Operations and Maintenance Report

Prepared for
City of Wichita

February 2017

245 North Waco Street
Suite 240
Wichita, KS 67202
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<td>AMSA</td>
<td>Association of Metropolitan Sewerage Agencies</td>
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<tr>
<td>ASCE</td>
<td>American Society of Civil Engineers</td>
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<tr>
<td>BCE</td>
<td>Business Case Evaluation</td>
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<tr>
<td>CAD</td>
<td>Computer-Aided-Design</td>
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<td>CADD</td>
<td>Computer-Aided-Design and Drafting</td>
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<tr>
<td>CCP</td>
<td>Capital Construction Projects</td>
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<td>CFR</td>
<td><em>Code of Federal Regulations</em></td>
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<td>CIP</td>
<td>Capital Improvement Program</td>
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<tr>
<td>CIS</td>
<td>customer information system</td>
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<td>City</td>
<td>City of Wichita</td>
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<td>CM</td>
<td>corrective maintenance</td>
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<td>CMOM</td>
<td>Capacity Management, Operations, and Maintenance</td>
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<td>COF</td>
<td>Consequence of Failure</td>
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<td>CSO</td>
<td>combined sewer overflow</td>
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<td>CSS</td>
<td>combined sewer system</td>
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<td>CWA</td>
<td>Clean Water Act</td>
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<td>DBB</td>
<td>design-bid-build</td>
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<tr>
<td>DB</td>
<td>design-build</td>
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<tr>
<td>DBO</td>
<td>design-build-operate</td>
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<tr>
<td>DBFOM</td>
<td>design-build-finance-operate-maintain</td>
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<tr>
<td>EMCP</td>
<td>Environmental Monitoring and Compliance Program</td>
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<td>ERP</td>
<td>Emergency Response Plan</td>
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<td>ES</td>
<td>Engineering Services</td>
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<td>ESRI</td>
<td>Environmental Systems Research Institute</td>
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<tr>
<td>fps</td>
<td>feet per second</td>
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<tr>
<td>FOG</td>
<td>fat, oil, and grease</td>
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<td>FSE</td>
<td>food service establishment</td>
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<td>FTE</td>
<td>full-time equivalent</td>
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<td>GIS</td>
<td>geographic information system</td>
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<tr>
<td>gpd</td>
<td>gallon(s) per day</td>
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<td>GRD</td>
<td>grease removal device</td>
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<td>HAZMAT</td>
<td>hazardous material</td>
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<td>HR</td>
<td>Human Resources</td>
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<tr>
<td>Acronym</td>
<td>Meaning</td>
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<tr>
<td>I/I</td>
<td>infiltration and inflow</td>
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<td>IPP</td>
<td>Industrial Pretreatment Program</td>
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<tr>
<td>IT</td>
<td>information technology</td>
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<tr>
<td>If/day</td>
<td>linear feet per day</td>
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<td>KDHE</td>
<td>Kansas Department of Health and Environment</td>
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<td>LOF</td>
<td>Likelihood of Failure</td>
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<td>MG</td>
<td>million gallon(s)</td>
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<td>MIS</td>
<td>Managed Information System</td>
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<td>MSDS</td>
<td>material safety data sheet</td>
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<td>NACWA</td>
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<td>O&amp;M</td>
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<td>OSHA</td>
<td>Occupational Safety and Health Administration</td>
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<td>P3</td>
<td>Public Private Partnership</td>
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<td>PM</td>
<td>preventive maintenance</td>
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<td>PPE</td>
<td>personal protective equipment</td>
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<td>QA</td>
<td>quality assurance</td>
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<tr>
<td>RII</td>
<td>rainfall-induced inflow</td>
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<td>SCADA</td>
<td>supervisory control and data acquisition</td>
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<td>SCREAM</td>
<td>System Condition and Risk Enhanced Assessment Model</td>
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<td>SOP</td>
<td>standard operating procedure</td>
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<td>SSO</td>
<td>sanitary sewer overflow</td>
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<td>SUO</td>
<td>Sewer Use Ordinance</td>
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<td>USEPA</td>
<td>U.S. Environmental Protection Agency</td>
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<tr>
<td>VfM</td>
<td>Value for Money</td>
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<tr>
<td>WEF</td>
<td>Water Environment Federation</td>
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<td>WERF</td>
<td>Water Environmental Research Foundation</td>
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<td>WTP</td>
<td>water treatment plant</td>
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<td>WWTP</td>
<td>wastewater treatment plant</td>
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<td>yr</td>
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Executive Summary

In 2015, the City of Wichita Water and Wastewater Departments (the City) issued a Request for Proposal (RFP) seeking assistance developing a comprehensive risk analysis of the existing infrastructure; a staffing and operations evaluation and optimization plan; and an overall asset management plan focused on proactive maintenance rather than reactive maintenance. This operations and maintenance (O&M) report provides in summary form the staffing and operations evaluation, and recommended optimization scenarios, as the key deliverable to the Wichita Utility Optimization and Asset Management Program. The utility assessment data gathered and analyzed in the development of this O&M report were input into Wichita’s Decision Support Tool (DST) and informed the O&M portion of all Business Case Evaluations (BCEs) and the Value for Money (VfM) reports accordingly.

Focusing on the O&M aspects of the RFP’s intention primarily, this report was developed around three core stages of analysis. It incorporates how O&M performance might be impacted by implementing optimal O&M strategies and practices to enhance existing staffing capacity. In this report, the three core stages of analysis pursued are as follows:

1. City Current Status (Section 2)—discussion of the current status of water and wastewater O&M;
2. “Business as Usual” Case (Section 3)—projections of risks and costs if the current mode of O&M continues as-is;
3. Optimized Business Case (Section 4)—how current O&M can be optimized and improved by the City (includes challenges to sustained optimization and recommendations re overcoming);

This report is intended to be read in conjunction with the DST technical memorandum and the Capital Improvements Plan technical memorandum.

1.1 Current Status

The existing water and wastewater infrastructure and staff are currently meeting regulatory limits and demand from City customers. Achieving these results has not been without varying degrees of adversity for the water and wastewater department teams. However, in performing the one-on-one interviews and other data collection necessary to the development of this report, it was clear that there is a commendable degree of dedication and pride motivating the staff to continue meeting the water and wastewater needs of the City with the resources at hand. From CH2M’s experience evaluating and operating hundreds of utilities around the world, this employee attitude is a make-or-break component necessary to the implementation of significant positive change, and is a true asset to the City.

Additionally, the City’s leadership has shown commitment to the restoration and stewardship of these legacy utilities through the issuance of the comprehensive evaluative RFP, and significantly, a willingness to begin addressing these legacy investments by authorizing moderate increases to Wichita’s existing rates, which have for decades been kept very low on a nationally and regionally-ranked basis. It is not uncommon for U.S. cities to find that managing rates at or below inflation, largely through deferred maintenance, can eventually result in more significant capital investment needs and staffing support.

Through the development of the Condition Assessment and this analysis of how O&M is currently managed, CH2M has identified the following key risks to the continued reliability and cost-effectiveness of the City’s water and wastewater enterprises:

- **Critical Infrastructure Needs 1**—Investment in the Main Water Treatment Plant (WTP) stands out as a highest priority within the overall Condition Assessment findings due to its age and critical role in
SECTION 1 EXECUTIVE SUMMARY

Supporting the community, since it is the only drinking water source. An additional investment strategy could include implementation of a new WTP, such as the proposed NW WTP, which provides treatment redundancy and risk reduction.

- **Critical Infrastructure Needs 2**—Another project that stands out next in sequence of priority is Biological and Nutrient Removal (BNR) treatment, most likely at Wastewater Treatment Plant (WWTP) No. 2 due to its limitations in meeting pending nutrient removal effluent requirements.

- **Risk of Catastrophic Failure 1**—The raw wastewater pipeline to WWTP No. 2 is a single point of failure, which could result in shutdown of the plant for an extended period of time if it were to ruptured.

- **Risk of Catastrophic Failure 2**—The raw water supply line to the Main WTP is a single point of failure potentially affecting the whole of the population served.

- **Staff Skills**—Staffing is currently at 332 full-time equivalent (FTE) employees. Technical, regulatory, safety and management training are all categories of significant need in order for the current staff to accomplish their work in a manner that supports performance, achieves compliance, manages risk, and ensures optimally cost-effective O&M of the utility. Understaffing is apparent, some key management roles must be filled on a priority, such as a full-time Water Quality Manager at the Main WTP, and the development of succession/recruitment strategies is suggested.

- **Safety**—Recent accidents, including a fatality, highlight the necessity for developing a safety culture which protects employees while limiting recordable injuries and associated costs. The city’s current staffing plan, training, and operational policies and procedures need updating to ensure safety programs are in line with national best practices.

- **Compliance**—Compliance with applicable rules, laws and permit conditions, including future requirements, must be considered in the overall O&M of the facilities. Non-compliance can lead to fines, public health impacts, and damage to the environment, all of which can result in eroded trust with customers, regulators and other organizations. Compliance issues may be from any combination of the above factors and/or other factors not listed above such as weather, minor equipment failures or process disruptions.

The annual operating budget is currently at $59.5 million. While this value appears adequate on the surface, there are potential O&M savings to be realized that may assist in offsetting expected capital expenditures. Additionally, current O&M may be artificially inflated due to the increased maintenance activities associated with the demands of running aged infrastructure past its useful design life.

It is clear from the O&M evaluation that there is opportunity to achieve significant life-cycle cost savings simply by better integrating operating policies and procedures with managerial, financial and human resource management systems. Optimized operations would involve, in part, implementing systems that talk to each other and enable effective day-to-day management performance reporting and long-term planning to support proactive maintenance.

1.2 “Business as Usual” Baseline Case

The first step of the analysis following comprehensive O&M assessment was to project the existing O&M staffing and processes, and current infrastructure conditions forward to model likely outcomes, using the risk items from the previous section. The City is in the process of evaluating how best to optimize management of the utilities going forward. A continued “Business as Usual” approach is established as the Baseline Case for comparison.

In general, asset failures, staffing capabilities, and the absence of effective operational and managerial systems were the factors having the most significant impact on system risk, cost, and the ability to
maintain compliance and serve customer needs in the future. These risks identified in the DST model runs to determine the likely short term (annual) financial impact on the City, which in this case was approximately $3.2 million in additional unplanned O&M costs per year.

In addition to the cost impacts, the analysis indicates the City should expect to see an increase in permit violations (compliance risk) in the wastewater utility without upgrades, particularly at WWTP No. 2. Anticipated risks in the water utility on the current trajectory include the potential for treatment failures at the Main WTP resulting in possible boil water notices, water quality violations, and costly repairs under emergency conditions. The analysis does not monetize the associated regulatory fines, business interruption impact, or perception setbacks that may accompany coverage of any drinking water violations such as those occurring in Corpus Christi, TX and Flint, MI.

Finally, safety trends in the City are likely to result in more injuries to staff and a statistically likely additional fatality within 15 years, at the current rates of injury. The cost of injuries is nationally estimated at $8,600 per incident. CH2M chose not to place a monetized risk value on a fatality, and considers any such calculation unacceptable.

The outcomes projected under a “Business as Usual” case would strongly recommend that the City reject a continuation of status quo practices in favor of the most advantageous O&M optimization discussed below.

1.3 Optimized City-Self Perform Case

If the City is able to apply industry best practices to the O&M of the utilities, on a consistent, sustained and accountable basis over the life of the assets, then the City may achieve the favorable outcomes defined in the Optimized Self-Perform Case. These outcomes include reducing a substantial portion of the risks identified previously, especially those pertaining to compliance and safety. The City can also reduce its own operating costs through increased efficiency in power and chemical use. The adoption of more effective O&M systems can, if realized and sustained by the City, produce cost savings, accountability, reduced risk and improved performance. These improvements can include work order flow, operating repair and replacement (ORR) budgeting and deployment, and an integrated capital improvement program (CIP) with reporting that ties financial performance back to project performance results. Over time, optimizing these systems successfully may reduce the City’s need to fill certain vacant positions, and may free staff to fill other capacity needs or train into higher value positions.

Also, by closing the loop in the asset management cycle and managing capital upgrades more efficiently, the City will save millions on capital upgrades; however, there will still be a substantial need for major improvements. This need is discussed in the accompanying Capital Upgrades TM, which reflects the age and obsolescence of existing assets.

By implementing the recommendations for training and supporting O&M management systems, CH2M would expect over time that the City could realize approximately $7 million in annual O&M savings—or 11 percent of the current O&M budget each year. Several more million in revenue could be generated with a more equitable water and wastewater rate structure as well.

In contrast to the “Business as Usual” case with operating costs running at approximately $59.5 million per year (including $3.2 million in projected emergency or unplanned investments of a continued reactive approach), the annual operating budget under the optimized case in this section could be approximately $52.5 million per year. To accomplish the optimized case described above, the City would need to focus resources on building and sustaining the systems and processes outlined in this report, including outside consulting support as appropriate.
SECTION 2

Current Status

This section describes the current operating and maintenance mode for the City of Wichita water and wastewater facilities. There is also a discussion of the baseline costs under the current O&M approach. Recommendations for improvements are generally reserved for the alternative approaches discussed in later sections.

2.1 Operations

2.1.1 Water Treatment Plants

2.1.1.1 Main WTP with Central and East Treatment Basins

Liquid Stream

The City of Wichita utilizes a single Main WTP comprised of two main treatment basin trains with the largest being the Central Plant having a design capacity of 130 million gallons per day (MGD) and the East Plant with a capacity of 30 MGD (see Figure 2-1). The primary water source is Cheney Reservoir that contributes a flow range of 47 to 103 MGD through a 60-inch raw water pipeline that is treated with ozone prior to reaching the treatment plant site. The Equus Bed Well Fields, which are divided into the East and West Equus Bed Well Fields, provide a well water source to the water treatment facility. The East Equus Bed Well water is conveyed with a 48-inch pipeline and the West Equus Bed well water utilizes a 66-inch pipeline. The Equus Bed Well Fields can contribute flow ranges from 69 to 75 MGD. There are also local wells named E-Wells and S-Wells that have a combined capacity of 5.0 MGD where water can be routed to the treatment plants through 24-inch lines from each well.

The City has also constructed an aquifer storage and recovery (ASR) system that can pretreat water from the Little Arkansas River using an advanced treatment system, discussed in detail in a later section. Simply put, the pretreated water can be recharged to the Equus Bed Well Fields to maintain aquifer levels or the water can be conveyed to the treatment plants. The use of river water for the ASR process
is limited to only operating when the river is above base flow to meet water right requirements. Additionally, the pesticide atrazine has been detected in the river and treated water must meet maximum contaminant levels (MCL) to be recharged to the Equus Bed Well Fields.

The water entering the treatment plant first enters the aeration process which is comprised of multiple coke tray aerators that provide a cascading effect that aids in removal of primarily hydrogen sulfide, thus reducing taste and odor problems (Figure 2-2). The Central Plant has 19 aerators with 4 trays per aerator, and the East Plant has the same configuration with 6 aerators. The discharge from the filters is dosed with ferric sulfate, lime, and polymer prior to entering the rapid mix channel. Both plants have 4 axial impeller mixers with the Central Plant having right-angle vertical turbine and the East Plant having side-entry turbine style mixers.

After the rapid mix process, the flow enters the flocculation basins to condition and form a chemical floc to enhance settling in the downstream processes. The Central Plant has two cross-flow trains each equipped with three 12.5-foot-diameter horizontal paddle wheel flocculators. The flocculators are driven by a variable frequency drive (VFD) to provide three stages of mixing speeds for flocculation. The East Plant comprises one serpentine flow train with five 13.0-foot-diameter horizontal paddle-wheel flocculators. The drive motor is VFD driven with five stages of flocculators speed operation.

Primary and secondary sedimentation processes follow flocculation to provide settling area in the proper settling velocity range for proper sediment removal from the water. From flocculation flow enters the Central Plant primary sedimentation process through a perforated baffle wall. There are two trains in the primary sedimentation which are 160-foot by 160.5-foot and a sidewall depth of 15.5 feet. The East Plant primary sedimentation is divided into an East and West basin. The East Basin has a design capacity of 20-MGD, and the West Basin is a smaller basin with design capacity of 10 MGD. The flow from the primary sedimentation enters two secondary sedimentation basins at the Central Plant, while the East Plant has one secondary sedimentation basin.

After sedimentation processes each plant has the capability of adding carbon dioxide for pH adjustment prior to the filtration process. Flow from both facilities flows to a filter influent flume where the ability to add chlorine, ammonia, polyphosphate, and/or filter aiding polymer to the flow prior to filtration.
The filtration process is comprised of 14 dual media (sand and anthracite), rapid gravity filters. The filtration system is equipped with a concurrent air/water backwash system. Air during the backwash cycle is supplied by two 200-HP centrifugal blowers.

Filtered water flows to a clear well that supplies wash water storage tanks for the backwashing of the filters. The bulk of the filtered water from the clear well flows to downstream disinfection consisting of chlorine and ammonia addition. Finished water storage consists of two 3.0-MG (East and West) storage reservoirs, one 4.3-MG, one 7.5-MG, and one 10-MG storage reservoir. The Hess High Service Pump Station then provides the water distribution to the system from the various storage reservoirs.

**Solids Stream**

The Primary Sedimentation Basins for both plants utilize a circular sludge removal mechanism. The sludge has the option to be recycled to upstream of the rapid mix process or it can be pumped to solids handling through the sludge transfer pump station. Each plant has a dedicated recycled sludge pump station. The recycled sludge pump station for the Central Plant consists of two 15-HP centrifugal pumps and the East Plant has three 5.0-HP pumps. The Secondary Sedimentation basins for the Central Plant are equipped with chain and flight sludge removal systems using cross collectors to route sludge to a hopper which ultimately is routed to the sludge transfer pump station.

Secondary sedimentation for the East Plant does not have a removal system or associated pumps as does the Central Plant thus sludge removal is manually controlled. The sludge transfer pump station is equipped with three 25-HP centrifugal pumps that are designed to deliver flow to a 360,000-gallon gravity thickener. Thickened sludge is removed using two 40-HP centrifugal pumps to route the thickened sludge to storage lagoons. A wash water recovery basin can send flow to the gravity thickener influent or the flow can combine with the gravity thickener over flow where it is routed to the Central Plant flocculation process. The wash water recovery tank has a 340,000-gallon volume and is equipped with two 20-HP centrifugal pumps.

### 2.1.1.2 Equus Beds Aquifer Storage and Recovery

For future considerations, the City of Wichita instituted the Equus Bed ASR Project, Figure 2-3. Aerial View of the ASR WTP, that treats surface water from the Little Arkansas River and recharges into the Equus Bed Aquifer to maintain and store an additional drinking water source. The Equus Bed Well Fields

![Image of Equus Beds Aquifer Storage and Recovery](image_url)

*Figure 2-3. Aerial View of the ASR WTP*
SECTION 2 CURRENT STATUS

(EBWF) comprise 35 recharge/recovery wells, 31 production wells, 2 recharge basins, 1 recharge well, and approximately 65 miles of well piping. The EBWF has a production capacity of approximately 72 MGD and a recharge capacity of approximately 30 MGD.

Regulations require that the base flow of the Little Arkansas River which is currently at 30 cubic feet per second (CFS), must be exceeded before water can be drawn to the treatment plant. Water availability from the river can also be limited by the concentration of atrazine and bromide with the upper limits of these contaminants being 30 micrograms per liter (µg/L) and 430 µg/L respectively.

Water enters the treatment process through concrete intake bays each equipped with submersible pumps and mechanical mixers to prevent large debris from accumulating in the bays. Currently there are four duty pumps and one standby with a total pumping capacity of 33.0 MGD. A common header from the intake bays deliver the flow to a 2.7 MG pre-sedimentation basin. This basin serves to settle large solids without the use of chemical settling aids. This basin has a scraping mechanism to remove settled solids. A 48-inch pipe delivers flow to the settled water pump station which is equipped with two can style pumps with a total pumping capacity of 33.0 MGD. Water is then pumped to a series of five 500-micron strainers to remove solids prior to the next treatment process which is membrane filtration.

There are six membrane trains with a capacity of 5 to 7.5 MGD each depending on if all trains are in service or potentially in a backwash or cleaning cycle. Each train is equipped with 0.04-micron membrane filtration modules to remove turbidity, solids, and giardia/cryptosporidium pathogens from the water. From the membrane filtration portion of the treatment train the water flows to the advanced oxidation process (AOP), Figure 2-4, that utilizes a combination of ozone and hydrogen peroxide to break down atrazine and limit the formation of bromate. The AOP also acts as an additional treatment to further remove any remaining giardia/cryptosporidium pathogens. The AOP system can produce 4,200 lbs/day of ozone which produces an ozone residual of 15 mg/L at a flow rate of 30 MGD.

The AOP treated water flows to a 1.4 MG concrete clear well which serves as an equalization tank between the treatment plant and the high service pump station (HSPS). The HSPS has two split-case centrifugal pumps with a pumping capacity of 30 MGD. These pumps can deliver flow to recharge the...
EBWF or flow can be diverted for ultimate delivery to the City’s main water treatment facilities (Central and East Plants).

**Condition of Process and Operational Observations**

The ASR facility has been in limited full operation due to recent levels in the Little Arkansas River thus most of the equipment is in a static mode of maintenance and operation. The equipment is relatively new and according to the operational staff has not been operated solely under the control of the City without the supervision of the equipment vendors. There are no SOPs or ERPs related to the operation of the treatment processes. There is concern for the need for operator training and documented operational procedures (SOPs and ERPs) as some of these processes, such as the membrane and AOP treatment, are very complex in terms of O&M. It is recommended that the City have a review of what level of understanding that the existing staff has regarding the entire treatment process and what written procedures are necessary in the opinion of the operations staff, engineer, and vendor.

2.1.2 **Distribution System**

The City of Wichita water distribution system consists of approximately 2,500 miles of pipework, approximately 40,000 valves and 15,000 hydrants. There are approximately 152,000 residential meters and 6,000 commercial connections. Distribution system water lines vary in pipe diameter size from 2-inch to 48-inch with the large water mains consisting of diameters of 24-inch or greater. Many of these mains are located in the central portion of the city to direct water away from the Hess pump station. The distribution pumping and storage system is comprised of one booster station, three pumping stations with storage reservoirs, and three elevated storage tanks: Woodlawn Tower, WSU Tower, and NE Tank.

The service area of the city distribution system is divided into two pressure zones which are the Hess and Northeast. The majority of the distribution is supplied by the Hess pressure zone and the Northeast zone was created in 1980 to serve areas north of 21st Street and east of Woodlawn. Water in the Northeast zone is supplied by the Hess pressure zone and is pumped by way of the 37th Street and Webb Road Pumping Stations.

The 37th Street booster station consists of three pumps with a pumping capacity of 4.5 MGD and a firm capacity of 2.4 MGD. The Webb Road pump station is a multi-level station that is capable of discharging to the Hess and Northeast pressure zones. There are three 5.0-MGD pumps that convey water to the Hess Pressure Zone. The Hess zone pumps are supplied on the suction side by a 10.0-MGD underground storage reservoir. The Northeast Pressure zone is supplied from the Webb Road pump station from one 3.0-MGD pump with water being supplied to the pump from a storage reservoir and a 2.0 MGD tank that is supplied directly from the main WTP.

The distribution system has 24 sampling stations for total chlorine, monochloramine, free ammonia, nitrite, and bacteriological measurement. The bacteriological samples are collected and analyzed by the laboratory staff while the other parameters are analyzed and recorded by the distribution field operators.

**Condition of Process and Operational Observations**

The current water distribution superintendent has many years of experience in the industry and is scheduled to hold the position for two years prior to retiring. The plan is for the superintendent to focus efforts on the distribution system external of booster stations and the treatment plants. During this interim period the superintendent will mentor current staff to select a replacement at the end of the 2-year period.

Many of the water meters have been changed to a Badger meter automatic read type that can be read much faster than using traditional meter readers going building to building to manually record the
readings. Approximately 2,300 meters are still read manually, but these will be replaced in the near future.

The frequency of water line breaks is on average about 60 per month (720 per year) or approximately 28.8 breaks per distribution system 100 miles/year, which is more than three times the industry median of 9 breaks/100 miles (AWWA Benchmarking 2013 Survey Data and Analysis Report) (Figure 2-5). This would indicate significantly aging infrastructure and/or that a lack of preventative maintenance is occurring. It should be noted that the break number does not include leaks and seepage which is an additional repair task undertaken to address water losses.

