

Disinfectant	MRDLG (mg/L)	MRDL (mg/L)
Chlorine (as free Cl ₂)	4	4.0
Chloramines (as total Cl ₂)	4	4.0
Chlorine Dioxide (as ClO ₂)	0.8	0.8

Table 4-2
MRDLGs and MRDLs for Disinfectants

The monitoring and compliance requirements for disinfectants are summarized in Table 4-3.

Disinfectant	Monitoring	Compliance
Chlorine Chloramines	Same locations and time in distribution system as total coliforms	Running annual arithmetic average, computed quarterly, of monthly averages of all samples
Chlorine Dioxide	One sample/day/plant at entrance to distribution system ^a	Consecutive daily samples

^a If daily sample exceeds MRDL, additional samples are required in distribution system on following day.

Table 4-3
Monitoring and Compliance Requirements for Disinfectants

The Stage 1 DBPR allows short-term increases of chlorine and chloramines if required to protect public health or control specific microbiological problems.

Maximum Contaminant Level Goals and Maximum Contaminant Levels for Disinfection Byproducts

The Stage 1 DBPR lowers the TTHM standard (0.10 mg/L) established by the Total Trihalomethane Rule and regulates another class of DBPs formed by chlorination—haloacetic acids. In addition, Stage 1 DBPR regulates two inorganic DBPs—bromate and chlorite—which are byproducts of ozone and chlorine dioxide, respectively. Table 4-4 summarizes the MCLGs and MCLs for DBPs. The monitoring and compliance requirements for DBPs are summarized in Table 4-5.

Treatment Technique for Disinfection Byproduct Precursors

The Stage 1 DBPR requires water systems that treat surface water or groundwater under the direct influence of surface water using conventional filtration treatment to remove DBP precursors and thereby reduce DBPs by enhanced coagulation or enhanced softening, unless one or more of the following alternative compliance criteria apply:

- Total organic carbon (TOC) concentration in raw water is less than 2.0 mg/L.
- TOC concentration in treated water is less than 2.0 mg/L.

- TOC concentration in raw water is less than 4.0 mg/L; alkalinity in raw water is greater than 60 mg/L (as CaCO₃); and either TTHM and HAA5 concentrations in the distribution system are less than 0.040 mg/L and 0.030 mg/L, respectively, with any disinfectant; or the water system has made a clear and irrevocable financial commitment to technologies that will limit the levels of TTHMs and HAA5 in the distribution system to less than 0.040 mg/L and 0.030 mg/L, respectively.
- TTHM and HAA5 concentrations in distribution system are less than or equal to 0.040 mg/L and 0.030 mg/L, respectively, with disinfection by chlorine only.
- Specific ultraviolet absorbance at 254 nm (SUVA) in raw water is less than or equal to 2.0 L/mg-m.
- SUVA in treated water is less than or equal to 2.0 L/mg-m, where SUVA is determined in water prior to the addition of disinfectants or oxidants. (Bench-scale testing is required for plants that add disinfectants or oxidants prior to the treated water sampling point.)
- Treated water alkalinity is less than 60 mg/L (as CaCO₃) for softening systems.
- Magnesium hardness removal is greater than or equal to 10 mg/L (as CaCO₃) for softening systems.

Disinfection Byproduct	MCLG (mg/L)	MCL (mg/L)
Total Trihalomethanes (TTHM) ^a	-	0.080
Chloroform	0	-
Bromodichloromethane	0	-
Bromoform	0	-
Dibromochloromethane	0.06	-
Haloacetic Acids (five) (HAA5) ^b	-	0.060
Dichloroacetic acid	0	-
Trichloroacetic acid	0.3	-
Bromate	0	0.010
Chlorite	0.8	1.0

^a Total trihalomethanes is the sum of concentrations of chloroform, bromodichloromethane, bromoform and dibromochloromethane.

^b Haloacetic acids (five) is the sum of concentrations of monobromoacetic acid, dibromoacetic acid, monochloroacetic acid, dichloroacetic acid and trichloroacetic acid.

Table 4-4
MCLGs and MCLs for Disinfection Byproducts

DBP	Monitoring	Compliance
TTHM HAA5	Four samples/quarter/plant ^b	Running annual arithmetic average, computed quarterly, of quarterly arithmetic averages of all samples.
Bromate	One sample/month/plant ^c	Running annual arithmetic average of monthly samples, computed quarterly.
Chlorite (monthly)	Three samples/month/plant ^d	Monthly arithmetic average of samples
Chlorite (daily)	One sample/day/plant ^e	Violation of MCL triggers additional distribution system monitoring

^a For water samples using surface water or groundwater under the direct influence of surface water and serving 10,000 or more persons.

^b One sample taken at location representative of maximum residence time in distribution system; three samples taken at locations of system variability.

^c Applicable only for plants using ozone. Sample taken at entrance to distribution system while ozone system is operating under normal conditions.

^d Applicable only for plants using chlorine dioxide. One sample taken near first customer; one sample taken at location representative of average residence time in distribution system; one sample taken at location representative of maximum residence time in distribution system. Samples must be collected on the same day.

^e Applicable only for plants using chlorine dioxide; sample taken at entrance to the distribution system.

Table 4-5
Monitoring and Compliance Requirements for Disinfection Byproducts^a

Total organic carbon, a surrogate of DBP precursors, is used to measure DBP precursor removal performance. Systems failing to meet one of the alternative compliance criteria are required to provide from 15.0 to 50.0 percent Step 1 TOC removal, depending on the raw water TOC and alkalinity, as shown in **Table 4-6**.

Raw Water TOC (mg/L)	Raw Water Alkalinity (mg/L as CaCO ₃)		
	0 - 60	> 60 - 120	> 120 ^b
> 2.0 - 4.0	35.0%	25.0%	15.0%
> 4.0 - 8.0	45.0%	35.0%	25.0%
> 8.0	50.0%	40.0%	30.0%

^a Percent removal is between raw water and combined filter effluent.

^b Systems practicing softening must meet TOC removal requirements in this column.

Table 4-6
Step 1 Requirements for Removal of TOC by Enhanced Coagulation or Enhanced Softening ^a

The Stage 1 DBPR allows states to approve alternative minimum TOC removal (Step 2) requirements for conventional treatment systems that cannot reasonably meet the TOC removal requirements in **Table 4-6**. The alternative TOC removal (Step 2) requirement, which must be established by bench- or pilot-scale testing, is the level at which additional coagulant reduces:

- TOC removal to a rate of 0.3 mg/L per 10 mg/L alum addition or an equivalent addition of iron coagulant (this is termed “point of diminishing returns”); or
- pH to the enhanced coagulation Step 2 target pH shown in **Table 4-7**.

Raw Water Alkalinity (mg/L as CaCO ₃)	Target pH
0 - 60	5.5
> 60 - 120	6.3
> 120 - 240	7.0
> 240	7.5

Table 4-7
Enhanced Coagulation Step 2 Target pH

Systems using raw water with an alkalinity of less than 60 mg/L (as CaCO₃), and for which small amounts of alum or iron coagulant reduce the pH below 5.5 before significant TOC removal occurs, must add the necessary chemicals to maintain the pH between 5.3 and 5.7 until the rate of TOC removal reaches 0.3 mg/L per 10 mg/L alum addition or an equivalent addition of iron coagulant. Stage 1 DBPR also allows states to waive enhanced coagulation requirements for systems that cannot achieve 0.3 mg/L TOC removal per 10 mg/L alum addition at all doses of alum or an equivalent addition of iron coagulant. Compliance with the enhanced coagulation and enhanced softening requirements is based on the running annual arithmetic average of monthly samples, computed quarterly. Monitoring includes raw water TOC and alkalinity and treated water TOC.

4.2.6.2 Stage 2 DBPR

The Stage 2 DPBR was promulgated January 4, 2006 and took effect March 6, 2006 (71 FR388). **Table 4-8** outlines the Stage 2 DBPR MCLs and MCLGs, with changes from the Stage 1 DBPR denoted in bold text.

Disinfection Byproduct	MCLG (mg/L)	MCL (mg/L)
Total Trihalomethanes (TTHM) ^a	-	0.080
Chloroform	0.07	-
Bromodichloromethane	0	-
Bromoform	0	-
Dibromochloromethane	0.06	-
Haloacetic Acids (five) (HAA5) ^b	-	0.060
Dichloroacetic acid (DCAA)	0	-
Trichloroacetic acid (TCAA)	0.02	-
Monochloroacetic acid (MCAA)	0.07	-
Bromate	0	0.010

^a Total trihalomethanes is the sum of concentrations of chloroform, bromodichloromethane, bromoform and dibromochloromethane.

^b Haloacetic acids (five) is the sum of concentrations of monobromoacetic acid, dibromoacetic acid, monochloroacetic acid, dichloroacetic acid and trichloroacetic acid.

Table 4-8
Proposed Stage 2 MCLGs and MCLs for Disinfection Byproducts

Additional comments on the Stage 2 DBPR that apply to public water systems (community water systems and nontransient noncommunity water systems) that treat water with a chemical disinfectant or provide water that contains a chemical disinfectant are noted below:

- Maintain the MCLs for TTHM and HAA5 at 0.080 mg/L and 0.060 mg/L, respectively.
- Revise the four distribution sampling points for each water treatment plant (established by Stage 1 DBPR for water systems serving 10,000 or more persons) to the eight sampling points required for the Stage 2 DBPR population-based monitoring requirements for public water systems serving 50,000 – 249,999 people. Three of these sampling points must be at the highest TTHM locations, three at the highest HAA5 locations, and two from existing Stage 1 DBPR monitoring locations.
- Revise the basis for determining compliance with the TTHM and HAA5 standards from the running annual average (RAA) of all quarterly samples to a locational running annual average (LRAA) of quarterly samples; i.e., the TTHM and HAA5 standards must be met at each sampling location.
- Require that at least one set of quarterly samples be taken during the peak historical month for DBP levels.
- Maintain the bromate MCL at 0.010 mg/L and revisit the standard under a six-year review process. The federal advisory committee agreed that it is important to continue research on bromate detection, formation, treatment and health effects.

For water systems serving 50,000 – 249,999, the revised distribution system sampling points will be determined through an initial distribution system evaluation (IDSE) consisting of one year of monitoring, approximately every 60 days, at sixteen sampling sites, or system-specific study. The IDSE monitoring plan, or system-specific study plan, must be submitted by April 1, 2007, for systems serving between 50,000 and 99,000 people. System monitoring, or the system-specific study, must be completed by March 30, 2009. The IDSE report must be submitted by July 1, 2009. Systems with data sets available that meet EPA guidelines, or with sufficiently low DBPs (TTHM and HAA5 LRAA concentrations less than 0.040 mg/L and 0.030 mg/L, respectively) at all locations for a period of at least a year, may qualify for reduced monitoring.

The EPA intends to link the implementation schedules for Stage 2 DBPR and LT2ESWTR to balance the risks associated with simultaneously treating water to control microbial contaminants, disinfectants and DBPs. Affected water systems serving 50,000 to 99,999 people must comply with Stage 2 as follows:

- Stage 2: By October 1, 2012, TTHM and HAA5 concentrations must be less than 0.080 mg/L and 0.060 mg/L, respectively, based on the LRAA and the monitoring sites selected from the IDSE. States may allow an additional two years for compliance by water systems requiring capital improvements.

4.2.7 Filter Backwash Recycling Rule

The FBRR, which was promulgated on June 8, 2001, (66 FR 31086), applies to public water systems using surface water or groundwater under the direct influence of surface water that practice conventional or direct filtration and recycle spent filter backwash water, thickener supernatant, or liquids from dewatering processes.

Water systems must comply with the regulation by June 8, 2004. States may allow an additional two years for water systems requiring capital improvements.

The FBRR requires water systems to return recycle flows (spent filter backwash, thickener supernatant and liquids from dewatering processes) through all conventional or direct filtration processes or to an alternate location approved by the State.

4.3 Existing Water Treatment Plant

The City draws raw water from Kaw Reservoir and pumps it to the Stillwater WTP. **Figure 4-2** shows an overall water system schematic of the plant. **Table 4-9** summarizes the operating conditions of the plant and its major processes.

Plant Component	Data
Plant Capacity	18 mgd
Raw Water Storage Tank	
Dimensions (diameter x depth)	120' x 48'
Volume	4,060,000 gallons
Hydraulic Detention Time @ 18 mgd	5.4 hours
Solids Contact Clarifiers	
Number of Trains	3
Dimensions (diameter x depth from center)	90' x 19.72'
Volume (Clarifiers 1, 2, 3 Each)	835,000 gallons
(Total)	2,505,000 gallons
Hydraulic Detention Time @ 18 mgd	3.3 hours total
Surface Area (per Train)	6,362 ft ² total; 5,557 ft ² sedimentation
Overflow Rate @ 18 mgd	1080 gpd/ft ²
Weir Length (per Train)	760 ft
(Total)	2,280 ft
Weir Loading @ 18 mgd	7,960 gpd/ft
Recarbonation Basin	
Number of Trains	2
Dimensions (l x w x d)	73' x 15' x 14.5'
Volume (per Train)	118,000 gallons
(Total)	237,000 gallons
Hydraulic Detention Time @ 18 mgd	19 minutes
Filters	
Number of Filters	12
Dimensions (l x w) (1-8, 1985)	26'-9" x 15'
(9-12, 1999)	23'-2" x 20'
Area (1-8, each)	401.25 ft ²
(9-12, each)	463.33 ft ²
(Total)	5063 ft ²
Media Depth	
Anthracite and Sand	30 inches
Filter Loading Rate @ 18 mgd	2.5 gpm/ft ² (with all filters in service) 2.7 gpm/ft ² (with one large filter out of service)
Backwash Pump Capacity	9,600 gpm
Backwash Rate	minimum of 10 gpm/ft ² in 1985 filter cells
Ozone Contact Basins	
Number of Trains	2
Number of Zones	6
Volume (per Train)	76,000 gallons
(Total)	153,000 gallons
Hydraulic Detention Time @ 18 mgd	12 minutes
Clearwells	
Dimensions (Diameter x depth, 1985)	112' x 20'
(l x w x d, 1999)	203' x 115' x 20'
Volume (1985)	1,474,000 gallons
(1999)	3,492,000 gallons
(total)	4,966,000 gallons
Percent of Clearwell Volume/Plant Capacity	27%

Table 4-9
Stillwater WTP Process Components

4.3.1 Raw Water Storage and Meter Vaults

Raw water from Kaw Reservoir is stored at the plant in a 4-MG painted steel ground storage tank. Raw water from the storage tank splits to three raw water meter vaults. The coagulant chemicals, liquid alum and cationic polymer, are added at the raw water meter vaults. Chlorine and ammonia are also added at the meter vaults to form chloramine.

4.3.2 Solids Contact Clarifiers

The next step in the process is sedimentation, which occurs in the solids contact clarifiers. The treatment train was first constructed in 1985 with two clarifiers; however, during the expansion in 1999 one more clarifier was added to treat 18 mgd. All three solids contact clarifiers are 90-feet in diameter and the original clarifiers have a side-water depth (SWD) of 16.3 feet, whereas the clarifier constructed in 1999 has a SWD of 16.5 feet. As the water enters the clarifiers, lime slurry is added for softening. The Oklahoma Department of Environmental Quality (ODEQ) requires a minimum 3-hour detention time and maximum 1440 gpd/ft² upflow rate for softening solids contact clarifiers and 3.3 hours and 1080 gpd/ft² are provided with the three clarifiers at the plant.

4.3.3 Recarbonation

The recarbonation system at Stillwater WTP consists of two trains, both constructed in 1985. In these basins, carbon dioxide is used to lower the pH of the water prior to filtration. Before the water reaches the filters, chlorine and anionic polymer are added. The existing basins provide a detention time of 19 minutes at 18 mgd.

4.3.4 Filtration Modules

The filtration system consists of the original two modules built in 1985 and a third module built in 1999. Each declining-rate filtration module contains four cells and the media in each cell consists of 30 inches of anthracite and sand. Backwash is accomplished by hydraulic differential, and aided by surface wash. The original two modules use high-pressure water for surface wash, whereas the 1999 module uses air. With one of the large filters out-of-service, the filter loading rate is 2.7 gpm/ft², which is below the ODEQ maximum rate of 3 gpm/ft² for dual media filters.

4.3.5 Ozonation

After the filters, filtered water flows to the ozone contact basins. In the ozone contact basins, ozone is injected into the water as the primary disinfectant, and the two, six-zone trains provide the required contact time for disinfection.

4.3.6 Chloramination & Fluoridation

After the water leaves the ozone contact basins, ammonia and chlorine are added to form chloramine for residual disinfection. Sodium silico fluoride is also added just before the clearwells to provide for a fluoride residual in the distribution system.

4.3.7 Clearwells

Water is stored on site in two clearwells. The original clearwell was constructed in 1985 and has a 112-foot diameter, with a SWD of 20 feet. The clearwell constructed during the 1999 expansion is 203 ft by 115 ft with a SWD of 20 ft. The two clearwells provide approximately 4.9-MG of onsite water storage.

4.3.8 High- and Low-Service Pumping

Treated water is pumped into the distribution system via an onside pump station consisting of three high-service pumps and four low-service pumps. Each of these pumps has a capacity of 3 mgd. Located just ahead of this pump station are feed points where chlorine can be fed in an emergency situation.

4.3.9 Chemical Systems

Chemical feed rates for the existing plant, from 1990 through mid-2005, were gathered, tabulated, and used as a basis for analyzing the existing chemical feed systems. For new and upgraded water treatment plants, ODEQ requires all chemical systems to have at least 30 days of storage based on average plant doses for each chemical. Thus, for the purposes of our evaluation, we have computed chemical storage capacity based on an average chemical dose and maximum plant flow. Table 4-10 presents a summary of this analysis.

