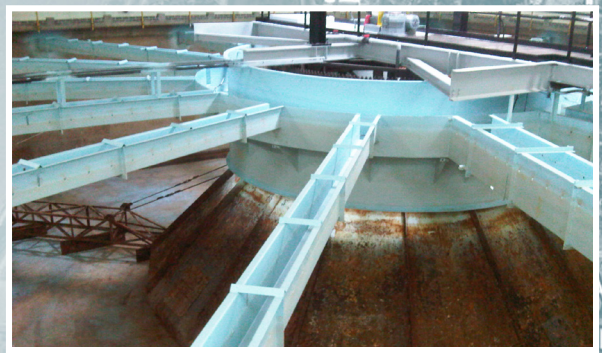
Strategic Capital Improvement Plan

Drinking Water System



Prepared for
City of St. Joseph, Michigan

Prepared by
CH2MHILL®

November 2014

Strategic Capital Improvement Plan

Drinking Water System

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Executive Summary

Purpose

The City of Saint Joseph, Michigan (City) is being proactive in planning water system capital improvements to maintain excellent water service to its customers. This Strategic Capital Improvement Plan (SCIP) is intended to provide a roadmap for water system improvements needed in the next 10 and 20 years.

Water system improvement projects were determined, then ranked in order of highest benefit to water customers. Asset management principles of reducing risk to provide excellent customer service were used to develop and prioritize the recommended improvement projects. An implementation plan was developed for the orderly implementation of projects through the 20 year planning period.

Goals

The City established the following major goals for the SCIP:

- Provide a road map of improvements needed over the next 20 years to maintain excellent customer service.
- Anticipate the future water demands and drinking water regulations that need to be met.
- Provide recommendations on how to improve reliability and water quality.
- Prioritize the projects that are identified based on benefits and accurate cost estimates.
- Develop an implementation schedule for the orderly execution of these projects.
- Incorporate the concept of risk-based asset management throughout the decision making process.

Background

The City owns and operates a public water supply, treatment and distribution system which supplies potable water to customers in Berrien County, Michigan. The St. Joseph water plant serves a population of approximately 9,000 people located in the City of St. Joseph and about 24,000 people in neighboring communities including Lincoln Charter Township, Royalton Township and St. Joseph Charter Township. The water system is governed by the Water Services Joint Operating Board.

The City obtains its source water from Lake Michigan. The water is pumped from a low lift pump station at the shore of the lake, to the water plant nearby. The water plant has a design capacity of 16 million gallons per day (mgd). The treatment processes include alum coagulation, upflow solids contact clarification and filtration. Chlorine is added for disinfection and fluoride for dental health.

The distribution system serving these areas has water storage totaling 6.4 million gallons (MG) (3.5 MG elevated, 2.9 MG ground) and 2 booster pumping stations. Average daily water use is about 4 mgd. Maximum daily water use is around 10 mgd.

Like many Midwest water utilities, the City is addressing aging infrastructure and declining water use. This SCIP is intended to outline needed improvements to maintain a reliable, viable water utility for the next 20 years. Recommended improvements were ranked based on the following benefit criteria:

- Reduce the risk of asset failure to maintain reliable service to customers
- Enhance water quality
- Maintain water quantity
- Provide excellent customer service

- Enhance health and safety

Approach

The following approach was used to meet the SCIP goals:

1. Establish goals for customer service.
2. Create an asset hierarchy, organizing major treatment, pumping, storage and conveyance assets.
3. Develop a risk assessment scoring system for assets, considering the consequence of failure and likelihood of failure. Then score each asset based on risk.
4. Conduct a condition assessment of some higher risk assets to provide more information on condition and likelihood of failure.
5. Conduct a process and capacity evaluation of the water plant.
6. Project future water demands.
7. Develop a list of improvement projects, based on risk, the condition assessment and the process/capacity evaluation.
8. Develop project evaluation criteria and rank the projects on the basis of benefits.
9. Estimate costs for each project.
10. Develop a prioritized implementation plan based on project benefits and costs.
11. Summarize the results into a final report.