![Breaks per 100 miles per year](image)

**Figure 2-5. Water Main Break Comparisons**

There are currently six main line crews that respond and repair breaks in the lines, valves, and hydrants. To the north there are six crews in the Water Service Group. This group addresses repair and replacement to meter pits, vaults, valve boxes and also performs valve exercising which includes hydrants. As a comparison, national benchmarking data suggests the average cost for O&M of a distribution of the scale the City manages should be approximately $17.9 million per year (AWWA, 2013), while the current budget is $13.9 million per year (City of Wichita 2016 Pro Forma). This suggests the staffing levels for managing the distribution system are inadequate by national standards.

The superintendent expressed the need for additional employees as the overtime budget in the previous year was exceeded by 364 percent. The superintendent stated that two temporary crews for valve exercising during the summer months would help in providing more time in the field for other repairs and rehab projects for equipment such as valves, meter vaults, water lines. Another concern is the need for compensation for CDL certified drivers as they are in demand and should be compensated to allow the city to retain these employees.

The fact that the superintendent is interim and the department needs more recruitment of new and younger employees into the workforce creates a significant concern for retaining the current level of service. The department is working on SOPs but as is the case in other departments, this is an area that needs immediate attention. There is a lot of work required in the field and the utility must ensure training is adequate to sustain efficiency of man power and plan for retirements of the seasoned staff.
2.1.3 Wastewater Treatment Plants and Biosolids Management

2.1.3.1 Wastewater Treatment Plant No. 1

Liquid Stream

WWTP No. 1 (Figure 2-6) in past years was a fully functional facility serving the central and eastern half of the city of Wichita as well as the majority of industrial contributors. Currently WWTP No. 1 serves as the major lift station for the city of Wichita. The processes of primary, secondary, biological, disinfection and solids handling have been discontinued at this facility which transfers these treatment requirements to WWTP No. 2.

WWTP No. 1 provides incoming wastewater screening upstream of the influent pumping station. Four front-cleaning bar screens with 0.75-inch openings are designated for influent screening, each of which can be isolated for independent operation based on flow (Figure 2-7). The screened flow is introduced to the influent pump station wet well which can be divided into two separate wet wells (North and South side). Each side contains four horizontal pumps for a total of eight for the entire system with two pumps on each side being equipped with a variable frequency drive (VFD) to control pump speed to match incoming gravity flow.
The discharge flow from the influent pump station is conveyed to a diversion structure that allows flow to be discharged to the extraneous flow holding basins or to Plant No. 2 for treatment. There are two 5-million-gallon storage basins that are concrete lined and perform much like a primary clarifier that are designed to receive extraneous flow. In addition, there is a 24-million-gallon storage lagoon which is also concrete lined. When influent flows exceed 80 million gallons, the excess sewage is diverted to the extraneous flow basins (EFBs). After influent flow rates decrease, the stored volume in the EFBs is transported to the influent pump station for directing the flow to Plant No. 2 for treatment. Influent flow that is directed to Plant No. 2 from the diversion structure is conveyed with a 66-inch reinforced concrete pipe operated under a full pipe condition and controlled by an actuated influent butterfly valve located at WWTP No. 2.

**Solids Stream**

The mechanical raking system on the bar screen removes solids from the face of the bar screen where the screenings are deposited into a water sluicing system. This system conveys the solids to a washing, fine screening, and compacting process. The washed and compacted solids are discharged into a dumpster and transported to the city solid waste disposal facility.
2.1.3.2 Wastewater Treatment Plant No. 2

Liquid Stream

The daily average flow for Plant No. 2 (shown in Figure 2-8) is around 40 MGD with flow sources coming from a 66-inch transmission line from the Plant No. 1 pump station and a 60-inch gravity sewer line from the western side of Wichita. Flow from Plant No. 1 has received preliminary screening through the ¾-inch mechanical bar screens located upstream of the Plant No. 1 influent pump station therefore this flow is directed to the Plant No. 2 primary treatment system. Flows received from the West Wichita Transmission Line are directed to the Plant No. 2 screening system. This system has two 5-foot-wide mechanically cleaned bar screens with a 0.5-inch opening. Screenings are conveyed to a washer/compactor with the final product being placed in a dumpster for ultimate disposal at the solid waste facility.

The screened wastewater flows to the influent pump station which contains four horizontal centrifugal pumps, each equipped with variable frequency drives (VFDs) and rated for 10-MGD. Flow is pumped to a common force main to the grit removal process that is comprised of two 20-foot diameter mechanical vortex grit chambers, each with a dedicated recessed impeller grit pump and grit classifier unit. The grit classifiers also receive additional flow from the sludge screens and are designed to wash and deliver grit to dumpsters for disposal at the solid waste facility.

The flow from the grit removal system is directed to primary clarification in the 180-foot diameter, 18-foot sidewall depth Plant No. 2 primary clarifier. Flow from the Plant No. 2 main influent pump station (Plant No. 1 flow) is directed to the 205-foot diameter, 18-foot sidewall depth Plant No. 1 primary clarifier. There is a backup primary clarifier that has the same dimensions as the Plant No. 1 primary clarifier and can be used as a backup intermediate or primary clarifier. Primary clarifier effluents are directed to the intermediate pump station which contains four axial flow pumps that provide the forced flow to drive the distribution arms of the trickling filters.

The trickling filter system is composed of eight 200-foot-diameter, rock media (6-foot 9-inch media depth) trickling filters. The trickling filters are divided into east and west banks each consisting of four filters. Effluent flow from the trickling filters flows to the intermediate clarification process which is comprised of three 205-foot diameter, 18-foot sidewall depth clarifiers with two normally in operation and one previously mentioned as a backup primary or intermediate clarifier. Flow from the intermediate clarifiers travels to the screw pump lift station for flow distribution to the aeration basins. Intermediate
clarifier effluent can also be directed to the intermediate pump station as a recycle flow to keep trickling filters hydraulically supplied during low flow periods.

The screw pump lift station contains four 84-inch diameter screw pumps that are variable in pumping rate which are controlled based on the level in the pump station wet well. This lift station delivers flow to a distribution box designed to split the flow to three aeration trains, each comprising two aeration basins which additional biological carbonaceous biochemical oxygen demand (cBOD) removal existing from the trickling filters and nitrification.

The aeration basins are supplied with air through fine bubble ceramic diffusers with the air source coming from three 300-horsepower blowers. The final part of secondary treatment comprises 6 160-foot, 14-foot sidewall depth final clarifiers with a single clarifier dedicated to a specific aeration basin (Figures 2-9 and 2-10).
The final clarifier effluent gravity flows to the disinfection process which has two ultraviolet (UV) treatment open channels that each contain two reactors (Figure 2-11). Each reactor contains 56 medium-pressure, high-intensity UV lamps to provide disinfection. Effluent from the disinfection process is then directed to three static mixers to provide re-aeration to the final effluent before ultimate discharge to the Arkansas River.

Figure 2-11. WWTP No. 2 UV Disinfection System

**Solids Stream**

The primary sludge from the East Primary Clarifier flows to the Plant No. 2 influent pump station and combines with the screened sewage. This flow stream is directed to the West Primary Clarifier and when in use Primary Clarifier No. 3. The settled primary sludge from these clarifiers combines with WAS from the final clarifiers in the 5,400-gallon mixed sludge distribution box. This sludge stream is thickened with three 45-foot-diameter, 18.0-foot side water depth dissolved air flotation (DAF) thickeners. The subnatant from the DAF process is recycled to the settle sewage pump station and the sludge from the intermediate clarifiers is recycled to upstream of the Plant No. 2 grit removal process.

The thickened float from the process is pumped with six 90.0 gpm progressive cavity pumps to a 12,100-gallon blend tank. There are four progressive cavity digester feed pumps that convey the sludge to four 100-foot diameter, 31.0-foot deep anaerobic digesters. Digested sludge is stored in three 617,000-gallon storage tank until dewatering activities are initiated. The digested sludge is pumped to the storage tanks with four 120-gpm recessed impeller pumps.
The digested sludge is dewatered using four 2-meter belt-filter presses (Figure 2-12). These belt-filter presses are designed to produce a cake from 18 to 20 percent solids concentration. 20,000 dry tons per year of dewatered sludge is taken to the 2.3 acre Biosolids Storage Facility (Figure 2-13). The City maintains three Class B land application fields with over 250 acres of approved land, and three full-time staff to handle some hauling and all application, plus the biosolids program manager. Landfill disposal has not been required, which indicates a well-run operation and enough storage to get through the 5 months when fields are not accessible for application.

**Condition of Process and Operational Observations**

Concerns expressed by the operational staff at Plant No. 2 were in regard to staffing levels, trickling filter rehabilitation, aeration system performance, odor control, and the condition of the 66-inch sewer line from Plant No. 1 to the Plant No. 2 influent pump station. Plant staff recognize that despite being the single largest point discharge in Kansas, KDHE regulators have given the City a lot of leeway to manage the plant and the relaxed regulatory approach will soon end with the changes to the effluent requirements.

Overtime hours are high according to staff, especially when others take vacation or sick time. The overtime was especially high in the solids handling process according to the operations staff. Site staff
was generally unhappy with recent changes that were made to the arrangement of supervisors to other sites, such as ASR. The staff mentioned that SOPs and ERPs are in the works but not available.

The needed rehab on the trickling filters is an issue that could cause process issues in the fact that these process units aid in reducing the biochemical oxygen demand (BOD) on the aeration process. Elevated BOD concentrations in the aeration process could limit the capacity to achieve complete nitrification and thus affect water quality in terms of ammonia-nitrogen levels. This is further complicated by the poor performance of the aeration system in the biological treatment processes downstream of the trickling filters.

The odor control system was not covered during the plant tour in terms of physical inspection but the operations staff did mention that this has been a problem and there are legal issues that have arisen from poor performance with the odor control process.

Process and compliance data management is through Excel spreadsheets rather than an industry standard LIMS or database system (e.g., WIMS, Op10), which staff would prefer.

2.1.3.3 Wastewater Treatment Plant No. 3 (Cowskin Creek Water Quality Reclamation Facility)

Liquid Stream
The Cowskin Creek Water Quality Reclamation Facility (Plant No. 3) receives flow from the northwest part of Wichita designed for an average daily flow of 2.0 MGD and a peak flow of 6.0 MGD (Figure 2-14). Collection system flow is distributed to Plant No. 3 through a 14-inch force main from a pumping station equipped with four 50-HP, variable speed, submersible pumps. The force main enters the plant influent pump station that has two 30-HP, variable speed, submersible pumps. The influent pump station pumps the sewage to the headworks process for preliminary treatment.

The headworks contains two spiral screens each rated for 6.0 MGD and one manual bar screen for back-up. Screening, conveying, compaction, and dewatering all occur within each unit. The headworks area also contains one nonmechanical vortex grit removal unit rated for an average flow of 2.0 MGD and peak flow of 6.0 MGD. From the headworks, wastewater flows by gravity to the biological processes which is comprised of two racetrack configured basins. The biological process is designed for biological nutrient removal (BNR) and flow is split and distributed to each treatment train at the anaerobic splitter box which contains 7.5-HP mechanical mixer. Each treatment train has two anaerobic basins equipped
with a 3-HP mechanical mixer, an anoxic basin equipped with a 15-HP mixer, and an aerobic extended aeration racetrack. Aeration is supplied from one 150-HP mechanical surface aerator in each train.

From the aeration basin, mixed liquor flows by gravity to two 60-foot diameter final clarifiers with a sidewall depth of 12-feet gravity mixed liquor settling. The final clarifier effluent flows to one cloth media disk filter for tertiary treatment prior to disinfection (currently offline and not necessary at this time to meet effluent goals). The disk filter contains a ¾-HP drive motor, high pressure spray pump, and a backwash suction pump. Effluent flow enters the UV disinfection channel and passes through a medium pressure, high intensity, UV disinfection unit comprised of a total of 16 lamps. Following the disinfection unit, a reuse water pumping system consisting of two 25-HP and one 10-HP vertical turbine pumps.

Solids Stream

In the headworks, screened solids are discharged to a dumpster for offsite disposal. The grit is conveyed from the grit tank to the grit screw conveyor washer with one 7.5-HP grit pump with washed and dewatered grit being discharged to a dumpster. RAS flow is pumped with three 15-HP variable speed pumps with one pump being designated for each final clarifier and one providing back-up redundancy. The WAS is pumped through the same suction line as the RAS pumps with two 3-HP constant speed centrifugal pumps. The WAS is pumped to a 512,000-gallon aerated storage tank that holds solids until thickening operations are conducted using one 2-meter gravity belt thickener (GBT) and associated polymer dosing system and feed/discharge pumps. The aerated storage tank is supplied with air from two 75-HP positive displacement blowers.

Thickened solids from the GBT are conveyed to the 328,000-gallon aerobic digester for further treatment and conditioning. Aeration and mixing are accomplished with two 100-HP positive displacement blowers and two 15-HP submersible mixers. The thickened solids from the process is pumped to a load out station and into a tanker truck. The solids are transported to Plant No. 2 where the sludge is mixed with sludge in Plant No. 2 and anaerobically digested and ultimately disposed of at the City Biosolids Storage Facility.

Condition of Process and Operational Observations

As the design flow for the plant is 2.0 MGD, the current flows to the facility have consistently been under half of the design flow. The operations staff mentioned problems with routinely removing total nitrogen and expressed concern with the internal mixed liquor recycle flows being too low. Recycle flows are controlled by a gate between the aeration basin and the anoxic zone. This gate was 100 percent open during the site visit which would indicate more than adequate mixed liquor recycle rates per the design. With lower influent flows and thus lower available carbon for the denitrification process, the inconsistent nitrogen removal could be attributed to inadequate carbon sources with both treatment trains in operation. A further investigation should be conducted to determine the need for both treatment trains to be in operation under current flow conditions. Significant power savings could be realized with the operation of one treatment train with reduction in aeration and mixing.

The solids treatment stream flows as WAS to an aerated holding tank until the solids are thickened and conveyed to an aerobic digester. According to the onsite operator the holding tank and digester blowers are always in operation. With flows being well below design flow, thus significantly lower sludge production, it is recommended that a further investigation be conducted to optimize solids treatment processes. It is possible that through decanting operations and determining the need for certain aerated tanks could significantly reduce blower run times and operation run time for thickening equipment. Also, digested solids are currently being returned to the sewer for retreatment downstream at WWTP No. 2. Until planned dewatering upgrades are completed (centrifuges) to allow hauling of dewatered cake to the Biosolids Storage Facility, digestion could be discontinued to save operating costs.
2.1.3.4 Wastewater Treatment Plant No. 4 (Four Mile Creek)

Liquid Stream

The Four Mile Creek WWTP (Plant No. 4) (Figure 2-15) currently serves the six Four Mile Creek sub-basins (east side of Wichita) and treats a daily average flow of approximately 2.8 MGD. The facility is being expanded for future flow contributions from an additional six basins thus the average daily flow design for the facility is 6.0 MGD and a 12.0 MGD peak wet weather flow. There are two EFBs with a combined volume of 20.7 million gallons located west of the facility. When influent flows exceed 6.0 MGD, two 20-HP vacuum primed pumps divert flow to the EFBs. The maximum pumping rate to the EFBs is 2.88 MGD. Flow is discharged from the EFBs to the treatment plant by gravity through a V-notch flow controlled sluice gate in the EFBs.

During normal flow conditions the flow enters the influent pump station wet well where there are three 2.52 MGD, self-priming pumps. The sewage is pumped to two open influent channels each with a capacity of 6.0 MGD and each containing a spiral bar screen equipped with a compactor unit. From the screening process the wastewater flows to two vortex grit removal systems to complete the headworks treatment processes. Grit is pumped from the grit chamber to the grit classifier with one 7.5-HP grit pump.

The headworks effluent flow is conveyed through a 36-inch pipe to a manhole where it is introduced to return activated sludge (RAS) flow and combines into a 30-inch pipe which then flows into the first of three anaerobic basins. Each anaerobic basin is equipped with a 5.0-HP submersible mixer. The flow then passes over a weir into the anoxic basin where the anaerobic basin effluent combines with mixed liquor from the anoxic recycle pumps. The anoxic basin has two 7.5-HP submersible mixers designed to provide adequate mixing at a flow rate of 6.0 MGD. Flow from the anoxic basin is delivered to the aeration basin through a 48-inch pipe to facilitate aerobic biological treatment for cBOD and ammonia oxidation (nitrification). The air to the aeration basin is supplied from three 75-HP blowers.

From the aeration basin flow is directed through a 48-inch pipe into a wet well to provide volume for the anoxic recycle pumps. Remaining mixed liquor volume flows under a baffle into another wet well and flows by gravity to the final clarifiers. There are two final clarifiers with one clarifier having a diameter of 80-feet and the smaller clarifier having a diameter of 60-feet. The combined effluent flows from the
clarifiers combines at a Parshall flume for flow measurement. After the flow measurement the flow is directed to a mixing chamber where a chlorine induction unit adds chlorine gas to the water for disinfection and the flow stream then enters a chlorine contact basin comprised of five open channels. At the beginning of the final channel sulfur dioxide is injected for dechlorination. The final channel is also equipped with coarse bubble diffusers for re-aeration before ultimate discharge into Four Mile Creek.

**Solids Stream**

Headworks compacted screenings and classified grit are deposited into separate dumpsters for offsite disposal at the city solid waste facility. Anoxic recycle flow from the aeration effluent wet well is delivered through two 30-HP, 6.0 MGD screw centrifugal pumps. The RAS flow from the final clarifier settled solids is conveyed to the anoxic zone with four screw centrifugal pumps. The 80-foot diameter clarifier has two 7.5-HP (1.5 MGD) dedicated to it and the 60-foot clarifier has two 5.0-HP (0.84 MGD) pumps for RAS pumping.

Scum from the final clarifiers is conveyed to a scum box that is located adjacent to the mixed liquor wet well that supplies anoxic recycle and RAS volume. WAS and the scum is removed using two 15-HP, 0.29 MGD progressive cavity pumps where the sludge is delivered to the aerobic digester/sludge holding tank. Sludge is removed from the digester/holding tank to a tanker truck using two sludge loadout pumps which are 15-HP, 0.36 MGD progressive cavity pumps. The digested liquid sludge is hauled by tanker truck to the War Industries Interceptor where the solids are conveyed to Plant No. 2 for further treatment.

**Condition of Process and Operational Observations**

The overall condition of the facility and equipment was very well kept and the operator has many years of experience running the plant. It was observed that the mixed liquor recycle pump doesn’t not have a VFD and thus runs at a constant speed. When the ratio of mixed liquor recycle (mixed liquor recycle and RAS pumping) exceeds four times the flow rate of the plant influent, the energy efficiency of pumping compared to denitrification rate starts to become significantly inefficient.

A follow-up investigation should be conducted to determine the cost value of having control over the speed of the mixed liquor recycle pump under current conditions. Also, the sludge handling operations should be investigated as possible cost savings could be realized in relation to current operations hauling liquid solids to the War Industries Interceptor and the efficiency of the aerobic digestion process. The initial thought is that the cost of aerobic digestion to reduce solids volumes and thus reducing the number of hauling trips to the interceptor could be more costly in terms of power consumption as the blowers are in constant operation. Further investigation could identify alternative operational methods to reduce power consumption.

**2.1.4 Wastewater Collection System**

The City of Wichita wastewater collection system is comprised of approximately 2,000 miles of pipelines with 150,000 service connections that serve a population of 470,000 people. There are 58 lift stations that aid in flow conveyance to the WWTPs. The sewer service areas are broken down into three district sewer basins which are listed below with the approximate size of the service area:

- Wastewater Plant No. 1 and No. 2 – 93,000 acres
- Four Mile Creek (Plant No. 4) – 9,500 acres
- Cowskin Creek Water Reclamation Facility (CCWRF) – 3,500 acres

The daily average flow in the collection system is approximately 42 MGD with 19 percent being industrial contributions to the wastewater plants. Industrial contributors include industries in aircraft manufacturing, metal finishing, refinery, food, dairy, and healthcare. In addition to the City of Wichita,
the collection system also serves the cities of Maize, Valley Center, Kechi, and Bel Aire in emergency situations. The collection system also conveys liquid biosolids to Plant No. 2 from the cities of Sedgwick and Valley Center as well as from wastewater plants No. 4 and No. 5.

Due to the relatively flat topography in Wichita, the system utilizes 58 lift stations with most being equipped with two equal capacity pumps with lift stations No. 6 and No. 22 having three, and lift stations No. 27 and No. 56 having four pumps. The lift stations discharge into a force main which have a varying range of pipe diameter from as small as 1-inch to as large as 24-inch. The force main system totals 146,700 feet of pipeline with approximately 77 percent of the pipework having a diameter of 8-inch or less. The two most common pipe materials in the collection system are polyvinyl chloride (PVC) and vitrified clay (VC) which total 97 percent of the pipe material found in the system. Of the VC pipe, approximately 7 percent has been rehabilitated with cured in place pipe (CIPP).

The crews for the collection system maintenance include the following:

- Combination Cleaning (Jet and Vacuum)
- Rodding and Root Control
- Manhole Rehab, Repair, and Adjustment
- Flushing
- Televising
- Inflow and Infiltration (I/I)
- Line Cleaning
- Line Repair
- Emergency Repair
- Flow Monitoring

There is a North and South group that each consist of line cleaning, combination cleaning, flushing, and emergency crews with the North having an I/I crew and the South having a flow monitoring crew. The televising group also has root control, cleaning, flushing, system rehab, and building/equipment repair crews. The fourth group is the repair crews that consist of internal point repair, manhole and line repair, line tap, manhole rehab, and manhole adjustment crews. There is also a second shift group that are comprised of emergency repair/response, rodding, and flushing crews.

Figure 2-16. Sewer Vactor Truck
Condition of Process and Operational Observations

The current number of positions budgeted for in the wastewater collections group is 86 and there are 3 positions that are vacant. There are concerns with the staff regarding the retirement of some senior personnel. It was also observed that the need for SOPs was quite evident and these have been started on according to field staff. The value of SOPs for training existing and especially new field crew members coupled with the concern of retiring senior collections staff exposes an even greater need to implement a program of producing SOPs.

A comment was made regarding the fact that home basement back-ups are not required to be reported as a sanitary sewer overflow (SSO) even though it is the result of a problem within the collection system. Being that the basement back-ups are not reported as an SSO, the urgency to address certain sewer problems may not be reflected when using only manhole overflows as a primary measurement parameter and excluding residential basement back-ups. Federal EPA guidelines and regulations around CMOM (capacity, management, O&M of sewer collection systems) consider basement backups as SSO events, so current reporting practices need to be corrected if this is in fact not being counted.

According to the staff, the vehicle fleet and general condition of field equipment is currently in “good” condition. There were concerns that the sewer master plan has not been updated since 2005 and that the sewer modeling software is outdated. The specific needs that indicated during the staff interviews were the following:

- Two additional televising crews
- One additional combination cleaning crew
- Two additional cleaning crews
- Data entry and televising review positions
- Back-up payroll employee
- One CIPP/T-Liner Crew

A suggestion was also made to hire interns to be tasked to perform smoke testing and manhole inspection to allow fully trained field personnel more time in the field to perform more collection system duties and also aid in overtime reduction. The staff was aware of the work that was needed to be addressed in the field but there is not enough time and personnel to complete. There was a sense that the time in the field efficiency is crippled by paperwork and data management as well as the need for documented SOPs. Many of the same staffing issues exist currently that were indicated on the CMOM plan in regard to training, SOPs, and recruiting new employees to replace the staff members that are close to retirement.

2.2 Maintenance

2.2.1 Water Treatment Plants

2.2.1.1 Main Water Treatment Plant

Maintenance activities for the Main WTP is led by the Plant Maintenance Supervisor and supported by a staff of 15 full-time employees including maintenance specialists, maintenance mechanics, electricians, electronics technicians and maintenance workers. The general condition of the facilities is considered to be in marginal, age appropriate, condition which takes into account the fact that the many of the assets in the facility are in excess of 40 years old and still in service. However, although still in service, many assets are nearing or at the end of their useful life expectancies.

The maintenance department meets daily, in the morning, to review work in progress, assign new work and discuss any new issues. A computerized maintenance management system (CMMS) or enterprise
asset management (EAM) system is not used by the Water Production or Water Distribution section but the staff recognizes its value and is highly anticipating and motivated for the integration of Lucity CMMS in their sections. An online blog system has been created, by the Plant Maintenance Supervisor and out of necessity, allowing Operations the ability to submit work requests. The management process is primarily verbal and written using office systems such as MS Word and Excel to record and track maintenance activities. Even though a CMMS program is not in place the daily protocols are consistent and do represent a management process that is adhered to by the staff. Staff have become a custom to maintaining hard copy work records for their own use which shows personal responsibility in managing equipment. Recently, the maintenance staff has taken the initiative to develop Standard Operating Procedures (SOPs) for safe operation of the ammonia and chlorine chemical systems. These systems are new and the installation and startup was primarily handled by the maintenance department. Additional SOPs have been drafted for mechanical procedures but need updating and approval from operations.

