12	$40,000

(OPCC report from B&West)

200 HP, two pumps

KWH rounded: 329,000

Storage Tanks: Assumed $150K every 15 years for repainting and maintenance
$10,000 per tank

No. of Tanks 2 (OPCC report from B&West)
(2 elevated tanks)

Pipelines: Assume 1 break every 20 miles and $3000 to fix each break

Total Pipeline Mileage	100 miles	w/o Davies 1 transmission main (OPCC report from B&West)
Total Breaks Per Year	5	
Total Line O&M	$15,000	

OPCC

Construction Land & Engineering	$28,552,000
Legal & Financial	$1,430,000
Contingency & Inflation	$5,720,000
Total OPCC	$35,702,000

$2,400,000	$ 48,000,000	20 years at 3%
$2,200,000	$ 72,600,000	33 years at 4.75%

Pipeline size	Pipe length	$/ft	Cost
4"	68,700	$20	$ 1,374,000
6"	83,600	$28	$ 2,340,800
8"	131,800	$40	$ 5,272,000
12"	158,700	$62	$ 9,839,400
16"	84,500	$83	$ 7,013,500
Feet	**527,300**		$ 25,839,700
mile	**100**		

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Sheet 4: Savannah Assessment Water Purchase Cost Calculations

2012 Water Purchase Costs

Table 6-2

Annual Water Purchase Volumes

	kgal/ Month
Annual water [1]	324,000
monthly water	27,000

(1) Sheet 1: Savannah Assessment Final Table Calculations

Missouri American - Cost to Purchase Water Calculation

	1,000 Gallons/ Month	Water Purchase Rates*	Cost per Month for Water Purchase ($)	Average Cost per kgal
Monthly Minimum Charge [1]	--	$1,293.43	$1,300	
For the first	100	$4.9217	$500	
For the next	1900	$3.8222	$7,300	
For the next	3000	$3.1847	$9,600	
For everything over 5MG/Month	22,000	$2.1721	$47,800	
Total Monthly Cost to Purchase Water from Missouri-American			$66,500	
Total Annual Water Cost			$798,000	$2.46

*Cost per table provided by Missouri American dated April 1, 2012

(1) 12" meter size was chosen for the monthly charge.

Savannah - Cost to Purchase Water Calculation

	kgal/ Month	Water Purchase Rates* ($/kgal)	Cost per Month for Water Purchase ($)	Average Cost per kgal
Monthly Minimum Charge [1]	1	$21.16	$21	
Per 1,000 Gallons	26,999	$12.51	$337,800	
Total Monthly Cost to Purchase Water from Savannah			$337,800	
Total Annual Water Cost			$4,053,600	$12.51

(1) Monthly minimum charge includes the first thousand gallons

*Cost per table provided by City of Savannah (Valerie) 26 June 2012

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Sheet 5: Savannah and GNWWC Assessment WTP Calculations and Data

Line Numbers for reference

Water Needs from the Water Treatment Plant

1	Savannah and Andrew 3 2030 Max. Day Demands	1.13	MGD		*(Chart on Page 6 of 2010 Savannah Feasibility Study)*
2	GNNWC Max. Day Demands	2.14	MGD		*(See Demand Summary Table from Stage 1 Report)*
3	Middle Fork Water Supply	0.32	MGD		*(See Demand Summary Table from Stage 1 Report)*
4	GNNWC Max. Day Demands w/ 10% Unaccounted for water added	2.35	MGD		*(Assumes a 10% increase in demands from WTP)*
5	WTP Finished Water Production	3.16	MGD		*(Lines 1 - 3 + 4)*
	WTP Source Water Needs (Assume 10% Plant Water loss)	3.48	MGD	5.39 cfs	*(Line 5 * 1.1)*

Existing Well Capacity (Page 2 of *2010 Savannah Feasibility Study*)

	Well No. 1	650	gpm	
	Well No. 2	650	gpm	
	Well No. 3	750	gpm	
6	Firm Yield	1300	gpm	*(Sum of capacity w/ largest well out of service)*
		1.872	MGD	