Chemical	Average Dose (mg/L)	Max ¹ Dose (mg/L)	Storage Capacity (days)	Storage Volume ²
Alum	46	148	19	11,800 gal
Lime	38	91	49	140 tons
Polymer	0.6	4.5	74	600 gal
Chlorine	4.1	6.7	20	12,000 lb
Ammonia	1.4	6.0	23	850 gal
Fluoride	0.9	3.2	30	4000 lb ³
Carbon Dioxide	No data	No data	No data	No data

¹ Data taken from average dosages, tabulated monthly, dating from 1990 to August 2005.

² Storage based on average chemical dose, unless otherwise noted.

³ Assumes at least 4000 lbs storage in bags.

Table 4-10
Chemical System Doses and Storage

By ODEQ definition, the storage capacity is adequate for all systems except alum, chlorine, and ammonia. With respect to chemical feed, the polymer, ammonia, and fluoride feed systems lack redundancy, and it should be considered to add redundancy during the next plant expansion. The lime and polymer storage capacities are easily adequate for present and near-term flows.

No historical data was available for the ozone system and liquid oxygen (LOX) storage. The ozone system consists of two 400 pound per day (ppd) ozone generators and an 11,000-gallon LOX storage tank. If one ozone generator is operating at 400 ppd and the transfer efficiency is 90%, a firm dose of 2.4 mg/L can be obtained at a plant flow 18 mgd. According to the plant staff, the typical ozone dose is around 0.75 mg/L, thus the ozone feed system is easily capable of handling the dose requirements. For an ozone feed rate of 400 ppd, a plant flow of 18 mgd, and a feed gas concentration of 8%, the LOX storage tank provides about 21 days storage. For an “average” plant dose of 0.75 mg/L and 18 mgd, the storage is about 74 days – well over the 30-day ODEQ requirement.

4.3.10 Current Regulatory Compliance

Treated water quality data was obtained from the City for TTHMs, HAA5, and bromate from 2003 through 2005. Because the plant uses ozone and chloramine for disinfection, the City does not experience high TTHM and HAA5 levels. Upon reviewing the historical data provided by the City, the system running annual averages (RAA) for TTHMs and HAA5 are typically less than 20 µg/L – which are well below the current regulatory limits of 80 and 60 µg/L, respectively.

With respect to bromate, the bromate levels measured by Accurate Lab in 2004 and 2005 have all been less than the 10 µg/L MCL. In 2003 and early 2004, the ODEQ lab analyzed bromate for the City. Due to analytical problems, some bromate values during this time period were recorded as greater than 10 µg/L; however, these measurements came into question and is one reason why the bromate samples are now analyzed by Accurate Lab. Based on the Accurate Lab data, the plant does not have any problem with bromate compliance.

4.4 Water Treatment Plant Expansion to 24 mgd (Phase I)

Because the existing 18-mgd plant is configured in 6-mgd treatment trains and due to the projected water demands identified previously, the next logical plant expansion would be to 24 mgd. We are calling this expansion “Phase I.” For expansion of the plant to 24 mgd, the recommendations are summarized as follows:

- Install a meter vault and a 90-ft solids contact clarifier to the south of the existing three units. This unit should be identical to the clarifier built in 1999.
- Install an additional four-cell filtration module, identical and to the north of the 1999 filter module.
- Replace all existing high- and low-service pumps, which are rated at 3 mgd. New pumps should be rated for 4 mgd and at the same discharge pressures as the existing high-service and low-service pumps. The modified pump station is likely to house four 75-hp low-service pumps and three 200-hp high-service pumps.

- Miscellaneous chemical system improvements.
- Miscellaneous piping improvements.

Notably, no additions or modifications are recommended for the raw water storage tank, ozone contactors, ozone generator room, LOX storage tank, or clearwells.

The rationale for the aforementioned recommendations and for leaving the clearwells and ozonation systems as they are is provided below. Additionally, the Phase I expansion is illustrated in **Figure 4-3**.

4.4.1 Raw Water Storage Tank, Meter Vault, and Solids Contact Clarifier

For 24 mgd, the detention time in the raw water storage tank is 4.1 hours. Other than some piping modifications, no additional raw storage is required.

For solids contact clarifiers, ODEQ requires a minimum 3-hour detention time and a 1440 gpd/ft² upflow rate. The plant operates well at the existing contactor upflow rates, so we recommend that these same loadings be used for planning purposes. At the current flow of 18 mgd, the clarifiers are loaded at 1080 gpd/ft² and have a detention time of 3.3 hours. To maintain this loading at the expanded flow of 24 mgd, it is necessary to add a fourth clarifier with the same internal diameter as the original three, or 90 feet. For ease of inlet/outlet piping installation, and to maintain an organized plant layout, this new clarifier should be installed directly south of the original three clarifiers. This will require re-routing of a plant road, as shown in **Figure 4-3**. Additionally, a new raw water meter vault with the required chemical application points will also be installed.

4.4.2 Recarbonation

For an expansion to 24 mgd, the detention time in the recarbonation basins reduces from 19 to 14 minutes. The ODEQ design requirement for recarbonation basins is 20 minutes, but the current basin is just under this time and we believe that 14 minutes is adequate detention time for proper stabilization. Thus, we would recommend no additional basins be provided and a variance obtained from ODEQ. The carbon dioxide feed system will most likely need some rehabilitation improvements as well.

4.4.3 Filtration

According to ODEQ, the three existing filtration modules cannot treat 24 mgd, since this flow would exceed the allowed filtration rate for dual-media filters of 3 gpm/ft². Thus, additional filtration capacity is necessary for the plant expansion to 24 mgd.

The existing filters operate at 2.5 gpm/ft² at 18 mgd. For planning purposes and because this loading is below the limit set by ODEQ, this filtration rate will be used as a design basis for the plant expansion. Installation of the fourth filtration module, with a surface area equal to the filter module built in 1999 is assumed. Air scouring is recommended over water due to its greater effectiveness at cleaning the filter.

4.4.4 Ozonation

At 24 mgd, ozone contactor residence time is reduced from 12.2 minutes to 9.2 minutes, which is considered ample. A firm dose, with one generator operating and one offline, is reduced from 2.4 mg/L to 1.8 mg/L. This is above the plant's reported typical does of 0.75 mg/L, but beneath the highest reported dose of about 3.0 mg/L (recalled from plant staff memory). It was noted the high does of 3.0 mg/L was recorded while experiments were being run on the plant, and is well above what would be dosed for treatment purposes. Thus, we believe the plant could be expanded to 24 mgd without any expansion to the existing ozone feed system.

With respect to LOX storage, ODEQ guidelines suggest that a 30-day supply of oxygen should be kept on site. The existing tank has a storage capacity of 11,000 gallons liquid oxygen. At 24 mgd and average ozone dose of 0.75 mg/L, the existing LOX tank provides 56 days of storage. Thus, no improvements are required. It should be noted that with reduced ozone contact time, the average dose may increase some. However, this should be evaluated in detail during the design phase.

4.4.5 Clearwells

At 24 mgd, clearwell capacity amounts to 20% of throughput. Ten percent is usually considered adequate for pumping control purposes. Thus, no clearwell expansion is recommended for 24 mgd.

4.4.6 High- and Low-Service Pumping

The firm capacity of the treated water pump station must be raised from 18 mgd to 24 mgd, yet there is little room in the pump station for placement of additional pumps and piping. The addition of new pumps may require a new pump house, and this should be avoided if possible.

A more efficient solution is to replace the existing pumps with larger pumps. The seven existing pumps are rated for 3 mgd (2080 gpm). The high-service pumps use 120-hp motors, and the low-service pumps use 60-hp motors. Firm capacity refers to one high-service pump out and the remaining six pumps running.

All seven pumps should be replaced with pumps rated for 4 mgd (2780 gpm). Such capacity may require 75-hp low-service pumps and 200-hp high-service pumps, for a total installed power of 900 hp. Operating power consumption would be roughly 600 hp.

4.4.7 Chemical Systems

4.4.7.1 Alum

A plant expansion to 24 mgd reduces the firm alum dose to 40 mg/L, which is below the historical average alum dose for the plant. Thus, an expansion of the alum system is necessary for the increased flow.

The existing four alum pumps are each rated for 10 gph. These should be removed and replaced with five 20-gph pumps. Four of the five alum pumps should each be dedicated to a single clarifier, and the standby pump should be able to dose any of the four clarifiers. This expansion increases firm dose capacity to 107 mg/L, which is greater than the 90th percentile (80 mg/L) of all recorded doses.

For this expansion, it is not practical to increase the alum storage time to 30 days for the average dose of 46 mg/L. It is recommended to use the existing storage tank, which allows for a 14-day storage time at the average dose. A variance could be obtained from ODEQ for this storage time variance, since CDM has done that for other chemical installations in Oklahoma.

4.4.7.2 Lime

At 24 mgd, the lime system is easily adequate both for dosing capacity and storage volume. However, the condition of the existing slakers, metering pumps, lime silo and miscellaneous equipment is fair to poor and replacement should be considered for this expansion to reliably treat 24 mgd.

4.4.7.3 Polymer

The existing polymer feed pumps are adequately sized and are in good condition, but the system operates without redundancy. Two addition polymer pumps should be installed. One should be a standby and the remaining four should each be dedicated to one of the four meter vault feed locations. At 24 mgd and at average dose, the polymer tanks provide a storage time of over 30 days, thus additional polymer storage is not required.

4.4.7.4 Chlorine

The chlorine feed system has adequate capacity, but the storage volume allows for 15 days of storage. The chlorine storage area was originally designed for four cylinders feeding and eight cylinders in storage. If storage for eight ton cylinders can be used, then 30 days of storage can be provided. Otherwise, we would recommend a storage variance be obtained from ODEQ.

4.4.7.5 Ammonia

At 18 mgd, the ammonia system consisting of two 150-ppd ammoniators, must operate without redundancy to provide the average dose. At 24 mgd, the system can still dose the average, but it cannot dose the 90th percentile of recorded doses. The existing units should be demolished and replaced with three 300-ppd units. One alone would provide the average dose, and a second could be used for higher doses. A third would be for standby.

At 24 mgd, the existing ammonia tank provides 17 days storage time. This amount of storage is considered adequate and CDM recommends obtaining a variance from ODEQ for storage.

One safety concern that was noted in our review of the ammonia facilities is the room is heated by an open-flame, forced air gas heater. Because the potential for an ammonia gas leak is always possible, open-flame heating should not be used. Thus, we recommend this be modified as part of this plant expansion.

4.4.7.6 Fluoride

The existing fluoridation system operates without redundancy in the fluoride dissolution step. The solution pumping capacity of the existing system is adequate, but the fluoride dissolution capacity is not. It is recommended to either modify the solution feed capacity of the existing system or convert the system to hydro fluosilicic acid, which would just involve a tank and two metering pumps. A decision on which alternative is recommended can be determined during the plant design phase.

4.4.8 Additional Raw Water Sources and Regulatory Compliance

As noted in the Section 2 - Raw Water Supply System, grab water samples were collected in July 2005 for Kaw Reservoir, Lake McMurtry and Lake Carl Blackwell and are listed below in **Table 4-11**.

Parameter	Kaw	McMurtry	Blackwell
Alkalinity	98.0 mg/L	156 mg/L	154 mg/L
Chloride	38.5 mg/L	17.6 mg/L	32.9 mg/L
pH	7.83 SU	8.26 SU	8.21 SU
Sulfate	22.8 mg/L	15.9 mg/L	20.2 mg/L
Total Dissolved Solids	250 mg/L	198 mg/L	224 mg/L
Total Organic Carbon	6.34 mg/L	5.32 mg/L	5.61 mg/L
Iron	4.1 mg/L	0.99 mg/L	0.95 mg/L
Magnesium	6.3 mg/L	16 mg/L	15 mg/L
Manganese	0.062 mg/L	0.036 mg/L	0.053 mg/L
Potassium (K)	6.1 mg/L	4.1 mg/L	4.3 mg/L
Sodium	29 mg/L	19 mg/L	29 mg/L
Total Hardness as CaCO ₃	110 mg/L	150 mg/L	150 mg/L
Calcium	81 mg/L as CaCO ₃	80 mg/L as CaCO ₃	87 mg/L as CaCO ₃

Table 4-11
Raw Water Quality Data: Kaw Reservoir, Lake McMurtry, and Lake Carl Blackwell

In comparing the values of individual water quality parameter for each source water, they are similar. Kaw has a higher iron content but slightly lower hardness. Kaw also has a somewhat lower pH, while Lakes Carl Blackwell and McMurtry have more alkalinity. However, it should be noted that these results are for one grab sample, and may not be representative of the lakes year round. Thus, before any design expansion is completed, we recommended that additional water quality samples be obtained to determine if, in fact, there could be a change in chemical feed doses (e.g., alum, lime, polymer) to treat the two new source waters.

The plant expansion to 24 mgd should not require any additional modifications to meet the promulgated regulations discussed in Section 4.2.

4.4.9 Summary of Phase I Capital Costs

The planning-level opinion of probable construction costs for the Phase I expansion to 24 mgd is summarized in Table 4-12.

Item	Cost
Phase I Plant Expansion to 24 mgd	
New Meter Vault and 90-ft Dia. Solids Contact Clarifier	\$1,650,000
New 4-Cell Filter Module	\$1,600,000
New High- and Low-Service Pumps	\$1,350,000
Chemical System Improvements	\$600,000
Miscellaneous Yard Piping	\$300,000
Miscellaneous Civil Sitework	\$200,000
Miscellaneous Electrical & Instrumentation	\$300,000
<i>Subtotal</i>	<i>\$6,000,000</i>
Contingencies (30%)	\$1,800,000
<i>Subtotal</i>	<i>\$7,800,000</i>
Contractor Mobilization, Bonds & Insurance (7%)	\$546,000
Contractor's Overhead & Profit (15%)	\$1,170,000
<i>Subtotal</i>	<i>\$9,516,000</i>
Engineering (10%)	\$952,000
TOTAL	\$10,468,000

^a All costs are 2006 dollars.

Table 4-12
Phase I Expansion to 24 mgd

4.5 Water Treatment Plant Expansion above 24 mgd (Phases II and III)

In looking at the water demand projections, two more plant expansions will be required between the Phase I expansion and 2043 in order to meet water demand through the master planning period of 2060. The next logical expansion is to 36 mgd plant capacity followed by a third expansion to 50 mgd capacity. In order to do these expansions economically while working within the site constraints of the plant, we recommend that each expansion be performed in one process train increments. That is, the Phase II expansion would be done with one complete treatment train that is sized for 13 mgd ultimate treatment capacity (12 mgd initial for the Phase II expansion). Likewise, the Phase III expansion would be performed using the same size 13-mgd treatment train as in the Phase II expansion.

This two-train concept for plant expansions above 24 mgd is proposed for a number of reasons.

- This approach facilitates the use of large sedimentation and filtration modules than were used for the existing plant and proposed for Phase I. Because larger modules are used for Phases II and III, these expansions can be carried out with fewer treatment trains, resulting capital cost savings, operational cost savings, and less maintenance. The surface loadings and detention times at each of the modules remain will be similar to those of the existing modules.
- The Phase I expansion to 24 mgd requires improvements to the existing chemical facilities but the chemical building cannot serve Phase II or Phase III flows. Hence, a new chemical building is proposed for Phase II.

4.5.1 Water Treatment Plant Expansion to 36 mgd (Phase II)

For expansion of the plant to 36 mgd, the recommendations are described below and illustrated in **Figure 4-4**.

4.5.1.1 Raw Water Storage Tank, Meter Vault and Solids Contact Clarifiers

At 36 mgd, the raw water storage tank will have a detention time of 2.7 hours. Since the tank historically provides minimal detention time, no additional raw water storage is recommended other than some piping modifications.

Although ODEQ design guidelines may permit an increased loading of existing clarifiers, it is not recommended at this time. The plant operates well at the existing contactor upflow rates, which are around 1080 gpd/ft², so this design basis will be used for planning purposes for future flows.

To maintain this surface loading using one larger clarifier, a 130-ft solids contact clarifier will be required. For a flow of 12 mgd, the upflow rate will be 1000 gpd/ft² and for a future rating of 13 mgd, the upflow rate will be 1080 gpd/ft².

4.5.1.2 Recarbonation

For the Phase II expansion, a new recarbonation basin is recommended. The basin size would be similar to the existing recarbonation basin so that no new basins would be required for the Phase III expansion.

4.5.1.3 Filtration Module

The existing filters are rated at 2.7 gpd/ft² with one large filter cell out for backwashing. Because the filters operate well at this loading, and because this loading is below the ODEQ rate for dual media filters, we will assume this filtration rate for planning purposes. For the plant expansion from 24 mgd to 36 mgd, we recommend one filter module with four cells, each measuring 28 feet by 28 feet. We have also assumed that air scour will be used.

4.5.1.4 Ozonation

Installation of a second ozone contact basin, identical to the first, is recommended for the expansion to 36 mgd. Like the recarbonation basins, the basin would be sized so that no new ozone basin is required for the Phase III expansion. With two operating

ozone generators, and one on standby, a firm ozone dose of 2.4 mg/L can be achieved. Hence, we recommend that a third 400 ppd generator be added for the Phase II expansion.

ODEQ guidelines suggest that a 30-day supply of oxygen should be kept on site. The existing tank has a storage capacity of 11,000 gallons liquid oxygen. At 36 mgd and average ozone dose (0.75 mg/L), it is estimated that this amount of oxygen is sufficient for 37 days. Thus, no additional storage is required.

4.5.1.5 Clearwells

At 36 mgd, clearwell capacity amounts to 14% of throughput. Ten percent is considered adequate. Thus, no clearwell expansion is recommended for 36 mgd.

4.5.1.6 High- and Low-Service Pumping

Phase II requires a new and expandable effluent pump building to the south of the existing building. The building will house two high-service pumps and two low-service pumps, all rated for 4.3 mgd, or 3,010 gpm.

The high-service and low-service pumps are rated for discharge heads of 81 feet and 162 feet, respectively. Each low-service pump has a 100-hp motor, and each high-service has a 200-hp motor, resulting in a total installed power of 600 hp. Operating power is roughly 375 hp.