Not having an off the shelf CMMS or EAM program in place is not considered a major deficiency. However, not maintaining an accurate asset registry or having standard maintenance procedures in place for preventive and corrective activities is considered a major deficiency by regulatory agencies. If processes and actions are not documented, then they are generally considered to not be in place. Preventive maintenance is calendar based with activities such as oil changes happening twice a year for slow mixers, clarifiers and sludge collectors. Maintenance supports operations regularly and are trained in HAZWOPER, CDL and as first responders for the chlorine and ammonia systems. No documentation for redirect is available for work initiated by Operations which has made it difficult to quantify. Job descriptions need to be updated to include actual duties performed.

During the site visit the following areas of the plant that were discussed with plant staff as potential for rehabilitation or replacement:

- North Thickener – Spare parts obsolescence
- West basin flocculator shafts - Rehabilitation
- Cathodic protection system - Not fully operational
- Ammonia tanks – Structural inspection due to age
- Underdrains, mud valves - Not operable
- Ferric Tank - Structural inspection due to age
- Actuators, many are 1993 – Parts obsolescence
- Lime slurry system - Pumps past useful life
- East plant boiler – Past useful life
- Aerators – Age, structural integrity

### 2.2.1.2 Aquifer Storage and Recovery Plant

At the time of CH2M’s site visit, the ASR Plant and intake facility were not operating due to the Little Arkansas River flowing below the required cubic feet per second for extracting water from the river. The ASR facility assets are assumed to be in excellent condition because they are essentially new. However, no formal maintenance plan has been developed for the facilities. It is highly recommended that maintenance plans be developed that address both offline and online operating scenarios. Offline maintenance plans are of particular importance as equipment that is out of service for extended periods of time are susceptible to corrosion, bearing flattening, drying seals, fluid leaks and seizing. Motors, pumps and valves are most vulnerable to failures associated with long periods of inactivity.

At a minimum, critical assets should be identified and maintained per manufacturer recommendations to insure plant operability when required.
2.2.1.3  Cheney Water Treatment Plant

The Cheney WTP (Figure 2-17) is located beside the Cheney dam and pumps water through a 60-inch force main to the 21st and Zoo pump station. The Cheney plant is operated and maintained by two full-time mechanic-operators. There are five 30 MGD, 4160 volt pumps at the plant with two controlled by variable frequency drives and three pumps using soft-starts. The motors are heated to limit moisture in the windings and have Resistance Temperature Detectors (RTDs) monitoring bearing and winding temperatures as an early failure detection. The pumps were new in 1998 and have between 40,000 and 60,000 operating hours on them. All pumps use SpiralTrac with packing and in combination with tungsten carbide sprayed sleeves the plant is getting 35,000 operating hours from the shafts. There is a 15 ton traveling hoist which allows pumps and motors to be pulled by staff. Pump rebuilds are performed by in-house staff and one pump was in the process of being rebuilt when CH2M was on site.

There are three self-cleaning strainers off the pump suction header for removal of debris. Cheney also uses a copper-electrode system which introduces a copper solution into the water and kills the zebra mussels. This system has proven to be very effective keeps the zebra mussel population to a minimal nuisance. The physical condition of the Cheney water transmission pipe is apparently good. However, the condition of the PRVs and ARVs is suspect as maximum flow through the pipe has been declining.

The ozone process is 10 years old and was installed for taste, odor and disinfection. The condition of the ozone facility was in good condition and maintenance of the facility is handled in house by Cheney staff and only specialty work is contracted. In 2014, two generators were installed, in a blast proof rated building to protect against tornado damage, and switchgear rehabbed. Generator maintenance, fluid changes and upkeep, is performed in house. Individually they are able to run two items (one pump and Ozone), in parallel they are able to operate three pumps and the ozone process. The switchgear was originally installed in 1998.

As is consistent across the water section, maintenance management for Cheney is paper driven process without the use of a CMMS. Records are maintained through a paper filing system and preventive maintenance is performed on a calendar basis. It was obvious to CH2M that Cheney staff do a suitable job maintaining and rehabilitating equipment. However, it is recommended that a formal maintenance plan be developed for the plant and be integrated with CMMS to support historical records, scheduling and planning.
During the site visit the following areas of the plant that were noted as potential for rehabilitation or replacement:

- Dam Cap - Known issue
- Switchgear – Obsolescence
- Electrical breakers – obsolescence
- ARV/Vacuum breakers on transmission lines

### 2.2.2 Distribution, Lift Stations, and Reservoirs

#### 2.2.2.1 Hess High Service Station

Hess Station provides water for the high service area of Wichita. The station is manned 40 hours per week by a supervisor and mechanic who are also on call to maintain Webb Rd, South East, 37th, Maple and the elevated tanks. There are eight pumps at Hess capable of pumping 35-40 MGD. All pumps are packed and do not use mechanical seals. The pumps are controlled by 4160 volt VFDs in a scheme that has pumps 1, 3, 5, 7 controlled by a single drive, pumps 4, 6, 8 controlled by a single drive and pump 2 controlled by a single drive. This limits the combinations by which the pumps may be operated. The pumps have a vacuum priming system that has never functioned as intended. However, this is not considered a critical flaw as the pumps have flooded suction bells and it would be an extreme occurrence to have the water level below the suction bell. There are no spare VFDs which could pose a risk if one were to fail as procurement and installation could take an excessive amount of time. There are four dewatering pumps available which were not run during the site visit but they apparently operate without issue.

Basic PMs exist for the pumps, motors and electrical gear including inspections and oil changes. The majority of the corrective and preventive maintenance performed by the Hess staff including pump tear downs. One pump assembly is rehabilitated annually by Hess staff. No CMMS is used but there is an O&M library on site and paper records are maintained. It is recommended that a formal maintenance plan be developed for the plant and be integrated with CMMS to support historical records, scheduling and planning.

Generators were installed in 2009 with an 8,000-gallon underground storage tank and can provide 2000kw of electricity. This allows for half of the main plant and Hess station to operate. The generators are located in a blast proof building to protect against tornadoes.

Water is drawn from main plant clear wells to fill below grade reservoirs and pumps take suction from a common 84-inch pipe that comes into the lower level of the plant. This pipe had noticeable corrosion at various weld-o-lets that should be further investigated for metal thickness. There was also leakage coming from the wall penetration where the 72-inch discharge line exits the building. The dehumidifiers, six large units, for this building are not functioning which has likely led to a higher level of corrosion to equipment than was expected if the units were operating. Air handlers and air conditioning were replaced in 2009 to keep the VFDs cool as they were failing on over temperature.

During the site visit the following areas of the plant that were noted as potential for rehabilitation or replacement:

- Dehumidifiers are not working and corroding bare metals
- 72-inch discharge line leaking at wall penetration.

#### 2.2.2.2 Webb Road

Webb Rd is a booster station which operates with 5 horizontal end suction centrifugal pumps that are between 150HP, 250 HP and 300 HP. Each pump is operated by its own VFD but there is no automated
pump program for maintaining levels and pressures. The station has underground one million gallon reservoirs receive water from Hess Station through a 36-inch pipe.

There is no CMMS or documented maintenance management plan for the Webb Rd assets. One pump had a rotating assembly being replaced and was out of service but all other equipment was operational at the time of inspection. Staff from Hess are responsible for the maintenance of the station which is primarily reactive. The station does not currently have a generator but will be receiving a new unit in 2016.

2.2.3 Wastewater Treatment Plants and Biosolids

2.2.3.1 Plant No. 1

Plant No. 1 has been converted from treatment facility into a large lift station and extraneous flows holding plant. The major equipment at the plant is for screening, screening disposal and pumping (Figure 2-18). Plant No.1 is unmanned and maintenance is dispatched from Plant No.2. The screening bar racks at Plant No.1 have undergone several rebuilds and should be considered for potential upgrade. The grit compacting and disposal system is newer operating in apparent good order (Figure 2-19).

Assets from Plant No.1 are included in the Avantis CMMS system and there is a history of preventive maintenance primarily on the life safety systems – gas detection, emergency lights. The PM program in place, through Avantis, is considered incomplete as detailed records for preventive and corrective maintenance performed are not complete.

Figure 2-18. WWTP No. 1 Bar Screens
2.2.3.2 Plant No. 2 and Biosolids

Maintenance operations for the five WWTPs, 58 lift stations and Biosolids is managed by the Sewage Treatment Division and primarily run from Plant No. 2. Maintenance activities are divided by craft and job type into three Sections: Electrical, Mechanical and Biosolids/Lift Station Maintenance. Each Section is led by a Supervisor who reports to a Division Manager. The maintenance staff at the WWTPs and facilities perform the majority of maintenance activities except for tasks required to be performed by licensed trades or work that is outside the reasonable abilities of the staff.

The Sewage Treatment maintenance supervisors are responsible for work and work order management. This process involves managing work requests and assigning work orders to the appropriate maintenance staff. The Sewage Treatment division uses Avantis CMMS as a work order management tool but it is not being fully utilized in a way facilitates making business decisions for the maintenance sections through proper asset management.

The Sewage Treatment maintenance sections are in the process of converting from Avantis to Lucity CMMS. It is recommended that the maintenance department take this opportunity to create a Lucity integration plan and re-define the business process that defines maintenance management for their facilities wastewater facilities. This includes:

- Validating the asset registries in Avantis prior to entering the information into Lucity
- Updating labor and cost centers
- Defining work order types
- Revising existing PM procedures for completeness including safety and job task details
- Schedule PM on appropriate calendar days, by run hours or by condition
• Develop planned, unplanned and emergency work flow procedures which define the work order and work management process and associated standard operating procedures
• Training on CMMS and staff roles and responsibilities

2.2.3.3 Plant No. 3 Cowskin Creek Water Quality Reclamation Facility

Cowskin Creek does not have dedicated on-site maintenance staff and maintenance personnel are dispatched from Plant No. 2 for maintenance activities. During the site visit the Headworks was being bypassed straight to aeration for repairs which were in progress. The Gravity Belt Thickener system was also offline during the visit but available for service.

Cowskin Creek does not have a formal maintenance plan in place for asset management. However, facility housekeeping was very good and other than assets that were offline for service all equipment was available and in apparent good working order. It is recommended that the pending CMMS transition be used to revise and further develop the asset management plan for the facility. This will include updating the asset registry, developing a manufacturer recommended preventive maintenance plan and a work order management plan to track work history against assets. Work maintenance and cost history are two critical components of the repair, rehabilitate or replace decision process and should be thoroughly tracked through CMMS.

2.2.3.4 Plant No. 4 Four Mile Creek

The Four Mile Creek Plant (Figure 2-20) has plant has an assigned operator to the site who also performs general site maintenance tasks. Regular mechanical maintenance tasks are dispatched from Plant No. 2 as is consistent with other wastewater facilities. Housekeeping at the plant was excellent and all plant equipment was available and in apparent good working order.
Four Mile Creek does not have a formal maintenance plan in place for asset management. It is recommended that the pending CMMS transition be used to revise and further develop the asset management plan for the facility. This will include updating the asset registry, developing a manufacturer recommended preventive maintenance plan and a work order management plan to track work history against assets. Work maintenance and cost history are two critical components of the repair, rehabilitate or replace decision process and should be thoroughly tracked through CMMS.

2.2.3.5 Plant No. 5 Mid Continent

The Mid Continent Plant (Figure 2-21) was not in operation when visited and no plans were in place for the plant to return to service. It is highly recommended that if the plant intends to continue to be off line that an offline maintenance program be initiated to preserve the mechanical and operational integrity of the facility. As recommended for all the wastewater facilities it is recommended that the pending CMMS transition be used to revise and further develop the asset management plan for the facility. This will include updating the asset registry, developing a manufacturer recommended preventive maintenance plan and a work order management plan to track work history against assets. Work maintenance and cost history are two critical components of the repair, rehabilitate or replace decision process and should be thoroughly tracked through CMMS. Offline maintenance plans are of particular importance as equipment that is out of service for extended periods of time are susceptible to corrosion, bearing flattening, drying seals, fluid leaks and seizing. Motors, pumps and valves are most vulnerable to failures associated with long periods of inactivity. At a minimum, critical assets should be identified and maintained per manufacturer recommendations to insure plant operability when required.
2.2.4 Collection System and Pump Stations

Maintenance of the conveyance system is the responsibility of the Sewer Maintenance Division. Work is distributed among five sections, each led by a General Supervisor. The cleaning and CCTV section focuses on video inspection of the sewers along with the associated flushing, cleaning and rehabilitation of the pipelines and joints. The repair and construction section focuses on repairs of pipelines and manholes, and making new connections to the sewers. Two field crew sections, one for the north portion of the service area and one for the south, focus on cleaning and flushing sewers, monitoring flows and detecting inflow and infiltration, as well as responding to emergencies. The fifth section works second shift and responds to emergencies, customer complaints and other collection system issues that require an immediate response.

Sewer Maintenance is not directly responsible for pump station, catch basin cleaning or force main maintenance but will support other divisions as requested. Service calls into the dispatch office at Water Distribution and response is delegated Sewer Maintenance as necessary. If the call is determined to be an SSO a Sewer Maintenance supervisor is directed to respond and complete the 24 hour report. After the issue is contained, mitigated and cleaned CCTV inspection is performed to determine the cause.

There are three CCTV crews and twelve cleaning crews who work to maintain the collection system. The cleaning crew are split into North and South and responsible for cleaning, flushing, infiltration and inflow monitoring and emergency response. The department goal is to increase CCTV footage and review to three times the current amount. Recently two new panoramic cameras, with side scan, have been purchased which are able to drive down the pipe and record full pipe scan images. These videos will be reviewed in the office to allow CCTV crews more time in the field. Twelve of the maintenance staff are PACP trained allowing for video review to occur in the field and in the office. Sewer Maintenance also has a manhole inspection program for the city and has two manhole raising crews for repairs.
Sewer Maintenance actively uses Lucity, which is integrated with GIS, to manage department operations, maintenance and repair activities. Sewer cleaning in mapped in GIS as are hot spots and flush points. Paper work orders managed by Sewer Maintenance supervisors who prioritize the work orders with severity ratings and distribute to field staff. Supervisors enter work order data into Lucity with problem codes for reporting and root cause analysis. Root cause information is then used to make repair, rehabilitation and replacement decisions.

### 2.3 Staffing and Training

Staffing of the treatment facilities, distribution and collection systems requires skilled and knowledgeable team members. In many cases, Kansas law requires these individuals to be certified to the appropriate levels and to maintain these certifications via continuing education. Having the appropriately skilled, trained, certified staff, at the appropriate staffing levels, is one of the largest challenges facing the City of Wichita Utilities Division today. At current the Utilities Division has 332.5 FTE staff with 139.5 FTE dedicated to wastewater related operations and 151 FTE to water related duties (Table 2-1). Another 42 are in planning, engineering and other utility management and support functions and are excluded from further analysis in this report. A total of 37 vacancies exist division wide on the table of organization, and have remained vacant mostly due to budget constraints.

In general staff members are competent at their jobs; however, many individuals could benefit from job specific training to allow them to advance their skills beyond those learned/handed down on the job in an effort to advance techniques within the department.

#### Table 2-1. Staff Benchmarks

<table>
<thead>
<tr>
<th>Facility</th>
<th>Water Treatment</th>
<th>Water Distribution</th>
<th>Wastewater Treatment</th>
<th>Wastewater Collection</th>
</tr>
</thead>
<tbody>
<tr>
<td>Staff count, FTE</td>
<td>35</td>
<td>116</td>
<td>53.5</td>
<td>86</td>
</tr>
<tr>
<td>Production, MGD/FTE</td>
<td>0.36</td>
<td></td>
<td>0.67</td>
<td></td>
</tr>
<tr>
<td>Current</td>
<td>0.25 (median)</td>
<td></td>
<td>0.30 (median)</td>
<td></td>
</tr>
<tr>
<td>Benchmark</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Transmission, FTE/100 mi.</td>
<td>4.9</td>
<td></td>
<td>4.2</td>
<td></td>
</tr>
<tr>
<td>Current</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Benchmark</td>
<td>4.7</td>
<td></td>
<td>6.4</td>
<td></td>
</tr>
<tr>
<td>Staff per supervisor</td>
<td>0.7:1</td>
<td>4.5:1</td>
<td>2.2:1</td>
<td>13:1</td>
</tr>
</tbody>
</table>

A more in depth look at the current staff number and training requirements follows.

#### 2.3.1 Water Plants

As mentioned in section 2.1.1.1, the City of Wichita has two main WTPs (Central and East), located on a common site, with a combined treatment capacity of 160 MGD. The City currently employs 35 staff including management, supervision and hourly workers at the WTP. This statistic does not include the number of positions that are on the existing table of organization that remain in an open and not filled status. The current table of organization is shown in Figure 2-23.
The WTP require oversight by at least one State of Kansas Class IV Water Supply System certified operators and while not directly required, it is generally recommended that all treatment plant staff work to become certified and maintain certification through continuing education. Those individuals that are certified operators are required to attend 10 hours of approved continuing education every two years to maintain their certifications. Typically, safety or other city sponsored training (i.e. annual ethics or anti-harassment training) would be in addition to these training requirements.

Traditionally the WTP has been a very hands-on type facility in that most all adjustments are monitored and executed by staff rather than automation. This situation continues today and modern technology has not been utilized via the installation of automatic control systems. In operating the facility, current methodology is for the Operation Supervisors in the control room to notify mechanics of needed changes and the mechanics make the requested changes in the field. Operations Supervisors monitor the process and the effects of changes made via control room supervisory control and data acquisition (SCADA) systems. In modern facilities, SCADA not only monitors the process, but many changes are made automatically through the programs with oversight for unusual conditions by highly trained operators who can intercede to control if circumstances dictate it. Between process changes, mechanics maintain plant equipment.

As can be seen on the table of organization, the WTP contains 1 management position, 18 supervisory, 13 hourly and 2 administrative positions. Not including the administrative positions in this calculation, this gives and 18:1 supervisor: manager ratio and a 0.7:1 hourly: supervisor ratio. Typically, in the utility industry, these ratios are generally 10:1 and 5:1 respectively; however, can be 5:1 to 20:1 depending on the specific job functions involved. In reviewing staffing to water production and delivery metrics, using the typical annual water production of 70 MGD, the plant is currently operating with a 0.36 MGD per employee ratio (WTP, raw water, and distribution combined); the median industry benchmark is 0.25 MGD per employee, and the top quartile is 0.33 MGD per employee (Figure 2-24). In other words, the City is operating the water system at the top end of nationally benchmarked utilities in terms of water production per staff member. This could indicate either an extremely efficient operation, or an understaffed one, depending on the risk factors and level of service provided.
2.3.2 Distribution, Lift Stations, and Reservoirs

The City operates and maintains the Cheney Reservoir, the Equus Bed Well Fields, the ASR system, several booster stations, 2,367 miles of water distribution mains and 150,000 water meters. Conducting these tasks require slightly different and highly specialized, yet related skillsets in comparison to operating the water treatment facilities. Specifically, a general understanding of hydraulics, equipment/pump operation, flow monitoring and water chemistry is required in the distribution system as well as the water plants. In addition to water treatment basics, distribution operators need to be familiar with and competent in the operation of heavy equipment like excavators, back hoes, dump trucks and other similar apparatus. In conducting the O&M of these facilities Wichita employs 116 current employees from supervision, maintenance, operations, heavy equipment operations, meter readers to clerical staff members. The current table of organization is shown in Figure 2-25.

While the State of Kansas does not currently require Distribution System employees to be certified or licensed. However, due to the level of professionalism and skillsets required to properly conduct their duties, staff in these areas require training to keep current on current trends and practices in the water treatment field, safety and vendor supplied training on specific brands or models of equipment in service.

As can be seen on the table of organization, the Distribution Division contains 1 management position shared between the pumping station and reservoir operations, 1 manager dedicated to the ASR WTP, 1 engineering position at the ASR WTP, 18 supervisory, 86 hourly (field labor) positions and 9 administrative/clerk positions. Not including the administrative/clerk positions in this calculation, there is an average of 19:1 supervisor: manager ratio and a 4.5:1 hourly: supervisor ratios. Granted the current organization in individual sections may have other ratios based on the specific job duties/classifications (e.g. the meter readers are supervised by one supervisor giving a 12:1 ratio in that group).

In reviewing staffing dedicated to the various functions within the distribution and compared to distribution system metrics, the system is operating with 4.9 FTE/100 miles of distribution piping, which is very similar to published benchmark data of 4.7 FTE/100 miles (Louisville Water Company), indicating an appropriate staff size, assuming services are being provided as required.
2.3.3 Wastewater Treatment Plants and Biosolids

As mentioned in section 2.1.3, the City of Wichita has four WWTPs (WWTP No. 2, Cow Creek, Four Mile and Midcontinent) and a facility that while formerly a functional WWTP now only serves as a major pump station (WWTP No. 1). Currently, Midcontinent WWTP is off line due to ongoing maintenance issues and is not staffed. Combined, the three functional treatment facilities have an average flow rate of 36 MGD. The biosolids processing facility is stationed at WWTP No. 2, this facility treats, stabilizes and ultimately disposes of all the biosolids produced between the four facilities. The City currently employs 53.5 FTE staff including management, supervision, administrative and hourly workers at the treatment facilities. This statistic does not include the number of positions that are on the existing table of organization that remain in an open and not filled status. The current table of organization is shown in Figure 2-26.

The WWTPs require oversight by at least one State of Kansas Class IV Wastewater Treatment Facility certified operator and while not directly required, it is generally recommended that all treatment plant staff work to become certified and maintain certification through continuing education. Those individuals that are certified operators are required to attend 10 hours of approved continuing education every two years to maintain their certifications.

Figure 2-25. Table of Organization Distribution, Pumping, and Reservoirs

* focused at WWTP 2
Because of the manual nature of the facility, operators must make most changes to the operation manually rather than utilizing supervisory control and data acquisition (SCADA) for control. Operations Supervisors monitor the process and the effects of changes made via control room SCADA systems. Plant equipment is maintained by mechanics as directed by maintenance supervisors.

In the smaller facilities, generally they are overseen by an operations supervisor and a small staff of operators and mechanics depending on the location. These smaller plants are not staffed 24 hours per day and have monitoring capabilities from off site to ensure alarms are transferred to the main plant to be addressed in off shifts.

Also housed at WWTP No. 2 is the biosolids processing activities for the system. Sludge produced at the outlying facilities are trucked to WWTP No. 2 for treatment, stabilization and disposal at the city owned landfill operation. In some cases, the solids are already digested before hauling and are blended into the WWTP No. 2 solids stream and treated jointly before ultimate disposal. A 3-person staff oversees this activity.

As can be seen on the table of organization the Wastewater/Biosolids Treatment group contains 1 management position, 16 supervisory, 34.5 hourly FTEs and 2 administrative positions. Not including the administrative positions in this calculation, this gives and 16:1 supervisor: manager ratio and a 2.2:1 hourly: supervisor ratio.

In reviewing staffing to production metrics, assuming a daily total treatment average of 36 MGD, the plants are currently operating with a 0.67 MGD/staff member ratio, compared to a national median benchmark of 0.30 MGD/FTE (AWWA, 2013). This indicates an understaffed operation, unless the plant was highly automated or unusually efficient for some other reason.
2.3.4 Collection System and Pump Stations

The City operates and maintains the 2037 miles of wastewater collection pipelines. Conducting these tasks, not unlike the distribution system operators, require slightly different and highly specialized, yet related skillsets in comparison to operating the wastewater treatment facilities. Specifically, a general understanding of hydraulics, equipment/pump operation and flow monitoring is required in the collection system as well as the wastewater plants. In addition to wastewater treatment basics, collections system operators need to be familiar with and competent in the operation of heavy equipment like excavators, back hoes, dump trucks, vac truck, jetting machines and other similar apparatus. In conducting the O&M of these facilities Wichita employs 86 current employees from supervision, maintenance, operations, heavy equipment operations, meter readers to clerical staff members. The current table of organization is shown in Figure 2-27.