New Well Capacity Needed

	Average Existing Well Size	683	gpm	
		0.984	MGD	
7	**Additional Well Needs**	**2**		*(Line 5 - Line 6)/Line 7, rounded up to nearest whole number…. Largest pump out of service is included in firm yield*

Raw Waterline Capacity: 3 miles of 16-inch PVC

	15.64	inches	PVC I.D. (Assumed Value, 16" Pipe Material of C905, DR 21)
Pipe Area =	1.33	square foot	http://www.all-about-pipe.com/pvc-pipe-dimensions.html#905dr18
Velocity at Future Flow=	4.04	feet per second	

Raw water pipeline velocity OK… Assume no replacement

Friction Loss at Current Conditions	20	feet	(Hazen Williams formula used during modeling process, C=130, L=3miles)
Friction Loss at Future Conditions	54	feet	***Don't know if this will impact existing wells***

Water Treatment Plant Assumptions

2 MGD Treatment Process

Number of Units for the Existing System

1 Aerator
2 Solids Contact Units
1 Recarbonation Basin (20 minute detention)
4 Filters
Lime
Gas Chlorine
4 Lagoons (90 days storage)

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Sheet 6: Savannah Assessment WTP Upgrade Cost Calculations

Table 3-1

Savannah WTP Expansion Costs						
Item No.	**Description**	**Unit**	**Quantity**	**2010 Unit Cost**	**Total Cost**	
1	Groundwater Wells	EA	2	$ 115,000	$ 230,000	*(Stage 1 Report Alt.ernative 2, Item 9)*
2	Raw Water Piping	LF	6700	$ 20	$ 134,000	*(Stage 1 Report Alt.ernative 2, Item 10)*
3	Solids Contact Unit	EA	1	$ 550,000	$ 550,000	*(Stage 1 Report Alt.ernative 2, Item 1)*
4	Filters	EA	2	$ 200,000	$ 400,000	*(Stage 1 Report Alt.ernative 2, Item 2)*
5	Chemical Feed Improvements	LS	1	$ 100,000	$ 100,000	*(Stage 1 Report Alt.ernative 2, Item 6)*
6	Electrical	LS	1	$ 210,000	$ 210,000	*(Stage 1 Report Alt.ernative 2, Item 5)*
7	Instrumentation and Controls	LS	1	$ 135,000	$ 135,000	*(Stage 1 Report Alt.ernative 2, Item 7)*
8	Yard Piping	LS	1	$ 75,000	$ 75,000	*(Stage 1 Report Alt.ernative 2, Item 8)*
9	Ammonia Feed Facility	LS	1	$ 70,000	$ 70,000	
10	Miscellaneous Maintenance	LS	1	$ 100,000	$ 100,000	*(Est. based on conversation between Bartlett & West and City of Savannah WTP Staff)*
	Subtotal				$ 2,000,000	
	Contingency, Overhead and Profit	35%			$ 700,000	
	Total WTP Expansion Costs (2010 Dollars)				$ 2,700,000	
	2012 Total WTP Expansion Costs		**1.03**		**$ 2,800,000**	*(Factor of 1.03 determined by dividing KC CCI 2010 Value by KC CCI June 2012 Value)*

Debt Service Payment for WTP Expansion *$200,000* *20 years at 3%*
$200,000 *33 years at 4.75%*

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Sheet 7: Savannah Assessment Annual Cost Calculations