The Phase II pump station is designed to house only the Phase II pumps, and not the Phase III pumps, since the space set aside for the Phase III pumps could sit empty for 20 years or more. It is preferable to make the building expandable, thus facilitating the addition of the Phase III pumps.

4.5.1.7 Chemical Systems

For the plant expansion to 36 mgd, a new chemical building is recommended to house alum, polymer, chlorine and ammonia. Likewise, a new lime storage and feed system is recommended to serve the new solids contact clarifier. With respect to fluoride, the expansion to 36 mgd will most likely require conversion to hydrofluosilicic acid or the system may require relocation to a new small building near the ozone contact basins. For the purpose of our evaluation, we have assumed the latter.

4.5.1.8 Regulatory Compliance

The plant expansion to 36 mgd should not require any additional modifications to meet the promulgated regulations discussed in Section 4.2. There is a possibility that bromate could be further regulated to 5 µg/L. Thus bromide levels should continue to be monitored in the raw water to ensure that bromate formation is not compromised. Should bromate becomes an issue, there are relatively simple bromate reduction techniques that can be evaluated, such as ammonia addition, pH reduction or chloramine addition prior to ozonation.

4.5.1.9 Summary of Phase II Capital Costs

The planning-level opinion of probable construction costs for the Phase II expansion to 36 mgd is summarized in Table 4-13.

Item	Cost
Phase II Plant Expansion to 36 mgd	
New Meter Vault and 130-ft Dia. Solids Contact Clarifier	\$1,950,000
New Recarbonation Basin	\$600,000
New 4-Cell Filter Module	\$2,000,000
New Ozone Contact Basins	\$850,000
New High- and Low-Service Pump Station	\$2,100,000
New Chemical & Fluoride Buildings and Lime Storage/Feed	\$1,850,000
Miscellaneous Yard Piping	\$500,000
Miscellaneous Civil Sitework	\$400,000
Miscellaneous Electrical & Instrumentation	\$1,800,000
<i>Subtotal</i>	<i>\$12,050,000</i>
Contingencies (30%)	\$3,615,000
<i>Subtotal</i>	<i>\$15,665,000</i>
Contractor Mobilization, Bonds & Insurance (7%)	\$1,097,000
Contractor's Overhead & Profit (15%)	\$2,350,000
<i>Subtotal</i>	<i>\$19,112,000</i>
Engineering (10%)	\$1,912,000
TOTAL	\$21,024,000

^a All costs are 2006 dollars.

Table 4-13
Phase II Expansion to 36 mgd

4.5.2 Water Treatment Plant Expansion to 50 mgd (Phase III)

For expansion of the plant to 50 mgd, the recommendations are summarized as follows:

- Install a second 130-ft solids contact unit, to the south of the meter vaults.
- Install a filtration module identical to that installed for Phase II.
- Install new ozone generators.
- Install one high-service pump, and two low-service pumps, all rated for 4.3 mgd.

Additionally, Figure 4-5 provides an illustration of the proposed improvements.

4.5.2.1 Raw Water Storage Tank, Meter Vault, and Solids Contact Clarifiers

At 50 mgd, the raw water storage tank has a detention time of 1.9 hours. Like the Phase II improvements, we will assume that only piping modifications will be required and no additional storage will be provided. Additionally, a new raw water meter vault and 130-ft diameter solids contact clarifier will be provided as in the Phase II improvements.

4.5.2.2 Recarbonation

For the ultimate plant flow of 50 mgd, the basins installed in Phase II will yield a detention time of 14 minutes, which is considered adequate. Thus no additional basinry will be required.

4.5.2.3 Filtration Module

To maintain the same filter loading rates, a new 4-cell filter module will be installed similar to the Phase II filter module.

4.5.2.4 Ozonation

The ozone contact basin installed in the Phase II expansion will also meet the detention time required for the expansion to 50 mgd. Thus, no new basinry will be required. With respect to the feed system, we recommend the existing three 400 ppd ozone generators be replaced with three new 400 ppd ozone generators, since considerable time will have passed between the Phase II and Phase III expansions. No increase in generator capacity is required since a firm dose of 1.7 mg/L can be provided (with one generator out).

For the Phase III expansion, a second 11,000-gallon LOX storage tank is recommended to double the existing storage capacity. At 50 mgd and an average dose of 0.75 mg/L, the storage time is over 50 days.

4.5.2.5 Clearwells

At 50 mgd, clearwell capacity amounts to about 10% of throughput and is considered sufficient. No clearwell expansion is recommended for 50 mgd.

4.5.2.6 High- and Low-Service Pumping

To accommodate 50 mgd, the Phase II building should be expanded, and a wall removed. In total, the new pump house should have four low-service and three high-service pumps, just as the existing pump house has. The similarity between the two pump houses is intended to facilitate the operation, maintenance, and control of the pumping systems. Thus, three new pumps should be installed at the expanded pump station. Each should be rated for 4.3 mgd. One should be for high service, and have a 200-hp motor. Two should be for low service, and have 100-hp.

Total connected power at the new pump house will be 1000 hp after the Phase III expansion. Operating power should be about 650 hp. Total firm capacity of the expanded station pump is 26 mgd, which combines with the existing pump station capacity to yield a total finished water pumping capacity of 50 mgd.

4.5.2.7 Chemical Systems

For the plant expansion to 50 mgd, additional chemical feed pumps and storage tanks will be required in the Phase II Chemical Building, which houses alum, polymer, chlorine and ammonia. An additional lime slaker will be added to the Phase II lime storage and feed system. Likewise, additional fluoride feed equipment will be housed in the Phase II fluoride facility. In addition to these improvements, we also

assume that much of the chemical feed equipment will require replacement as part of this expansion.

4.5.2.8 Regulatory Compliance

For the plant expansion to 50 mgd, it is always possible that future regulations may require additional improvements. Because it is difficult to put an exact cost to these improvements, we have assumed that some of the 30% contingency will cover these potential costs.

4.5.2.9 Summary of Phase III Capital Costs

The planning-level opinion of probable construction costs for the Phase III expansion to 50 mgd is summarized in Table 4-14.

Item	Cost
Phase III Plant Expansion to 50 mgd	
New Meter Vault and 130-ft Dia. Solids Contact Clarifier	\$1,950,000
New 4-Cell Filter Module	\$2,000,000
Existing Clarifier and Filter Improvements	\$1,800,000
New Ozone Generators and Diffusers	\$2,700,000
New High- and Low-Service Pump Station Expansion	\$1,450,000
New Chemical Storage & Feed Equipment	\$1,300,000
Miscellaneous Yard Piping	\$500,000
Miscellaneous Civil Sitework	\$550,000
Miscellaneous Electrical & Instrumentation	\$1,800,000
<i>Subtotal</i>	<i>\$14,050,000</i>
Contingencies (30%)	\$4,215,000
<i>Subtotal</i>	<i>\$18,265,000</i>
Contractor Mobilization, Bonds & Insurance (7%)	\$1,279,000
Contractor's Overhead & Profit (15%)	\$2,740,000
<i>Subtotal</i>	<i>\$22,284,000</i>
Engineering (10%)	\$2,229,000
TOTAL	\$24,513,000

^a All costs are 2006 dollars.

Table 4-14
Phase III Expansion to 50 mgd

4.6 Water Treatment Expansion Using OSU Water Treatment Plant

The OSU's water treatment plant has been inactive since 2001. It is a possibility that this treatment facility may be reactivated to supply potable water to supplement the City's drinking water producing capability if the City can acquire ownership of that facility.

It is anticipated that improvements to the treatment system would be required to enable that facility to produce water that meets current regulations. A detailed evaluation should be conducted at that point in time to determine the degree of modifications to the existing OSU facility required and compare its cost with the expansion cost at the City's WTP.

Reference Copy

Section 5

Financial Planning

5.1 Introduction

The financial plan assesses the financial impact that the recommended capital improvements will have on the Stillwater Utilities Authority's (SUA) future annual revenue requirements.

5.2 Approach

The analysis performed as part of this financial plan projects financial revenue requirements over a 50-year time horizon, through fiscal year (FY) 2055. This section included analysis of FY 2005 actual and budgeted operating expenses and the recommended projects within both the water and wastewater master plans. Based on this data and additional financial assumptions documented in this section, a projection is made for annual cash needs or annual financial revenue requirements: that is the projected amount of annual funds SUA needs to recover through both water and wastewater rates and charges to cover its operating and capital expenses.

In this section, the focus is on an implementation plan that seeks to integrate the master plan recommendations for both capital projects for expansion and replacement and recommendations for ongoing operating-type renewal expenditures. Tables in the appendices to this report project all costs through the 2055 study period.

It should be noted that this section does not include a cost-of-service study. It only projects total revenue needs and calculates an average annual cost per thousand gallons. A full cost-of-service study would look at customer classifications and allocation of costs to customer classifications at both a fixed and volume charge. The financial plan stops short of developing detailed rate schedules for every year of the analysis.

As part of the overall project, a detailed financial model that has the capability of creating the needed financial projections is developed. The focus is on demonstrating the relative impact of the various programs. Therefore no attempt has been made to smooth rate increases or mitigate peak years or overall increases.

In presenting the results a cost per thousand gallons projection is included that serves as a reference line, only. This added cost is intended only to provide some perspective on the relative magnitude of the increases. The revenue requirements for FY 2005 were used as a basis and are projected over the 50-year timeframe by using the escalation factors detailed in the following section.

5.3 Assumptions and Methodology

The primary tool used for this evaluation has been a detailed financial model that projects SUA revenue requirements over a multi-year forecast period, taking account of current capital and operating expenses, as well as current customer profiles.

5.3.1 Data Collection

The analyses presented in this report are based on data obtained directly from the SUA and water and wastewater master planning results. Data sources include:

- FY 2005 Detail Budget Report for SUA.
- FY 2003 and 2004 City of Stillwater Comprehensive Audited Financial Statements.
- FY 2003, 2004, and 2005 Stillwater Utilities Authority Financial Statements.
- Water and Wastewater sections of annual budget documents for FYs 2001 through 2005.
- Debt service schedules for all outstanding water and wastewater debt.
- City of Stillwater, Financial Review, January 2005.
- Customer billing information – summary of water usage and sales for FYs 2000 through 2005, summary of wastewater sales for FYs 2000 through 2005, billed usage and accounts by month for FYs 2000 through 2005, summary of total water purchases for all public purchasers for 1999 through 2004, and water consumption for July 2002 through October, 2005 commercial and residential classes only.
- SUA Ordinance 1835 and Article III from Trust Indenture-SUA.

Also used is a variety of data that has been developed in other SUA tasks. In particular, it includes the following data and information:

- Recommended project schedules developed as part of the Water Resources Master Plan.
- Preliminary Wastewater Capital Improvement Program Project Schedule and incremental operating costs supplied by Carter & Burgess, Inc., dated February 7, 2006.

5.3.2 Assumptions

A variety of assumptions was used in the development of the financial projections. These assumptions are grouped by functional area below:

- Operating Cost – operating costs are based on the FY 2005 actual expenditures. These operating costs are used as our base for projections. All operating costs are assumed to grow at an annual rate of 3 percent.
- Revenue bond debt was assumed to be a 25-year term at 5 percent interest and total issuance amount included a 2.6 percent estimate for issuance cost and 10 percent

for debt service reserve. It was assumed that repayment of debt would begin the fiscal year following the issuance of debt. Capitalized interest was not included.

- Oklahoma Water Resources Board (OWRB) State Revolving Fund (SRF) debt was assumed to be a 20-year term at 3.05 percent interest plus 0.50 percent administrative fee for water and 2.60 percent plus 0.50 percent administrative fee for wastewater. It was assumed that repayment of SRF debt would begin 2 years after the loan was awarded.
- Capital Projects include 10 percent for engineering and 30 percent for contingency.
- Capital Projects were assumed to be estimated in 2005 dollars and all projects were escalated using a 3 percent escalation factor from 2005 to the year in which the project was planned to begin design. It was assumed that most projects would begin with design in the first year and construction for 1 to 3 years depending upon the project.
- Engineering estimates were developed for incremental operating costs associated with the completion of capital projects. These new incremental operating costs were assumed to begin the year after the project was completed. The incremental operating costs were assumed to have been developed in 2005 dollars and were therefore escalated from 2005 to the year the costs were to begin, using the 3 percent escalation factor.
- Consumption – Total water consumption is assumed to grow at 2 percent per year.
- It was assumed that the target desired debt service coverage ratio would be 135 percent and the revenue requirements reflect that level of coverage.
- It was assumed that an operation and maintenance reserve would be created and maintained at 25 percent of the annual operational budget.
- It was assumed that the special sales tax revenue would be allocated between water and wastewater based on the relative amount of annual debt service each year for each of the services.
- It was assumed that total special sales tax revenue transferred to SUA each year would increase by 3 percent.
- It was assumed that the total transfer from the water and wastewater services each year to the general fund would be based on FY 2004 amount and would increase 3 percent annually.
- Investment and Miscellaneous Income – All non-rate revenue, such as service fees, penalties, or investment income is assumed to increase by 3 percent annually.

- Residential Household Consumption – We have assumed that, on average, a residential household uses 5,000 gallons of water per month.

5.3.3 Financial Model

In general, the financial model takes the current budget and recommended capital improvement plan and uses assumptions on future growth, financing, and any relevant changes to project future revenue requirements. The model calculates annual revenue requirements for both water and wastewater services.

5.4 Revenue Requirements

All financial projections are based on current year cash requirements, such that sufficient revenues must be generated in each budgetary year to meet the anticipated cash expenditures in that year. Direct and indirect operating expenses have been obtained from the FY 2005 SUA actual expenditures report and projected by adjusting for cost escalation. Capital costs consist of debt service on outstanding bonds and loans and projections of assumed new debt using both revenue bonds and SRF to fund the recommended capital improvement program. Capital costs also assume that some projects will be funded on a pay-as-you-go basis through system revenues. The summation of operating and capital costs and transfers to reserves yields the gross revenue requirement in each year.

SUA also receives investment and miscellaneous income, which including the special sales tax revenue, is then deducted from the gross revenue requirement.

5.4.1 Current Revenue Requirements

In order to begin building the financial analysis of the recommendations from the water and wastewater master plan, the current operating expenses and debt service schedules are used to set the base case.

Operating Expenses: The expenses for current operations includes such items as wages and salaries and employee benefits, as well as electricity, chemicals, and other utility related expenditures. In addition, there are both direct and indirect expenditures from the general fund. In the following tables we have consolidated the many line items into broader categories for each cost center. **Table 5-1** summarizes water expenditures and **Table 5-2** summarizes wastewater expenditures.

Debt Service: The expenses shown on **Table 5-3** represent the current debt service schedule. The 2005 Revenue Refunding issue refunded water, wastewater, and golf debt, so the debt service was allocated to both water and wastewater on the schedule, based on the debt taken out. The outstanding debt is a combination of bond debt and loans through the Oklahoma Water Resources Board. The last of this debt will be paid off in fiscal year 2025. It should also be noted that the 2005 loan borrowings show no debt service for fiscal year 2005, that debt does begin in fiscal year 2006 so there is over a million dollar increase in debt service in fiscal year 2006 from previous years

Expenditures		FY 2005
Water-Administration		
Personnel Costs	\$	213,035
Services and Other		153,100
Contracts		247,670
Direct and Indirect Costs		194,703
Subtotal Water-Administration		808,508
Water System Treatment Costs		
Personnel Costs		447,454
Chemicals, Materials and Other		411,270
Utilities		258,000
Repair and Maintenance		46,900
Subtotal Water System Treatment Costs		1,163,624
Water Line Management		
Personnel Costs		517,878
Materials and Other		494,627
Repair and Maintenance		10,450
Subtotal Water Line Management		1,022,955
Total Water less Equipment	\$	2,995,087

Table 5-1
Historical Water Operation and Maintenance Expenses

Expenditures		FY 2005
Wastewater Administration		
Personnel Costs	\$	207,901
Materials and Other		22,300
Other Contracts		164,824
Direct and Indirect Costs		119,383
Subtotal Wastewater Administration		514,408
Wastewater System Treatment Costs		
Personnel Costs		336,348
Materials and Other		259,431
Repair and Maintenance		15,300
Subtotal Wastewater System Treatment Costs		611,079
Wastewater System Collection Costs		
Personnel Costs		305,211
Materials and Other		85,250
Repair and Maintenance		64,050
Subtotal Wastewater System Collection Costs		454,511
Wastewater Pretreatment		
Personnel Costs		100,734
Services and Other		47,550
Maintenance		35,000
Subtotal Wastewater Pretreatment		183,284
Total Wastewater	\$	1,763,282

Table 5-2
Historical Wastewater Operation and Maintenance Expenses

Issue Name	2006	2007	2008	2010	2011	2012	2013	2014	15	
Water System										
2002 DWSRF	\$ 184,736	\$ 183,871	\$ 183,039	\$ 182,140	\$ 181,275	\$ 180,410	\$ 179,568	\$ 178,679	\$177,814	\$176,949
2002 Revenue Bonds	1,848,090	2,038,318	2,044,280	2,042,471	863,600					
2005 Revenue Refunding	<u>415,184</u>	<u>455,800</u>	<u>464,639</u>	<u>479,907</u>	<u>892,942</u>	<u>1,191,408</u>	<u>1,193,011</u>	<u>578,739</u>	<u>0</u>	<u>0</u>
Subtotal	2,448,010	2,677,989	2,691,958	2,704,518	1,937,817	1,371,818	1,372,579	757,418	177,814	176,949
Wastewater System										
2002 CWSRF	265,126	263,890	262,705	261,419	260,183	258,947	257,749	256,475	255,239	254,003
2005 CWSRF	446,677	516,230	516,230	516,230	516,230	516,230	516,230	516,230	516,230	516,230
2005 Revenue Refunding	<u>602,839</u>	<u>661,813</u>	<u>674,646</u>	<u>696,816</u>	<u>1,296,535</u>	<u>1,729,902</u>	<u>1,732,230</u>	<u>840,318</u>	<u>0</u>	<u>0</u>
Subtotal	1,314,641	1,441,933	1,453,581	1,474,465	2,072,948	2,505,079	2,506,209	1,613,023	771,469	770,233
Total Water and Sewer	\$3,762,651	\$4,119,922	\$4,145,539	\$4,178,984	\$4,010,764	\$3,876,898	\$3,878,788	\$2,370,440	\$949,283	\$947,182

Table 5-3
Existing Debt Service

Issue Name	2016	2017	2018	2020	2021	2022	2023	2024	2025
Water System									
2002 DWSRF	\$176,098	\$175,218	\$174,353	\$173,488	\$172,627	\$171,757	\$ 85,555		
2002 Revenue Bonds									
2005 Revenue Refunding	<u>0</u>	<u>0</u>	<u>0</u>	<u>0</u>	<u>0</u>	<u>0</u>	<u>0</u>	<u>0</u>	<u>0</u>
Subtotal	176,098	175,218	174,353	173,488	172,627	171,757	85,555	0	0
Wastewater System									
2002 CWSRF	252,791	251,532	250,296	249,060	247,834	246,588	245,352	122,214	
2005 CWSRF	516,230	516,230	516,230	516,230	516,230	516,230	516,230	516,230	516,230
2005 Revenue Refunding	<u>0</u>	<u>0</u>	<u>0</u>	<u>0</u>	<u>0</u>	<u>0</u>	<u>0</u>	<u>0</u>	<u>0</u>
Subtotal	769,021	767,762	766,526	765,290	764,064	762,818	761,582	638,444	516,230
Total Water and Sewer	\$945,119	\$942,980	\$940,879	\$938,778	\$936,691	\$934,575	\$847,137	\$638,444	\$516,230

Table 5-3
Existing Debt Service (Continued)

due to debt already issued. That increase in debt service will account for part of the revenue requirement increase covered later in this section but is not related to the new capital improvement program.