As can be seen on the table of organization the Collection System group contains 1 management position, 6 supervisory, 78 hourly FTEs and 1 administrative (clerk) positions. Not including the administrative positions in this calculation, this gives and 6:1 supervisor: manager ratio and a 13:1 hourly: supervisor ratio. Typically, in the utility industry, these ratios are generally 10:1 and 5:1 respectively; however, can be 5:1 to 20:1 depending on the specific job functions involved. In reviewing staffing to production metrics, assuming 2037 miles of lines serviced, the collection system group is currently operating with 4.2 staff members per 100-mile ratio. A benchmark for this metric, using utilities with more than 1,500 miles of piping, suggests a 6.4 FTE/100 mile comparison, which shows a potential that the Wichita system in understaffed.

Like the Distribution System, the State of Kansas does not currently require Collection System employees to be certified or licensed. However, due to the level of professionalism and skillsets required to properly conduct their duties, staff in these areas require training to keep current on trends and practices in the wastewater collection/treatment field, safety and vendor supplied training on specific brands or models of equipment in service. This training is in addition to City required training for safety, human resources related or others required by state law of employees.
2.4 Costs

Ultimately the cost of doing business in the utility industry comes down to four key categories, labor, maintenance, chemicals, and power costs (Figure 2-28). While these expense categories are not all encompassing, they do represent the largest budget line items that are encountered in the utility business sector. One key item that is not being evaluated as part of this report is the investment in capital improvements/upgrades and the requirements to keep up with aging infrastructure as well as the expansion of service areas as the City grows or becomes a sustainable entity for the future in developing other water sources and enacting conservation measures.

![Figure 2-28. Current O&M Budget Cost Centers](image)

Combining the cost of operation and the need for capital improvements are two factors in the setting of rates. Generally speaking, operational costs impact the annual budget and tend to be the more scrutinized line item at budget time. Smart capital reinvestment can have more impact on operational costs over time than most consider. For example, when considering the cost of operating and maintaining out of date (i.e. older than 20 years) pumping systems/motors, investing in upgraded, and higher efficiency systems can have longer term benefits in lowering, or maintaining current costs as incremental costs increase (i.e. electric rates increase yet kwh usage decreases). As such, costs should be evaluated for opportunities to invest in capital for capacity upgrades that have potential to reduce overall operational costs.

It is well known that the costs of operation, upkeep, replacement, loan repayment and other related costs are all factors in setting utility rates. In turn, pressure is on the utility from the ratepayers to keep costs low so that rates remain low. Artificially keeping rates low and at the same time ignoring upkeep, capital reinvestment and operational costs will have limited near term benefit yet create a situation where the backlog of deferred maintenance will reach critical levels and in the end cost more in the future than had things been addressed over time. This is known as the pay some now vs. pay more later scenario and time and time again, the result of paying more later is significant increases in rates rather than small incremental ones over time that would reflect proper investment in the respective utility systems.
At current the City of Wichita spends $56.3 million annually on operational costs. This is further broken down to $30.4 million for wastewater related expenses and $25.9 million for water related expenses. The expenses above are further broken down and reviewed in Table 2-2.

### Table 2-2. Distribution of O&M Costs Among Facilities, 2016 Estimates

<table>
<thead>
<tr>
<th>Facility</th>
<th>Labor</th>
<th>Chemicals</th>
<th>Utilities</th>
<th>Solids Handling</th>
<th>Maintenance</th>
<th>Other Expenses</th>
<th>TOTAL</th>
</tr>
</thead>
<tbody>
<tr>
<td>WWTP No. 1 Grove St.</td>
<td>$108,447</td>
<td>-$</td>
<td>$80,826</td>
<td>$28,408</td>
<td>$500,000</td>
<td>$95,300</td>
<td>$812,981</td>
</tr>
<tr>
<td>WWTP No. 2 Main</td>
<td>$2,869,966</td>
<td>$988,005</td>
<td>$2,869,764</td>
<td>$18,939</td>
<td>$3,000,000</td>
<td>$834,975</td>
<td>$10,581,649</td>
</tr>
<tr>
<td>WWTP No. 3 Cow Creek</td>
<td>$286,531</td>
<td>$20,836</td>
<td>$335,539</td>
<td>$3,252</td>
<td>$500,000</td>
<td>$100,600</td>
<td>$1,246,757</td>
</tr>
<tr>
<td>WWTP No. 4 Four Mile</td>
<td>$138,291</td>
<td>$45,508</td>
<td>$302,670</td>
<td>$6,568</td>
<td>$500,000</td>
<td>$95,300</td>
<td>$1,088,337</td>
</tr>
<tr>
<td>WWTP No. 5 Midcontinent</td>
<td>$54,224</td>
<td>$25,552</td>
<td>$371,637</td>
<td>-$</td>
<td>$500,000</td>
<td>$102,650</td>
<td>$1,054,063</td>
</tr>
<tr>
<td>Biosolids</td>
<td>$233,620</td>
<td>-$</td>
<td>$16,165</td>
<td>-$</td>
<td>$250,000</td>
<td>$377,950</td>
<td>$877,735</td>
</tr>
<tr>
<td>Collections</td>
<td>$5,788,706</td>
<td>-$</td>
<td>$309,100</td>
<td>-$</td>
<td>$3,000,000</td>
<td>$837,900</td>
<td>$9,935,705</td>
</tr>
<tr>
<td>East/Central WTPs</td>
<td>$3,486,875</td>
<td>$3,382,601</td>
<td>$318,292</td>
<td>-$</td>
<td>$2,000,000</td>
<td>$727,750</td>
<td>$9,915,518</td>
</tr>
<tr>
<td>Cheney Res/WTP</td>
<td>$184,979</td>
<td>-$</td>
<td>$1,229,092</td>
<td>-$</td>
<td>$500,000</td>
<td>$105,300</td>
<td>$2,019,371</td>
</tr>
<tr>
<td>ASR WTP</td>
<td>$630,927</td>
<td>$50,000</td>
<td>$220,149</td>
<td>-$</td>
<td>$500,000</td>
<td>$397,225</td>
<td>$1,798,301</td>
</tr>
<tr>
<td>Equus Beds</td>
<td>$273,918</td>
<td>-$</td>
<td>$742,081</td>
<td>-$</td>
<td>$500,000</td>
<td>$351,925</td>
<td>$1,867,924</td>
</tr>
<tr>
<td>Hess PS and Res</td>
<td>$151,719</td>
<td>-$</td>
<td>$2,970,334</td>
<td>-$</td>
<td>$500,000</td>
<td>$95,300</td>
<td>$3,717,353</td>
</tr>
<tr>
<td>Distribution</td>
<td>$5,746,344</td>
<td>-$</td>
<td>$247,727</td>
<td>-$</td>
<td>$2,500,000</td>
<td>$1,032,650</td>
<td>$9,526,721</td>
</tr>
<tr>
<td>Admin</td>
<td>$3,774,135</td>
<td>-$</td>
<td>-$</td>
<td>-$</td>
<td>-$</td>
<td>$3,774,135</td>
<td>$3,774,135</td>
</tr>
<tr>
<td>Total</td>
<td>$23,728,681</td>
<td>$4,512,502</td>
<td>$10,013,376</td>
<td>$57,167</td>
<td>$14,750,000</td>
<td>$5,154,825</td>
<td>$58,216,551</td>
</tr>
</tbody>
</table>

#### 2.4.1 Labor

At current, total labor costs for all departments within the City of Wichita’s Utility Division is $23.3 million broken down to $12 million wastewater and $11.3 million water related. When looking at the total staffing between wastewater and water related activities, with 139.5 FTE staff dedicated to wastewater related operations and 151 FTE to water related duties (plus 42 for administrative and planning functions). When considering the overall average FTE cost for the entire division, for budgeting purposes, $70,075 can be utilized for comparison purposes, or an average of $33.69 per labor hour.

It is important to note that the labor costs per FTE shown above includes fringe benefit costs such as leave time, insurance, retirement contributions and other benefit costs and this value is not the amount received by the average employee in take home pay. Generally speaking, the City of Wichita’s fringe benefits package accounts for, on average, 46 percent of the above cost, leaving the average take home pay of $37,841 per FTE in the Utilities Division.
As mentioned previously, 37 FTE positions are listed as vacant on the table of organization for the Utilities Division. The benchmarking analysis suggests the City is indeed currently understaffed without these positions being filled. These positions were left vacant as part of cost cutting activities where open positions were left unfilled to lower labor costs. Without filling these positions, and using the average of $70,075 per position, the Utilities Division is currently avoiding the expense of $2.6 million in additional labor costs. As part of this report, alternative organizational structures will be evaluated in an effort to continue with this cost savings measure, and perhaps other ways to improve efficiency long term.

2.4.2 Maintenance

Maintenance activities, conducted at the appropriate time and in appropriate methods and materials serve to extend the useful life of the City’s utilities infrastructure. Maintenance not conducted in the appropriate time or using appropriate methods and materials may not achieve the goal of extending useful life, and may in the end, cost more in wasted effort and damaged equipment. Maintenance costs as defined for this report includes parts, supplies, lubricants, tools and contracted work utilized in maintaining systems and equipment.

Currently the Utilities Division spends $15.2 million annually on maintenance activities. This value is split almost 50/50 between wastewater and water portions of the Utilities Division. Specifically, $7.7 and $7.5 million on the wastewater and water portions respectively. Additional discussion on maintenance activities was covered previously in section 2.2 above.

2.4.3 Chemicals

Chemicals are necessary for the purification of raw water to make drinking water, to take raw sewage and convert it to clean water and to ensure compliance with applicable regulations. Chemicals are used to improve settling of solids from the water, to disinfect and ensure harmful organisms are destroyed protecting human health, remove contaminants as required by regulations (i.e. phosphorus) to thicken solids produced and reduce the volume to be disposed and to protect against corrosion in the distribution system.

Currently the Utilities division spends approximately $3.9 million in treatment chemicals. This figure is allocated $2.6 million to wastewater treatment and $1.3 million to water treatment. In breaking down the costs further, the wastewater chemicals purchased are various forms of polymers, ferric chloride, chlorine, sulfur dioxide and alum. Water chemicals are flocculants/coagulants such as ferric sulfate, lime and polymers, ammonia and chlorine (for disinfection) and polyphosphate (corrosion control). Generally, polymers, depending on the type, are the more expensive chemicals to purchase, with some as expensive as $30 per gallon.

Chemical use is typically optimized via process adjustments made by operators at either water or WWTPs. Operators should be skilled in evaluating chemical dose rates, feed pump calibration and able to calculate various process control formulas to optimize the dosage and still maintain compliance with applicable regulations. Unfortunately, without these skills, chemical overfeeding typically occurs as it is easier to overfeed as the targeted action will generally be met and will be met in varying conditions. This is known as “set it and forget it” mentality and is also bolstered with “if a little bit is good a whole lot must be better” mindset. Both of these situations create circumstances where compliance is maintained, but at a much higher cost than in an equivalent optimized facility.

Purchasing of chemicals is done under bid contracts and it would be expected due to the size of Wichita Utilities and the purchasing power of a larger entity, that the best bid prices are received. However, depending on the origin of the chemicals purchased, transportation costs may be substantial in the overall pricing, especially on those chemicals that are used in large quantities. Bidding the purchase of chemicals can also contribute to increased costs as vendors are required to meet various contract requirements that may prohibit the City from actually getting the lowest price, and to take advantage of
prices when they fall. Additionally, depending on the specification and the chemicals purchased, there may be opportunities for alternative chemical use that without working with various vendors to identify alternatives may result in purchasing a cheaper chemical, yet one that has to be used in large quantities rather a more expensive one used in smaller quantities and may net an overall higher cost. As such, the purchasing of chemicals should include a complete evaluation of the function and alternatives during the bidding process.

2.4.4 Biosolids

Biosolids processing and disposal, while not the largest line item in the budget, still accounts for approximately $58,000 of impact. This cost is derived strictly from the cost of disposal of approximately 2900 tons of biosolids (with screenings included as well) per year. Other costs related to biosolids treatment include labor, chemical, energy, equipment and repairs which are all listed under other line items. The above cost is allocated 50 percent to WWTP No. 1, 33.1 percent to WWTP No. 2, 5.7 percent to Cow Creek WWTP, 11.5 percent to Four Mile WWTP and 0 percent to Midcontinent WWTP as it is currently off line.

At current, as described in section 2.1.3, each treatment facility has their own solids storage and handling system. In many cases, the solids are digested, hauled to WWTP No. 2, blended in with the solids produced at WWTP No. 2 and then digested/stabilized and dewatered again. While this practice provides a reduced stabilization loading on the WWTP No. 2 digestion processes, it is redundant to reprocess already treated biosolids. As such this is likely an opportunity to save processing costs at the smaller facilities to look at discontinuing digestion at the outlying plants. This savings opportunity is from the additional chemical, electrical and labor required to operate these processes and then to reprocess at WWTP No. 2 and the costs associated at that location.

Biosolids are currently disposed in the city landfill and the Utilities Division pays a tipping fee to the Solid Waste Division. Based on $20 per ton, this is a significantly lower fee than the national averages, so if the city landfill is no longer capable of taking biosolids, the cost for disposal may increase significantly. Furthermore, if landfilling continues in the future as the preferred disposal option over land application, the amount of treatment required and the associated costs of treatment, may be reevaluated for reduction as landfilling does not carry the same stabilization requirements as land application.
2.4.5 Power

While utilities (electric, natural gas, fuel oil, and telecommunications) in general are typically lumped together, what gets lost in this way of summarization is the disproportionate amount of the utility expenses dedicated to electrical usage (Figure 2-29). When considering the size, age and continuous use of most of the electrical equipment within the Utilities Division, it should be no surprise on the amount of electric used in a year. In Wichita’s case, the Utilities Department utilizes over 83 million kilowatt hours of electricity annually. This equates to over $9.1 million in electrical costs division-wide. When evaluating the current usage vs. predicted usage, actual power use is slightly less than the power usage models indicate and this is likely the result of conservative approaches to run times on various equipment. In reviewing the power models, the breakdown of expected usage and cost is shown in Table 2-3.

<table>
<thead>
<tr>
<th>Location</th>
<th>kWh</th>
<th>Expense</th>
</tr>
</thead>
<tbody>
<tr>
<td>WWTP No. 1</td>
<td>734,780.2</td>
<td>$80,826</td>
</tr>
<tr>
<td>WWTP No. 2 Main</td>
<td>25,945,577.3</td>
<td>$2,854,014</td>
</tr>
<tr>
<td>WWTP No. 3 Cow Creek</td>
<td>3,014,558.1</td>
<td>$331,601</td>
</tr>
<tr>
<td>WWTP No. 4 Four Mile</td>
<td>2,715,747.5</td>
<td>$298,732</td>
</tr>
<tr>
<td>WWTP No. 5 Midcountry</td>
<td>3,378,519.2</td>
<td>$371,637</td>
</tr>
<tr>
<td>Biosolids</td>
<td>146,956.0</td>
<td>$16,165</td>
</tr>
<tr>
<td>Collections</td>
<td>2,743,179.3</td>
<td>$301,750</td>
</tr>
<tr>
<td>East/Central WTPs</td>
<td>2,893,564.3</td>
<td>$318,292</td>
</tr>
<tr>
<td>Cheney Res/WTP</td>
<td>11,006,516.9</td>
<td>$1,210,717</td>
</tr>
<tr>
<td>ASR WTP</td>
<td>2,001,357.5</td>
<td>$220,149</td>
</tr>
<tr>
<td>Equus Beds</td>
<td>6,710,992.1</td>
<td>$738,209</td>
</tr>
</tbody>
</table>
Table 2-3. Electrical Use and Cost by Location

<table>
<thead>
<tr>
<th>Location</th>
<th>kWh</th>
<th>Expense</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hess PS and Res</td>
<td>26,812,128.0</td>
<td>$2,949,334</td>
</tr>
<tr>
<td>Distribution</td>
<td>2,204,340.5</td>
<td>$242,477</td>
</tr>
<tr>
<td><strong>Totals</strong></td>
<td>90,308,216.8</td>
<td>$9,933,904</td>
</tr>
</tbody>
</table>

As can be seen in Table 2-3, the locations associated with the larger usage is associated with the locations with the largest equipment (i.e., pumps, blowers) and/or the largest amount of equipment. While the model predicts a higher power usage than actual, the model inputs likely account for additional run times than actual and may not fully account for current power optimization practices already in place.

Specific to power optimization, while not true in all cases, most of these facilities also have older equipment and are operating electrical motors that are significantly less efficient than newer ones available today. This illustrates the potential for further power optimization via capital improvement upgrades.

Table 2-4 below represents the cost allocation from current expenses to water treatment/distribution and wastewater treatment. In addition, the table considers the total available capacity per each system, water or wastewater and compares to current kWh usage on daily average basis. The resulting value expressed in kWh/MGD can be used to compare the systems to other similar utilities as well as monitoring a baseline for future power savings improvement/efforts.

Table 2-4. Annual Electrical Usage

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Water (160 MGD Capacity)</td>
<td>47,709,536</td>
<td>130,711</td>
<td>$5,248,049</td>
<td>$14,378</td>
<td>817</td>
<td>$90</td>
</tr>
<tr>
<td>Wastewater (63 MGD Capacity)</td>
<td>34,974,318</td>
<td>95,820</td>
<td>$3,847,175</td>
<td>$10,540</td>
<td>1521</td>
<td>$167</td>
</tr>
</tbody>
</table>

Another aspect to consider in the current power costs. As electric utilities seek rate increases, the impact on Wichita’s Utilities Division can be significant with even small rate hikes. The above calculations utilize an average kWh cost of $0.11. Even a $0.01 increase in the kWh cost, while seemingly small, can have significant implications to the overall budget. The aforementioned $0.01 increase would result in an annual power bill increase of over $900,000. As such, the City should monitor proposed electrical rate increases and budget accordingly, or explore alternatives in reducing the amount of electrical power purchased from the electric utility.

2.4.6 Other

The other category for the budget section catches all expenses not specifically outlined above. Expenses falling under this category include contract services (e.g., laboratory, maintenance), heating fuels, information technology, communications, fleet vehicle repairs/maintenance, insurance and supplies not related to maintenance activities. The other category accounts for an annual expense of $4.7 million which is apportioned $2.9 million and $1.8 million respectively to wastewater and water.
As the other category contributes a total impact of approximately 10 percent to the division’s overall budget, the ability to review costs in this area can have an impact on the overall budgetary picture. However, there are circumstances where increases in the other line item budget may have offsets elsewhere and the overall budget picture should be considered if this category increases.

Generally speaking, contracted services or laboratory services are workloads that are sent off site due to lack of personnel, lack of skillsets or lack of facility capabilities and should be evaluated against labor and supply costs. For example, sending out machining work in the maintenance area may increase as a skilled machinist retires and isn’t replaced; however, the cost of the additional contract work may be offset by savings in the labor area. Similarly, laboratory contract expenses can be evaluated against the cost of purchasing, operating and maintaining expensive laboratory equipment, such as an ICP unit used for conducting metals analysis. The costs associated with the purchase or in discontinuing internal analysis should be evaluated against the cost of sending analysis out to other certified laboratories in relation to overall impacts to the budget picture.
SECTION 3

“Business as Usual” Case

This section presents a forecast of the current trajectory of operations, maintenance, staffing and costs for the City, with a focus on regulatory and safety risks for the staff and community. Of the options presented in this report for handling O&M, this might be characterized as the “do nothing different” alternative.

As noted in Section 2, water quality has been very good historically and the records we reviewed show that the City has not experienced any significant compliance events. The outstanding raw water quality enjoyed by the City plays a major role in this. However, significant risk factors threaten this record of performance in the future: staff skills/training, and the condition and age of the existing facilities.

3.1 Staff Skills and Training

Staff skills are perhaps the biggest risk to any treatment system – even the best designed and maintained system will fail without the right operating approach and the ability to recognize problems that demand attention. The operation of a water or wastewater treatment system is a tremendous responsibility that can carry heavy consequences for failure, such as jeopardizing public health and criminal penalties for negligent operators. Recent events in Flint, Michigan are a vivid reminder of this reality.

Our interviews with staff at the Main WTP lead us to think that some kind of regulatory failure in the near future with the water system is more likely than is advisable for a municipal water system, given the skills of the operating staff. There did not appear to be a plan in place to backfill the key water quality manager role at the water plant (currently being filled on a part-time basis by the retired manager), and the subordinate operator positions appear to have only very basic water quality and regulatory understanding of the system. Part of this seems to stem from hiring policies within the City, which prevent posting an open position until the previous employee has completely left the post, such that knowledge transfer is all but prevented. Another factor is that the State of Kansas operator certification program allows staff to take the top-level exam and skip the lower level steps completely as most other states and national programs require, even if that person is not in a focused operations role. Without better qualified operators, and without the leadership of a knowledgeable water quality and operations manager at the plant, the City is at risk.

The level of knowledge displayed by the wastewater plant staff we interviewed was very good. Lead operators at each of the sites were well informed about their treatment processes, operating trade-offs, and the specifics of what upgrades were needed and why. Even with reductions in staffing levels from unfunded or frozen budgets, operators have maintained strong permit compliance performance and what appears to be generally good morale. Maintaining the current staffing plan, skill levels and organization should not have as much of an impact on regulatory compliance on the wastewater side of the utility.

Distribution and collections staff also appeared to be reasonably knowledgeable and well trained in their job duties. In fact, the wastewater collection system manager expressed high praise for the knowledge and abilities of the field staff. There was a need for two additional TV crews, two cleaning crews, more data entry and video review staff as stated by the manager. The concern was not the technical capabilities of the field staff but the amount of work exceeding available man hours. The benchmark metrics in the previous section support this sense of being understaffed.
Figures 3-1 and 3-2 show the relative maturity levels for different core skill sets of the O&M staff in each group we evaluated (water, wastewater, distribution and collections). The ratings are on a 1-5 scale, with 3 being industry typical and a 5 being world class.

Staff Skills (Water/Wastewater)

![Staff Skills (Water/Wastewater)](image1)

**Figure 3-1. Water/Wastewater Treatment Staff Skill Assessment**

Staff Skills (Distribution/Collection)

![Staff Skills (Distribution/Collection)](image2)

**Figure 3-2. Distribution/Collection Systems Staff Skills Assessment**

Safety is another indicator of staff skills and training, especially for organizations looking to achieve “world class” status. As a benchmark, recent City safety data from 2014 was used to calculate typical
OSHA reporting metrics, which the City is exempt from conducting. This is still a useful method to
determine safety performance, and is a recommended practice for the City to track and trend these
statistics. There were 274 safety incidents (151 recordable) out of approximately 2,600 city employees in
2014. With 332 full-time Utility Department employees, there were 19 recordable safety incidents. This
equates to a total recordable rate (TRR) of roughly 6.2 for both the City and Utility Department. This is
slightly worse than the overall national public water and wastewater utility score (North American
Industry Classification System code 2213) of 5.3, but is as much as four times higher than the safety
incidents for private water utility providers. And as one might expect, the higher the TRR, the more likely
it is to suffer a fatality. Using national statistics, Wichita’s Utility Department might suffer a fatality every
15 years at the current recordable rate and number of staff. Private sector water/wastewater fatalities
might only occur every 61 years. Given the recent fatality of a Utility Department employee from a
safety incident, reports of other near misses, and the limited safety training or culture evident among
staff or management, the current trajectory for the City is to continue to have dozens of injuries among
its staff every year.

3.2 Maintenance and Capital Repairs

A second risk factor is the condition of the treatment infrastructure, such as the Main WTP and Cheney
Reservoir. The water plant has performed well for the City for nearly 80 years, but it is clearly showing
significant signs of decay and is at the end of its useful life. Capital repairs are backlogged, such as the
failing roof over the filter gallery, lack of inspection and media replacement for the filters in over 20
years, or footing wall repairs at the reservoir, which reduces what even the very dedicated maintenance
team and plant managers can do to maintain the facilities. Similarly, there are multiple “single points of
failure” in the system (e.g., raw water feed lines, solids disposal piping) that could in the near future
cause a catastrophic failure to the water supply system for days or weeks. From a maintenance and
upgrade risk standpoint, the water plant is the highest priority.

On the wastewater side, maintenance and capital repair projects are also a risk issue. The old rock
trickling filter technology at Plant No. 2 will not be able to provide adequate treatment for the expected
biological nutrient removal permit requirements in the next permit renewal, and this plant is one of the
largest point discharges in Kansas so the regulators will be motivated to make substantial improvements
to the effluent water quality limits for the plant. Current performance is threatened by having several of
the trickling filters offline and in disrepair (currently only three out of 12 units are operable), along with
a variety of other smaller projects (e.g., waste activated sludge pumps, dissolved air flotation units)

National standards were reviewed to offer a reasonable basis for the recommended annual repair and
replacement budget for buried infrastructure, and three sources were found: The updated Water
Environment Research Foundation report (01-CTS-207, 2002 by Black & Veatch), the EPA, and the ASCE
in their 1998 survey and report. (Careful review suggests that the EPA relies on the WERF and ASCE
studies for their information.) These reports suggest an annual replacement schedule of 0.5 percent per
year for collection and distribution systems in average condition, due to the long service life of buried
infrastructure (50-90 years). Similar studies on vertical assets indicate a somewhat more aggressive
budget requirement due to the shorter life of the assets (generally between 25-50 years). As Table 3-1
shows below, total capital support for the water and wastewater infrastructure is at 68 percent of
recommended levels.