Savannah Expense Breakout - 2011-12

		D	WTP	Year Starting	Distribution	WTP
OPERATING EXPENSES[1]	**Type**	**PERCENT**		**2011**	**Expenses**	**Expenses**
Administration Salaries, Benefits, etc.	Non-Variable	50%	50%	$46,697	$23,349	$23,349
Maintenance Salaries, Benefits, etc.	Variable	33%	67%	$140,091	$46,230	$93,861
Sales Tax	Variable	100%	0%	$12,273	$12,273	$0
Credit Card Expense	Variable	50%	50%	$3,738	$1,869	$1,869
Training	Non-Variable	50%	50%	$942	$471	$471
Uniforms	Non-Variable	50%	50%	$1,200	$600	$600
Postage	Variable	100%	0%	$4,320	$4,320	$0
Telephone	Non-Variable	50%	50%	$3,410	$1,705	$1,705
Service Agreements	Non-Variable	50%	50%	$864	$432	$432
Chemicals and Fertilizer	Variable	0%	100%	$94,990	$0	$94,990
Fuel and Oil	Variable	0%	100%	$6,985	$0	$6,985
Oil and Asphalt	Variable	0%	100%	$0	$0	$0
Rock and Chat	Variable	0%	100%	$4,000	$0	$4,000
Repairs and Maintenance	Variable	50%	50%	$20,925	$10,463	$10,463
Supplies	Non-Variable	50%	50%	$2,337	$1,169	$1,169
Lagoon Cleaning	Variable	0%	100%	$25,000	$0	$25,000
Professional Services	Non-Variable	50%	50%	$6,000	$3,000	$3,000
Printing and Publications	Non-Variable	50%	50%	$1,091	$546	$546
Commercial Insurance	Non-Variable	50%	50%	$6,580	$3,290	$3,290
Utilities	Variable	0%	100%	$82,334	$0	$82,334
Lab Supplies and Equipment	Variable	0%	100%	$3,134	$0	$3,134
Dues and Permits	Non-Variable	50%	50%	$3,152	$1,576	$1,576
Missouri Primacy Fee	Variable	50%	50%	$6,500	$3,250	$3,250
Testing Service	Variable	0%	100%	$129	$0	$129
Trash Disposal	Non-Variable	50%	50%	$651	$326	$326
GNWWC Membership	Variable	100%	0%	$6,484	$6,484	$0
Equipment and Vehicles (Moved to R&R)	Variable			$0	$0	$0
Loan Payments - Water Metering System	Variable	100%	0%	$95,904	$95,904	$0
Annual Payment to Replacement Fund[4]	Non-variable	100%	0%	$69,005	$69,005	$0
User Charge Analysis Services	Variable	100%	0%	$5,587	$5,587	$0
	Total Operating Expenses			$654,000	$0	$362,000
DEBT SERVICE BREAKOUT					$0	
Debt Service Savannah WTP[2]	Non-Variable	0%	100%	$719,000	$0	$719,000
Debt Service Savannah Distribution[3]	Non-Variable	100%	0%	$550,000	$550,000	$0

1 The operating costs are per *Savannah Water Rate Analysis Addendum* (04/02/2012) Scenario 6 Chart 3

2 $699,000 in 2009-2010 with $10,000 annual increase per *2010 Savannah Feasibility Study* , Page 10.

3 $1,268,975 for 2012 per *Savannah Water Rate Analysis Addendum* (04/02/2012) Scenario 6 Chart 6 subtract $719,000 for WTP remaining balance of $549,975 assigned to Distribution

Interest on current Debt Service estimated at 4.5-percent for 33 years per *Stage 1 Report* (05/12/2011) Page 7-2

Interest on the Debt Service for future loans: 20 years at 3-percent per the *Savannah Water Rate Analysis Addendum* (04/02/2012) Scenario 6 Chart 6

4. $69,000 from *Savannah Water Rate Analysis Addendum* (04/02/2012) Scenario 6 Chart 3 used for the distribution system.

Table 4.1 - 2011-2012 Estimated WTP and Distribution Expenses

Total Non-Variable Expenses for WTP	$36,000
Total WTP Debt Service	$719,000
Total Variable Expenses for WTP	**$326,000**
Total WTP Expenses	$1,081,000
Total Expenses Associated with Distribution	$842,000
TOTAL EXPENSES in 2011-12	$1,923,000

2011 Water Sales Volume , kgal	204,400

(*2010 Savannah Feasibility Study* Chart on Page 6, Estimated at 560,000 gallons per day total sales)

Table 4.2 - 2011-12 Expenses per kgal of Water Sold

Total WTP Expenses per kgal Sales	$ 5.30
Total Distribution Expenses per kgal Sales	$ 4.10
Total 2011-12 $ per kgal	$ 9.40