This completes the base information of current requirements except for revenues and transfers to the General Fund.

Other Revenues: These revenues consist of miscellaneous customer charges for connecting to the system, interest income, and special sales tax revenue, etc. These are all sources of revenue, which are not a direct result of monthly water or sewer service user rates. Since revenues are presented for SUA in the financial statements, as combined for the four services – water, wastewater, solid waste, and electric, an allocation method was developed to separate certain revenues like interest income between the four services. Historically all the special sales tax revenue has been credited to water in the City of Stillwater Financial Review report.

Since the enabling ordinance did not stipulate that water only benefit from this revenue source, in lieu of a written policy on which to base the distribution of these funds to any particular service and in light of the substantial wastewater capital improvement needs recommended for SUA, it was determined that it would be more equitable to share this revenue source between water and wastewater. It is also recommended that this revenue source be used to fund either capital projects or debt service resulting from funding capital projects. For the purposes of our projections allocation of this revenue source is made between water and wastewater each year based on the proportion of water and wastewater debt service each year. Thus, it equitably distributes this revenue source to partially offset the amount of total projected debt service for each year. On **Table 5-4** where the miscellaneous non-user fee revenue is presented, the special sales tax funds are all allocated to water, but in future projections these funds are allocated between water and wastewater services.

Types of Revenue		Fiscal Year
		2005
Water System Miscellaneous Revenues		
Meter Testing	\$	200
Per Acre Water Line Fee		30,000
Water Meters & Fittings		55,000
Water Tie In Fees		6,000
Water Tower Rental		25,800
Interest Income		140,000
Sales Tax		5,379,498
Total		\$ 5,636,498
Wastewater System Miscellaneous Revenues		
Utility Tie On Fees	\$	3,000
Water Closet Fee		65,000
Interest Income		36,000
Sales Tax		
Total		\$ 104,000

Table 5-4
Miscellaneous Non-User Fee Revenue

5.4.2 Projected Revenue Requirements

Projected new revenue requirements are made up primarily of funding for capital projects and new or incremental operating costs.

5.4.2.1 Capital Improvement Requirements

A key element of this financial analysis is the recommended capital improvement projects presented in other sections of this master plan and in the wastewater master plan presented in a separate document, to meet the needs of the service area. The complete capital project schedule is presented in **Appendix A-2** to this report. For illustration purposes the capital projects for water and wastewater for fiscal years 2006 through 2015 are included in **Tables 5-5 and 5-6**.

The methodology was to assume the funding source or sources for each project. Some projects are shown as being funded through pay-as-you-go or partially funded through that method with the balance of the funding being through a combination of SRF and revenue bonds. There is no guarantee that SRF funding will be available in any one year, but we have balanced the proportion of funding so the rate need would not be wholly dependent upon SRF funding.

Although SRF funding is very advantageous in the long run, in terms of total interest expense for borrowing, in the short term, when compared to revenue bond debt financed over 25 years, there is not a significant difference in annual expense. By using a combination of both bonds and SRF, the average expense over the long term should not be significantly different than that projected in the debt service tables.

Table 5-5 illustrates the capital projects for water through 2015 and a projected method of funding each project through the funding sources as discussed.

PROJECT	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015
Raw Water Back Up										
OWRB-SRF	1,937,000	15,300,000			35,091,000					
Long Term Borrow	0			6,380,000	28,711,000					
Total	1,937,000	15,300,000	0	6,380,000	63,802,000	0	0	0	0	0
Water Intake										
Long Term Borrow					1,514,000					
Total	0	0	0	0	1,514,000	0	0	0	0	0
Water Distribution System										
Pay as Go		1,482,070		1,578,700	1,020,490		1,500,000	1,345,500		1,042,910
OWRB-SRF			6,527,200			3,571,715				
Long Term Borrow	877,220	7,894,980	5,232,730			2,767,195				
Total	877,220	9,377,050	11,759,930	1,578,700	1,020,490	6,338,910	1,500,000	1,345,500	0	1,042,910
WTP Expan. to 24 mgd										
Long Term Borrow	0		1,155,000	10,395,000						
Total	0	0	1,155,000	10,395,000	0	0	0	0	0	0
Total Water System										
Pay as Go	0	1,482,070	0	1,578,700	1,020,490	0	1,500,000	1,345,500	0	1,042,910
SRF	1,937,000	15,300,000	6,527,200	0	35,091,000	3,571,715	0	0	0	0
Long Term Borrow	877,220	7,894,980	6,387,730	16,775,000	30,225,000	2,767,195	0	0	0	0
Total	\$2,814,220	\$24,677,050	\$12,914,930	\$18,353,700	\$66,336,490	\$6,338,910	\$1,500,000	\$1,345,500	\$ -	\$1,042,910

Table 5-5
Recommended Water Capital Projects Through 2015

PROJECT	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015
New WW Mains										
Long Term Borrow	282,113	287,756	293,511	299,381	305,368	311,476	317,705	324,059	330,541	337,151
Total	282,113	287,756	293,511	299,381	305,368	311,476	317,705	324,059	330,541	337,151
New Interceptors										
OWRB		4,165,000								4,165,000
Long Term Borrow	1,190,000	6,545,000	0	0	0	0	0	0	1,190,000	6,545,000
Total	1,190,000	10,710,000	0	0	0	0	0	0	1,190,000	10,710,000
Tertiary Filters										
OWRB					4,900,000					
Long Term Borrow	0			1,400,000	7,700,000	0	0	0	0	0
Total	0	0	0	1,400,000	12,600,000	0	0	0	0	0
Sewer Rehabilitation										
Long Term Borrow	1,632,898	1,665,556	1,698,867	1,732,845	1,767,502	1,802,852	1,838,909	1,875,687	1,913,201	1,951,465
Total	1,632,898	1,665,556	1,698,867	1,732,845	1,767,502	1,802,852	1,838,909	1,875,687	1,913,201	1,951,465
Lift Station Rehabilitation										
Pay as Go	455,000	455,000	455,000	455,000	455,000	455,000	455,000	455,000	455,000	455,000
Total	455,000	455,000	455,000	455,000	455,000	455,000	455,000	455,000	455,000	455,000
Total Wastewater System										
Pay as Go	455,000	455,000	455,000	455,000	455,000	455,000	455,000	455,000	455,000	455,000
OWRB	0	4,165,000	0	0	4,900,000	0	0	0	0	4,165,000
Long Term Borrow	3,105,011	8,498,312	1,992,378	3,432,226	9,772,870	2,114,328	2,156,614	2,199,746	3,433,742	8,833,616
Total	3,560,011	13,118,312	2,447,378	3,887,226	15,127,870	2,569,328	2,611,614	2,654,746	3,888,742	13,453,616

Table 5-6
Recommended Wastewater Capital Projects Through 2015

Table 5-6 shows the wastewater projects. It should be noted that the cost estimates for the wastewater projects are based on estimates received from the City's other consultant in February, 2006 and may not be the final numbers presented in that master plan report. In addition, we have added an estimate for engineering and contingency to the wastewater project amounts received.

For most projects an amount intended for engineering design and permitting was pulled out of the project costs estimated for each project into the preceding year to that year the project was planned to begin construction. Also, although a project might take more than one year to construct, all the construction costs were shown in the year that construction was to begin, since the funds would generally be borrowed in one lump sum amount shortly before projects were bid. Some projects were shown in multiple years like water lines, because they could be broken down into smaller segments and spread over more than one year. Also, some projects like the water distribution system represent a series of multiple projects to be done over the 50-year planning period as the system grows. Only one water treatment plant expansion is shown on **Table 5-5**, but the full 50-year table in **Appendix A-1** includes three expansions over the 50-year period.

For the wastewater projects the same methodology was used. In addition, some projects on the recommended wastewater schedule don't begin until after 2015, so those will only appear on the table in **Appendix A-2**. Some projects that appeared on the wastewater improvement table were determined not to be appropriate for capitalization due to the nature of the project and are included in the new operating costs category presented later in this section.

As noted in the assumption list earlier in this section, an inflation factor was added to each project beginning fiscal year 2006 to represent the increased cost of construction during the study period. That inflation is not included in **Tables 5-5 and 5-6** and **Appendices A-1 and A-2**, as the intent is to present the project costs in a manner which would allow them to be matched to costs listed in other sections of the master plan report.

A summary of project costs by year and type of funding source by year was created to develop the estimated total project cost that would need to be provided by either pay-as-you-go or borrowing in each year. That summary is presented in **Appendix A-3** and does include the inflated cost for each project. Debt service was projected for the 50-year study period for all projects summarized in **Appendix A-3**.

It was assumed that for revenue bond funding bonds would be issued no more frequently than every two years due to the expense of issuance costs. **Appendix A-4** shows a summary of the accumulated project cost to be funded in various years and, on a separate line, the amount including issuance costs and debt service reserve amounts. It also shows the total new projected annual debt service for those issues for

both water and wastewater. For the revenue bonds issues, total amount to be issued was calculated by factoring in issuance costs and a debt service reserve using the factors summarized in the assumptions section earlier. Debt service was carried through the 25-year estimated debt service period for each revenue bond issue.

SRF debt was issued at the project amount, since the administrative cost is included in the interest rate as discussed earlier. Debt service was calculated for the 20-year period for each issue, based on interest rates as quoted in the assumptions section earlier. **Appendix A-4** summarizes debt issues for each year and total annual debt service for new debt for both revenue bonds and SRF.

For simplicity it was assumed all borrowing would be through revenue bonds or SRF. The SUA financial advisor may recommend interim short term financing for some projects that will be taken out at the appropriate time for timing of the bond market and other factors. There were no calculations made for short-term financing, as it would eventually be rolled into long-term financing, but those measures could produce lower total annual new debt service in some years.

Assumptions were made for each project as to what the funding makeup would be in terms of pay-as-you-go, revenue bonds and SRF loans. The general philosophy was to create a balance of the funding types taking into consideration the types of project. For example, to the extent possible, renewal and replacement or rehabilitation type projects were funded through pay-as-you-go. Due to the total amount of these projects and the timing, they could not all be funded in that manner. The need for a renewal and replacement reserve will be discussed later in this section.

There are many alternative financing combinations that may be considered by SUA for projects as the suggested construction dates draw near, and the existing SUA financial situation at that time will be taken into consideration. These projections and assumptions were made to facilitate analysis of the impact of new projects on the water and wastewater financial picture and customer rates.

It was stated in the section earlier that special sales tax revenue is allocated in future years between water and wastewater based on total debt service in each year. The table labeled **Appendix A-5** summarizes both existing and projected annual debt service and calculated the percentage each year that was used to perform that special sales tax revenue allocation.

5.4.2.2 Projections of New Operating and Maintenance Costs

Costs were developed along with the projected capital costs for operating new facilities or increases in operating costs for facilities which were being expanded. **Table 5-7** summarizes the new and incremental operating costs using descriptions that match the capital improvement plan. It was assumed that the increased or new costs would begin the year after construction was estimated to be completed. That planned year on the table is indicated by the start year. In addition, since those costs

Description	2005 Dollars	Start Year	Inflated to Start Year
Administration	\$ 191,492	2011	\$ 229,000
Water System Treatment			
First Expansion	677,376	2011	809,000
Second Expansion	466,000	2022	770,000
Third Expansion	1,711,000	2043	5,261,000
Water Line Management			
Raw Water Backup	116,000	2009	131,000
Water Intake	480,000	2013	608,000
Water Dist Impr	45,200	2009	51,000
Water Dist Impr	149,500	2010	173,000
Water Dist Impr	125,300	2015	168,000
Water Dist Impr	118,800	2020	185,000
Wastewater System Treatment Costs			
Tertiary Filters	500,000	2011	597,000
Phosphorus Removal	250,000	2019	378,000
Expansion One	750,000	2029	1,525,000
Expansion Two	750,000	2052	3,009,000
Wastewater System Collection Costs			
New Interceptors	107,100	2008	117,000
New Interceptors	107,100	2016	148,000
New Interceptors	34,020	2026	63,000
New Interceptors	40,320	2031	87,000
New Interceptors	31,500	2046	106,000

Table 5-7
Summary of New or Incremental Operating Costs

generated were in today's dollars the cost was inflated in each case to the year it was to begin. Thus the Inflated to Start Year column indicates the first year cost for that improvement in future year costs and, thereafter, that first year cost along with existing operating costs has been inflated annually.

As the recommended capital improvement plan shows several different interceptor projects over the years, they are shown separately by the year in which the incremental costs would begin.

In addition to these costs, costs were developed for annual renewal and replacement operating costs for the wastewater facilities. These costs were included in the capital improvement tables developed by Carter & Burgess but were deemed to be operating and not capital costs. Some of the costs, such as the replace diffusers costs and I&C upgrades costs for the treatment facility, do not appear each year as they were not required annually. The other costs listed are associated with the collection and transmission system. These wastewater renewal and replacement operating costs are summarized in **Appendix A-6** for the 50-year study period.

5.4.2.3 Transfers to the General Fund

Historically, the SUA has made transfers to the general fund from all four of the services: water, wastewater, sanitation waste and electric. These transfers were studied to determine if there was a pattern that could be useful in projecting these transfers into the future years of the study period, since they are part of the revenue requirement. **Table 5-8** summarizes the revenues credited to each service under Sources. In some years, these sources include bond or loan proceeds which accounts for the sudden peaks in revenue. The numbers shown are directly from the City of Stillwater Financial Review, January 2005. The Transfer In labeled as "water" represents the special sales tax transfer in.

Under outflow expenses, capital expenditures are included which were often funded by bond or loan proceeds so there are spikes in expenses in some years. The "Transfers Out" in that section is the transfers out to the General Fund. The majority of those funds came from electric and water each year with much smaller amounts from the wastewater and sanitation services. Since neither the percentage of transfer out to total source nor the percentage of transfer out compared to revenues appeared to remain consistent or grow consistently during the period 1998 to 2004, the transfers out to the general fund in our projections were made based on a logical philosophy.

The intention was to keep the proportion of total funds coming from water and wastewater fairly consistent while slowly increasing the contribution from wastewater. Although revenues from wastewater were less than revenues from water, over the past years the wastewater operating revenue has grown, so the difference in proportion is not very great. In FY 2005 (not shown on the table), for example, operating revenue from water was \$4.7 million and from wastewater \$3.8 million. Therefore, over the study period

Description	1998	1999	2000	2001	2002	2003	2004
Sources							
Revenues							
Electric	\$25,642,859	\$26,887,845	\$27,286,988	\$32,250,599	\$29,273,506	\$29,127,266	\$30,276,495
Water	4,613,779	4,572,422	6,185,702	9,941,994	6,032,421	4,733,538	5,120,746
Wastewater	1,531,134	1,720,667	2,239,479	3,576,825	10,635,690	11,964,353	8,082,176
Sanitation	2,036,449	1,968,063	2,024,673	2,229,171	2,684,869	2,957,271	3,013,897
Subtotal	33,824,221	35,148,997	37,736,842	47,998,589	48,626,486	48,782,428	46,493,314
Transfers In							
Water	4,668,652	4,878,912	5,135,350	6,010,149	5,434,210	5,397,908	6,084,853
Total--Sources	38,492,873	40,027,909	42,872,192	54,008,738	54,060,696	54,180,336	52,578,167
Outflows							
Expenses							
Electric	20,625,260	23,027,697	23,439,462	27,031,965	25,760,796	25,461,636	27,412,101
Water	5,613,788	6,329,840	7,579,974	12,673,658	8,102,981	5,515,329	6,231,302
Wastewater	1,781,705	1,746,789	2,520,369	2,760,793	8,713,134	10,178,930	7,666,714
Sanitation	1,963,871	2,029,152	2,130,555	2,367,767	2,448,174	2,849,318	2,851,396
Subtotal	29,984,624	33,133,478	35,670,360	44,834,183	45,025,085	44,005,213	44,161,513
Transfers Out							
Electric	2,285,707	2,031,721	3,238,203	5,206,363	5,461,870	5,471,068	3,388,113
Water	3,213,820	3,317,350	4,234,231	5,515,974	5,229,568	6,505,829	5,114,956
Wastewater	326,530	290,246	462,600	743,766	780,267	781,581	484,016
Sanitation	204,081	181,404	289,125	464,854	487,667	488,488	302,510
Subtotal	6,030,138	5,820,721	8,224,159	11,930,957	11,959,372	13,246,966	9,289,595
Total--Outflows	\$36,014,762	\$38,954,199	\$43,894,519	\$56,765,140	\$56,984,457	\$57,252,179	\$53,451,108
Excess of Revenues over Expenses	\$ 2,478,111	\$ 1,073,710	\$ (1,022,327)	\$ (2,756,402)	\$ (2,923,761)	\$ (3,071,843)	\$ (872,941)
Transfer Out as % of Total Sources	15.67%	14.54%	19.18%	22.09%	22.12%	24.45%	17.67%
Transfer Out as % of Revenues	17.83%	16.56%	21.79%	24.86%	24.59%	27.16%	19.98%

Table 5-8
Historical Pattern of Transfers out to General Fund from Water and Wastewater

the amount of the general fund transfer coming from the wastewater service was gradually increased and the burden on the water service reduced in the meantime. In addition, it is assumed that the total transfer to the General Fund would increase by 3 percent each year, the same factor that was used for operating expense growth.