<table>
<thead>
<tr>
<th>Facility</th>
<th>Water Plants + Supply</th>
<th>Wastewater Plants</th>
<th>Distribution System</th>
<th>Collection System</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total Capacity, MGD</td>
<td>160</td>
<td>63</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Total Length, Miles</td>
<td></td>
<td></td>
<td>2,367</td>
<td>2,037</td>
</tr>
</tbody>
</table>
One significant limitation that is not reflected in the budget numbers is the ability of the City to manage and execute capital repair and replacement projects, which are usually complex. Each of these projects requires at least one, and often several, capable leaders to devote time and attention to getting the project completed. This could be engineers, purchasing agents, construction foreman, mechanics, or operators. The staffing level analysis conducted for this study was limited to Utility Department staff and did not include some of these vital support positions, where such vacancies could be having a substantial impact.

Strategically, the City has lacked a guiding approach from a system wide master plan and a life cycle asset management plan which form the cornerstone of an effective management plan. Such plans are being composed at the time of this report writing and we must collectively ensure that they capture the complete needs of the City for the next 20 years. Having and adhering to well-developed plans will keep the City on track to spend their capital dollars wisely, and in the appropriate sequence from a permit/process standpoint, and also a financial planning perspective. The “status quo” option would accept the past practice of “one-off” projects that do not follow a coherent long term or sustainable plan, and fail to allocate limited resources towards the highest priorities. The recent Midcontinent wastewater plant may fall into this category, with millions spent on a plant that is not running. ASR is arguably another example, since it is not designed to provide potable water directly to the City, while any number of failures at the neglected East/Central WTPs could cripple the City’s drinking water delivery.

### 3.3 Operations and Maintenance Costs

Our expectation is that the current O&M costs will increase each year as system failures occur, and force the City to spend limited funds on emergency repairs (Figure 3-3). Having staff with only basic skills will lead to unnecessary costs for utilities, chemicals and labor. Also, the current safety culture and training levels will likely continue to generate unplanned expenses.

This is typical of many utilities that are managed in a reactive manner, and is all too often the only method available to utility staff when proactive planning and funding is denied them. The following graph shows the annual cost variation that is likely, with as much as a 20 percent cost overrun possible in any given year, with an expected $3.2 million annual cost overrun most likely (based on a Monte Carlo simulation of 20,000 scenarios). This brings the expected actual annual operating budget from $56.3 million to $59.5 million per year.
Industry standard assumptions around increasing corrective maintenance costs as equipment exceeds its planned life expectancy backs this up, and the DST includes this to show how costs will continue to escalate beyond the City’s ability to sustain. The following table demonstrates how the current practice of pushing equipment and facilities past their useful life threshold dramatically increases maintenance costs long term, compared to the same system where capital reinvestment is conducted as equipment reaches its end of service. Ironically, in an effort to save money, the City will have spent more total dollars by trying to push the facilities too far at the end of the 30-year planning period.

3.4 Recommendations and Implementation

No changes to current management, training, staffing, operating or maintenance practices are required for the “Business as Usual” case. However, as this section highlights, the results of this approach would likely lead to compliance failures, a high rate of staff injuries and possibly more fatalities, unplanned annual costs, and continued degradation of system infrastructure at a higher than necessary cost. This approach does not achieve the stated goals of the City in creating a “world class” utility. We strongly recommend the City to consider any of the other options presented in this report and as part of the DST analysis as a better approach.
Optimization Case

In this section we explore ways the City might improve their current O&M practices to improve compliance, reduce major equipment failures, minimize injuries to staff, and still save cost in the long run. We also present “best practices” approaches to various aspects of O&M that would support this optimized approach long term for the City to implement. All of it is built around how CH2M manages our own water and wastewater operations for other clients, so we are not recommending anything we would not do ourselves.

4.1 Water Regulatory Compliance

As noted earlier, regulatory compliance is a particular concern and a top priority (along with safety) for a water/wastewater utility. The following discussion highlights areas of focus for the City to verify their adherence to regulatory and industry standards (preferably by using a third party auditor or consultant), which helps to ensure an optimized and world class department.

4.1.1 Lead and Copper Rule, Disinfection Byproducts Rule

As part of the evaluation of the Wichita Utilities system and in light of the national attention surrounding the Flint, Michigan, and Sebring, Ohio, water issues, especially those concerning lead and copper results as a by-product of corrosive water, CH2M evaluated the existing Wichita water monitoring data against a “reasonableness” scale. In other words, to ensure that data being produced in the system is similar to what would be reasonably expected based on chemical models of water treatment.

To accomplish the above work, raw and finished water data produced by Wichita Utilities was entered into the Water! Pro version 2.52 model and evaluated for corrosively and disinfection byproduct formation. Additionally, the raw water data, coupled with information used in treatment was evaluated for its expected final water outcomes and compared to the model outputs. While data utilized was an annual average and compared to annual average Wichita data, rather than identical single data points for the most accurate comparisons, the data from the model did reasonably match with data generated by Wichita’s in house and contract laboratories, giving a comfort level to existing water quality conditions.

Specific to the results the Table 4-1 indicates actual results vs. modeled results of specific concern.

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Modeled Data</th>
<th>Actual Data</th>
</tr>
</thead>
<tbody>
<tr>
<td>Lead</td>
<td>0.15 µg/l</td>
<td>0.16 µg/l</td>
</tr>
<tr>
<td>Copper</td>
<td>0.02 mg/l</td>
<td>&lt;0.01 mg/l</td>
</tr>
<tr>
<td>Ortho Phosphate (as P)</td>
<td>0.16 mg/l</td>
<td>0.05 mg/l</td>
</tr>
<tr>
<td>HAAs</td>
<td>32.4 µg/l</td>
<td>10 µg/l</td>
</tr>
<tr>
<td>THMs</td>
<td>44.7 µg/l</td>
<td>29 µg/l</td>
</tr>
</tbody>
</table>

All values seem to be in line with expected model data. When looking at disinfection byproducts (DBPs), they are significantly lower in the actual samples than predicted by the model. This could be attributed to data used for the model being a single point in time vs. actual values being an annual average and the
associated temperatures, CT, chlorine doses and hydraulic detention time within the distribution system at the time of actual sampling throughout the year.

Specific to the above mentioned conditions at sampling, sampling for both Lead/Copper and DBPs is highly subjective to the techniques used, as has been discovered in Flint and Sebring cases (i.e., operations personnel flushing systems/sample locations before sampling). This would of course fall to the sampling entity to ensure the most accurate results. Without having specific knowledge of the sampling protocols used for the collection of the above data, one has to assume appropriate protocols were used not only for the timing of samples, the preservation, hold time and analysis protocols as well. Any deviation from the accepted and approved standard methods has potential for altering results.

It should be noted that lead and copper values have potential to become elevated if current water treatment practices are altered. The data produced by Wichita indicates a negative Langelier Saturation Index Value (LSIV) of -0.19 as an average value for 2015. A negative number indicates an aggressive water capable of stripping calcium carbonate coatings from distribution systems. Once this coating is removed aggressive water begins attacking the metal pipe materials and leaching dissolved minerals into the water. To combat this negative LSIV Wichita adds orthophosphate at a dose of 0.5 mg/l which should be sufficient to provide a protective coating of the distribution system and prevent leaching of metals from pipelines. However, as mentioned previously, if treatment practices are altered, the orthophosphate dose and/or other parameters should be monitored closely to ensure lead and copper values are not negatively impacted.

Based on the above brief study of results developed in the Water!Pro model vs. actual results reported by Wichita Utilities, the actual data appears to be realistic and accurate. Furthermore, it appears that the reported compliance with lead, copper and DBP values/rules is accurate based on the provided information. As DBP and lead/copper compliance is very site specific, each individual sample point would need to be reviewed in further depth for a complete audit of the compliance status; however, from a high level view it appears the system is in compliance based on 2015 data.

4.1.2 Total Organic Carbon Performance

TOC is the concentration of total organic carbon, in milligrams per liter, measured using heat, oxygen, ultraviolet irradiation, chemical oxidants, or combinations of these oxidants that convert organic carbon to carbon dioxide, rounded to two significant figures. TOC is a surrogate measure for precursors to formation of disinfection by-products.

In accordance with §290.112 for Total Organic Carbon (TOC), Water Systems must achieve the Step 1 removal requirements, meet one of the alternative compliance criteria, or apply for the alternative Step 2 removal requirements.

To be successful, the City must achieve the Step 1 removal requirements and the Step 1 TOC percent removal requirements indicated in Table 4-2.

<table>
<thead>
<tr>
<th>Source Water TOC (mg/L)</th>
<th>Source-water alkalinity (mg/L as CaCO3)</th>
<th>Less than or Equal to….</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>0 to 60</td>
<td>60 to 120</td>
</tr>
<tr>
<td>≥ 2.0 – 4.0</td>
<td>35.0 percent</td>
<td>25.0 percent</td>
</tr>
<tr>
<td>≥ 4.0 – 8.0</td>
<td>45.0 percent</td>
<td>35.0 percent</td>
</tr>
<tr>
<td>≥ 8.0</td>
<td>50.0 percent</td>
<td>40.0 percent</td>
</tr>
</tbody>
</table>
Although there are alternative compliance criteria to meet TOC requirements (Table 4-3), these were reviewed by CH2M, the current operations do not qualify for any of the alternatives.

Table 4-3. TOC Compliance Criteria

<table>
<thead>
<tr>
<th>Alternative Criteria</th>
<th>Criteria Met</th>
</tr>
</thead>
<tbody>
<tr>
<td>The source water TOC level is less than 2.0 mg/L, calculated quarterly as a running annual average</td>
<td>✗</td>
</tr>
<tr>
<td>The treated water TOC level is less than 2.0 mg/L, calculated quarterly as a running annual average.</td>
<td>✗</td>
</tr>
<tr>
<td>The source water TOC level is less than 4.0 mg/L, calculated quarterly as a running annual average; the source water alkalinity is greater than 60 mg/L (as calcium carbonate (CaCO3), calculated quarterly as a running annual average; and the total trihalomethanes (TTHM) and haloacetic acid-group of five (HAAS) running annual averages are no greater than 0.040 mg/L and 0.030 mg/L, respectively</td>
<td>✗</td>
</tr>
<tr>
<td>The TTHM and HAAS running annual averages (RAA) are no greater than 0.040 mg/L and 0.030 mg/L, respectively, and the system uses only chlorine for primary disinfection and maintenance of a residual in the distribution system. The TTHM and HAAS RAA’s for the RBSWTP are 0.031 and 0.011 respectively.</td>
<td>✗</td>
</tr>
<tr>
<td>The system’s source water specific ultraviolet absorbance (SUVA), prior to any treatment, measured monthly, is less than or equal to 2.0 liters per milligram-meter (L/mg-m), calculated quarterly as a running annual average.</td>
<td>✗</td>
</tr>
<tr>
<td>The system’s finished water SUVA, measured monthly at a point prior to any disinfection, is less than or equal to 2.0 L/mg-m, calculated quarterly as a running annual average.</td>
<td>✗</td>
</tr>
<tr>
<td>The system practices softening, cannot achieve the Step 1 TOC removals required by paragraph (1) of this subsection, and has treated water alkalinity less than 60 mg/L (as CaCO3) and calculated quarterly as a running annual average.</td>
<td>✗</td>
</tr>
<tr>
<td>The system practices softening, cannot achieve the Step 1 TOC removals required by paragraph (1) of this subsection, and has magnesium hardness removal greater than or equal to 10 mg/L (as CaCO3), measured monthly calculated quarterly as a running annual average.</td>
<td>✗</td>
</tr>
</tbody>
</table>

TOC Running Annual Average data was unavailable so we could not determine if compliance is being met, so 2014 annual average data was reviewed instead. With an average raw TOC of 4.4 mg/L (Cheney) and an average finished TOC of 2.8 mg/L, TOC removal is approximately 33 percent. For the raw source alkalinity of 168 mg/L (Cheney), the Step 1 removal should be at least 25 percent, but again this was only using the annual average data and not the quarterly running average data as required.

The City should determine the yearly removal ratio of TOC. The yearly removal ratio is the running annual average of the quarterly averages of the monthly averages. To determine this value, for each quarter in the compliance year, determine the monthly removal ratio, add the removal ratios and divide by three. Then, add the quarterly removal ratio and divide by four. Keep in mind, if the yearly removal ratio is less than 1.00, a treatment technique violation has occurred unless a Request for Alternate TOC Requirements has been submitted and approved by KDHE.

4.1.3 Chemical Dosing and Documentation

A review of Total Organic Carbon (TOC) documentation, observations of floc formation/settling and filter performance and the absence of a process control strategy suggests a lack of understanding with
regards to chemical treatment requirements and application rates on the part of the operators and past
managers. The document review did not provide evidence of chemical pump calibrations, a process
control strategy, an operations plan, jar testing results or filter profiles. Pump calibrations are not being
conducted routinely to ensure accurate chemical injection. Chemical dosages are not being recorded as
a dry (or active) weight as chemical solution strengths can change with each delivery, especially
coadulant chemicals. Jar test equipment exists (Figure 4-1), but is not utilized by the operation staff.

![Figure 4-1. Typical Jar Testing Procedure in Progress](image)

Regulations require Systems that treat surface water or groundwater under the direct influence of
surface water maintain a record of the amount of each chemical used each day. We could not determine
if this information was being documented daily, and should be part of the suggested compliance audit to
verify. We also suggest the following:

- Optimizing floc formation and settling at the water plant will improve TOC removal, reduce settled
turbidity, and provide longer filter runs.
- Provide on-site training for operations staff on how to create stock solutions, conduct jar tests,
calculate chemical dosages from wet weight to dry weight and to convert jar test results to chemical
pump rates (i.e., from mg/L to mL/min).
- Initiate weekly (at a minimum) chemical pump calibration to ensure accurate chemical injection.
- Conduct daily jar testing to optimize chemical conditioning.
- The Daily Rounds Sheet should be modified to capture the amount of chemical used each day and
track historic usage for process optimization if not being done already.
- Training is needed on chemical feed concepts and practices, especially for chloramine formation.

4.1.4 Filters and Backwashing

Operators report that the filters have not been inspected nor has the media been replaced in over 20
years. The automatic backwash system seems to be operational, including both water and air scour
steps.

KDHE regulation requires filters to be designed and operated to ensure adequate cleaning during the
backwash cycle:
• The rate of filter backwashing shall be regulated by a rate-of-flow controller or flow control valve.

• The rate of flow of backwash water shall not be less than 20 inches of vertical rise per minute (12.5 gallons per minute per square foot) and usually not more than 35 inches of vertical rise per minute (21.8 gallons per minute per square foot).

• The backwash facilities shall be capable of expanding the filtering bed during the backwash cycle.
  – For facilities equipped with air scour, the backwash facilities shall be capable of expanding the filtering bed at least 15 percent during the backwash cycle.
  – For mixed-media filters without air scour, the backwash facilities shall be capable of expanding the filtering bed at least 25 percent during the backwash cycle.
  – For mono-media sand filters without air scour, the backwash facilities shall be capable of expanding the filtering bed at least 40 percent during the backwash cycle.

The point in citing these requirements is that monitoring the backwash cycle effectiveness is required to satisfy the design and operational requirements of the Surface Water Treatment Rule. This may be accomplished by using a bed expansion tool which can be fabricated by City staff from parts purchased at a local hardware store.

1. Plastic half-inch pipe is cut in one inch increasing increments.
2. Pipes from one inch to twelve inches are then attached to a base, which is temporarily mounted at the media surface.
3. A routine backwash is performed.
4. The operator then visually inspects each pipe for captured media.
5. The highest pipe that captures media will determine the bed expansion in inches. Divide the bed expansion, in inches, by the media depth, in inches, and multiply the result by 100.
6. This will give the bed expansion in percent expansion.
7. Compare this result to the recommendations above.

If adequate expansion cannot be achieved with the existing backwash equipment, a CIP Project should be planned to address the deficiency.

4.1.5 Turbidimeters

Online turbidimeters must be properly calibrated and all calibrations and adjustments well documented. Comparison of these reading should then be made with calibrated bench top reading to confirm agreement between the two methods. Typical state regulations require all bench top turbidimeters be calibrated with primary standards at least once every 90 days. Each time the turbidimeter is calibrated with primary standards, the secondary standards must be standardized. The calibration of bench top turbidimeters must be checked with secondary standards each time a series of samples is tested, and if necessary, recalibrated with primary standards.

An On-line Analyzer Logbook must be developed for documenting all readings and adjustments made to all analyzers. The logbook must be maintained at a central location and available for review upon request. A laboratory review auditor would expect to see this or similar documentation to ensure appropriate due diligence by plant staff to maintain water quality performance.
4.2 Distribution System

4.2.1 Daily Remote Chlorine Residual Tests

State regulations outline the number of disinfectant residual samples that must be taken in the distribution on a monthly basis. These fall into two categories:

1. Disinfectant residual samples collected at the same time as coliform samples.
2. Disinfectant residual samples collected throughout the distribution system.

120 samples are required to be collected and analyzed per month, assuming a City customer base of 148,000 (2014 data). Furthermore:

- You may use the disinfectant residual measurement from a scheduled coliform sample as the measurement for that day.
- Even if you collect several coliform samples on one day, the residuals count for that day only. For example, if you take seven coliform samples on Monday, you still must measure disinfectant residuals each day the rest of the week.
- To make sure you make the best use of the samples you take, you need a list that tells what to sample for, when to take each sample, and where to take each sample. This list is actually a required part of your PWS’s monitoring plan.
- Public water systems that haul water are required to take a disinfectant residual sample from each load of water hauled, and must base their report calculations on this data.
- Begin taking a daily chlorine residual in the distribution system at a remote location. You are allowed to use current bacteriological monitoring locations as a daily sampling site as long as you identify the site(s) in the Monitoring Plan. It is further recommended that a minimum of four sample sites be identified and used on a rotating basis (one site per day) to demonstrate water quality throughout the distribution system not just at one remote location.
- The record of remote chlorine residuals must be entered into a bound book with numbered pages and include all required chain of custody information.

4.2.2 Tracking Water Loss During Flushing Activities.

Dead-end water mains conveying finished water shall be flushed either quarterly or in accordance with written flushing program established by PWS. The City system utilizes weekly flushing and maintains a three ringed binder listing the locations flushed and the date of flushing. The City does not meet the KDHE requirement to flush all dead-end water mains at least monthly. The City is required to have a written flushing program.

When shown the flushing records for the City, it was noted that water loss for each flushing event was not being measured and documented. It is very important to capture this information to ensure accuracy in reporting the Annual Water Loss within the water system. Taking into account the ongoing and severe drought conditions in many parts of the Midwest, it is to be expected that the KDHE will place more emphasis in water conservation and, as a result, impose mandatory water conservation measures on systems with a high unaccounted for water loss.

If not already in place, we recommend:

- Developing a written flushing program which documents locations, flushing dates and quantities of water flushed at each location on a monthly basis, for all dead end mains, and other locations where it is determined that there may be a water quality issue.
• Purchase a portable water meter that can be attached to the diffuser assembly to track water usage for each hydrant flushing event. Document meter readings in a bound book with numbered pages. Use the documented data annually when completing the Annual Water Loss Report for KDHE.

4.2.3 Bacteriological Samples Following Water Line Repair

In its Rules and Regulations for Public Water Systems, the KDHE requires bacteriological sampling and testing following a repair to a water main when the repair is NOT made under pressure meaning that water service had to be turned off to one or more people to perform the repair.

A review of available records could not confirm that this was currently being done in the City distribution system. When asked, the operator stated that he did not have many breaks but when they occurred, samples were not being taken, as such this is a violation of the KDHE regulations, placing compliance of the system at risk.

Following a line repair or replacement (R&R) when the R&R could not be made under pressure, collect bacteriological samples from the sample site and within 5 service connections upstream and downstream and have those samples analyzed for the presence of total coliform bacteria. If all sample results are negative no further action is required. If any samples are found to be Total Coliform positive, immediately notify the KDHE for guidance and instruction. Essentially, newly installed lines and repaired mains must be disinfected and samples collected. Lines may be placed into service only after sample results are Total Coliform negative. There is a requirement of at least one sample per 1000 feet of line. Any positive samples require the entire process of disinfection, flushing, and sampling to be repeated until a negative sample is achieved. This process requires time to collect the sample and get it to the lab, and then at least 24 hours to perform the coliform test.

There are situations when the line must be activated for fire protection or other reasons before the testing is completed and a negative sample confirmed. If the line was not isolated and held until sampling confirmed, then CH2M recommends that KDHE should be notified for guidance as it will be difficult to determine the impact to the overall system. At a minimum, a location specific boil alert may be required.

If boil alerts become required, it is important to have a plan and system in place for notifying affected users. Some utilities go door to door with “door hangers” while others utilize local media or reverse 911 systems, depending on complexity of the situation and capabilities of existing notification systems. In any case, a plan must be developed and followed ahead of its need, not being prepared for this type of emergency can result in confusion and/or customers not being informed appropriately. In some cases, media contacts need to be developed for all hours’ access to get the word out and in the middle of an emergency is not the time to make the first call to a newsroom.

When taking Coliform samples following water line R&R mark those samples as “SPECIAL” These samples are not included as part of the required monthly sample set and are not considered when determining compliance with the Total Coliform Rule.

4.2.4 Valve Exercising Program

Valve exercising is a procedure that verifies proper location, operation, and material condition of valves, and initiates replacement as necessary (Figure 4-2). The physical operation of a valve and the documentation of the actions and procedures necessary to do so are equally important.

The KDHE has adopted by reference recommendations and Standards from the American Water Works Association (AWWA). By citing these recommendations and Standards the KDHE is recommending all water utilities initiate a Valve Exercise Program that requires all valves (such as distribution and transmission valves, air valves, and blow-offs) to be inspected and operated on a regular basis.

The main objectives of a comprehensive Valve Exercise Program are to:
- Improve valve reliability
- Reduce water loss
- Identify critical valves on distribution system
- Measure and document valve operation
- Develop trend analysis

According to AWWA, “Each valve must be operated through a full cycle and returned to its normal position on a schedule that is designed to prevent a buildup of tuberculation (rust formation in pipes as a result of corrosion) or other deposits that could render the valve inoperable or prevent a tight shutoff. The interval of time between operations of valves in critical locations or valves subjected to severe operating conditions must be shorter than for other less important installations, but can be whatever time period is found to be satisfactory based on local experience. The number of turns required to complete the operation cycle must be recorded and compared with permanent installation records to ensure that full gate travel (i.e., it can be opened and closed) is maintained.”

“A recording system must be adopted that provides a written record of valve location, condition, maintenance, and inspections of the valve,” AWWA standards continue, “Each valve must be operated through one complete operating cycle. If the stem action is tight as a result of buildup on the stem threads, the operation must be repeated until the opening and closing actions are smooth and free. A full inspection must be performed and any problems must be reported immediately to the person responsible for necessary repairs.

“To carry out a meaningful inspection and maintenance program, it is essential that the location, make, type, size, turns, close direction, and installation date of each valve be recorded. Depending on the record keeping system used, other information may be entered into the permanent record.”

Figure 4-2. Operators Exercising Valves using Automatic Valve Turning System
Some valve manufacturers simply recommend exercising their valves at frequency based upon local experience. However, consistent with *Water Distribution Systems Handbook* & AWWA’s Manual M44, isolation valves should be exercised at least once every 1 or 2 years.

We suggest the City develop a written valve exercising program consistent with all AWWA Standards.

### 4.2.5 Hydrant Maintenance Program

Like any other piece of equipment, if not operated and maintained properly, fire hydrants may not work when needed the most (firefighting, line flushing) (Figure 4-3). As with valve exercising, the KDHE has adopted by reference recommendations and Standards from the American Water Works Association (AWWA) for fire hydrant documentation, O&M. The American Water Works Association (AWWA) recommends all hydrants be inspected regularly, at least once a year. In freezing weather, dry-barrel hydrants may need to be inspected in spring and fall.