Reduction in Expense to the City of Savannah	**Scenario 2**
Total WTP Expenses per kgal Sales	$ 8.67
Total Distribution Expenses per kgal Sales	$ 4.10
Total 2011-12 $ per kgal	$ 12.77

Reduction in Expense to the City of Savannah	**Scenario 1**
Total WTP Expenses per kgal Sales	$ 3.52
Total Distribution Expenses per kgal Sales	$ 4.10
Total 2011-12 $ per kgal	$ 7.62

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Sheet 8: Savannah Assessment Cost to Produce Water Calculations

Table 4.3 - Projected WTP O&M Expenses

Line		Column 1 2011-12 Estimated WTP O&M	Column 2 Projected O&M Expenses
1	Total Non-Variable Costs	$36,000	$36,000
2	Total Variable Costs for WTP(1)	$326,000	$957,000
3	Total Debt Service	$719,000	$700,000
4	Total WTP Expenses	$1,081,000	$1,693,000

5 (1) Added 10% to the Chemical Costs to Account for Additional Ammonia Feed

6	2011 Water Sales Volume , kgal(1)	204,400
7	Projected Water Sales Volume, kgal	583,000

8 **New WTP Debt Service Payment w/ Expansion Debt Service Included**

9	Existing WTP Purchase Value	7,000,000	
10	WTP Expansion OPCC	2,800,000	
11	Total Project Cost	9,800,000	
12	Debt Service Payment for WTP Expansion	$700,000	20 years at 3-percent
		$600,000	33 years at 4.75-percent

(1) *2010 Savannah Feasibility Study* Chart on Page 6, Estimated at 560,000 gallons per day total sales.

Line - Column	Link Source
Line 1, 2 & 3 - Column 1	Sheet 7: Savannah Assessment Annual Cost Calculations
Line 10 - Column 1	Sheet 6: Savannah Assessment WTP Upgrade Cost Calculations
Line 7 Column 1	Sheet 1: Savannah Assessment Final Table Calculations

CDM Smith

PROJECT:	Phase V Savannah Assessment	COMPUTED BY :	TAP	CHECKED BY:	SAS
JOB NO.:	51115-85333	DATE :	6/27/2012	REVIEWED BY:	JEP
CLIENT:	USACE KC District	REVISION NO.:		PAGE NO. :	

Description:

Sheet 9: Savannah Assessment Water System Demands Calculations

	GNWWC		Savannah & Andrew #3	
50 % of 2030 Max day use	1,775,000		1,130,000	Savannah & Andrew #3 Source: WaterSystemDemands(Modeling)
50 % of 2030 Average Gallons per day	887,500		565,000	
50 % of 2030 Average Gallons per year	323,937,500		206,225,000	
50 % of 2030 Thousand gallons per year	324,000		206,000	530,000 combined thousand gallons/year
50 % of 2030 Thousand gallons per year [(1)]	356,000		206,000	562,000 combined thousand gallons/year

(1) GNNWC plus 10-percent loss

CDM Smith

PROJECT: Phase V Savannah Assessment | COMPUTED BY: TAP | CHECKED BY: SAS
JOB NO.: 51115-85333 | DATE: 6/27/2012 | REVIEWED BY: JEP
CLIENT: USACE KC District | REVISION NO.: | PAGE NO.:

Description:

Sheet 10: Water System Demands

Savannah Assessment Draft Assumptions for Review
26-Jun-12

Summary of Stage 1 Water System Demands

District/City	Water Demands (MGD) 2030 Max. Day[4]	50-Percent 2030 Max. Day	2030 Average Day Demand[5]	Water Supply
Andrew County PWSD #1	1.17	**0.59**	**0.29**	
Andrew County PWSD #4	0.09	**0.05**	**0.02**	
City of Albany	0.50	**0.25**	**0.13**	
City of Barnard	0.05	**0.03**	**0.01**	
City of Bolckow	0.10	**0.05**	**0.03**	
City of Grant	0.25	**0.13**	**0.06**	MF
City of King City	0.20	**0.10**	**0.05**	
City of Maysville	0.19	**0.10**	**0.05**	
City of Stanberry	0.23	**0.12**	**0.06**	MF
DeKalb County PWSD #1 [1]	0.40	**0.20**	**0.10**	
Gentry County #1	0.25	**0.13**	**0.06**	
Gentry County #2	0.10	**0.05**	**0.03**	MF
Nodaway County #1 [2]	0.60	**0.30**	**0.15**	
Savannah/Andrew		**1.13**	**0.57**	
Middle Fork Water Company[3]				**0.32**
Total	4.13	**2.91**	**1.45**	