Appendix A-7 summarizes the projected transfer out from water and wastewater over the 50-year study period. The transfer out line is in bold on the table to make it easier to discern.

5.4.3 Rate Revenue Requirements

Now that all the revenue requirement components have been identified, the rate revenue requirement for each of the services can be identified. **Table 5-9** summarizes the total revenue requirements for water through FY 2012, and **Table 5-10** summarizes the total revenue requirements for wastewater through 2012. The complete rate revenue requirement summary for water and wastewater for the 50-year study period is presented in **Appendices A-8 and A-9**.

The summary table identified projected operation and maintenance and debt service both for the existing system and for the projected recommended capital plan projects and other renewal and replacement needs as discussed earlier in this section. A calculation is also made to determine the amount of funds needed to make a debt service coverage test of 135 percent. Thus, the amount shown on the table is the additional funds necessary to make the test which were not available through other sources such as pay-as-you-go projects.

It was also recommended that the water and sewer utility maintain a certain operation and maintenance reserve above budgeted cash needs. The O&M Reserve Fund line on these tables represents the calculation to build a reserve equal to 25 percent of the total operation and maintenance costs. Some communities also call this a cash flow reserve. This line will show a greater increase during years in which there is a larger increase in operating costs from previous years as happens in FY 2011.

These tables show total expenses and non-user revenue sources, such as the projected special sales tax and miscellaneous revenue. After these revenues are netted from the total expenses line, the rate revenue requirement is shown on the last line. This rate revenue requirement is the amount of funds that must be raised through user rates each year. As can be seen on **Tables 5-9 and 5-10**, the total water revenue need doubles between 2006 and 2009 and the total wastewater revenue need doubles between 2006 and 2012. When reviewing the 50-year revenue requirement it should be remembered that all costs are increased annually for inflation which accounts for part of the increases from year to year.

Description	2006	2007	2008	2009	2010	2011	2012
Operations & Maintenance							
Existing	\$ 2,929,014	\$ 3,016,060	\$ 3,105,716	\$ 3,198,063	\$ 3,293,180	\$ 3,391,150	\$ 3,492,059
New Project	-	-	-	182,000	360,460	1,409,274	1,451,552
Total--O&M	2,929,014	3,016,060	3,105,716	3,380,063	3,653,640	4,800,424	4,943,611
Capital Expenses	30,900	31,827	32,782	33,765	34,778	35,822	36,896
Debt Service Existing	2,448,010	2,677,989	2,691,958	2,704,518	1,937,817	1,371,818	1,372,579
New	-	1,302,051	1,443,057	2,590,331	7,676,663	7,676,663	10,551,916
Pay-as-you-go Existing	-	-	-	-	-	-	-
New	-	1,572,000	-	1,777,000	1,183,000	-	1,845,000
Total--Capital	2,478,910	5,583,867	4,167,797	7,105,615	10,832,258	9,084,303	13,806,392
Reserve Fund Deposits							
O&M Reserve Fund	-	21,761	22,414	68,587	68,394	286,696	35,797
Debt Service Coverage	856,803	-	1,375,489	-	-	2,252,943	-
Total--Reserve Deposits	856,803	21,761	1,397,903	68,587	68,394	2,539,639	35,797
Transfers Out to General Fund	4,500,000	4,800,000	5,000,000	5,200,000	5,300,000	5,500,000	5,600,000
Total Expenses	10,764,727	13,421,688	13,671,416	15,754,264	19,854,291	21,924,365	24,385,800
Sales Tax Revenue	4,986,795	3,538,408	3,585,777	3,935,537	4,365,419	4,239,445	4,432,790
Misc. Revenues	264,710	272,651	280,831	289,256	297,933	306,871	316,078
Rate Revenue Requirement	\$ 5,513,223	\$ 9,610,629	\$ 9,804,808	\$ 11,529,472	\$ 15,190,939	\$ 17,378,049	\$ 19,636,933

Table 5-9
Projected Water Revenue Requirement FY 2006-2012

Description	2006	2007	2008	2009	2010	2011	2012
Operations & Maintenance							
Existing	\$ 1,815,919	\$ 1,870,134	\$ 1,925,976	\$ 1,983,494	\$ 2,042,736	\$ 2,103,757	\$ 2,166,607
New Project	<u>665,000</u>	<u>684,000</u>	<u>822,000</u>	<u>1,234,510</u>	<u>1,271,125</u>	<u>1,906,849</u>	<u>2,270,595</u>
Total--O&M	2,480,919	2,554,134	2,747,976	3,218,004	3,313,862	4,010,606	4,437,202
Capital Expenses	234,634	241,673	248,923	256,391	264,083	272,005	280,165
Debt Service Existing	1,314,641	1,441,933	1,453,581	1,474,465	2,072,948	2,505,079	2,506,209
New	-	1,152,387	1,152,387	1,452,166	2,668,695	2,668,695	3,468,577
Pay-as-you-go Existing							
New	<u>469,000</u>	<u>483,000</u>	<u>497,000</u>	<u>512,000</u>	<u>527,000</u>	<u>543,000</u>	<u>560,000</u>
Total--Capital	2,018,275	3,318,993	3,351,892	3,695,023	5,532,725	5,988,780	6,814,952
Reserve Fund Deposits							
O&M Reserve Fund	179,409	18,304	48,461	117,507	23,965	174,186	106,649
Debt Service Coverage	<u>-</u>	<u>406,708</u>	<u>366,629</u>	<u>-</u>	<u>1,108,610</u>	<u>1,093,635</u>	<u>1,424,526</u>
Total--Reserve Deposits	179,409	425,012	415,089	117,507	1,132,575	1,267,821	1,531,175
Transfers Out to General Fund	1,400,000	1,400,000	1,400,000	1,350,000	1,400,000	1,400,000	1,500,000
Total Expenses	6,078,603	7,698,139	7,914,957	8,380,533	11,379,162	12,667,207	14,283,329
Sales Tax Revenue	554,088	2,168,702	2,292,546	2,119,135	1,870,894	2,183,957	2,183,314
Misc. Revenues	<u>107,120</u>	<u>110,334</u>	<u>113,644</u>	<u>117,053</u>	<u>120,565</u>	<u>124,181</u>	<u>127,907</u>
Rate Revenue Requirement	\$ 5,417,395	\$ 5,419,104	\$ 5,508,768	\$ 6,144,345	\$ 9,387,704	\$ 10,359,069	\$ 11,972,108

Table 5-10
Projected Wastewater Revenue Requirement FY 2006-2012

5.4.4 User Rate Impact

The financial impact that a capital improvement plan has on the annual funding needs of a utility as well as the individual rate-payer in the area is always a concern in an analysis of this type. Since the determination of precise user demand characteristics and cost allocation factors for different customer classes were beyond the scope of this assignment, this analysis cannot yield precise rate schedules. However, for the purposes of this financial plan, projection of an estimated cost per thousand gallons can provide a useful tool in assessing the impact of the capital improvement plan, not only on SUA as a whole, but also on the average customer in its service area.

5.4.4.1 Estimated Annual Volume Sales

Water - In order to develop a cost per thousand gallons, an estimate of annual sales was calculated. Annual water sales for FY 2004 was obtained from billing records and the 2.2 billion gallons was grown at annual rate of 2 percent to perform the cost per thousand gallon calculation for the 50-year study period.

Wastewater - The wastewater annual billed amount was not available through the billing system, so that number was calculated by using the annual wastewater sales, subtracting the revenue from the university contract and the estimated annual revenue from the base charge of the wastewater user fee, and dividing by the current user rate per thousand gallons. Using this approach the estimated annual wastewater volume is 1.2 billion gallons. This was then used to project wastewater volume for future years.

5.4.4.2 Average Residential Household Bills

Table 5-11 shows user rate impact for the study period. In addition to the cost per thousand gallon calculation, the annual cost per average residential household is also calculated using the cost per thousand gallon calculation. This is not a projection of actual user rates as stated earlier but is used for comparison purposes only. When the projected cost are analyzed in a rate study there would be a base charge so the actual cost per thousand gallons of water would be lower and the impact on the average residential customer might be less.

Rate changes are roughly equivalent to changes in the annual water and wastewater revenue requirements, once anticipated growth in consumption is factored in. The table also provides a comparison of average household bills calculated on this table to the median household income for Stillwater. Median Household Income (MHI) has been projected by using the 2000 Census figure and then inflating it to FY2006. MHI was equal to \$25,432 in the 2000 census and is assumed to increase at an average annual rate of 3 percent to 2006 and beyond.

Description	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015
Rate (\$/1000 gallons)										
Water	\$ 2.46	\$ 4.21	\$ 4.21	\$ 4.85	\$ 6.27	\$ 7.03	\$ 7.79	\$ 7.86	\$ 6.79	\$ 7.20
Sewer	<u>4.45</u>	<u>4.37</u>	<u>4.35</u>	<u>4.76</u>	<u>7.13</u>	<u>7.71</u>	<u>8.74</u>	<u>7.48</u>	<u>7.34</u>	<u>7.74</u>
Combined	6.92	8.57	8.56	9.61	13.40	14.74	16.53	15.34	14.13	14.94
Average Annual Residential Household Bill (based on 5,000 gallons per month)										
Water	\$ 147.69	\$ 252.41	\$ 252.46	\$ 291.05	\$ 375.96	\$ 421.65	\$ 467.12	\$ 471.50	\$ 407.31	\$ 431.84
Sewer	<u>267.24</u>	<u>262.08</u>	<u>261.19</u>	<u>285.62</u>	<u>427.83</u>	<u>462.84</u>	<u>524.42</u>	<u>448.96</u>	<u>440.68</u>	<u>464.53</u>
Combined	414.93	514.49	513.65	576.66	803.78	884.49	991.54	920.46	847.98	896.37
Affordability--Household Bill as % of Median Household Income										
Water	0.36%	0.60%	0.58%	0.65%	0.82%	0.89%	0.96%	0.94%	0.79%	0.81%
Sewer	<u>0.65%</u>	<u>0.62%</u>	<u>0.60%</u>	<u>0.64%</u>	<u>0.93%</u>	<u>0.98%</u>	<u>1.08%</u>	<u>0.89%</u>	<u>0.85%</u>	<u>0.87%</u>
Combined	1.02%	1.22%	1.19%	1.29%	1.75%	1.87%	2.03%	1.83%	1.64%	1.68%

Table 5-11
Projected User Rate Impact

Description	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025
Rate (\$/1000 gallons)										
Water	\$ 6.75	\$ 6.83	\$ 7.98	\$ 7.74	\$ 7.81	\$ 7.91	\$ 8.54	\$ 8.36	\$ 8.30	\$ 8.11
Sewer	<u>8.43</u>	<u>8.67</u>	<u>9.34</u>	<u>9.82</u>	<u>9.93</u>	<u>10.28</u>	<u>10.63</u>	<u>10.57</u>	<u>10.87</u>	<u>11.80</u>
Combined	15.18	15.50	17.32	17.57	17.74	18.19	19.17	18.93	19.18	19.91
Average Annual Residential Household Bill (based on 5,000 gallons per month)										
Water	\$ 404.79	\$ 409.76	\$ 478.95	\$ 464.62	\$ 468.44	\$ 474.39	\$ 512.43	\$ 501.67	\$ 498.22	\$ 486.57
Sewer	<u>505.84</u>	<u>519.95</u>	<u>560.44</u>	<u>589.45</u>	<u>596.00</u>	<u>616.72</u>	<u>637.81</u>	<u>634.09</u>	<u>652.48</u>	<u>707.84</u>
Combined	910.63	929.71	1,039.38	1,054.07	1,064.44	1,091.10	1,150.25	1,135.76	1,150.70	1,194.41
Affordability--Household Bill as % of Median Household Income										
Water	0.74%	0.73%	0.82%	0.78%	0.76%	0.75%	0.78%	0.74%	0.72%	0.68%
Sewer	<u>0.92%</u>	<u>0.92%</u>	<u>0.96%</u>	<u>0.98%</u>	<u>0.97%</u>	<u>0.97%</u>	<u>0.97%</u>	<u>0.94%</u>	<u>0.94%</u>	<u>0.99%</u>
Combined	1.66%	1.65%	1.79%	1.76%	1.72%	1.72%	1.76%	1.68%	1.66%	1.67%

Table 5-11
Projected User Rate Impact (Continued)

Description	2026	2027	2028	2029	2030	2031	2032	2033	2034	2035
Rate (\$/1000 gallons)										
Water	\$ 8.05	\$ 8.69	\$ 8.60	\$ 8.35	\$ 7.90	\$ 7.69	\$ 7.36	\$ 7.32	\$ 7.32	\$ 6.32
Sewer	<u>10.82</u>	<u>12.88</u>	<u>12.98</u>	<u>13.62</u>	<u>14.76</u>	<u>14.60</u>	<u>14.03</u>	<u>13.82</u>	<u>13.67</u>	<u>12.89</u>
Combined	18.87	21.57	21.58	21.97	22.66	22.29	21.40	21.14	21.00	19.21
Average Annual Residential Household Bill (based on 5,000 gallons per month)										
Water	\$ 483.08	\$ 521.62	\$ 516.13	\$ 501.09	\$ 473.87	\$ 461.54	\$ 441.88	\$ 439.15	\$ 439.41	\$ 379.29
Sewer	<u>649.06</u>	<u>772.77</u>	<u>778.86</u>	<u>816.99</u>	<u>885.83</u>	<u>875.90</u>	<u>842.00</u>	<u>829.28</u>	<u>820.42</u>	<u>773.29</u>
Combined	1,132.15	1,294.39	1,295.00	1,318.08	1,359.70	1,337.44	1,283.87	1,268.43	1,259.82	1,152.58
Affordability--Household Bill as % of Median Household Income										
Water	0.66%	0.69%	0.66%	0.62%	0.57%	0.54%	0.50%	0.48%	0.47%	0.39%
Sewer	<u>0.88%</u>	<u>1.02%</u>	<u>1.00%</u>	<u>1.01%</u>	<u>1.07%</u>	<u>1.03%</u>	<u>0.96%</u>	<u>0.91%</u>	<u>0.88%</u>	<u>0.80%</u>
Combined	1.54%	1.70%	1.66%	1.64%	1.64%	1.57%	1.46%	1.40%	1.35%	1.20%

Table 5-11
Projected User Rate Impact (Continued)

Description	2036	2037	2038	2039	2040	2041	2042	2043	2044	2045
Rate (\$/1000 gallons)										
Water	\$ 5.84	\$ 6.17	\$ 6.20	\$ 6.20	\$ 7.02	\$ 6.92	\$ 7.18	\$ 8.56	\$ 8.03	\$ 7.68
Sewer	<u>12.74</u>	<u>13.09</u>	<u>12.93</u>	<u>12.51</u>	<u>14.24</u>	<u>13.49</u>	<u>14.16</u>	<u>13.50</u>	<u>14.25</u>	<u>14.29</u>
Combined	18.58	19.26	19.14	18.71	21.25	20.41	21.35	22.06	22.27	21.97
Average Annual Residential Household Bill (based on 5,000 gallons per month)										
Water	\$ 350.50	\$ 370.14	\$ 372.18	\$ 371.96	\$ 420.94	\$ 415.05	\$ 431.00	\$ 513.56	\$ 481.58	\$ 460.80
Sewer	<u>764.41</u>	<u>785.29</u>	<u>776.00</u>	<u>750.57</u>	<u>854.13</u>	<u>809.35</u>	<u>849.86</u>	<u>810.06</u>	<u>854.82</u>	<u>857.69</u>
Combined	1,114.91	1,155.43	1,148.19	1,122.53	1,275.07	1,224.40	1,280.85	1,323.63	1,336.40	1,318.49
Affordability--Household Bill as % of Median Household Income										
Water	0.35%	0.36%	0.35%	0.34%	0.38%	0.36%	0.36%	0.42%	0.38%	0.36%
Sewer	<u>0.77%</u>	<u>0.77%</u>	<u>0.74%</u>	<u>0.69%</u>	<u>0.77%</u>	<u>0.70%</u>	<u>0.72%</u>	<u>0.66%</u>	<u>0.68%</u>	<u>0.66%</u>
Combined	1.13%	1.13%	1.09%	1.04%	1.14%	1.07%	1.08%	1.09%	1.06%	1.02%

Table 5-11
Projected User Rate Impact (Continued)

Description	2046	2047	2048	2049	2050	2051	2052	2053	2054	2055
Rate (\$/1000 gallons)										
Water	\$ 7.74	\$ 8.00	\$ 8.15	\$ 8.18	\$ 8.40	\$ 8.14	\$ 8.46	\$ 8.59	\$ 8.62	\$ 8.68
Sewer	<u>14.99</u>	<u>14.63</u>	<u>15.67</u>	<u>15.05</u>	<u>18.12</u>	<u>17.90</u>	<u>19.54</u>	<u>19.08</u>	<u>18.88</u>	<u>19.68</u>
Combined	22.73	22.63	23.83	23.23	26.53	26.04	28.00	27.67	27.50	28.36
Average Annual Residential Household Bill (based on 5,000 gallons per month)										
Water	\$ 464.27	\$ 479.97	\$ 489.20	\$ 490.88	\$ 504.18	\$ 488.48	\$ 507.63	\$ 515.33	\$ 516.95	\$ 521.03
Sewer	<u>899.50</u>	<u>877.84</u>	<u>940.41</u>	<u>903.05</u>	<u>1,087.44</u>	<u>1,074.12</u>	<u>1,172.49</u>	<u>1,144.80</u>	<u>1,132.97</u>	<u>1,180.65</u>
Combined	1,363.77	1,357.80	1,429.61	1,393.93	1,591.62	1,562.60	1,680.12	1,660.13	1,649.92	1,701.68
Affordability--Household Bill as % of Median Household Income										
Water	0.35%	0.35%	0.35%	0.34%	0.34%	0.32%	0.32%	0.31%	0.31%	0.30%
Sewer	<u>0.68%</u>	<u>0.64%</u>	<u>0.67%</u>	<u>0.62%</u>	<u>0.73%</u>	<u>0.70%</u>	<u>0.74%</u>	<u>0.70%</u>	<u>0.67%</u>	<u>0.68%</u>
Combined	1.02%	0.99%	1.01%	0.96%	1.06%	1.01%	1.06%	1.01%	0.98%	0.98%

Table 5-11
Projected User Rate Impact (Continued)

Using the same formula for calculating a cost per thousand gallons for fiscal year 2005 (for comparison purposes) as was used for the projected years shown on **Table 5-11**, water cost would be approximately \$2.15 per one thousand gallons and wastewater \$2.23 (this is not equivalent to current rates). Part of the increase in the wastewater cost per thousand gallons in 2006 from \$2.23 to \$4.45 is due to already issued debt service which begins in FY 2006 as discussed earlier in the debt service section. In addition, there are increases to operating costs and pay-as-you-go projects for rehabilitation work. However, in terms of real burden on the ratepayers, the impact is not considered high in terms of EPA guidelines. The projected annual household bill relative to median household income is described by EPA as affordable if it is under 2.5 percent for water. Over the study period the water percentage to median household income never rises above 1 percent.