A good Hydrant O&M program requires good records. A great source for all sorts of recordkeeping forms relating to hydrant O&M is in the *AWWA Manual of Water Supply Practices (MOP)*, “Installation, Field Testing and Maintenance of Fire Hydrants.” Not only is this publication a good source of recordkeeping forms, it also is one of the most comprehensive guides to fire hydrant O&M.

We recommend the City develop a Hydrant Maintenance Program based on *AWWA Manual of Water Supply Practices*, “Installation, Field Testing and Maintenance of Fire Hydrants”, if one does not already exist.
4.2.6 Cross Connection or Backflow Records.

Cross connection Control and backflow prevention requires a robust Cross Connection and Backflow Prevention program. A critical element of a successful program includes having a plan in place that provides guidance on hazard identification, inspections, testing, a description of the current program (i.e., staffing, tracking, surveying, testing, training and fee requirements) and evaluation of the current program, proposed changes and implementation plans. The plan must also include an explanation of how the public water system will satisfy state regulatory requirements. The plan should also contain a schedule of when facilities are inspected and surveyed; records of all device locations; correspondence, including notices of violation; and a list of devices and inspections of approved backflow prevention devices.

At the time of the review, a Backflow Prevention Plan was not available and there were no available records to document the location of system backflow prevention units or a history of inspection/testing. If it does not exist already, we advise the City to develop a Cross Connection and Backflow Prevention Program that includes all state requirements.

4.2.7 Distribution System Repairs

Beginning on January 4, 2014, a new national law amended the Safe Drinking Water Act required all products in contact with drinking water to have a 0.25 percent maximum lead content for all wetted components using a surface based averaging formula. This rule impacts virtually every component of a water treatment and distribution system from the treatment plant to plumbing fixtures. The new lead free law applies to a wide variety of products used in water distributions systems, including meters, pumps, valves, pipes, fittings, or fixtures that come into contact with potable water. This includes corporation stops, curb stops, service fittings and couplings, meter valves, meter couplings, check valves, and backflow valves (Figure 4-4). Fire hydrants are exempt from this regulation. Leaded components already installed in distribution systems by January 4, 2014, will be grandfathered in. Utilities can make repairs in place, but once a component is removed from the system for any reason, it has to be replaced with a lead-free component.
Figure 4-4. Distribution System Operators Conducting Typical Water Main Line Repair

We recommend the following actions:

- Inventory all spare parts used in the repair of distribution system components to ensure that they meet the new lead free standard.

- Identify and prioritize components that will need to be changed over to lead-free.

- Review current suppliers to ensure they will continue to provide reliable products that are lead-free.

- Sort out inventory. The approved brass fittings will be stamped with an NL to designate that the part/fitting is lead-free. Lead free identifiers can be:
  - LF in casting
  - LF in model description on nameplate
  - Lead free labels

- When a new shipment is received, check each piece for the NL Identifier. DO NOT accept any parts or fittings that do not have a lead free identifier.
4.2.8 Water Distribution Operations Plan

The City should have a comprehensive operations plan that outlines the activities and the individuals directly responsible for various aspects of the drinking water system. The Operations Plan must provide detail on who and how decisions are made regarding the day-to-day O&M of public water system production and distribution. The Plan must contain information on

- How system pressures will be maintained
- How disinfection will be achieved and how disinfection procedures will be initiated
- How routine microbiological samples will be taken and the procedures to be followed in the event of a positive result
- How chlorine residuals and microbiological samples will be collected and analyzed following repairs or installation of lines or appurtenances
- Who is responsible and how chemical feed systems, filtration and disinfection will be managed

The City should develop an Operations Plan to include project responsibilities, job descriptions, Standard Operating Procedures (SOPs), and process targets.

4.2.9 National Sanitation Foundation Certification

All chemicals, additives and any additional or replacement process media used in treatment of water supplied by public water systems must conform to American National Standards Institute/National Sanitation Foundation (ANSI/NSF) Standard 60 for direct additives and ANSI/NSF Standard 61 for indirect additives. Conformance with these standards must be obtained by certification of the product by an organization accredited by ANSI. Copies of these certifications must be maintained on file with the water system and available for review upon request. At the time of the review, copies of NSF Certifications for treatment chemicals were not available.

If not already completed, the City should:

- Obtain copies of NSF Certifications for all treatment chemicals and filter media from the supplier.
  Place copies of these Certification in a file so that they are immediately available upon request.

4.2.10 Logbooks

During site visits to the Cheney, ASR and East/Central WTPs, we observed that log books were not being used consistently. The City staff needs to use the book in a consistent manner, documenting all operational changes, the time the change was made, who made the change, and why the changes were made. Some information normally kept in log books was being done on separate checklists or clip boards.

When incidents occur, the logbook is required to record the nature of the incident, as well as any corrective and/or preventative action taken. The log book should be a bound book preferably with numbered pages to ensure that information is legally defensible, true to the last entry and provides an accurate accounting of all activities that have occurred during each shift.

Daily logbook requirements include:

- Certified operator(s) on duty and hours on site
- Daily shift recordings of water quality (raw, process and final);
- Volume of water produced;
- Water loss at the works;
- Chemical dosing rates, chemical use and chemical stock levels;
- Equipment failures and repairs,
• Incidents.

When incidents occur, the following information is required to be recorded in the Logbook:

• Date of Incident;
• Site of Incident;
• Staff member who identified the incident;
• Details of non-conformance;
• Corrective and Preventative action taken;
• Signature by WTP Superintendent, and
• Close-out signature by Drinking Water System Manager.

4.2.11 Other Plans and Documentation

4.2.11.1 Monitoring Plan

Every Public Water system is required to have a Monitoring Plan. This requirement was part of the Federal Stage I Disinfectants and Disinfecting Byproducts Rule. Although a Monitoring Plan for the RBSWTP was located during the review, it was found to be out of date and incomplete. The Monitoring Plan should include all of the information listed below. Failure to have an administratively complete monitoring plan and failure to maintain an up-to-date monitoring plan constitutes a monitoring violation and may result in reporting violations.

• Information on the location of all required sampling points in the system.
• The location of each sampling site at a treatment plant or pumping station is designated on a plant schematic.
• An identification of each entry point into the distribution system either by a written description of the physical location of each entry point to the distribution system or by indication on a distribution system or treatment plant schematic.
• The address of each sampling site in the distribution system or the location of each distribution system sampling site is designated on a distribution system schematic.
• A distribution system schematic that clearly indicates the following: (i) the location of all pump stations in the system, (ii) the location of all ground and elevated storage tanks in the system, and (iii) the location of all chemical feed points in the distribution system.
• A written description of sampling frequency and a schedule with a list of all routine samples required on a daily, weekly, monthly, quarterly and annual basis and an identification of the location where the samples are located.
• An identification of the analytical procedures that are used to perform the required analyses and identifies all of the laboratory facilities that may be used to analyze samples required by the Administrative Code and other regulations.
• A written description of the methods used to calculate compliance with all MCLs, MRDLs and treatment techniques that apply to the system.
• An administratively complete Monitoring Plan should be developed for the City Water System. This plan should be reviewed annually or more frequently to ensure that it is always up-to-date.

4.2.11.2 Emergency Preparedness Plan and Emergency Operations Plan

Every community water system is required to have an Emergency Operations Plan (EOP) which outlines the actions that should be taken during a disruptive event or threatening event which may affect or
affects the quantity or quality of water served by a system. This plan must be reviewed and updated every two years or every time there is a change in the system.

An EPP/ERP for the City Water System was not available for review, other than the recent Earthquake Response Plan (December 2015). An emergency preparedness plan must provide for any applicable production, treatment, transfer and service pumps at an adequate flow rate and at a minimum pressure of 35 psi in the far reaches of an affected distribution system, including multiple pressure planes. If applicable, the emergency preparedness plan must provide the following information:

- Contact information, including names, emergency telephone and pager numbers, and email addresses.
- List all ground, surface, and purchased water sources, with locations and individual capacities.
- List all interconnections with other water providers; whether normally open or closed; size; whether wholesale, purchase, or both; available capacity; and any other pertinent information. Include the names of each interconnection and their contact information, including names, titles, telephone and pager numbers, and email addresses.
- List the capacity and power requirements of all treatment equipment.
- For each chemical, list the type of storage, volume, and volume required per day during emergency operations.
- Provide a copy of all water distribution and transmission piping maps
- Provide the maximum and average daily demands.
- List all primary electrical power sources.
- List all equipment necessary to provide water to customers at the required minimum pressure and adequate flow rate, and the power requirements for each piece of equipment.
- List the size, location and fuel requirement in gallons per hour at the load necessary to maintain emergency operations for all on-site manual and automatic auxiliary power equipment, and provide information as to how the affected utility determined the necessary fuel quantity.
- Provide documentation as to how the affected utility will ensure that it maintains an adequate supply of fuel during emergency operations.
- List the size, location, fuel requirement in gallons per hour at the load necessary to maintain emergency operations, and the name of the system sharing the equipment for all shared auxiliary power equipment. Include the other system’s contact persons with their emergency telephone and pager numbers and email addresses.
- Provide a copy of any leasing and contracting agreements, including mutual aid agreements with other retail public utilities, exempt utilities, or providers or conveyors of potable or raw water service, if the agreements provide for coordination with the division of emergency management in the governor’s office. If leasing, include the vendor’s name, location, and contact information.
- List all portable generators’ power, phase, type of quick-connect, fuel type, and fuel demand in gallons per hour.
- Provide specifications, a description, and detailed capacity information for all on-site electrical generation or distributive generation equipment. Include all fuel demands for this equipment.
- List all direct or right angle drive emergency power equipment with the name, type of engine, fuel type, and fuel demand in gallons per hour.
- Provide details for any other proposed alternative.
• For each fuel tank, provide the location, volume, name of fuel suppliers, contact names, titles, telephone and pager numbers, and email addresses.

• List all local and state emergency responders and their emergency contact telephone and pager numbers. Include medical facilities.

• List all priority water users, such as hospitals and nursing homes, and their emergency contact names, titles, telephone and pager numbers, and email addresses.

• List any bulk water haulers that could be used, including contact names, telephone and pager numbers, and email addresses.

• Provide the system’s designated media spokesperson with a list of local media contact names, titles, type of media, 24 hour telephone and pager numbers, and email addresses.

• Provide the water restrictions that the system will implement during an emergency response.

• Provide a proposed time frame for full implementation of the emergency preparedness plan.

4.2.11.3 Risk Management Plan

Section 112(r) of the Clean Air Act Amendments requires EPA to publish regulations and guidance for chemical accident prevention at facilities that use extremely hazardous substances (see Table 4-4). These regulations and guidance are contained in the Risk Management Plan (RMP) rule.

The City RMP was not available for review. The information required from facilities under RMP helps local fire, police, and emergency response personnel prepare for and respond to chemical emergencies. Making RMPs available to the public also fosters communication and awareness to improve accident prevention and emergency response practices at the local level. The RMP rule was built upon existing industry codes and standards. It requires companies that use certain flammable and toxic substance to develop a Risk Management Program.

Facilities holding more than a threshold quantity of a regulated substance in a process are required to comply with EPA’s Risk Management Program regulations. The regulations require owners or operators of covered facilities to implement a risk management program and to submit an RMP to EPA.

Table 4-4. Partial List of Regulated Toxic Substances and Threshold Quantities for Accidental Release Prevention

<table>
<thead>
<tr>
<th>Chemical name</th>
<th>CAS No.</th>
<th>Threshold quantity (lbs)</th>
<th>Basis for listing</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ammonia (anhydrous)</td>
<td>7664-41-7</td>
<td>10,000</td>
<td>a, b</td>
</tr>
<tr>
<td>Ammonia (conc. 20 percent or greater)</td>
<td>7664-41-7</td>
<td>20,000</td>
<td>a, b</td>
</tr>
<tr>
<td>Chlorine</td>
<td>7782-50-5</td>
<td>2,500</td>
<td>a, b</td>
</tr>
</tbody>
</table>

a. Mandated for listing by Congress.
b. On EHS list, vapor pressure 10 mmHg or greater

Each facility’s program must address three areas:

• Hazard assessment that details the potential effects of an accidental release, an accident history of the last five years, and an evaluation of worst-case and alternative accidental releases;

• Prevention program that includes safety precautions and maintenance, monitoring, and employee training measures; and

• Emergency response program that spells out emergency health care, employee training measures and procedures for informing the public and response agencies (e.g., the fire department) should an accident occur.
The plans are revised and resubmitted to EPA every five years.
The East/Central WTPs have large quantities of gaseous chlorine and ammonia that certainly qualify the site for an RMP, and given the plant location in a highly populated area. We recommend that City staff determine if a RMP has been developed and submitted to the EPA. If a copy of the RMP is found, review the document to ensure that it is up to date (5 years) and contains all required elements. If found, determine if the RMP has been revised and resubmitted within the last 5 years.

4.2.11.4 Material Safety Data Sheets

A Material Safety Data Sheet (MSDS) is a document that contains information on the potential hazards (health, fire, reactivity and environmental) and how to work safely with the chemical product. It is an essential starting point for the development of a complete health and safety program. It also contains information on the use, storage, handling and emergency procedures all related to the hazards of the material. The MSDS contains much more information about the material than the label. MSDSs are prepared by the supplier or manufacturer of the material. It is intended to tell what the hazards of the product are, how to use the product safely, what to expect if the recommendations are not followed, what to do if accidents occur, how to recognize symptoms of overexposure, and what to do if such incidents occur.

As a Public Water System, the City is required to maintain MSDS for every chemical stored and used. Typically, all MSDS are stored in a labeled loose leaf binder in a central location. Employers may computerize the MSDS information as long as all employees have access to and are trained on how to use the computer, the computers are kept in working order, and that the employer makes a hard copy of the MSDS available to the employee or safety and health committee/representative upon request.

There are nine categories of information that should be present on an MSDS. These categories are specified in the Controlled Products Regulations and include:

1. Product Information: product identifier (name), manufacturer and suppliers’ names, addresses, and emergency phone numbers
2. Hazardous Ingredients
3. Physical Data
4. Fire or Explosion Hazard Data
5. Reactivity Data: information on the chemical instability of a product and the substances it may react with
6. Toxicological Properties: health effects
7. Preventive Measures
8. First Aid Measures
9. Preparation Information: who is responsible for preparation and date of preparation of MSDS

Many companies automatically send the MSDS with the purchased chemical. However, the best way to make the most current MSDS is available a copy of the MSDS can be requested when the chemical is ordered. If you already have the product but need an MSDS for it, contact the manufacturer (either look on the product packaging or ask Purchasing to find a manufacturer contact for you). Most manufacturers will fax or mail you an MSDS right away, and many large manufacturers of chemical products have MSDS websites for their products. If you have any trouble getting the manufacturer to send you an MSDS, you may need to write a letter requesting the MSDS so that you have documentation of your request in case OSHA ever inspects us. If it is considered a nonhazardous product for which no MSDS is required (e.g., a product with no hazardous ingredients or that is packaged and
intended for general household or office use), the manufacturer must be willing to tell you that in writing.

As an employer the City should make sure that all controlled products have an up-to-date (less than three years old) MSDS when it enters the workplace. The MSDSs must be readily available to the workers who are exposed to the controlled product and to the health and safety committee or representative. If a controlled product is made in the workplace, the employer has a duty to prepare an MSDS for any of these products. If new, significant information becomes available before the three years has elapsed, the supplier is required to update the product label and MSDS.

If there is no new information on the ingredients by the end of the three-year period, the supplier must review the MSDS and the label for accuracy, revise it where necessary, and revise the preparation date on the MSDS.

A link to additional information on MSDS documentation and training requirements can be found by accessing the following link: https://www.osha.gov/html/faq-hazcom.html

4.2.11.5 Source Water Protection Plan

To give water utilities and community members the information they need to decide how to protect their drinking water sources, the Safe Drinking Water Act requires that the states develop EPA-approved programs to carry out assessments of all source waters in the state. The source water assessment is a study that defines the land area contributing water to each public water system, identifies the major potential sources of contamination that could affect the drinking water supply, and then determines how susceptible the public water supply is to this potential contamination. Public utilities and citizens can then use the publicly available study results to take actions to reduce potential sources of contamination and protect drinking water.

A copy of the SWSA should be on file at with the state. In 1996, the Safe Drinking Water Act was amended and Section 1453 was added, providing states with federal funding to complete source water assessments for their public water systems. It is the intent of Congress that public water systems use the information in their source water assessment to develop a drinking water source protection plan (SWPP).

Producing safe clean and affordable drinking water involves using a multiple barrier approach comprised of three main interrelated steps; (1) protecting source water supply areas, (2) treating drinking water to standards, and (3) monitoring and maintaining the integrity of the drinking water distribution system to ensure successful delivery to customers. However, the single most important barrier continues to be source water protection for the following reasons (Trust for Public Lands, 2004):

- The emergence of new contaminants that suppliers may not be prepared to test or treat
- More frequent spikes in contaminant loads due to storms and flooding that make treatment more challenging
- Constantly changing standards and regulations regarding new contaminants, which are present in the water long before they are identified as threats to public health
- Increases treatment and capital costs due to higher pollutant loads and changing water quality standards
- The loss of natural lands to development impacts not only the quality and quantity of drinking water, but also the cost of treating it.
- With the loss of natural barriers protecting the source water supply, man-made or engineered barriers should be introduced in treatment.
A Source Water Protection Plan (SWP Plan) should be developed for the City in order to better protect its water supply for future generations, reduce long term operating costs and carbon footprint, avoid future treatment requirements, improve planning and response to future spills and water quality events, and leverage upstream investments to protect its water supply.

4.3 Wastewater Regulatory Compliance

4.3.1 Discharge Monitoring Report Preparation

Proper review and calculation of data for the monthly Discharge Monitoring Report is critical. CH2M recommends development of a procedural SOP to follow when they prepare DMRs. Spreadsheets can be used to facilitate compliance with the E-DMR system, and perform the necessary calculations for entry into the DMR.

4.3.2 Permit Compliance Checklist

A checklist can serve as an aid for operators to meet compliance requirements, especially when permit requirements have changed after a significant plant upgrade. The checklist could be prepared that summarizes key compliance requirements, and can be used each month to verify all requirements have been met, including reporting requirements. It is a detailed checklist of not just specific permit limits that must be met daily, but also the less obvious and sometimes periodic requirements buried in permits, such as for quarterly or annual toxicity studies, or sludge metals concentrations, or even sampling of the receiving water quality. We have found that many mandatory permit requirements can be included by reference to EPA regulations, but not explicitly stated in the site specific permit, forcing the permit holder to do the reference checking and research to determine what is applicable to their situation. Regulators will hold staff accountable for these indirect requirements just as they will for the listed tables in the permit. Also, other permits are likely to be in effect at the site, such as for backup generators (air quality), or stormwater runoff control, which are also subject to regulatory enforcement.

We recommend that a complete permit checklist, with indirect references, be created for operators to use and sign every month as part of their reporting process, to ensure strict and complete compliance with all regulatory requirements. Key requirements that only show up periodically can then be added to a calendar, Outlook, CMMS or other software tools as reminders to staff that less common testing or sampling is required.

A thorough review of the NPDES permit should include not only the permit limit table for each outfall, including seasonal limits or outfalls that have requirements only when active is the basic start of the checklist. Each sample location has multiple pollutants or data to monitor at varied frequencies per day, week, month, quarter or year. Establishing a checklist to ensure all required samples are collected is an absolute minimum. In addition to permit discharge tables, close attention must be paid to the part II and III of the permit that discusses specific requirements to the plant (part II) and general requirements of all dischargers (part III).

Part II generally contains compliance deadlines/schedules for meeting new limits, submitting various reports or studies and will vary based on the programs in place (i.e., biosolids, pretreatment, CMOM, SSO, CSO). Some programs, such as pretreatment, may require specific compliance sampling of industries within certain time frames or frequencies with reports to follow on a quarterly or annual basis, for example. Other contents of this section pertain to any compliance schedules that the facility is under and milestone dates for meeting new limits, initiating studies (i.e., biomonitoring, toxicity reduction evaluations [TRE]) as required.
Part III contains general language of the permit and has specific deadlines for reporting incidents, be they overflows, discharge violations or other conditions as outlined in the permit. These conditions should also be included on the suggested checklist.

4.4 Operating Practices and Data Management

All the tools for documenting our operational thinking and actions generally do one of two things: they make clear what we intend to do, or they document what we have just done and the result of it; everything is either a plan or a record.

Consider adding work order system tracking for O&M, ORR program management system. CIP program management system tying back to the Master and Life Cycle Asset Management Plans. Integrating all of these elements into a cohesive management plan supported by managerial and financial MIS that reflects annual budgeting and the longer term Mater and Life Cycle Asset Management plans.

4.4.1 Standard Operating Procedures and Binders

A review of systems indicates that there is a lack of standardized procedures and general record keeping systems at the treatment facilities. There are some procedures posted on walls or in operating areas, but they have not been updated and are not in a standard format. CH2M HILL has provided examples of Standard operating procedures for cleaning and calibration of the dissolved oxygen probes at the facility, as well as training on developing procedures. SOPs lay out a recipe for making something happen that anyone could do. This will ensure that all staff are trained on correct procedures and that there is agreement among staff on specific steps to be followed. Periodic updating is required, so it makes sense to limit the number of SOPs to only the most critical or complex tasks. CH2M HILL has provided a binder for the SOPs and recommends that as a first step, copies of existing procedures are placed in the binder with the longer term goal of updating all SOPs in a common format.

4.4.2 Unit Process Control Plans

Unit Process Control Plans (UPCPs) focus on only major processes (e.g., activated sludge, primary treatment, disinfection) and are written by the plant staff rather than outside technical support. They serve primarily as teaching tools for new staff, or when process changes are made so everyone understands the new operating strategy for that unit process, and how it relates to others. An essential function of the UPCP is to provide operations staff with a common, agreed upon strategy toward operating a unit process.

4.4.3 Updated Operations and Maintenance Manuals

Design engineers typically write O&M manuals for new plants, which details how the designers envisioned how the plant would operate and why certain equipment was installed or sized in the plant. Design criteria is of particular interest in these manuals as a reference for plant staff, but it is up to the project team to determine what the true limits of the plant are, and what impacts they have. O&M manuals can be a good starting point in writing UPCPs or SOPs. Caution should be exercised when deviating from an O&M manual, with careful documentation of the reasons and notification of the state regulator.

It is recommended that the O&M manuals be updated, and the operators retrained on the contents. This can be a collaborative effort, where the staff does the updating of the manuals in a facilitated workshop. Operating/discharge permits require each plant to have a current O&M manual.
4.4.4 Rounds Sheets

Nothing replaces plant staff walking around the project site and observing operations first hand. Operator rounds sheets may be used to help train new operators, or to organize data recorded from local instrumentation, but these will be highly customized for each facility. Managers are routinely seen making these rounds as well at the best run plants.

CH2M HILL recommends the plant develop standard shift rounds sheets to facilitate consistent operations and data collection, as well as providing a standard format for data entry into a plant operational and laboratory data tracking system.

4.4.5 Process Setpoints

Process setpoints are developed by reviewing compliance requirements in permits and other governing agreements, such as a state grant agreement, and determine the governing effluent quality which allows all compliance requirements to be met. Once that is known, operational setpoints can be determined for final effluent quality and process variables within the treatment process that give operations the information needed to monitor and control the plant to achieve compliance. Typically, a safety factor is applied to permit values and process setpoints ensure final effluent quality are within permit limits. Target effluent quality has an impact on chemical and energy usage and budgets and should be selected with awareness to those impacts.

4.4.6 Process Control

An operators’ job is to control, not be controlled by, the system he manages. Otherwise, he is simply a dictation device to record what the plant has done.

Process control is a deliberate, active process (Figure 4-5). Plant teams must identify which things they control directly and which things are results of changing the things they control directly (this is analogous to “independent” and “dependent” variables or “inputs” and “outputs” depending on what terminologies we are accustomed to). Often something is a result in one context but a controlling parameter in another. An example: In the process of primary clarification in wastewater treatment, primary sludge withdrawal rate is a parameter over which we have direct control; we pump a lot or a
little – it is our operational decision. Blanket depth in the primary clarifiers is the result; it is something we are seeking to affect by adjusting withdrawal rate. Blanket depth in turn, is a control parameter for optimization primary sludge concentration. Withdrawal rate is the figurative “knob” we turn to affect blanket depth, which is the “knob” for controlling sludge concentration.

After identifying “control” and “result” parameters, operators have to set targets for their process results. When results trend away from targets, operators make adjustments in the appropriate control parameter(s). Operators will apply theory and experience to produce rules-of-thumb that can help determine by what magnitude to change control parameters to see the desired change in process results.