Total Water Supply Demand		2.91	MGD
10% System Losses		3.08	MGD

Note 1: Listed demand for DeKalb County PWSD #1 includes 25 percent of overall utility demand for Stage 1
Note 2: Assumes only another 0.3 MGD average day and 0.6 MGD maximum day purchased not full system demand
Note 3: Water supply for City of Grant and City of Stanberry
Note 4: Source *Stage 1 Report* Section 2
Note 5: Divided out the 2.0 factor

The 2009 water demand data were divided by the 2009 utility population projections to determine a gallon per capita per day (GPCD). The GPCD was then multiplied by the 2030 projected population to determine the annual water demand and average day water demand. Consistent with the 2009 Phase II Report, a peaking factor of 2.0 was multiplied by the average day water demand to estimate the maximum day demands.

Average Gallons per day	1,452,500
Average Gallons per year	530,162,500
Thousand gallons per year	530,163

Date: 27 June 2012
By: Molly Pesce
Checked: Bruce Hattig
Re: 16164.012 Great NW Phase IV Technical Memo, Stage I Total Cost, Savannah Alternative

BARTLETT & WEST
SERVICE. THE BARTLETT & WEST WAY.

OPCC Pipeline			
Diameter (in)	Length (feet)	Unit Cost ($ per foot)[1]	Extension
4	68,700	$ 20.00	$ 1,380,000
6	83,600	$ 28.00	$ 2,350,000
8	160,000	$ 40.00	$ 6,400,000
12	158,700	$ 62.00	$ 9,840,000
16	30,400	$ 83.00	$ 2,530,000
		Total	$ 22,500,000

Notes:

1) Unit prices include design, material, installation and land.

2) Pipe lengths were rounded to the nearest 100 feet, unit cost per foot were rounded to nearest dollar and every subtotal was rounded up to the nearest $10,000.

3) Kansas City Construction Cost Index (CCI) was used to scale up older OPCC prices to June 2012 dollars. These can be seen below:

Escalation Factor:
KC CCI Value for June 2012 = 10695.37

Date: 27 June 2012
By: Molly Pesce
Checked: Bruce Hattig
Re: 16164.012 Great NW Phase IV Technical Memo, Stage I Total Cost, Savannah Alternative

BARTLETT & WEST
SERVICE. THE BARTLETT & WEST WAY.

OPCC Water Storage Tanks			
Tank ID	Height (feet)	Volume (x1000 gal)	Extension[1]
1	169	120	$ 770,000
2	141	80	$ 650,000
Clearwell	--	280	$710,000
		Total	$ 2,130,000

OPCC Pump Stations						
Pump Station ID	Flow (gal/min)	Flow (MGD)	Head	Total HP	Number of Pumps	Extension[1]
1	1,300	1.90	180	100	2	$ 470,000
Flow Control Structure	--	--	--	--	--	$ 82,000
					Total	$ 552,000

HP = (Flow*Head)/efficiency, rounded to the nearest 50

OPCC for Savannah Stage I Option	
Transmission Lines	$ 22,500,000
Elevated Water Storage Tanks	$ 2,130,000
Pump Stations	$ 552,000
Total	$ 25,182,000

Note:
(1) Unit prices include design, material, installation and land.

Date: 27 June 2012
By: Molly Pesce
Checked: Bruce Hattig
Re: 16164.012 Great NW Phase IV Technical Memo, Stage I Total Cost, Savannah Alternative

BARTLETT & WEST
SERVICE. THE BARTLETT & WEST WAY.