EPA wastewater criteria are provided in steps: an annual percentage above 2 percent is considered a high residential indicator, below 1 percent, low, and between 1 and 2 percent, a mid-range indicator. Over the study period the wastewater annual percentage indicator is often below 1 percent and sometimes falls in the mid-range but never in the over 2 percent range.

It should be reiterated that this study did not include a cost-of-service evaluation. As seen on **Table 5-11**, the increases in cost per thousand gallons are rather uneven and would seem to cause occasional large jumps in rates and, sometimes, even a decrease. When a full cost-of-service study is performed, use of a more even rate schedule would be recommended, probably proposing an increase in each year. However, this more even rate schedule would result in more moderate increases each year instead of the large jumps seen on **Table 5-11**.

5.5 Water Assets Renewal and Replacement

The water projects presented earlier in this section concentrate on the growth of the system. In order to look at the renewal and replacement capital needs for the water system a schedule was developed based on data from the Stillwater asset record report.

Table 5-12 summarizes pertinent information from this record such as original cost, accumulated depreciation, and depreciation period in years. In addition percentage of asset depreciated is calculated by dividing the accumulated depreciation by the installed or original cost. This calculation indicates how soon the asset may need to be replaced. The table also shows the amount of the annual depreciation by group of assets and the average number of years already depreciated.

For the purposes of estimating long range renewal and replacement needs all equipment is excluded since it normally would be replaced when needed through the annual budget process. Some utilities do maintain a separate equipment replacement fund to plan for long range replacement of all equipment which is especially helpful when the need arises to replace the expensive large pieces. The analysis was

Asset Description	Depr Period	Installed Cost	Accumulated Depreciation	Asset % Depleted	Annual Depr	Aver No of Yrs Depreciated
Water Bldg	25	559,551	19,749	3.5%	\$ 22,382	0.88
Hydrants, Meters and Valves	25	359,893	356,199	99.0%	\$ 14,396	24.74
Pumps, Piping and Mains	25	6,672,631	6,138,969	92.0%	\$ 266,905	23.00
Total for Category		7,592,075	6,514,917			
Water Treatment Plant	30	18,362,375	6,003,399	32.7%	\$ 612,079	9.81
Water Tower/Tank	30	1,041,485	361,515	34.7%	\$ 34,716	10.41
Pumps, Piping and Mains	30	5,621,270	1,577,635	28.1%	\$ 187,376	8.42
Total for Category		25,025,130	7,942,549			
Operations Service Center	40	86,482	46,289	53.5%	\$ 2,162	21.41
Water Tanks	40	341,580	333,508	97.6%	\$ 8,540	39.05
Total for Category		428,062	379,796			
Kaw Pipeline and Pump House	50	27,211,066	12,193,076	44.8%	\$ 544,221	22.40
Total Water Assets for Replacement		\$ 60,256,333	\$ 27,030,338		\$ 1,692,777	

Table 5-12
Water System Assets
Summary of Original Cost and Asset Life

concentrated on assets with a useful life of 25 years or more and excluded a few smaller expenditures for items such as fencing. There were a few assets with useful lives of 31 and 49 years and we grouped those with other categories for simplicity.

The table also highlights that the water assets in total are about 45% depreciated. This table demonstrates the large dollar amount of assets that will need to be replaced in the future.

A schedule of asset replacement in future years is also developed to analyze the amount of funds that would need to be set aside in a water renewal and replacement reserve to fund these future replacements. This table is presented on Appendix A-10. The cost of various asset categories is distributed to the year in which the asset would need to be replaced based on the asset life used the Finance Department. It should be noted that these replacement costs are in the dollars of the year in which they were constructed and that the actual replacement costs are likely to be higher.

Several assumptions were made in making these projections: 1) that for assets like hydrants, meters, pumps, piping for example some of them would likely be replaced each year instead of waiting since they were likely constructed over a period of time and would not all need replacing at one time; for those assets we spread the cost over the future years. 2) We also spread the water tank replacement over several years assuming they would not all be replaced at one time.

The renewal and replacement fund schedule demonstrates the approximate amount of funds that would need to be set aside each year to have sufficient funds available when the large replacements such as the KAW pipeline came due.

The last three rows of the table show transfers in, transfers out for the replacements itemized above on the table and balance forward. There is a sizable balance at the conclusion of the table but the table only goes out 30 years so those funds would be used for future years.

In order to have funds available in the years in which it is needed and to smooth out this financial need; a renewal and replacement fund is recommended. This allows the City to transfer planned amounts into the fund each year in a more or less uniform fashion and avoid budgetary high peaks in the years in which much needs to be replaced.

From a practical standpoint most utilities handle these replacements through a combination of replacement reserves such as demonstrated here and borrowing for the larger replacements. This alleviates some of the burden from rates having to support the reserve transfers, increases outstanding debt but allows the large capital expenditures to be spread over more time through annual debt service repayments.

To obtain a true picture of future replacement needs asset replacement cost would need to be estimated based on future dollars.

The projected transfers to the water asset replacement reserve as presented here were not included in the revenue requirements sections discussed previously.

5.6 Mitigation Strategies

The projections in Section 5.4 assumed that SUA increases rates as costs increase. The intent was to show the raw effect of SUA's projected capital program. However, SUA may want to look at other financial management policies to modify that anticipated rate path. In this section, we describe some tools or policies available for SUA.

As indicated in the previous section, SUA should have a full cost-of-service study to mitigate the rate peaks and smooth the overall pattern of rate increases. These tools will not lower the total financial requirements over time but, rather, may smooth out the cost increase path so that the impact is not as severe in certain years. Other key tools of mitigation strategies are as follow:

- ***Use accumulated cash balances to smooth increases and shave peaks.*** SUA may use available cash balances earned by the water and wastewater service to directly offset revenue requirements in particular years. In addition, a long-term rate schedule could increase rates in early years more rapidly than indicated by revenue requirements in order to accumulate surplus to smooth the required increases over time. This mechanism will utilize a rate stabilization reserve to ensure that the funds accumulated for these purposes are not transferred out.
- ***Extend debt terms to more closely match asset life and spread costs over longer time period.*** In our assumptions we used 20 years for SRF debt and 25 for bonds. The bond period could be extended to 30 years or more. From a rate perspective, this has the effect of lowering the revenue requirement through year 25 and then increasing it in subsequent years. Longer debt terms will however, increase the total amount to be repaid.
- ***Backload principal payments to ease the repayment burden in the early years of debt repayment.*** This would work in conjunction with the existing debt service schedule, keeping early payments as low as possible until different points in time in which current debt issues are paid off. This would mean higher total interest paid over the course of the bond issue period but would lower total revenue requirements in the early years.
- ***Obtain grants for any projects that are eligible.*** Grant programs generally have a long lead time so application must be made far enough in advance to obtain funding when it is necessary, but they are certainly worth the extra effort required to obtain them. All numbers and costs identified in this report excluded grants since they could not be guaranteed, and therefore these projections could be considered "worse case" if any grant funds can be obtained.

- *Impose additional new capital cost fees for new customers that reimburse the system for the overall system capacity that will be used by new customers.*
Existing fees paid by developers and municipalities are focused more on the direct costs of connecting new customers to the system than on the full capacity impacts. Even an additional \$2,000 impact fee, each, for water and wastewater would bring in over \$800,000 a year that could be used to off set the cost of growth related projects and ease the future burden on existing customers.

These are a few suggested mitigation options. They would need to be explored with your financial advisor as cash flow schedules are received.

5.7 Gap Analysis and Recommendations

As part of our review process we have identified several recommendations to improve financial planning for the water and wastewater utility.

5.7.1 Cost of Service Study

The utility needs a full cost-of-service study to project user rates needed to support the utility and the capital improvement recommendations. Although it would be impracticable to have a cost-of-service study for the full 50-year study period, a 10-year forecast period would be reasonable. As the utility service area grows, the rate structure needs to become more sophisticated. A cost-of-service study will identify the economic contribution each customer class should be making and may recommend changes in rate structure, in addition to recommending rates for each class for each year in the forecast period.

Many utilities are adopting 10-year rate schedules, now, allowing them to plan financial needs further into the future and present a more stable revenue picture to the rating agencies. Usually these studies are updated every 3 or 4 years to incorporate changes that may have occurred which would affect the forecasting. Having a 10-year rate schedule in place is a great benefit to a growing utility. The cost-of-service study will incorporate the capital improvement plan and allow the utility to see a more precise customer impact analysis than was possible in this planning effort. It may also include looking at a true impact or capacity fee to help the utility fund the many projects that are needed due to new customer growth.

5.7.2 Rate Stabilization Fund

As discussed earlier the raw revenue need cost per thousand gallons showed a very uneven amount from year to year, which should be smoothed out by the adoption of a long-term rate schedule. It is important, when possible, to set rates that will generate some surplus each year that can be accumulated and held for the years that have a greater cash need. This is part of the rate smoothing process.

A rate stabilization fund should be set up to identify those surplus funds as planned for future years. A policy should be adopted that outlines how the amount of funds

transferred into the fund is identified each year and when and under what conditions those funds are later expended. For example, the utility might want to restrict the use of those funds to capital improvement projects through pay-as-you-go funding.

It is important that the utility be able to plan ahead and depend on the funds being available when they are needed to fund projects. Generally, it is not necessary to identify the project to be funded, just define what is considered a capital project for that fund.

5.7.3 Establish a Renewal and Replacement Fund Reserve

As described earlier in this report, there is considerable need for funds for renewal and replacement projects. Although some needs were identified to be funded as part of the annual operating and maintenance budget, there were also ongoing renewal and replacement needs that would qualify for capitalization. Some of these projects were identified as projects that would be needed each year, but others were scattered over the study period.

A renewal and replacement fund reserve allows the utility to identify an amount that should be set aside from revenues each year and accumulated until funds are sufficient to initiate the project as identified. This process ensures that funds will be available when needed, allows planning for this component of the revenue requirement in a cost-of-service study, and mitigates the effect these projects have on rates by avoiding rate peaks. It is also an indication for regulators and bond rating agencies of the utility's well thought out plan for funding renewal and replacement needs.

5.7.4 Adopt a Financial Policy Plan

Many utilities adopt a financial policy plan which establishes policies that the utility and the governing body have established for managing the utility finances. This plan, for example, could set out guidelines for rate stabilization and renewal and replacement fund. It might also include a policy for allocating the special sales tax revenue between the services included in SUA. In this study the debt service ratio was used to allocate those funds between water and wastewater, but there are, of course, many variations that could be considered.

A financial policy should also identify goals, such as percentage of capital projects or percentage of renewal and replacement projects would be funded pay-as-you-go versus debt funding. Another goal should be defining SUA's target debt service coverage ratio and operation and maintenance reserve fund amount or formula.

For SUA, since there is an annual transfer to the general fund in addition to the direct and indirect costs transfers, a policy should be established that identifies the amount of funds or the formula for the allocation of the transfer of funds from the four services in SUA. It is difficult for the utilities to plan ahead with any certainty if they do not know the amount of funds that will be left in SUA each year and how much

they can carry forward as surplus for utility needs. These are just a few examples of financial policies. Examples from other communities can be provided, but the policies should be tailored for SUA individually.

Reference Copy

Section 6

Benchmarking

6.1 Introduction

The Stillwater Utilities Authority (SUA) operates a raw water supply system, a water treatment facility and a water distribution system to supply safe drinking water to the City's residents and customers outside city limit. The operations appear to be efficient and effective. It is the Authority's desire however, to become the best in its class in providing good quality product at a competitive cost. This section provides a comparison of SUA's operations with similar size utilities in both public and private sectors. The comparisons focus on level of staffing for water distribution system and treatment facility as well as unit operating cost to produce satisfactory product. The section further evaluates some management tools that may be used to potentially enhance the efficiency and effectiveness of SUA's operations.

6.2 Water Distribution System Evaluation

Labor is the largest cost component in the operation and maintenance (O&M) of a water distribution system. The evaluation of O&M efficiency and effectiveness for the distribution system focused on staffing of the system. The staffing requirements are calculated based on the work activities that have to be accomplished using as a gauge, AWWA Standards that show typical man-hours needed to complete a task. If the calculated staffing requirement is greater than the utilities' current staffing level for the tasks accomplished, it indicates that the utility operates more efficiently and effectively than the average of utilities in its peer group.

In estimating the number of people to complete the work, it is necessary to determine the amount of time each person is available for work. Of the 2,080 work hours a year, employees are absent an average of five days (40 hours) for sickness and have twelve days (96 hours) of holidays, an average of 10 days (80 hours) for meetings and training reducing the total number of hours available to 1,864 annually. Assuming that the average employee has earned three weeks (120 hours) of vacation, the available hours are further reduced to 1,744 annually. This number is used in the evaluation as an equivalent to a full time employee (FTE).

The Stillwater Water Utility Department is divided into the following three program areas, Water Administration, Water Distribution and Water Treatment. Current water distribution staffing level at the City of Stillwater Water Utility is described in Table 6-1.

Water Distribution Personnel	Fiscal Year 2003 – 04	Fiscal Year 2004 – 05
Superintendent	0.50	0.50
Supervisor	0.50	0.50
Utility Maintenance Worker	11.00	11.00
Laborer	3.00	3.00
Part Time Labor (Custodian)	0.75	0.75
Total FTE	15.75	15.75

Table 6-1
Staffing Levels for Water Distribution System

Table 6-2 shows the Workload Statistics developed as a part of the City's Annual Budget document.

Water Distribution Workload Statistics	2002 – 03	2003 – 04	2004 – 05	Total (3 Years)	Average (3Years)
New Meter Installation	235	385	280	900	300
Meters Replaced	291	140	226	657	219
Meters Raised and Lower	32	67	28	127	42
Water Line Repairs	138	189	144	471	157
Hydrant Repaired, Replaced, Installed	22	26	08	56	19
Line Locates	7,874	7,083	7,385	22,342	7447
Miscellaneous work orders	289	846	877	2,012	671
Main Line Installed (feet)	360	230	2,380	2,970	990

Table 6-2
Workload Statistics

The following definitions describe the work load activities used by the Stillwater Water Utility:

- **New Meter Installation** – Activity involves the installation of new residential, commercial and industrial water meters.
- **Meters Replaced** – Activity involves the replacing of an existing residential, commercial, and industrial water meter.
- **Meters Raised and Lower** – Activity includes the raising or lowering of a water meter to prevent damage.
- **Water Line Repaired** – Activity is based on actions taken to repair leaks in water mains, line valves, hydrant branches, and service lines.

- **Hydrants Repaired, Replaced, Installed** – Activity is based on the installation, operation, repair and replacement of fire hydrants in the distribution system in order to allow for the distribution system to function and to protect health and safety of the community.
- **Line Locates** – Activity is based on locating and marking water utility to prevent damage from someone digging in the vicinity of the water line.
- **Main Line Installed** – Activity is based on installing a new water main line that can no longer be repaired.
- **Miscellaneous Work Orders** – Activity includes miscellaneous work such as turn on/off, meter repairs, miscellaneous customer calls.

6.2.1 Water Distribution Staffing Analysis

6.2.1.1 Current Tasks

The work effort of the water distribution group includes a variety of activities from repairing major water main breaks to flushing dead-ends.

Water Mains

Over the past three years, the utility handled an average of 157 water main breaks. During the three years, the maximum number of main breaks in a given year equaled 189. Main breaks are not uniformly spaced throughout the year and must be handled as an emergency, therefore staffing for main breaks is based on the maximum number, not the average.

Level of Effort: $189 \text{ breaks/yr} \times 4 \text{ people} \times 12 \text{ hr/person/break} = 9,072 \text{ man-hours}$

The number of hours required annually is equivalent to slightly more than 5 people ($9,072 / 1,744 = 5.20 \text{ FTE}$).

New Meter Installation

Over the past three years, the utility handled an average of 561 new, replaced, raised and lowered water meters. During the three years, the maximum number of new, replaced, raised and lowered water meters in a given year equaled 743. The work on meters are not uniformly spaced over the years, therefore staffing for meters is based on the maximum number, not the average.