In order to succeed in exerting control over multiple interrelated processes, plant teams must frequently and unfailingly document their targets, results, and process control changes. Some gifted individuals can hold a lot of information in their heads, but teams’ heads are not wired together. Tangible representation of targets, results, and changes are necessary to meet stringent compliance goals. Weekly process control meetings and accompanying records are the common approach for this. A greater or lesser frequency may be sensible depending on the nature of the processes.

To go from control to mastery of the plant systems will require a higher level of attention to the subtleties and details of O&M. If we compare it to control of an automobile, what we described above is analogous to competent driving about town. We have first to be good enough at it to keep our license. Mastery suggests that the team will need to be accomplished enough in our driving to beat others in a race. A champion racecar driver perceives minuscule changes in status and makes subtle adjustments to stay in control while pushing to new levels of performance. Operators need to train themselves to be more sensitive and dexterous in applying creativity and the principles described in this report to get more performance out of their processes, and satisfaction in their careers.

For City staff, we recommend frequent training programs on all aspects of water and wastewater O&M in gradually increasing levels of sophistication, and supported by outside experts available to answer questions when needed. The benefit to staff would be to build all of them to a point where they are all qualified to be Class 4 water or wastewater operators in any state, and have the ability to handle nearly any treatment or maintenance challenge. The training section below outlines the basic courses we recommend.

4.4.7 Operations Database

Another permit requirement is that a project keeps a record of their reportable data for up to 7 years. The format is not stipulated in federal or state regulations, but both written (e.g., log books, lab sheets, operator rounds sheets) and electronic (e.g., Op10, Excel) formats are required. Additional calculations and records may be kept in the database for process control purposes, but these should generally be minimized to what is useful to support decisions and transfer information among staff.

Operations staff should think of themselves as custodians of that database. They need to take responsibility for keeping it accurate and current. Some entry errors can be avoided by using software features that change the color of a number if it is outside of selected limits. Data entry can seem like a rote task but staff should engage their mind in the process and review the data as they enter it, not only to check for reasonableness as a QA/QC measure, but it is a convenient time to look for trends and anomalies in process performance.

An operations database, above all, needs to be useable. It should be a natural extension of the operators’ understanding of the plant’s processes. Any staff member must be able to access it and enter data. Any operator should be able to write new formulas and create new reports and graphs so that he/she can view process information in new ways as needs or an inspiration may require. The database is an operator’s window to the condition and performance of his processes.
Spread sheets have a tremendous assortment of features and can be a powerful tool for analyzing operational data. Data can be exported or cut and pasted from operational software into spreadsheets for analysis or for sharing with other people in our profession. Spread sheets however, are not ideal for managing large long-term or on-going sets of data as operations usually require. Operators should resist the temptation to do occasional bits of process calculations on isolated spreadsheets. The effort we put into collecting and verifying data may be partially wasted if it is entered into a stand-alone spreadsheet rather than into the plant operational database. Information entered into the database on the other hand, is available for its originally envisioned purpose and then also available for use in any other analyses or reports an operator may want to create with it. Databases collect and store the data, spreadsheets are for analysis and manipulation. It is recommended that even a basic Excel spreadsheet be created to track and record critical process data, which the plant currently lacks.

4.4.8 Trending

Trend graphs can be fantastically useful to operators. Visual representations of the magnitude and direction of a measurement over time help an operator understand the behavior of processes intuitively. Graphs showing several related parameters at the same time, limits, and process performance over previous time periods are more enlightening to an operator than viewing and comparing tabulated results.

Another presentation of data that can be meaningful for operators is to graph one parameter against another. This creates a visual representation of the degree to which one parameter correlates or tracks with another (directly or inversely, linearly or non-linearly). This kind of graph can suggest a causal link between parameters. For example, if the volume of trash collected at a City’s parks is graphed against area rainfall, one might see an inverse relationship. In rainy weather, fewer people may visit parks, therefore trash collection may be required less often.

Sometimes when we represent results of our measurements to ourselves, the power and flexibility of computer graphing is less important than location and immediacy. In-the-field or point-of-use-graphs may be hand made on paper or dry-erase boards. An example: Upon a visit to a remote lift station, a plotting of pump run times may indicate a very recent change suggesting that a pump is clogged. The operator can identify and react to that problem on the spot.

The SCADA system has good trending capabilities and should be used. Also, with the use of a data management spreadsheet discussed in the preceding section, process data should be trended weekly and posted for all operators to see.

4.4.9 Weekly Process Meetings

Tracking and communicating process trends and activities is extremely important to the success of a plant. Weekly meetings are recommended, and might include members of both the O&M teams, and between shifts to improve plant-wide team communications. Recording minutes from these meetings documents your due diligence to regulators and your managers, and is a convenient way to track process trends and actions taken.

4.5 Maintenance and Capital Improvement Program

Maintenance management encompasses the strategy, processes and tactics involved in the assessment, upkeep, and optimization of equipment and other infrastructure assets. It includes establishing goals associated with reliability, planned versus reactive maintenance, and responsiveness. It defines how work is identified, planned, scheduled, executed, completed, and analyzed. Maintenance management should also define the process of determining the best level and type of planned maintenance performed on assets. For example, assets having a very low consequence of failure may be delegated to receive only very basic maintenance, essentially run-to-failure. On the other extreme, assets having a
severe consequence upon failure should be considered for a reliability-centered maintenance (RCM) program. But, most assets will fall into the middle range, requiring preventive maintenance (i.e., maintenance at regularly scheduled intervals) or predictive maintenance (i.e., condition-based maintenance).

Good maintenance management requires establishment of standard maintenance procedures that are developed with consideration of operational reliability and maximizing asset life, while minimizing life-cycle costs. Also required are processes to prioritize, plan, coordinate and schedule maintenance activities. Establishing performance measures and targets, monitoring and reporting actual performance, and analyzing maintenance practices to continually improve and add value are also crucial components of maintenance management. In addition, leveraging technology, such as CMMS, Geographic Information Systems (GIS), Customer Information Systems (CIS), Financial Information Systems (FIS) can benefit the management of maintenance through more robust analysis, increased responsiveness and improved communications.

4.5.1 Computerized Maintenance Management System

CH2M emphasizes proper equipment and facility maintenance as part of our maintenance approach. A proper maintenance program begins with an accurate asset list, along with a thorough audit and analysis of equipment condition, warranty status, and repair records. Data gathered from the analysis is used to populate a CMMS (Computer Maintenance Management System) to establish baselines for ongoing, and system wide maintenance services. The CMMS serves as the foundation of a total maintenance approach and is one of the key tools within systems integration to guide and track O&M activities.

A successful maintenance program can extend the life of the managed assets for many years, resulting in long-term cost savings. A properly managed CMMS will assist plant staff with monitoring asset condition, scheduling routine inspections, directing maintenance and repairs, manage inventory, and track distribution and collection system maintenance.

The CMMS will also track planned, emergency, and unplanned maintenance and aid in the reporting to state and federal regulator by providing documentation of activity related to permit or compliance.

A quality CMMS system will help manage many different aspects of the maintenance program including:

- Work order management
- Work planning (contractor / Associates)
- Work scheduling and resource balancing
- Employee utilization management
- Equipment performance / reliability (down time/repair cost)
- Condition based Monitoring
- Service history
- Repair costs
- Warranty information

Work order management is one of the most important aspects of a successful CMMS system. The work order contains vital information to be used in making informed and cost affective decisions in a timely and defensible manner. The work orders also provide near real-time feedback which aids in keeping the associates in a preventive as opposed to reactive maintenance management mode. This enables management to have visibility of their system and allows the transformation for asset data into usable information which will help make sound decisions affecting the future of an asset.

The CMMS should be used for the prioritization, planning and scheduling of routine maintenance and corrective maintenance. Proper planning and scheduling of work will increase employee utilization and reduce extraneous repair costs by minimizing unplanned work delays (e.g. parts shortages, labor
shortages). The CMMS should record contractor activities including tasks performed and hours spent onsite so accurate details of contractor cost and work performed are kept. Incorporating CMMS into the work management process is a dynamic process that requires input from all staffing levels. As work is organized and evaluated within the system a more customized and site specific maintenance approach me be developed each asset type at the facilities.

Asset condition, service history and repair cost/cost of ownership are key asset management factors which should be utilized to make decisions regarding asset rehabilitation or replacement. These factors will impact the decisions to repair an existing asset, rehabilitate the asset to a percentage of its original condition or replace the asset for lower cost of ownership over its lifespan.

Information pertaining to an asset warrantee should be placed into the system in order to properly meet the maintenance requirement from the supplier and manufacture. The CMMS will provide documented support that proper maintenance was performed in the event of a failure or claim. By entering these data, it may also prevent extra cost of repair to an asset that would otherwise be covered by a manufactures warranty.

At its core, a CMMS is a tool which maintains historical records so that performance may be measured against goals. In order to accomplish this reports must be established that align with and support the department’s business goals. Standard Operation Procedures (SOPs) must also be documented which define the goals of the reports, the data that drives the report and responsibilities of the staff to review and provide feedback on report content. An example of common maintenance department CMMS output reports include:

- Life-cycle asset costs
- Asset descriptions and specifications
- Asset maintenance frequencies and histories
- PdM, PM, and CM activity status reports
- Job completion reports
- Calibration reports
- Back log and work order status reports
- Inventory control levels of spare parts and availability for optimization
- Custom reports m be created for client or regulatory requirements.

CH2M’s approach to maintenance management incorporates computer technologies coupled with sound management practices. CH2M also understands that Lucity, a full featured CMMS, is in the process of being configured for integration across the water and sewer utilities. Lucity has the ability to be configured to meet the particular needs of the utility and CH2M recommends that the integration include the following:

- Accessible to all users both plant based and mobile remote users through online connectivity
- Integration into other plant functions such as operations, inventory, laboratory, management, and administration
- Tracking of repair records and affiliated maintenance costs for each piece of equipment in the water and wastewater departments
- Configured to support the planning and scheduling of all maintenance activities
- A complete equipment and critical spare parts inventory
- Repair warranty tracking
- Work exceptions tracking, equipment status tracking, and equipment repair priority reports
- CIP tracking
The CMMS has several additional features that will benefit the utility. It can easily generate custom reports, such as Management Summary Reports, other than the basic raw data-only type of reports generally provided. The CMMS will produce concise, easy-to-read equipment reports that provide specific information based on manufacturer, type, location, or operating system and subsystem. This information will include:

- lifecycle costs
- Maintenance frequencies and histories
- Status reports on all maintenance functions including:
  - routine maintenance
  - PM, PdM, CM

These reports will also focus on issues such as job completion reports, work order status, and manpower utilization.

These actions may extend the useful service life of some equipment beyond the availability of replacement parts to the point where even though it is still serving a useful purpose, it has become outdated. In these situations, a sensitivity analysis will be conducted based on reliability, suitability, and cost efficiency to determine whether or not it makes sense to continue using such a piece of equipment. If it makes sense to keep the unit in service as long as possible, then the plant will secure a source of critical spare parts, and where prudent, actually purchase and stock these critical spare parts at the project.

Ordinary plant maintenance activities will be conducted on three levels: routine preventive, predictive, and corrective.

By concentrating on preventive and PdM, the staff will minimize costs:

- protecting warranties
- reduce expensive emergency repairs
- Planning maintenance activities
- Continuously monitoring equipment conditions
- Extend equipment life to manage future capital expenses.

The plant staff can then perform full PM’s for mechanical, electrical, and instrumentation equipment according to manufacturers’ recommendations and industry best practices. In addition, staff will perform the optimal number of PdM tasks and testing on a regular basis— including oil analysis, infrared testing, and vibration analysis. The combination of these efforts will aid in maintaining equipment in reliable, economic service for its expected service life or beyond. While reducing high-cost capital expenditures by addressing any problems before they become equipment failures. This approach safeguards system reliability.

CH2M can perform a detailed inventory of equipment and a baseline condition assessment if requested. We can document all equipment including type, manufacturer, installation date and comments, warranties in effect, and manufacturers’ O&M recommendations.

4.5.2 Condition Assessment

One of the key first steps that CH2M takes when we operate a treatment plant for a community is to conduct a condition assessment of all the equipment and facilities. We use a database tool called ACES (Asset Condition Evaluation System) to track each piece of equipment and the condition rating given to it, and then we apply risk criteria that is defined in a workshop with the client to determine what equipment needs to be repaired or replaced first. This not only improves plant performance but reduces
costs for the communities we serve. We then repeat the condition assessment on a periodic basis (every 2 years) to trend the overall plant condition. More frequent checks are done on critical equipment such as blowers, filters, or UV systems.

The field team would be responsible to complete, with exceptions noted, the external overview physical inspections using a grading system of 1 through 5 for evaluation, with 1 being near new and 5 being that the asset is unserviceable. The details of this grading system would be discussed during the project workshop activities. Functional, qualitative, or quantitative testing of outputs is not typically needed, but vibration and infrared analyses can be performed if it is deemed appropriate to gauge the condition of the assets.

CH2M would then employ our Asset Condition Evaluation System (ACES®) to consider risk, criticality, and anticipated equipment life in the development and updating of the Repair and Replacement Plan.

A Baseline Report would be provided to the City detailing the baseline status of major equipment. In addition, we will provide additional PdM Evaluation Reports detailing the condition of the major equipment, which will include the basis for establishing immediate and long-term maintenance needs, as discussed in the next section.

4.5.3 Capital Improvement Program

Capital planning is a vital long term aspect of the proper function of any infrastructure, but is often neglected due to both financial and political constraints. It has been proven repeatedly that rational long term capital planning and execution is more economical than short term reaction to failures.

It is recommended that a capital improvements plan be developed for each of the major facilities in the City system that takes into account the condition of the assets as discussed in the previous section, but also near term expansion needs for the plant that may have been defined as part of other studies. We have found that a detailed five year plan is the most useful for most communities since it has a long enough window to act in advance, but is short enough to require some degree of attention and urgency from decision makers. Longer term 20 year plans are often “kicked down the road” without action, but may also be required by decision makers. When properly constructed, these plans are somewhat flexible and can allow for funding realities or opportunities while clearly presenting the risks associated with changes.

Many organizations build capital plans that include annual, 5-year, 10-year, and the standard 20-year plans and update annually. Annual updates ensure that attention is paid to the plan on at least a yearly basis, and allow for the reprioritization of projects should it be necessary due to need, budget or to combine with other projects as needed. In addition, these plans should be coordinated between the water, wastewater, distribution and collection departments to provide for opportunities for cost sharing on large projects or to coordinate on underground infrastructure project (i.e. complete a water line and sewer line replacement on same street(s) prior to repaving).

4.6 Staff Management

For this optimized O&M alternatives, we recommend the City consider the advantages of improving staff training and knowledge as a means of improving the value each employee provides to the O&M of the water/wastewater system. This may balance the demand for simply adding additional staff to the roster to meet needs.

As noted in Section 3, the current staffing count is roughly 332 FTE in the water and wastewater departments. City data suggests as many as 37 open positions (already designated but not currently filled) or about 10 percent of the total planned staffing. With the right tools and training, the current staff can readily accomplish the work of these vacant positions. Over time through natural attrition rates, this is one of the methods contract operators use to gradually reduce operating costs: as training
and support systems are developed, replacing some vacant positions becomes less of a need. In the meantime, we recommend the key positions listed in Table 4-5 be filled as soon as possible with highly qualified staff, either as direct hires by the City to fill vacancies, or with temporary consultant staff:

Table 4-5. Recommended Immediate Key Hires or Temporary Augmentation

<table>
<thead>
<tr>
<th>Position</th>
<th>Credentials</th>
<th>Risk Factors to Mitigate</th>
</tr>
</thead>
<tbody>
<tr>
<td>Water Quality Manager (at East/Central WTPs)</td>
<td>Top certified in water and distribution operations; Bachelor’s Degree or higher; experienced with lab and regulations; 15 years minimum in utility management</td>
<td>Public health, compliance reporting, City reputation, process control, cost control, staff guidance, training</td>
</tr>
<tr>
<td>Capital Project Manager(s) for equipment replacement projects</td>
<td>Bachelor’s Degree in engineering; 10 years minimum in water/wastewater design and project management</td>
<td>Regulatory compliance, cost control on unnecessary corrective maintenance</td>
</tr>
<tr>
<td>Collection System Field Crew (1 or 2 full two man crews)</td>
<td>High school diploma, 5 years minimum in construction or related field (if under direction of experienced supervisor), CDL</td>
<td>SSO management, pump station and sewer maintenance, cost control</td>
</tr>
<tr>
<td>Wastewater Operators (4)</td>
<td>High school diploma, 10 years of utility experience, Class C or higher wastewater license</td>
<td>Operations support at WWTP No. 2 (dewatering), Cowskin Creek and Four Mile Creek plants, Midcontinent plant when back online</td>
</tr>
</tbody>
</table>

The most important item to consider for improving current training is to create a culture which embraces growth and development. This must include input from all levels within the organization. This is closely related to the mission, vision and values of the organization, and these lead to more specific items including strategy and tactics. It is recommended that the City go through this sort of exercise as a part of implementing the training plan (and other asset management plans as well). The base that this creates provides the multi-level support of a training plan that is needed for best implementation.

In general, there seemed to be a need for training supervisory and management staff on “new” methods of supervision – staff development, mentoring, encouragement, open respectful communications, and performance management. This should be a major focus area for supervisory and management staff.

When a culture of learning and growth is created, the training program will be self-supporting and automatically spur informal supplements the formal program.

4.6.1 Technical Training

Some of the courses are recommended to be performed by outside providers (consultants, vendors, training specialists) while some are planned for presentation by internal staff (Table 4-6). A combination or sequence is likely, especially at the beginning – an outside provider can be utilized to start the program with a planned hand off to internal staff.
Table 4-6. Recommended Technical Training

<table>
<thead>
<tr>
<th>Attendees</th>
<th>Topic</th>
<th>Suggested Attendance Schedule</th>
</tr>
</thead>
<tbody>
<tr>
<td>Lab staff, Treatment Plant Supervisors</td>
<td>Understanding Water Chemistry with Practical Applications</td>
<td>One treatment plant supervisor every-other year</td>
</tr>
<tr>
<td>Lab Staff, Treatment Plant Supervisors</td>
<td>Fundamentals of Drinking Water Treatment</td>
<td>One treatment plant supervisor every-other year</td>
</tr>
<tr>
<td>Collection System Supervisors</td>
<td>Upgrading Your Distribution System Maintenance Program</td>
<td>One distribution system supervisor / manager per year</td>
</tr>
<tr>
<td>Lab Staff, Treatment Plant Supervisors</td>
<td>Water Treatment Processes and Technologies</td>
<td>One treatment plant supervisor per year</td>
</tr>
<tr>
<td>Management</td>
<td>Advanced Asset Management Practices for Water and Wastewater Utilities</td>
<td>One manager per year</td>
</tr>
<tr>
<td>Maintenance Supervisors</td>
<td>Pumps and Motors</td>
<td>One supervisor per year</td>
</tr>
<tr>
<td>Treatment plant supervisors and management</td>
<td>Improving Your Energy Efficiencies in Water and Wastewater Treatment, Collection and Distribution</td>
<td>One supervisor or manager per year</td>
</tr>
<tr>
<td>Treatment Plant Supervisors, Lab Staff, Management</td>
<td>AWWA Annual Conference and Exposition (June)</td>
<td>Two employees per year</td>
</tr>
<tr>
<td>Treatment Plant Supervisors, Lab Staff, Management</td>
<td>WEFTEC (Water Environment Federation Technical Exhibition and Conference) (September / October)</td>
<td>Two employees per year</td>
</tr>
<tr>
<td>Treatment Plant Treatment Plant Supervisors, Lab Staff, Distribution System Supervisors, Management, Mechanics</td>
<td>Kansas WEA Annual Conference (3 days)</td>
<td>Two employees per year</td>
</tr>
</tbody>
</table>

Table 4-7 show suggested training levels by position classification. The initial training does not include specific training for job tasks, rather it is intended for general training (whether in-house or outside) in addition to the on-boarding process of specific task training.

Table 4-7. Training by Job Category.

<table>
<thead>
<tr>
<th>Initial Training by Area (Hours)</th>
<th>Total</th>
<th>Safety</th>
<th>Management / Leadership</th>
<th>Technical (In addition to that required for certification)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Management</td>
<td>52</td>
<td>*</td>
<td>32</td>
<td>20</td>
</tr>
<tr>
<td>Supervisory / Foreman</td>
<td>40</td>
<td>*</td>
<td>32</td>
<td>8</td>
</tr>
<tr>
<td>Line Level</td>
<td>8</td>
<td>*</td>
<td>0</td>
<td>8</td>
</tr>
</tbody>
</table>

* Initial safety training level is not included in this listing.

<table>
<thead>
<tr>
<th>Annual Training by Area (Hours)</th>
<th>Total</th>
<th>Safety (Suggested level for budgeting purposes)</th>
<th>Management / Leadership</th>
<th>Technical (In addition to that required for certification)</th>
<th>CEU Requirements for Maintenance of Certification (Assumed at 30 hours per 3 year period, varies by position)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Management</td>
<td>58</td>
<td>8</td>
<td>20</td>
<td>20</td>
<td>10</td>
</tr>
<tr>
<td>Supervisory / Foreman</td>
<td>40</td>
<td>12</td>
<td>10</td>
<td>8</td>
<td>10</td>
</tr>
</tbody>
</table>
4.6.2 Compliance Training

A special note about compliance training: regulatory compliance awareness is perhaps taken for granted as just part of the operator’s profession, but very few get any formal training in the legal or regulatory complexity of treatment plant permits. Very few operators realize that they are criminally liable for violations of the Safe Drinking Water Act and/or the Clean Water Act by being negligent in their duties as an operator. Regulators take a very dim view of any permit violations, whether they are for effluent quality or simply reporting errors. Both may be considered equally damaging in terms of violating regulations. Both factors played into the conviction and jail sentences for the many operators and supervisors in Flint, MI.

We strongly recommend a “crash course” in compliance training for City management and staff. Compliance training is designed to standardize procedures and schedules for regulatory data gathering and reporting, inspection and maintenance of analysis equipment, and staff accountability for compliance-support activities. Course content includes training in proper techniques for data-gathering open and honest communications, how to avoid common practices that are not legal. It also covers report preparation, equipment maintenance, and inspection, monitoring regulatory changes, and communication procedures. It does not guarantee correct action by all operators, but it does give them the awareness that they probably have never had before of the serious nature of compliance to their careers. Recent events in the national news underscore the need for this.

4.6.3 Safety Training

Safety training should be mandatory for everyone in the water and wastewater departments, and generally should follow OSHA guidelines even though the City is not subject to OSHA inspections. Training topics could include, at a minimum, those listed in Table 4-8.

<table>
<thead>
<tr>
<th>24-Hour Hazardous Waste</th>
<th>Back Safety</th>
<th>Globally Harmonized System (GHS)</th>
<th>Safety Coordinator Construction Refresher</th>
</tr>
</thead>
<tbody>
<tr>
<td>OSHA 502 Course - Update for Construction Trainers</td>
<td>Battery Recycling Training</td>
<td>H2S Awareness</td>
<td>Safety Coordinator/Hazardous Waste</td>
</tr>
<tr>
<td>8 Hour Hazardous Waste Supervision Training</td>
<td>Behavior Based Loss Prevention System (BBLPS)</td>
<td>Hand Safety</td>
<td>Safety Coordinator/Hazardous Waste Refresher</td>
</tr>
<tr>
<td>8-Hour Hazardous Waste Refresher Training</td>
<td>Benzene</td>
<td>Hazard Communication</td>
<td>Scaffold Safety</td>
</tr>
<tr>
<td>OSHA 510 Construction Course</td>
<td>Blood borne Pathogens</td>
<td>Hearing practical</td>
<td>Scissor Lift</td>
</tr>
<tr>
<td>40-Hour Hazardous Waste</td>
<td>Confined Space Awareness</td>
<td>HSE Employee Commitment Statement</td>
<td>Smith System Small Vehicle Forward Motion</td>
</tr>
<tr>
<td>40-Hour Hazardous Waste - OJT</td>
<td>Confined Space Entry</td>
<td>Initial Safety Coordinator Course</td>
<td>Smith System-Small Vehicle Backing</td>
</tr>
<tr>
<td>OSHA 10-hr Construction Safety Awareness</td>
<td>CPR 2 Year</td>
<td>Laboratory Safety</td>
<td>Stairways and Ladders</td>
</tr>
</tbody>
</table>
Table 4-8. Minimum Safety Training.