Total Cost Summary		
Construction, Land & Engineering	$	25,182,000
Legal & Financial (5%)	$	1,260,000
Contingency & Inflation (20%)	$	5,040,000
Total	$	31,482,000

Date: 27 June 2012
By: Molly Pesce
Checked: Bruce Hattig
Re: 16164.012 Great NW Phase IV, Stage 1 Total Cost Technical Memo, MO American Alternative

BARTLETT & WEST
SERVICE. THE BARTLETT & WEST WAY.

Opinion of Probable Construction Costs (OPCC) Pipeline			
Diameter (in)	Length (feet)	Unit Cost ($ per linear foot)[1]	Extension
4	68,700	$ 20.00	$ 1,380,000
6	83,600	$ 28.00	$ 2,350,000
8	131,800	$ 40.00	$ 5,280,000
12	158,700	$ 62.00	$ 9,840,000
16	84,500	$ 83.00	$ 7,020,000
		Total	$ 25,870,000

Notes:

1) Unit prices include design, material, installation and land.

2) Pipe lengths were rounded to the nearest 100 feet, unit cost per foot were rounded to nearest dollar and every subtotal was rounded up to the nearest $10,000.

3) Kansas City Construction Cost Index (CCI) was used to scale up older OPCC prices to June 2012 dollars. These can be seen below:

Escalation Factor:

KC CCI Value for June 2012 = 10695.37

Date: 27 June 2012
By: Molly Pesce
Checked: Bruce Hattig
Re: 16164.012 Great NW Phase IV, Stage 1 Total Cost Technical Memo, MO American Alternative

BARTLETT & WEST
SERVICE. THE BARTLETT & WEST WAY.

OPCC Water Storage Tanks			
Tank ID	Height (feet)	Volume (x1000 gal)	Extension[1]
1	169	120	$ 770,000
2	141	80	$ 650,000
Clearwell	--	280	$ 710,000
		Total	$ 2,130,000

OPCC Pump Stations/Flow Control						
Pump Station ID	Flow (gal/min)	Flow (MGD)	Head	Total HP	Number of Pumps	Extension[1]
1	1,300	1.90	180	100	2	$ 470,000
Flow Control Structure	--	--	--	--	--	$ 82,000
					Total	$ 552,000

HP = (Flow*Head)/efficiency, rounded to the nearest 50

OPCC for MO American Stage I Option	
Transmission Lines	$ 25,870,000
Elevated Water Storage Tanks	$ 2,130,000
Pump Stations	$ 552,000
Total	$ 28,552,000

Note:
1) Unit prices include design, material, installation and land.

Date: 27 June 2012
By: Molly Pesce
Checked: Bruce Hattig
Re: 16164.012 Great NW Phase IV, Stage 1 Total Cost Technical Memo, MO American Alternative

BARTLETT & WEST
SERVICE. THE BARTLETT & WEST WAY.

Total Cost Summary		
Construction, Land & Engineering	$	28,552,000
Legal & Financial (5%)	$	1,430,000
Contingency & Inflation (20%)	$	5,720,000
Total	$	35,702,000