Level of Effort: $743 \text{ meters (new, replaced, raised \& lowered)/yr} \times 2 \text{ people} \times 2 \text{ hr/person/installation} = 2,972 \text{ man-hours}$

The number of hours required annually is equivalent to slightly less than 2 people ($2,972 / 1,744 = 1.70 \text{ FTE}$).

Hydrant Repaired, Replaced, Installed

Over the past three years the utility handled an average of 19 hydrant repairs and installations. During the three years, the maximum number of hydrant repairs and installations in a given year equaled 26. The work on hydrants are not uniformly spaced over the years, therefore staffing for hydrants is based on the maximum number, not the average.

Level of Effort: $26 \text{ hydrants/yr} \times 4 \text{ people} \times 12 \text{ hr/person/hydrant} = 1,248 \text{ man-hours}$

The number of hours required annually is equivalent to slightly less than 1 person ($1,248 / 1,744 = .72 \text{ FTE}$).

Line Locates

The City is required by law to locate and mark its water utility. Typically there is a person that has the knowledge and skill to locate lines using both electronic locators and maps. The average number of locates equaled 7,447 for a three year period. During the three years, the maximum number of locates in a given year equaled 7,874 and staff must respond to this need promptly after a request is filed, therefore staffing for line locates is based on the maximum number, not the average. The number of locates one employee can perform is estimated to be 15 per day.

Level of Effort: $7,874 \text{ locates} / 15 \text{ locates} \times 8 \text{ hr/day} \times 1 \text{ employee} = 4,199 \text{ man-hours}$

The number of hours required annually is equivalent to slightly more than 2 people ($4,199 / 1,744 = 2.41 \text{ FTE}$).

Miscellaneous Work

Over the past three years the utility handled an average of 671 miscellaneous work orders, which includes service repairs, valve repairs, and turn on/off's. During the three years, the maximum number of miscellaneous work order in a given year equaled 877. Staffing for miscellaneous work orders is based on the maximum number, not the average.

Level of Effort: $877 \text{ miscellaneous work orders/yr} \times 3 \text{ people} \times 6 \text{ hr/person/work order} = 15,786 \text{ man-hours}$

The number of hours required annually is equivalent to nine people ($15,786 / 1,744 = 9.05 \text{ FTE}$).

Water Main Installation

Though water utility staff installed new water main in the past, this type of work can be planned to accommodate anticipated growth and may be implemented as contracting work. Therefore, no manpower requirement is included in this analysis.

The total staff need for the distribution system is summarized in **Table 6-3**. Based on this analysis and the current workload, staffing requirement is calculated to be 19

FTE, representing a staff shortage of more than three employees based on AWWA Standards for a typical water utility. Though the maximum number of event may not occur simultaneously in all work categories in a given year, the current staff at times works long hours to complete tasks and to make up the deficit of three employees. Additionally, current staff performed new water main installation and the man-hours for this work were not included in the staffing requirement of 19 FTE.

Water Distribution Staffing	Average (3 Years)	Max.	Workload Hours	Number of Employees
New Meter Installation / Replaced / Raised / Lower	561	743	2,972	1.70
Water Line Repairs	157	189	9,072	5.20
Hydrant Repaired, Replaced, Installed	19	26	1,248	.72
Line Locates	7,447	7,874	4,199	2.41
Miscellaneous work orders (Includes valve repair, water service repairs, turn on/off, flushing).	671	877	15,786	9.05
Total FTE			33,277	19.08

Table 6-3
Workload Staffing Analysis

6.2.1.2 Additional Tasks

Currently there is no scheduled effort to conduct a preventive maintenance program on valves and fire hydrants in the system. If the water distribution intends to perform an aggressive valve and fire hydrant preventive maintenance program, staffing levels could potentially increase further over the current levels.

The staffing levels required to meet a preventive maintenance program would be as follows:

Valve Preventive Maintenance Program

The water distribution system has approximately 14,000 valves in the system. In developing a preventive maintenance program, the water distribution system should look to exercise 10% of the valves in the system each year, which would equal 1,400 valves annually. This would be a significant undertaking, since presently distribution valves are only exercised during emergency shut downs. The following is the staffing level of effort needed to implement a valve exercising program:

$$\text{Level of Effort: } 1,400 \text{ valves/yr} \times 2 \text{ people} \times 1 \text{ hr/person/valve} = 2,800 \text{ man-hours}$$

The number of hours required annually is equivalent to more than 1 person ($2,800 / 1,744 = 1.61$ FTE).

Hydrant Preventive Maintenance

The water distribution system has approximately 4,600 fire hydrants in the system. For the purpose of this analysis, maintenance personnel should check hydrants at a

frequency of every three years. This may vary depending upon local requirements (some utilities require personnel to check each hydrant on an annual basis).

$$\text{Level of Effort: } 1,534 \text{ hydrants/yr} \times 1 \text{ person} \times 1 \text{ hr/person/hydrant} = 1,534 \text{ man-hours}$$

The number of hours required annually is equivalent to slightly less than 1 person (1,534 / 1,744 = .88 FTE).

6.2.2 Water Distribution Staffing Plan

To perform current tasks and implement the preventive maintenance program, the City of Stillwater Water Utility may need to increase the staffing level for the water distribution system by more than five employees as indicated in **Table 6-4**. As growth continues staffing level must be further expanded to meet the anticipated needs.

Water Distribution Staffing	Workload Hours	Number of Employees
Staffing Levels 2004 / 2005		15.75
Current Staffing Level		15.75
Water Distribution Staffing Evaluation (workload hours)		
Staffing Level Based Off Workload Hours	33,277	19.08
Increase in Level of Service (Preventive Maintenance Program)	4,334	2.48
Revised Staffing Level	37,611	21.56
Net Increase from Current Staffing Level		5.81

Table 6-4
Workload Staffing Analysis

Should the City decide to increase staff, there are two approaches. The first is to increase staff in the implementation of a preventive maintenance program. The second is to recognize that the total number of hours being required to operate and maintain the system is exceeding the current staffing levels and temporary help may be obtained on an as-needed basis to meet the demand. Overtime can be scheduled as well to make available additional man power for handling urgent tasks. As work activities change, staffing levels should be evaluated on an annual basis.

6.3 Water Treatment Plant Staffing Evaluation

Benchmarking compares the efficiency of operations for similar organizations and it has been used in both public and private sectors to examine operations, costs and performance. Companies and utilities subsequently incorporate "best in class" practices as a means of improving performance. Typical benchmarking activities can range from data gathering and matrix comparisons to full implementation of new policies and procedures by applying effective systems in use at "best in class" entities.

For this evaluation, the benchmarking process was designed to gather basic system and operational data from several comparable water treatment facilities. Our primary interest was obtaining relative cost information. The benchmarking evaluation was approached from two perspectives. The first compared the City of Stillwater against averages of performance for public and private operations. The second look compared Stillwater against several specific facilities that were deemed to be comparable geographically and in size and type.

6.3.1 Data Sources

Data for this benchmarking evaluation was extracted from a variety of sources. The primary sources of the collected data were:

- Data collected during recent CDM utility competitive assessments
- Responses to CDM phone surveys, supplemented with actual budgets and annual reports when available from comparable utilities

The evaluation may be marginally biased as the comparison plants were not selected randomly. One of the intents of the evaluation was to compare Stillwater against those plants that were considered to be efficiently and cost-effectively run. To further increase the usefulness of this study, privately operated facilities were also included as a measure in **Table 6-5**.

In developing the water treatment staffing plan, the focus is on comparing against a number of local and regional water facilities located in the areas of the Midwest and the Southwest. The water treatment facilities were compared based on operation and maintenance cost against their average daily production of finished water in million gallons per day (MGD).

City	Population Served	Average Production (MGD)	Maximum Capacity (MGD)	Number of Employees	Operating Cost	Chemical Cost	Electrical Cost	O&M Cost Per MGD
Bloomington, IN	68,779	13.6	24.0	12	\$ 918,315	\$ 270,000	\$ 519,200	\$ 67,523
Belton, TX	31,315	6.0	24.0	7	\$1,053,600	\$ 410,000	\$ 525,000	\$175,600
Waco, TX	98,132	14.0	24.0	12	\$1,196,000	\$ 182,000	\$ 490,000	\$ 85,428
Temple, TX	58,664	11.2	25.0	15	\$1,646,550	\$ 246,676	\$ 375,000	\$147,013
Manhattan, KS	56,539	11.6	20.0	14	\$1,401,295	\$ 320,000	\$ 395,000	\$120,801
Guthrie, OK	10,066	1.2	3.0	4	\$ 352,984	\$ 61,100	\$ 65,520	\$294,153

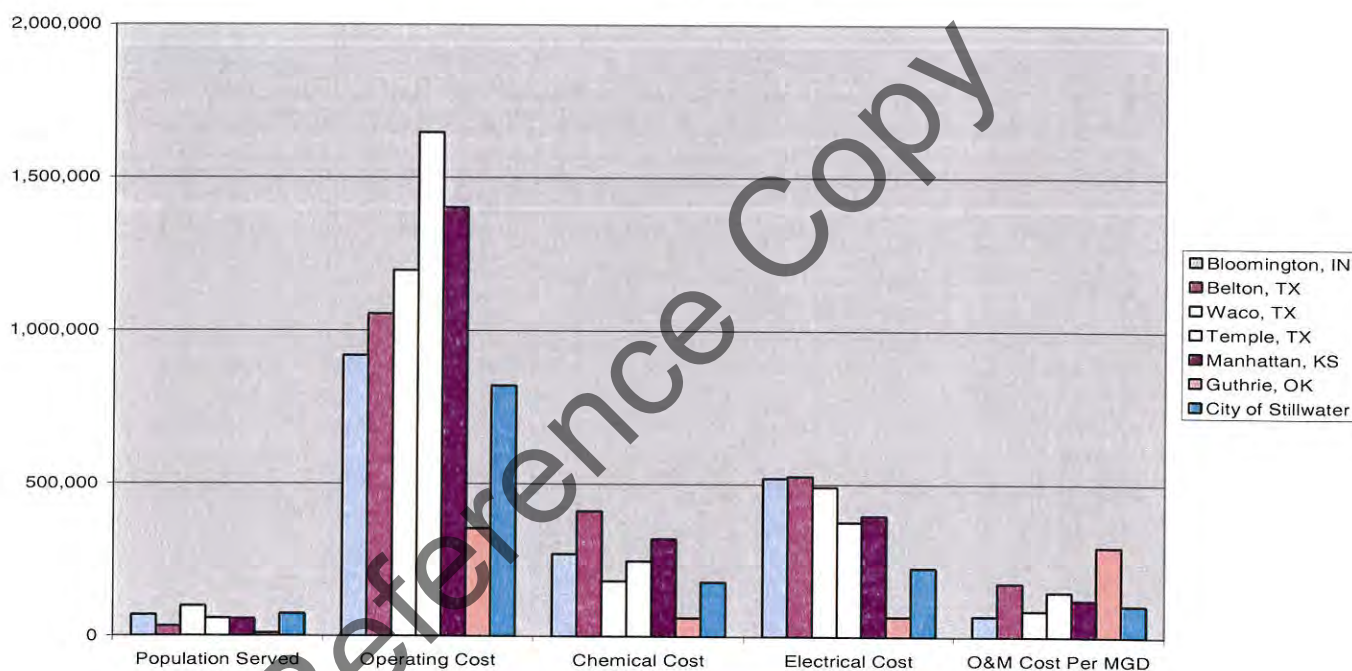
Table 6-5
Water Treatment Plant Survey Comparative Plant Data

The City of Stillwater water treatment facility currently serves a population of approximately 67,000, which includes city residents, Oklahoma State University students, Rural Water Corporation #3 and 51 East Water. The average daily demand

is 7.9 MGD while the maximum daily demand equals 17.0 MGD. The number of employees operating and maintaining the treatment facility equals 9.0 FTE. **Table 6-6** is a comparison of six (6) public and two (2) contract operators to the City of Stillwater's water treatment plant.

The following Benchmark Chart indicates that the public agencies surveyed have a population that resembles the City of Stillwater. The difference being that majority of these public agencies have a higher per capita use of water than the City of Stillwater. The City of Stillwater O&M cost per MGD is comparable to all of the public agencies.

Benchmarking Bar Chart 1



In reviewing the City's costs it is apparent that the operations at the City's water treatment plant is competitive to other public agencies.

	Approx. Population Served	Average Production (MGD)	Maximum Capacity (MGD)	Number of Employees	Operating Cost	Chemical Cost	Electrical Cost	O&M Cost Per MGD
Average	53,900	9.6	20.0	11.0	\$1,094,790	\$248,296	\$394,953	\$114,040
City of Stillwater	67,000	7.9	17.0	9.0	\$819,927	\$177,855	\$224,431	\$103,788
Contract Operator	90,200	14.4	22.0	15.0	\$1,414,936	\$238,653	\$587,985	\$98,259

Table 6-6
Water Treatment Plant Survey Average Comparative Plant Data

The operating cost per MGD for the City of Stillwater's Water Treatment Plant as compared to the surveyed public utility agencies is approximately 9% lower. In terms of the number of employees, the City of Stillwater has 1.13 employees per MGD, whereas the survey cities have on average 1.14 employees per MGD. The Contract Operator had a staffing level of 1.04 employees per MGD. The City's staffing level appears to be competitive compared to the surveyed public agencies. As the water treatment plant is expanded, additional staff should be considered to manage the increase in work activities.

Overall, the findings of the benchmarking evaluation reflect favorably on the operation of the Stillwater water treatment plant and suggest that the plant is operating as efficient as other utilities that are considered as "best in class". Based on this benchmarking information, Stillwater water treatment facilities compare favorably with peer facilities and are relatively low-cost and efficient operations.

6.4 Efficiency Enhancement Tools

There are available management tools that can be used to enhance the efficiency and effectiveness of water and wastewater utilities. One of the commonly used software program that CDM recommends to better manage the utilities' maintenance activities is a Computerized Maintenance Management System (CMMS). The City has invested in a variety of information systems and technologies in an effort to improve efficiency throughout its organization, but it has not effectively established nor communicated its technology vision for these systems.

CDM recommends the following vision for utilities that provide Water and Wastewater services:

Integrated information systems and technologies that provide enterprise-wide communications capability and allow data access that improves the performance of operations and enables the utility to consistently achieve its goals and objectives.

Key elements of a more systematic and comprehensive approach include:

- A defined CMMS that is effective in planning, scheduling, and monitoring the efficient use of the utility's resources (funds, staff and equipment).
- Integration of the CMMS with the City's Geographic Information System (GIS), and ultimately with additional technology tools such as SCADA and financial information systems to guide long-term capital improvement planning and to manage the timely rehabilitation and replacement of system assets.
- Availability of and access to centralized, accurate information for use by departments, managers, and other decision-makers for the effective management of treatment, distribution system operations, and customer service.

6.4.1 Existing System

6.4.1.1 Water Treatment

The water treatment plant maintenance personnel are responsible for maintaining all of the process and electrical distribution equipment, facilities (buildings, grounds, etc) and rolling stock. The treatment plant maintains an electronic database listing of certain assets. While the listing covers a fairly broad category of equipment, there is a lack of accuracy of the asset information and there is no formal process in place for creating new asset records and/or decommissioning retired assets. None of the assets currently inventoried are organized in a hierarchical structure that will facilitate cost roll-up and/or performance analysis or are assigned criticality rankings.

Other important asset-related information such as asset components, specifications, blueprints, as-built documents, O&M manuals, etc (other than some standard preventive maintenance procedures), are generally not recorded in any electronic database, but about half of the assets have some hard copy information associated to them. In addition, currently there is no direct link between the plant's asset register and the city's general ledger account. Staff did believe that asset valuation, revaluation and depreciation was being tracked somewhere within the city's finance department.

Generally speaking, many established processes and practices for the execution of maintenance activities do exist at the treatment plant.

The current work identification/request practice typically originates with plant staff identifying the need for corrective maintenance. Any employee can then complete a work order (generally only for the more significant repair needs) that is forwarded to a plant supervisor for approval and scheduling. Currently, the treatment plant follows a structured planning and scheduling process in the execution of their corrective maintenance activities, but it is difficult to capture and retrieve work history.

The Water treatment plant has a scheduled preventive maintenance program that utilizes both plant staff and outside service providers for many of its assets. A portion of the preventive maintenance that is accomplished by plant staff is scheduled and tracked using a paper system, which could be easily converted into an electronic CMMS.

Inventory management is based on tracking and entering information in the City's HTE financial system. The treatment plant does maintain a storeroom with limited stock on site.

6.4.1.2 Water Distribution

The water distribution system personnel are responsible for maintaining water mains, pump stations, valves, hydrants, etc. for the city and some surrounding areas. The distribution system's asset information currently is stored in the City's Geographic

Information System. The accuracy and extent of the information recorded about the various assets is accurate based on staff knowledge. The water mains, hydrants and valves are grouped by location.

Many established processes and practices for the execution of maintenance activities exist for the water distribution group. There are a number of customer sources that generate work requests for the department such as the public calling in complaints or requests for locates and/or service requests from other departments like engineering or fire.

Generally, all work requests are captured in the HTE workorder system. The use of HTE however, is cumbersome and requires a significant amount of staff time to create workorders and track inventory. It was indicated that staff spends approximately 1 ½ full time staff inputting and retrieving information from the system. There is a formal planning and scheduling program and the pre-planning and scheduling of work was described as being problematic given the current HTE software.

6.4.2 CMMS Implementation

There are three major steps in implementing a CMMS program; procurement, data collection, and implementation.

Under procurement, it is necessary to evaluate the functional and technical requirements of the CMMS. Determining how the system would best fit in with Stillwater utility. During the procurement phase the development of the Request for Proposal, interviewing of CMMS vendors, selecting of software, and the final execution of a contract will take approximately 20 weeks.

Once the contract has been negotiated with the selected vendor, the next phase prior to implementation is the data collection phase. This phase will require data collection to occur at the City's facilities. Once information is collected, it will be placed in an electronic database to be used with the CMMS. During data collection, the data available in the GIS will be reviewed for accuracy. The data development phase could range from 8 to 24 weeks depending upon the accuracy of the data in the GIS.