<table>
<thead>
<tr>
<th>24-Hour Hazardous Waste</th>
<th>Back Safety</th>
<th>Globally Harmonized System (GHS)</th>
<th>Safety Coordinator Construction Refresher</th>
</tr>
</thead>
<tbody>
<tr>
<td>OSHA 10-Hr General Industry Course</td>
<td>Dangerous Goods Shipping</td>
<td>Lead</td>
<td>Traffic Control</td>
</tr>
<tr>
<td>OSHA 30-hr Construction Course</td>
<td>Drug Free Workplace Training</td>
<td>Lockout/Tagout</td>
<td>Vinyl Chloride</td>
</tr>
<tr>
<td>OSHA 30-Hr General Industry Course</td>
<td>Drum Handling</td>
<td>LOTO Practical</td>
<td>Waste Management</td>
</tr>
<tr>
<td>AED Training 2 year</td>
<td>Electrical Safety Awareness</td>
<td>Manual Lifting</td>
<td>Welding/Hot work</td>
</tr>
<tr>
<td>Aerial Lifts</td>
<td>Ergonomics Awareness</td>
<td>Medical Services First Aid 2yr</td>
<td></td>
</tr>
<tr>
<td>Asbestos Awareness</td>
<td>Excavation Practical</td>
<td>New Employee Safety Orientation</td>
<td></td>
</tr>
<tr>
<td>Awareness Training: Const Site Storm Water Runoff Mgmt</td>
<td>Excavation Safety Training awareness</td>
<td>NFPA 70E Risk Cat 2 (Limited) Qual Person 2012</td>
<td></td>
</tr>
<tr>
<td>Awareness Training: Air Compliance</td>
<td>Fall Protection awareness</td>
<td>Noise/ Hearing Conservation</td>
<td></td>
</tr>
<tr>
<td>Awareness Training: Chemical Mgmt. at Const Sites</td>
<td>Fall Protection Practical</td>
<td>Personal Protective Equipment</td>
<td></td>
</tr>
<tr>
<td>Awareness Training: Environmental Program</td>
<td>Field Awareness Safety Training</td>
<td>Process Safety Management</td>
<td></td>
</tr>
<tr>
<td>Awareness Training: Natural &amp; Cultural Resources</td>
<td>Fire extinguishers Practical</td>
<td>Remediation Waste Training</td>
<td></td>
</tr>
<tr>
<td>Awareness Training: Petroleum Storage</td>
<td>Fire Extinguishers</td>
<td>Safe Behavior Observation Training</td>
<td></td>
</tr>
<tr>
<td>Awareness Training: Waste Management</td>
<td>Forklift Safety</td>
<td>Safety Coordinator Construction</td>
<td></td>
</tr>
</tbody>
</table>

However, not every employee needs the same safety training. To determine the appropriate training levels, all staff can be assigned to a worker category (WC) first, based on the most conservative estimation of the kind of office or field activities they could reasonably perform. There are some unique challenges in creating safety WCs since the staff we observed performs work not at a single site, but instead continually move from one site to another doing many different tasks.

**Office** - staff who will never leave the office area, not even to do a facility tour. This includes administrative, financial analysts, purchasing and IT functions.

**Field** - associates that will walk around during inspections and tours but will not operate systems in a plant setting. This includes asset management and senior managers.

**Operators and Maintenance** - hands on people who will be turning wrenches and taking samples. This will be the largest training group, and typically requires about 30 hours of training per year.
Electrical - This is the most select group and requires the most detailed training and credentials, and includes everything in the O&M group plus specialized arc-flash and related open panel high voltage training due to the nature of their work.

The benefits of safety programs and safety training in particular are well documented. A commonly cited metric is that for every dollar spent on incident prevention, an organization saves $3-$8 in unexpected costs (American Society of Safety Engineers, June 2014). Another way to look at it is that each recordable safety incident can cost the City $8,600 (based on national data) per occurrence for insurance, administrative time, lost hours, overtime to cover for the absent employee, medical costs, and workman’s compensation premiums. With 151 recordable incidents in the City in 2014, a reduction in safety events could save the City as much as $1.3 million per year.

4.7 Operations and Maintenance Cost Management

Sustainable plant optimization is about meeting or improving compliance while reducing the resources required. The first step of optimization involves baselining chemicals and energy usage and setting goals for reduction with strategies identified for measuring parameters and monitoring progress. Operations staff require access to usage and operating cost data for energy and chemicals on a regular basis to track and control. Real-time data through a SCADA interface provides the best information for operations to adjust quickly when usage deviates from targets.

4.7.1 Energy

Energy optimization can often be linked to goals established by the utility’s organization, or by local, state or federal governments. Energy usage at a facility can be divided into two categories: energy usage that is fixed and energy usage that is variable with the amount of flow treated or level of treatment. Fixed energy usage, such as lighting and building HVAC, will require a different approach than variable energy usage, such as pumping, mixing and aeration.

The first step in optimizing energy is to audit energy usage and develop a monitoring plan. Energy saving ideas can be evaluated based on the cost per amount of energy saved, or on other criteria such as ease or speed of implementation. Common energy saving modifications include variable speed drives (VSD) for pumps and blowers, or dissolved oxygen control that turns down blowers.

Based on a fairly typical savings of 10 percent on power consumption and demand through energy optimization, the City could save over $1 million per year on power costs. Some example projects to evaluate for Wichita could include:

- Lighting retrofits at all larger facilities (LED and high efficiency lighting/fixtures, timers)
- HVAC retrofits at all facilities (verify temperature setpoints, replace aging fans/blowers)
- Aeration system automation (DO setpoint for aeration control in aeration basins)
- Improved fine bubble diffuser technology (Ovivo and similar systems offer 30 percent efficiency improvement over most traditional fine bubble diffusers)
- Real time power monitoring (energy dashboard for each major facility allows operators to monitor the impact of equipment choices, which can be tracked/trended)
- Pump motor replacements (as aging equipment is replaced using an industry-standard capital reinvestment strategy, power demands decline from higher efficiency motors)
- Timers and off-peak operating cycles (operators can learn to manage when equipment is operated to take advantage of should and off peak usage rates)
- Wetwell level controls (with so many pump stations in the system, it would be a very useful study to verify that wetwell lead/lag pump setpoints are optimized).

Of these projects, we recommend the real time power monitoring dashboard as one of the first activities, which will support all the other energy optimization projects that follow. The mantra: “You can’t improve what you don’t measure” applies here. An example dashboard which could be added inexpensively at every plant is shown below, along with power metering devices that are cheap ($500 each) and can be added to whatever MCC you want to monitor.

![Figure 4-6. Energy Monitoring SCADA Screen](image)

### 4.7.2 Chemicals

To be optimized, chemical dosing needs to be linked to process targets and the chemical dosage reduced until the process target is sensitive to changes in the chemical dosage. For each of the chemicals used, CH2M recommends attention to the following items:

- **Flow pacing**—Any chemical used in the liquid process train, such as polymer, alum, caustic or acetic acid, should be flow paced on the plant effluent flow meter 4-20mA signal. Ideally, additional feed rate trim signals could be added to the chemical pump controls to make finer adjustments based on specific feedback meters, but flow pacing is the primary control needed.

- **Calibration**—An SOP is required for calibration and checking feed rates for all chemicals. The draw down calibration columns are complicated to use for the operators, with a number of valves and features that make them difficult. Calibration is strongly recommended to verify dosage accuracy.

- **Usage tracking**—The amount of chemical used is extremely important information necessary to properly control the system. Trending this data, ideally recorded daily, can tell operators a lot about the conditions of the system. This is a classic example of the saying “you can’t improve what you don’t measure.”
Employing these simple techniques typically results in at least a 5 percent savings in chemicals usage at most sites where we have seen it used. For the City, that would translate to roughly $200,000 per year in savings.

### 4.7.3 Revenues

The City may be missing a significant source of revenue based on how water is billed to developers. For instance, based on City data, a typical city residential 3/4” water tap generates $12.62/yr in minimum charge fees to the City, while a 10” tap to a development or subdivision only generates $167.95/yr in minimum charge fees – roughly 13 times higher. At first glance, this might appear reasonable based on the tap size diameter, but the water delivered by a 10” tap is the equivalent of 178 residential taps, not just 13, since the area of the tap is what drives water delivery. A similar approach can be applied to sewer rates as well.

Table 4-9 demonstrates how the rates would change for one rate category (inside city minimum charge) using this area based method to more fairly represent water usage.

<table>
<thead>
<tr>
<th>Tap Size</th>
<th>Tap Diameter, in.</th>
<th>Tap Area, sq in</th>
<th>Ratio to 3/4” by Area</th>
<th>Current Rate</th>
<th>Potential Rate</th>
</tr>
</thead>
<tbody>
<tr>
<td>5/8”</td>
<td>0.6</td>
<td>0.3</td>
<td></td>
<td>$12.62</td>
<td>$12.62</td>
</tr>
<tr>
<td>3/4”</td>
<td>0.8</td>
<td>0.4</td>
<td>1.0</td>
<td>$12.62</td>
<td>$12.62</td>
</tr>
<tr>
<td>1”</td>
<td>1.0</td>
<td>0.8</td>
<td>1.8</td>
<td>$12.62</td>
<td>$22.44</td>
</tr>
<tr>
<td>1 1/2”</td>
<td>1.5</td>
<td>1.8</td>
<td>4.0</td>
<td>$16.40</td>
<td>$50.48</td>
</tr>
<tr>
<td>2”</td>
<td>2.0</td>
<td>3.1</td>
<td>7.1</td>
<td>$20.88</td>
<td>$89.74</td>
</tr>
<tr>
<td>3”</td>
<td>3.0</td>
<td>7.1</td>
<td>16.0</td>
<td>$35.16</td>
<td>$201.92</td>
</tr>
<tr>
<td>4”</td>
<td>4.0</td>
<td>12.6</td>
<td>28.4</td>
<td>$46.70</td>
<td>$358.97</td>
</tr>
<tr>
<td>6”</td>
<td>6.0</td>
<td>28.3</td>
<td>64.0</td>
<td>$70.72</td>
<td>$807.68</td>
</tr>
<tr>
<td>8”</td>
<td>8.0</td>
<td>50.3</td>
<td>113.8</td>
<td>$94.54</td>
<td>$1,435.88</td>
</tr>
<tr>
<td>10”</td>
<td>10.0</td>
<td>78.5</td>
<td>177.8</td>
<td>$120.96</td>
<td>$2,243.56</td>
</tr>
<tr>
<td>12”</td>
<td>12.0</td>
<td>113.1</td>
<td>256.0</td>
<td>$167.95</td>
<td>$3,230.72</td>
</tr>
</tbody>
</table>

Scaling all the rates in this fashion (on an area of the tap, not diameter) to the inside city, outside city, and fire protection, using the ¾” tap fee as the basis rate, results in $6.5 million in addition revenue that could be realized just in water rates for commercial customers (and quite a bit more if this was also applied to residential accounts). This may not be entirely possible, but it points to an opportunity for the City to be fairly compensated for the water and wastewater services they provide to customers.

### 4.7.4 Operations and Maintenance Cost Savings

By implementing the recommendations contained in this section of the report, we would expect over time that the City could realize nearly $7 million in annual O&M savings—about 11 percent of the current O&M budget each year (see Table 4-10). Several more million in revenue could be generated with a more equitable rate structure as discussed above.
Table 4-10. Potential Optimized O&M Cost Savings per Year

<table>
<thead>
<tr>
<th>Category</th>
<th>Impact on Annual Budget</th>
</tr>
</thead>
<tbody>
<tr>
<td>Electrical Optimization (10 percent of total)</td>
<td>$1,000,000</td>
</tr>
<tr>
<td>Chemical Optimization (5 percent of total)</td>
<td>$200,000</td>
</tr>
<tr>
<td>Predictive Maintenance (10 percent of total)</td>
<td>$1,400,000</td>
</tr>
<tr>
<td>Training and Knowledge Transfer</td>
<td>$2,600,000</td>
</tr>
<tr>
<td>Safety Program</td>
<td>$1,300,000</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>$6,500,000</strong></td>
</tr>
</tbody>
</table>

The risk factors identified in Section 3 are avoided to a large extent as well by using an optimized program approach, especially regulatory compliance and labor risks. Compared to the “As Is” case in Section 3, at approximately $59.5 million per year (including $3.2 million in monetized risks), the annual operating budget under the optimized case in this section could be approximately $51.5 million per year.

It should be noted that the current overall water/wastewater utility budget, for the current average annual flows managed, are in line with national averages (about $2,500 per MG treated). This could suggest that while overall costs are in-line with benchmarks, our findings suggest an imbalance where optimization can be found. For instance, the labor pool is understaffed, but extra money spent on expensive corrective equipment maintenance.

### 4.8 Operations and Maintenance Consulting Support

The City can achieve the listed improvements and savings with a focused program and top level management support, but we often see these programs fail unless guided from the outside since there is significant status quo inertia in the current operating culture that must be overcome (Figure 4-7). The

![Figure 4-7. Program Failure Analysis](image)
City can choose from a range of options to address the need for consulting and staff training and augmentation.

Typically with O&M consulting support, O&M experts work with City staff for a period of time (likely 2-5 years) to build upon current practices that are working well for the City, and champion the implementation of upgrades to other programs that need support. These experts could also bridge critical gaps (such as the vacant Water Quality Manager) while the City finds suitable replacements. Finally, any such program should carefully track progress against specific and measurable goals, and report this frequently to City managers.

The payback on investment in this kind of support is usually very rapid – the program envisioned for the City would pay for itself within the first few years. Table 4-11 presents the O&M consulting support key elements for consideration to support your optimization goals.

Table 4-11. Expert Augmentation Support Needs

<table>
<thead>
<tr>
<th>Facility</th>
<th>Water Treatment and Distribution</th>
<th>Wastewater Treatment and Collection</th>
<th>Approximate Level of Effort</th>
</tr>
</thead>
<tbody>
<tr>
<td>Operations</td>
<td>Process optimization, jar testing, chemical selection, water process control training, energy dashboard</td>
<td>Process optimization, chemical selection, solids inventory control training, energy dashboard</td>
<td>1 FTE at East/Central WTPs; 1 FTE at WWTP No. 2 for 3 years</td>
</tr>
<tr>
<td>Maintenance</td>
<td>Condition assessments, KPI, planner/scheduler, workflows, maintenance best practices training at all sites</td>
<td>Condition assessments, KPI, planner/scheduler, workflows, maintenance best practices training at all sites</td>
<td>1 FTE at East/Central WTPs; 1 FTE at WWTP No. 2 for 3 years</td>
</tr>
<tr>
<td>Compliance</td>
<td>Audit, compliance and regulations training, recordkeeping</td>
<td>Audit, compliance and regulations training, recordkeeping</td>
<td>3 FTE team for audit and training, for 3 months</td>
</tr>
<tr>
<td>Safety</td>
<td>OSHA style audit, training, repairs, metrics</td>
<td>OSHA style audit, training, repairs, metrics</td>
<td>2 FTE team for audit and training for 6 months</td>
</tr>
<tr>
<td>Tools (e.g., CMMS, LIMS)</td>
<td>Lucity setup, operations database (WIMS or similar) setup and training, automated reporting</td>
<td>Lucity setup, operations database (WIMS or similar) setup and training, automated reporting</td>
<td>1.5 FTE for Lucity setup and workflows for 1 year; 1 FTE for WIMS or similar setup for 1 year</td>
</tr>
<tr>
<td>Capital Planning</td>
<td>Capital reinvestment projects in expired equipment (e.g., filters, pumps, lime slakers)</td>
<td>Capital reinvestment projects in expired equipment (e.g., diffusers, screens, pumps)</td>
<td>1 FTE project manager for 2 years</td>
</tr>
<tr>
<td>Program Management</td>
<td>New WTP, raw and finished water pipeline design and construction</td>
<td>Upgrade to WWTP No. 2, and modifications to collection system and pump stations</td>
<td>To be determined</td>
</tr>
<tr>
<td>Supplemental Staffing</td>
<td>Water Quality Manager and capital project manager positions as needed</td>
<td>Operators, field crews and capital project managers as needed</td>
<td>TBD for up to 1 year</td>
</tr>
</tbody>
</table>
Attachment A
Compliance and Self Disclosures
White Paper
Attachment A
Compliance and Self Disclosures White Paper

One of the most important functions a utility controls is production of water and treatment of wastewater. These two utilities require proper operations and maintenance and are key to a community's wellbeing. Compliance with regulatory requirements is often seen at the measure of success for this facilities and seems to always be a subject of importance in any discussion of water and wastewater treatment. At the management level these discussions typically revolve around the data generated for reporting and comparisons against permit/regulatory requirements. Data that shows compliance is taken as the indicator that all is well. This occurs because the numeric data reported is an easily measurable quantity and is generally more accessible than other measures of utility performance. Test data that shows compliance with permit limits, however, is not a guarantee that all is well or that the facilities are actually in compliance. This is true for many reasons. Permits are much more complex than simply a set of limits which much be met. Indeed, the numeric limits usually constitute a smaller portion of the requirements than the narrative requirements and practices that are required by the permits and regulations.

An important factor in permits is how well the operational staff understands them. Written in a semi “legal language” style these permits can easily be misinterpreted. Permit reporting on the other hand is almost exclusively numeric limits which is more easily understood and must be reported on a monthly basis. Operational staff in charge of this reporting must review the criteria of numeric standard at regular intervals in order to make these reports and the periodic review leads to operators understanding the numeric information to the point of memorization. Consequently, a strong feeling of understanding permits is developed in the operating staff. The narrative requirements of the permit, however, seldom require review and are often misunderstood or unknown by the staff.

Complicating this situation is a lack of full understanding concerning the full ramifications of permits. Both water and wastewater permits are legally binding documents which if not met may be pursued by both State and federal authorities as either a civil or criminal matter. Despite mention of this issue in the standardized training available to operators, few people in operations understand the full scope of this issue. Wastewater NPDES permits are issued under the authority of the Clean Water Act (CWA). The CWA is one of the most draconian laws in the federal arsenal. It is one of the only set of laws that criminalizes negligence. Simply failing to do something that an operator knew or should have known to do can be pursued as a criminal matter. Both water and wastewater regulations carry heavy penalties and strong consequences which can be levied not only against intentional wrong doing but for operational actions which are based simply on misunderstanding or failure to take exactly the right actions.

The majority of operators work from a set of motives that are based on the same measuring system that uses the numeric data as the bell weather of successful operation. Taking pride in their work they see numbers that don't meet limits as a sign of personal failure that leads them to adopt practices that “improves” performance. An extremely small percent of operating staff would ever change non-compliant number to compliant data “falsification” and rightfully would be offended if thought to do so. There are other ways, however, that an operator can alter the values reported. Common among these is selective monitoring which can occur in a number of ways. Taking a sample when the results are likely to be best seems to simply be putting your best foot forward. Also common is the practice of finding that a frequently monitored parameter is not compliant at a time very near when a compliance sample should be taken and making a change followed by waiting for the change to bring the facility back into
compliance before taking the reportable data. Operational staff may even be correct when they state that the number obtained in this manner is more representative of what happened that day. The only problem, the practice is almost always not legal. Frequently operators will use titrations or hand held meter readings to generate data for a permit which specifies the requirement for continuous monitoring. While most mistakes revolve around not understanding how data must be generated other issues include not understanding when notifications must be made, how data must be generated and many other common misunderstandings. These issues are important and every year utilities, industries and private contractors pay millions of dollars in fines and in both civil and criminal defense for such errors in judgment.

So given the difficulty of knowing exactly what actions are being taken by operational staff, how can utilities best protect themselves? Most authorities rely on training as an answer which is a positive step, however, most training available focuses treatment types and strategy. A more robust approach is to initiate a compliance program that trains operators in how data must be generated and pitfalls to avoid. The compliance system should analyze the exact permit requirements and set up a system whereby operating staff on a day by day basis review the day’s requirements. Finally, compliance audits that emphasize a focus on practices and operational procedures should periodically be conducted which actually observe operators performing their compliance duties can provide tremendous insight into how well a utility is actually doing.

So what if a compliance audit finds that employees have made mistakes in judgment which do not meet the legal requirements of permits and regulations? The good news is that there are incentives for self-auditing as long as it is followed by voluntary disclosure (referred to as self-disclosure) to the regulatory authorities. For wastewater, EPA has a policy that a matter will not be pursued as a criminal matter if it is self-disclosed. EPA may still pursue the matter with civil remedies including fines but even here a self-disclosure of a matter achieves a considerably better position. The size of fines are based on using a matrix that determines the gravity of non-compliance or non-legal practice A factor is specifically added

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1 Compliance training focusing on these issues is available from CH2MILL
for self-disclosure that adjust the gravity\(^2\) downward resulting in lessening of fines and even the use of Supplementary Environmental Project (SEP) that allows the funds to be spent on improvements in the community. While the case for self-disclosure is not as clear cut for drinking water infractions, the situation is almost always improved for disclosing issues. The catch to self-disclosure is that it must specify how the problem will be fixed and the issue actually addressed which must then be carried out. Some tips to getting the best credit for self-disclosure include:

1. Self-disclosures should be in writing and should be sent in hard copy with proof of receipt. Email can also be used to supplement hard copy correspondence, but cannot be used exclusively. Keep a copy of the exact final document and date when it was sent.

2. Always be comprehensive in the disclosure with all due effort to make sure that full operation has been investigated. An important facet to self-disclosure is that it removes the matter disclosed from criminal pursuit, however, *it does not protect other issues that were not disclosed*. A follow up investigation by EPA or the State is often conducted and other issues that may be found during these subsequent regulatory operations can still be pursued with the full remedies prescribed by law.

3. Keep the matters confidential between the investigator and the utility staff that needs to know until after the self-disclosure is made. Frequently the mistake is made to try to use the investigation to correct issues as the investigation proceeds. Operators who become nervous about the issue or decide that it is not really an issue may elect to contact government on their own which can lead to the loss to self-disclose and subsequent government investigation.

4. If a matter is found, the utility has the right to take enough time to fully understand the issue as long as a good faith effort is being made to aggressively pursue and investigate the exact nature and size of the issue(s). An acceptable time period could range from a week to several weeks. If the matter cannot be investigated in less than a month a partial investigation can be done and a pre-report issued to the regulators indicating the nature of investigation and that the investigation is still under way.

5. Once an investigation is completed, a natural hesitancy can exist to self-disclose especially on very serious matters. It is very important to “Go Ugly Early” and send in a report. In the most expensive case investigated by the author of this paper, an issue was found at a wastewater plant but was not disclosed or corrected for three months after the investigator left. Before a disclosure could be made a government investigation was initiated. Defense costs exceeded $22 million dollars.

6. Always indicate in the subject line that the document is a self-disclosure and include in the first paragraph the facility name, the permit(s) identification number(s), the size of plant, and who owns it. This quick reference at the beginning assures that the document is quickly identifiable. This is important because the letter will usually be utilized by the regulator multiple times and making it easy to track is advantageous to the emotional tempo of the situation.

7. Indicate that you have performed an investigation(s) and the time period along with when final results of the investigation were received.

8. Factually specify the issues discovered. Be careful not to express opinions, do not speculate on motives, or the importance of the issue or environmental impact. Do not draw conclusions - let the regulators state the impacts.

9. If known, indicate how long the situation has occurred or if you do not know for certain state this fact as well.

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10. Indicate how widespread the issue has been such as that to the best of your knowledge this has been the practice of all operators, a single shift, or a few operators. In general, however, it is a good practice to not mention specific names in the document.

11. If incorrect data has been reported for which corrective data is available, indicate that reports will be resubmitted. Also provide examples of the reported data and the true data. A good practice in this regard is to use the previously reported data that is the most incorrect. Later when the full reports are refilled it is apparent that the most important data was earlier reported and regulators gain trust. If the data cannot be corrected because the correct data is not available, indicate so in the report.

12. Indicate exactly the steps that will be taken to remedy the issues and prevent them from re-occurring in the future. This should be specified point by point. It is very important to make sure that all steps are achievable and also assure that they are instituted.

13. If a government investigation has already commenced, a self-disclosure generally cannot be initiated. However, if a utility becomes aware that issues appear to have become a concern to regulators and an onsite government investigation has not been commenced, it is often successful to have an experience investigator contact the regulator and inform them that an investigation is in progress. The investigator in this situation should be empowered to indicate to government officials that the results of the investigation will be shared at its conclusion. In this situation even if no issue is found, a report should be made.

14. Key to the success of the self-disclosure is always do what you say you will do. If this becomes impossible inform the regulator, include the reasons why and what will be done as an alternate. This policy not only protects the utility but also leads to actual improvements to operations, and protects the public and the environment.