Appendix C

Modeling Results

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*********************************************************************
*                            E P A N E T                            *
*                     Hydraulic and Water Quality                   *
*                     Analysis for Pipe Networks                    *
*                          Version 2.0                              *
*********************************************************************
```

Input File: GNWM060812_Final_6.26.12.net

Link - Node Table:

Link ID	Start Node	End Node	Length ft	Diameter in
1.0162	68	74	10162.686914	12
1.1581	68	70	11581.574341	4
1.1657	26	22	11657.038111	6
1.1822	104	102	11822.620010	6
1.1968	114	110	11968.320629	6
1.2017	36	38	12017.922727	6
1.3013	118	106	13013.826443	6
1.3460	106	104	1346.075806	6
1.5196	52	54	1519.641904	12
1.5365	82	80	1536.532012	12
1.5446	90	92	15446.070031	8
1.5674	32	30	15674.961321	12
1.5691	92	94	1569.152084	8
1.5959	66	68	15959.819592	12
1.6066	16	18	16066.804309	4
1.8250	46	48	182.501228	12
1.8459	94	86	18459.301675	8
1.9917	70	72	1991.774676	4
2.0119	116	114	20119.608534	6
2.1568	56	44	21568.539906	12
2.1670	54	32	21670.464758	12
2.3242	44	38	23242.244417	12
2.3802	40	26	23802.035341	6
2.4084	28	24	24084.498377	20
2.4177	58	34	24177.515445	12
2.5129	48	50	25129.350828	12
2.5353	102	78	25353.873600	6
2.5889	14	10	25889.584379	20
2.8238	24	14	28238.778423	20
3.2253	34	30	3225.314085	12
3.3439	76	56	33439.479866	12
3.8233	82	84	3823.306848	12
4.0457	22	20	4045.793140	4
4.3962	74	78	4396.201542	6
4.6302	62	64	4630.219304	4
4.7735	42	40	47735.474348	6
4.8455	42	44	48.455106	6

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Link - Node Table: (continued)

Link	Start	End	Length	Diameter

ID	Node	Node	ft	in
5.2250	66	60	5225.059631	12
5.2454	86	84	524.540397	8
5.2723	30	28	5272.349217	20
5.8835	98	96	5883.562586	8
6.0250	118	116	6025.010246	6
6.2382	80	76	6238.238968	12
6.4895	88	90	6489.571012	8
6.8067	112	126	6806.791685	6
7.2724	96	88	7272.475021	8
8.4980	110	112	8498.010253	6
9.0407	50	52	9040.789898	12
9.0846	58	62	9084.672978	4
9.0886	60	58	9.088616	12.000000
9.5379	100	98	9537.921842	8
9.5526	38	46	9552.681515	12
9.6784	20	16	9678.451233	4
2	2	44	1000	16
3	4	5	1360	12
4	68	5	2732	12
5	5	74	7430	6

Node Results:

Node ID	Demand GPM	Head ft	Pressure psi	Quality
10	-1482.63	1309.82	168.08	0.00
100	303.47	1119.76	74.64	0.00
102	0.00	1249.06	49.77	0.00
104	0.00	1248.04	48.33	0.00
106	0.00	1247.93	48.28	0.00
110	0.00	1243.54	38.58	0.00
112	0.00	1242.81	116.30	0.00
114	0.00	1244.57	44.14	0.00
116	0.00	1246.29	119.24	0.00
118	0.00	1246.81	100.96	0.00
126	27.95	1242.23	90.44	0.00
14	471.18	1299.96	121.18	0.00
16	0.00	1140.71	126.48	0.00
18	79.86	1071.30	54.34	0.00
20	0.00	1182.52	92.17	0.00
22	0.00	1200.00	143.07	0.00
24	0.00	1294.67	76.20	0.00
26	0.00	1206.98	84.44	0.00
28	0.00	1290.16	79.36	0.00
30	0.00	1289.17	93.88	0.00
32	0.00	1282.50	164.91	0.00

Page 3
Node Results: (continued)