The final phase of implementation is the configuration, testing, report development, training and deployment phase. At this point, the system is configured and the testing and training of staff is completed by the vendor.

6.4.3 Program Costs

Table 6-7 presents the estimated costs for the procurement, data collection and implementation phases of a CMMS program. These are estimated amounts based on the current needs described by utility staff.

Baseline Costs	Cost	Assumptions
Procurement Consulting	\$40,000	Engineering services to assist in RFP preparation and execution of the contract.
Data Collection	\$40,000	Data collection assumes that the GIS has complete asset information on distribution system assets, i.e. valves, hydrants, water mains, etc. Data collection will primarily collect asset information at the water treatment plant using a consultant and utility staff.
<i>Sub-total</i>	<i>\$80,000</i>	
<u>Implementation</u>		
Hardware	\$12,000	Assumes one server.
Software	\$75,000	Assumes 6 dedicated user licenses for CMMS.
Configuration, Testing & Training Services	\$75,000	
<i>Sub-total</i>	<i>\$162,000</i>	
Total	\$242,000	

Table 6-7
Estimated CMMS Program Cost

Section 7

Assets Management System

7.1 Introduction

The Stillwater Utilities Authority (SUA) is undertaking a significant long-term effort to ensure appropriate and cost-effective utility services over the long term. Among these efforts are several key projects including this asset management effort. As part of this overall effort, the SUA requested that CDM undertake a small-scale asset management pilot program for the water and wastewater departments that would:

- Focus its attention on those foundational asset-related data and knowledge elements required of any asset management program,
- Establish an asset hierarchy template for the department,
- Introduce a business risk analysis process to prioritize the department's assets,
- Develop a condition assessment strategy, and
- Develop a demonstration repair, rehabilitate and replacement plan for a subset of the department's facilities.

Public and elected officials are demanding more thorough justifications for any capital expenditures. Stillwater, like many utilities, faces the situation where major assets are reaching or exceeding their useful life spans but user fees do not reflect the investment required to address this level of investment. The concept of asset management for public utilities was pioneered in Australia and New Zealand. A number of public utilities throughout the United States are beginning to employ such methods to make strategic asset funding decisions, minimize costly emergency repairs, enhance the efficiency and effectiveness of asset maintenance programs, and meet new accounting and regulatory requirements. The intended effect is to extend the useful life of assets, provide an orderly asset repair and replacement program, minimize rate increases and maintain favorable investment grade bond ratings.

Asset Management is a utility management program for providing the public with a cost-effective level of service through the creation, acquisition, maintenance, operation, rehabilitation and disposal of assets for existing and future customers. Asset management is a way that utilities choose to conduct their business and requires developing an overall approach and strategy that puts their infrastructure assets in the forefront of their business strategy. In essence, asset management programs recognize that for infrastructure intensive businesses, assets are the key to their success. Asset management requires a vision of the business and putting in place the necessary processes and approaches to ensure that the business vision is met.

There are many definitions of asset management. The CDM team frequently uses this one:

“Asset management is a systematic process of maintaining, upgrading, and operating physical assets cost effectively. It combines engineering principles with sound business practices and economic theory, and it provides tools to facilitate a more organized, logical approach to decision-making. Thus, asset management provides a framework for handling both short and long range planning.”

With that as a foundation, asset management requires that an understanding be developed on the lifecycle of individual assets, from planning for the asset all the way through to disposal of the asset and how the performance of those assets affects the overall business. The development of asset management strategies for all of the utility's assets follows from the basic understanding of individual asset lifecycles. The goal of a strategic asset management plan seeks to maximize the cost-effective use of municipal capital assets over the life of the asset.

Specific business objectives of SUA that can be furthered by this pilot effort and from full implementation to asset management include helping ensure effective, reliable water and wastewater treatment, keeping Stillwater assets from avoidable maintenance risk, providing evidence and sound reasoning for capital expenditures, and avoiding inefficient financial expenditures. An effective asset management program will ultimately help SUA achieve some very important advantages:

- Improved overall system reliability
- Reduced cost of ownership
- Networked information system that supports effective decisions regarding maintenance, repair, and replacement
- Developing a complete, maintainable inventory of Stillwater assets
- Creating a “living” program that includes both information and tools to support planning and financing well into the future
- Being able to effectively demonstrate and validate future infrastructure needs to its stakeholders

7.1.1 Background

While SUA is taking a key initial step by this pilot effort, it is important to point out the limited focus of this asset management pilot program. This asset management pilot effort was designed to only address certain foundational elements that are requisite for any asset management program, assess the data, practices and procedures that the City has in place that are supportive of asset management and introduce City staff to asset management concepts and expected outcomes. The pilot program provides a gap analysis of the City's posture in moving forward with a complete asset management program.

In determining whether to move forward, SUA must keep in mind that while asset management "is a systematic process of maintaining, upgrading and operating physical assets," a robust asset management program also incorporates 'balanced scorecard' management approaches that examine the 'cause and effect' relationships that effect organizational success in regard to employee development, succession planning and management, ability to manage/retain knowledge and data, and organizational culture. The key elements of a comprehensive asset management plan include the following:

- Processes and practices of the asset portfolio life cycle management,
- Necessary information support systems,
- Related data and knowledge requirements,
- Service delivery tactics, organizational and people issues, and ultimately,
- The utility's Total Asset Management Plan (TAMP).

To be successful in implementing this type of asset management program, all plans require that certain foundational elements must be in place before the more sophisticated program contents can truly be engaged - many of which were the focus of this pilot effort.

7.1.2 Pilot Project Approach

The Stillwater Utilities Authority initiated this pilot project to evaluate and examine its current asset management capabilities, and to establish the foundation for asset management practices at the utility. This asset management pilot effort examined the Water and Wastewater Departments' current asset registry (recorded assets including attributes and maintenance work history tracking), how those assets were organized from an asset management reporting and analysis perspective, how well the utility tracked the condition of its infrastructure assets, how assets were prioritized from a business risk perspective, and if the utility had a formal repair, rehabilitate and replacement decision-making process in place.

The project was not a full-scale organizational assessment, benchmarking and gap analysis effort. Rather, it utilized a focus group approach involving utility management staff to assess current utility business practices and relied on the CDM team's asset management experience to uncover any gaps between the current business practices and generally accepted best asset management practices.

In addition, the project completed practical asset management tasks that can be used by the utility moving forward in its asset management efforts. This includes identifying and recording the utility's assets and related information, organizing those assets for maintenance cost and asset condition analysis, ranking and prioritizing those assets according to business risk and mission criticality, beginning

to develop a condition assessment strategy based on those rankings, providing condition rating protocol to be used in performing future 'visual' condition assessments, performing a condition assessment on set of 'pilot' assets, and then using those assessments along with asset replacement costs to develop a demonstration Repair, Rehabilitate, Replacement Plan (RRRP) for the pilot area assets.

7.1.2.1 Workshops

The CDM team conducted two workshops with Stillwater Utilities Authority management staff. In addition to information gathering, the workshops were designed to communicate project goals and to develop key inputs and policy assumptions necessary for asset management. These include asset inventory, priority ranking, condition assessment protocols and criticality rankings. Ultimately the workshops created a pilot project implementation plan with schedule of activities, built an asset hierarchy template for the entire utility, and developed the asset criticality ranking the utility's assets.

7.1.2.2 Asset Management 'Pilot' Area Activities

As described above, in order to provide the utility practical examples of asset management techniques, a team of CDM and utility treatment plant management performed condition assessments on a set of pilot area assets (Raw Water Pumping), examined historical maintenance history for those assets including installation date, cost, and annual maintenance costs (including major rehabilitations), performed research to determine current asset replacement costs (labor and material) and developed a demonstration RRRP for the pilot area assets. In addition, CDM and treatment plant management staff developed a 'complete' asset hierarchy for the wastewater treatment plant processes down to individual Maintenance Managed Items (MMI) and their components e.g., pump, motor, etc.

7.1.2.3 Findings and Recommendations

Based on the results of the workshops with utility management staff and the activities related to the asset management pilot area activities, findings and recommendations were developed. These recommendations focus on implementing those asset management foundational elements tailored to Stillwater Utilities Authority current and future needs.

7.1.3 Organization of Report

Below is a description of the first five sections and seven appendices of this report. The contents of the report are summarized below:

- **Section 7.1 – Introduction** - Presents a background of the Asset Management project, outlines the project approach, and provides a summary of the organization of the report.

- **Section 7.2– Asset Management Program Overview** – This section presents an overview of a generic asset management initiative describing its general purpose, structure, components and benefits to the utility.
- **Section 7.3 – Asset Management Pilot Program Overview** - This section presents an overview of Stillwater’s Pilot Program activities.
- **Section 7.4 – Major Findings** - This section presents an overview of the findings relating to Stillwater’s current asset management related practices and associated improvement needs.
- **Section 7.5 – Implementation Recommendations** - This section presents recommendations for the implementation of an asset management program at the City of Stillwater.

Appendices

- Appendix B-1* - A glossary of terms important to the discussions within this report.
- Appendix B-2* - Asset Data Collection Template
- Appendix B-3* - Asset Hierarchy Template
- Appendix B-4* - Wastewater Treatment Plant Hierarchy
- Appendix B-5* - Asset Criticality Ranking
- Appendix B-6* - Repair, Rehabilitate, Replacement Plan for Pilot Area (on CD)
- Appendix B-7* - Workshop PowerPoint Presentations (on CD)

7.2 Asset Management Program Overview

This section provides an overview of a comprehensive Asset Management Program envisioned at public utilities attempting to institute asset management best practices. The appropriate program for City of Stillwater should seek to mesh what is available and proven in asset management with what their current situation is and what their future needs will be. Generally, an appropriate asset management system will:

- Be based on a holistic integrated approach that incorporates new practices (both management and work practice), improved technology, and a supportive work culture.
- Develop affective asset management practices including an asset registry with ‘parent-child’ relationships (asset hierarchy), an asset criticality identification procedure, condition assessment process, asset valuation process, improved capital and operations and maintenance (O&M) planning processes, improved maintenance practices, and optimized renewal decision-making.
- Improve asset information availability through the use of asset information systems such as a Computerized Maintenance Management System (CMMS), a

Geographical Information System (GIS), a Supervisory Control and Data Acquisition system (SCADA), and other management reporting systems.

- Facilitate and sustain a supportive work environment (culture) to sustain asset management practices and optimize the use of new technology. The work environment should incorporate an effective asset management structure, training, knowledge management and promote a motivated, willing work force.

The preceding description provides the basis for the comparing the current environment at Stillwater Utilities Authority with an envisioned future asset management scenario. It also provides the basis for the specific recommendations for Stillwater Utilities Authority detailed in Section 7.5.

7.2.1 Asset Management Program Concepts

7.2.1.1 An Integrated, Holistic Approach

A successful comprehensive Asset Management implementation is more than new practices. Improved organization performance is a function of effectively integrating technology, work process, and people. Effectively implementing asset management requires attention to all three. Exclusive or overbalanced emphasis on one element or another is not effective. Technology alone, for example, will not buy an effective asset management system. A new software system will not achieve its advertised benefit unless it is properly implemented. Changed work practices will not be sustained without supportive, motivated people. Likewise motivated people cannot achieve change without at least some improvements in practice (methods) and technology. **Figure 7-1** (below) illustrates the three elements of an effective asset management implementation.



Figure 7-1
Asset Management Implementation

7.2.2 Asset Management Concepts

This section describes the major elements of a comprehensive, integrated asset management system. It is organized in line with the three segments illustrated in **Figure 7-1**; Asset Management Processes, Information Technology, and People.

7.2.2.1 Asset Management Practices and Procedures

Proper business practices are the heart of an effective asset management implementation. We have separated these practices into several key elements. We discuss these below and follow them with a discussion of the technology component and the people component of an effective asset management implementation. The key elements are as follows:

Asset Registry, Hierarchy and Criticality Ranking

The asset registry is a listing of the utility's assets that is best kept in an electronic database for ease of manipulation and analysis. It is the backbone of a best-practice asset management system because all asset managers must first understand what assets they are responsible for to begin managing them effectively. Generally, a well developed asset registry will not only include the asset description and function but essential component attributes such as equipment type, manufacturer, material, size and/or capacity, installation date, estimated life expectancy and replacement cost, etc. (Note: It is important to differentiate between the asset and the equipment components that make up that operating unit or asset. As such, assets are often referred to as a Maintenance Managed Item (MMI) that refers to the entire operating unit that can be made up of a number of equipment components, e.g., blower, gear drive, motor.) The asset registry should also allow for reconciliation of an asset in the asset registry (usually recorded and tracked within a CMMS) with an asset in the agency's financial accounting system.

An asset hierarchy is simply the logical organization of assets that supports effective cost roll-up and condition analysis. Most asset hierarchies follow the process flow diagram representing the overall operation of the utility and related systems and/or plants and is built upon a series of 'parent/child' relationships. Most asset hierarchies are set up to support both high-level 'asset management' decision-making and more immediate or local 'maintenance management' decision-making. As such, most hierarchies begin at the top level of an organization and are built-out down to the MMI level. A sample generic hierarchy down to the sub-function level is illustrated in **Figure 7-2**.

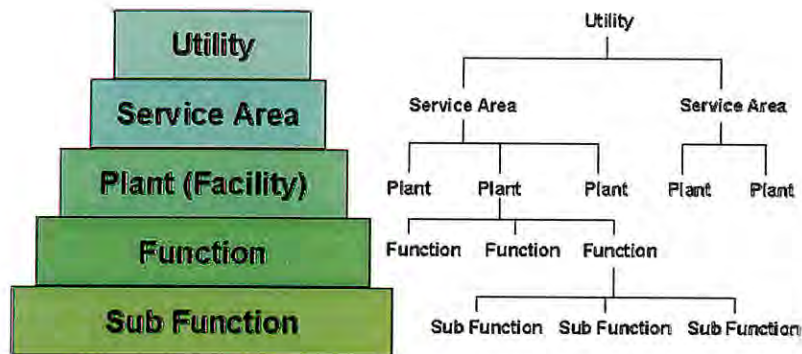


Figure 7-2
Generic Asset Hierarchy

A key element is to classify assets into rankings of importance or criticality. This starts by understanding your business objectives, related performance expectations and recognizing that all assets are not 'created equal.' Ranking the utility's assets according to criticality is a qualitative analysis of assets' failure events, and their impact on the business goals of the agency. An assessment process generally factors the 'consequence of failure' (C of F) and the 'probability of failure' (P of F). Consequence of failure generally follows assessment criteria based on health and safety, economic loss and statutory obligations that looks at the resultant effects if a particular asset fails. Probability of failure is done by analyzing historical frequency and types of failures to determine the likelihood of the asset failing in the future.

Asset Condition

Comprehensive asset management programs include an ongoing assessment of the owner's assets that evaluates and estimates of the remaining useful lives for the assets based on their condition. It is important to remember that condition assessments must be made at regular intervals and that the deterioration of the assets' condition should be tracked over time to forewarn utility management of upcoming capital investment needs. It is, therefore, the beginning of a continuous, ongoing process of an asset management program.

Fortunately, condition assessment techniques such as vibration and oil analysis, infrared thermography, and ultrasonic technologies in recent years have been improved and become less expensive. However, the actual application of the various assessment techniques in cost effective and meaningful fashion requires both creativity and common sense. It is neither wise nor cost effective to assess all of the utility's assets in the same fashion. For most assets, visual inspection assessments along with basic performance testing are sufficiently effective. It is advisable to expend the greatest amount of attention to those assets that are most critical to the success of the organization. The condition assessment strategy should be directly linked to an asset's criticality ranking as described above. The most critical assets that

are the heart beat of the system will garner the most attention and expenditure of assessment dollars. As an example, an internal evaluation may produce a strategy where 65 to 75% of equipment should have basic visual and/or performance testing done on them, 25 to 30% of equipment are monitored using walk-around technologies (vibration, oil, thermography analysis), and 2 to 4% of equipment may warrant SCADA performance monitoring or scanning type imbedded devices. And ultimately it is important to develop the protocol for how 'condition' rating is determined for visual and historical assessment, as well as how to 'weight' individual ratings when more than one technique is used for any particular asset.

Asset Management Plans

Structured, well planned asset management plans ensure that assets perform as designed for their full life expectancy. In the past, maintenance managers have operated from the principle that there are two types of maintenance procedures; corrective repairs and scheduled preventive maintenance. Too often, to the detriment of the utility, breakdown repairs dominate the maintenance workload and become the main focus and purpose of the maintenance department. Even where preventive maintenance is practiced, if the diagnosis of the likely failures of asset is inaccurate and/or if all assets are prioritized similarly, this can result in a high level of maintenance activity and cost that doesn't necessarily result in a corresponding level of equipment reliability. Fortunately, the growth in more sophisticated maintenance methodologies (Reliability Centered Maintenance, Failure Modes, Effects and Consequences Analysis, etc) and in the application of predictive maintenance techniques provide the opportunity for utilities to use analysis and prediction as the means to achieve asset reliability.

Asset management plans are instituted by establishing a structured framework for developing a set of maintenance activities called Standard Maintenance Plans (SMP) that demonstrate a technically feasible and cost-effective maintenance strategy for defined asset groups that have similar design, failure modes and frequencies. The process emphasizes the use of operation and maintenance experience guided by sound methodologies to establish documented maintenance plans that ensures the application of uniform, consistent and cost-effective maintenance activities, and facilitates analysis of equipment groups.

Once established, individual SMP's can be aggregated across sub-systems and systems to quantify the magnitude of the maintenance effort and related skill sets that are needed to achieve overall business goals. In essence, from a maintenance management perspective, the individual asset plans all roll-up to create the overall asset management requirements and plan.

Asset Valuation

This is the step that gives asset management its name. Without this step, we would be talking about "infrastructure maintenance" or "facilities management." But we are talking, indeed, about asset management and how to most cost effectively acquire,