Node ID	Demand GPM	Head ft	Pressure psi	Quality
34	0.00	1286.40	91.12	0.00
36	159.72	1227.94	76.45	0.00
38	0.00	1253.94	89.41	0.00

40	0.00	1221.25	91.19	0.00	
42	79.86	1249.86	75.16	0.00	
44	0.00	1249.97	75.19	0.00	
46	0.00	1258.01	71.15	0.00	
48	0.00	1258.09	71.19	0.00	
50	0.00	1268.78	160.10	0.00	
52	0.00	1272.63	94.26	0.00	
54	0.00	1273.28	93.54	0.00	
56	0.00	1244.73	88.54	0.00	
58	0.00	1265.62	97.20	0.00	
60	0.00	1265.61	97.33	0.00	
62	39.93	1226.38	130.93	0.00	
64	39.93	1220.84	108.47	0.00	
66	0.00	1262.17	80.62	0.00	
68	0.00	1251.64	97.25	0.00	
70	0.00	1246.26	133.13	0.00	
72	23.96	1245.33	130.13	0.00	
74	0.00	1251.61	81.72	0.00	
76	0.00	1236.62	156.82	0.00	
78	0.00	1251.23	61.93	0.00	
80	0.00	1235.10	138.70	0.00	
82	0.00	1234.73	124.15	0.00	
84	0.00	1233.80	132.29	0.00	
86	0.00	1232.88	127.64	0.00	
88	0.00	1159.47	141.89	0.00	
90	0.00	1170.82	117.95	0.00	
92	0.00	1197.84	146.56	0.00	
94	0.00	1200.59	153.04	0.00	
96	0.00	1146.74	83.04	0.00	
98	0.00	1136.45	130.36	0.00	
5	267.53	1250.15	68.09	0.00	
2	-212.00	1250.00	73.23	0.00	Tank
4	201.24	1250.00	61.10	0.00	Tank

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Link Results:

Link ID	Flow GPM	Velocity fps	Unit Headloss ft/Kft	Status
1.0162	27.95	0.08	0.00	Open
1.1581	23.96	0.61	0.46	Open
1.1657	79.86	0.91	0.60	Open
1.1822	-27.95	0.32	0.09	Open
1.1968	27.95	0.32	0.09	Open
1.2017	-159.72	1.81	2.16	Open
1.3013	-27.95	0.32	0.09	Open
1.3460	-27.95	0.32	0.09	Open
1.5196	-410.91	1.17	0.43	Open
1.5365	-303.47	0.86	0.24	Open
1.5446	-303.47	1.94	1.75	Open
1.5674	-410.91	1.17	0.43	Open
1.5691	-303.47	1.94	1.75	Open
1.5959	520.68	1.48	0.66	Open
1.6066	79.86	2.04	4.32	Open
1.8250	-410.91	1.17	0.43	Open
1.8459	-303.47	1.94	1.75	Open
1.9917	23.96	0.61	0.46	Open

2.0119	27.95	0.32	0.09	Open
2.1568	-303.47	0.86	0.24	Open
2.1670	-410.91	1.17	0.43	Open
2.3242	-251.19	0.71	0.17	Open
2.3802	79.86	0.91	0.60	Open
2.4084	-1011.45	1.03	0.19	Open
2.4177	-600.54	1.70	0.86	Open
2.5129	-410.91	1.17	0.43	Open
2.5353	-27.95	0.32	0.09	Open
2.5889	-1482.63	1.51	0.38	Open
2.8238	-1011.45	1.03	0.19	Open
3.2253	-600.54	1.70	0.86	Open
3.3439	-303.47	0.86	0.24	Open
3.8233	303.47	0.86	0.24	Open
4.0457	79.86	2.04	4.32	Open
4.3962	27.95	0.32	0.09	Open
4.6302	39.93	1.02	1.20	Open
4.7735	79.86	0.91	0.60	Open
4.8455	-159.72	1.81	2.16	Open
5.2250	-520.68	1.48	0.66	Open
5.2454	-303.47	1.94	1.75	Open
5.2723	-1011.45	1.03	0.19	Open
5.8835	-303.47	1.94	1.75	Open
6.0250	27.95	0.32	0.09	Open
6.2382	-303.47	0.86	0.24	Open
6.4895	-303.47	1.94	1.75	Open
6.8067	27.95	0.32	0.09	Open
7.2724	-303.47	1.94	1.75	Open
8.4980	27.95	0.32	0.09	Open

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Link Results: (continued)

Link ID	Flow GPM	Velocity fps	Unit Headloss ft/Kft	Status
9.0407	-410.91	1.17	0.43	Open
9.0846	79.86	2.04	4.32	Open
9.0886	-520.68	1.48	0.66	Open
9.5379	-303.47	1.94	1.75	Open
9.5526	-410.91	1.17	0.43	Open
9.6784	79.86	2.04	4.32	Open
2	212.00	0.34	0.03	Open
3	-201.24	0.57	0.11	Open
4	468.77	1.33	0.54	Open
5	0.00	0.00	0.00	Closed