Results

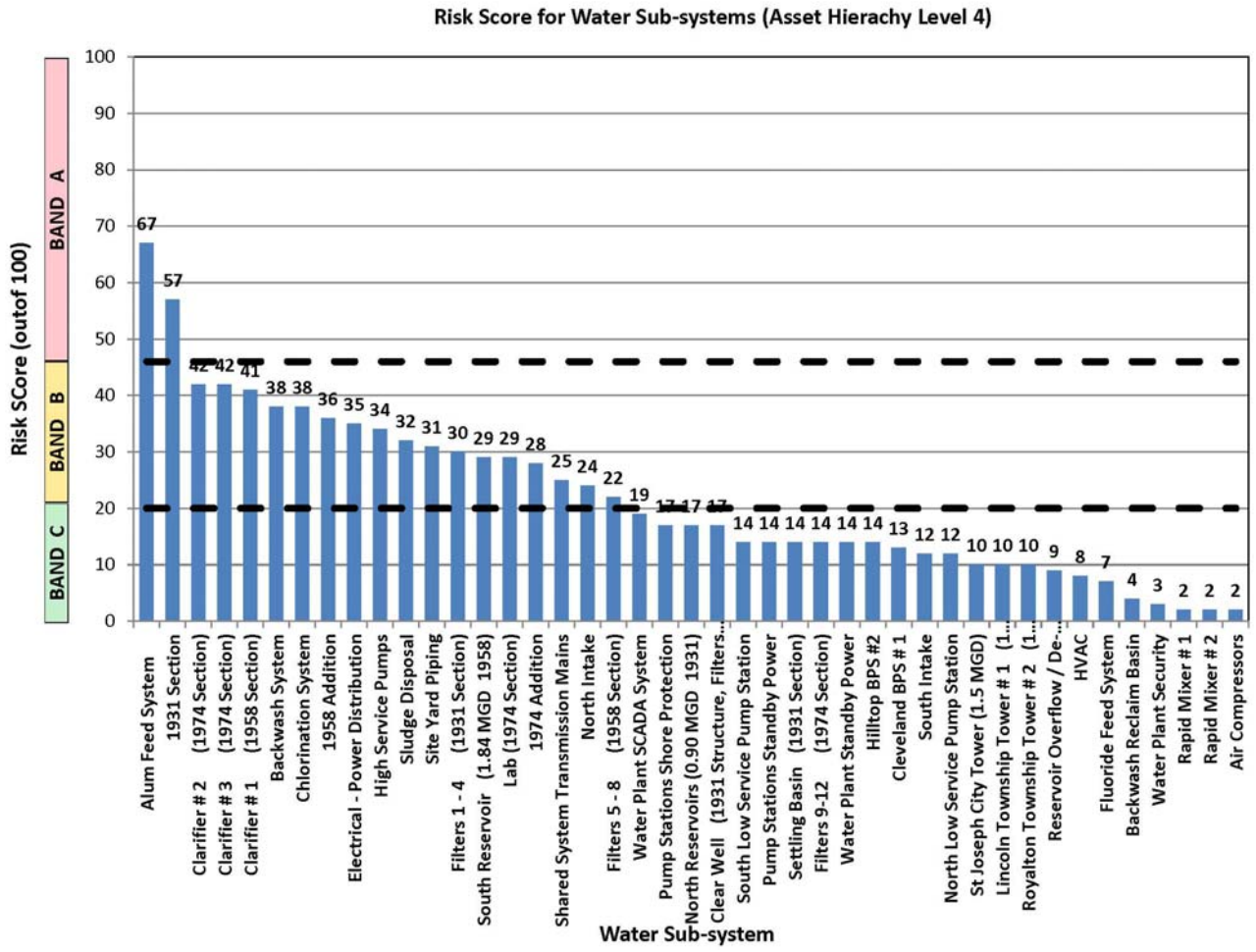
Asset Risk Evaluation

The water plant and pump station assets were organized into an orderly list (Asset Hierarchy). Each asset was evaluated for consequence of failure and likelihood of failure. These factors determined the relative risk of that asset in terms of being able to meet water customer service levels if that asset failed.

The results of the asset risk evaluation are shown in Exhibit ES-1. This information was used to prioritize the on-site condition assessments on the highest risk assets. After the condition assessment, the risk scores were adjusted to reflect actual observed conditions.

EXHIBIT ES-1

Asset Risk Chart (Post Condition Assessment)

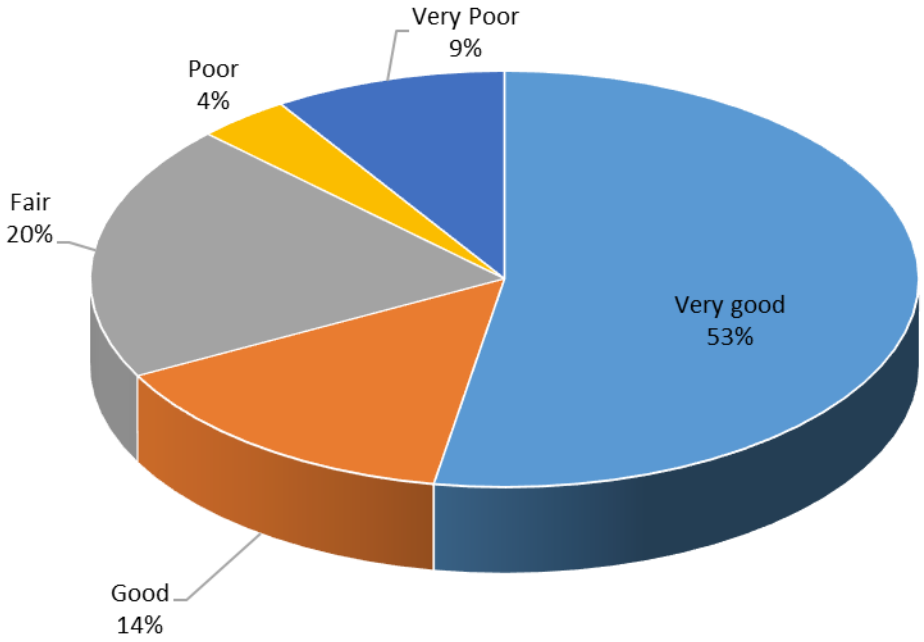


Condition Assessments

Condition assessments of selected water supply, treatment and pumping assets were conducted by professionals in electrical, mechanical, architectural and structural infrastructure. CH2M HILL worked closely with City staff during the condition assessment.

Overall results indicated that although many assets are old, they are well maintained. Exhibit ES-2 shows that 67% of the mechanical and electrical assets were in very good or good condition and 33% were in fair, poor or very poor condition. Many assets are beyond their predicted useful life and still operating satisfactorily. Although the City is getting good value from their assets by taking care of the equipment, over the next 10 and 20 years replacement or major repair will be required.

EXHIBIT ES-2
Mechanical and Electrical Condition Assessment Results



The original portions of the water plant are over 80 years old, including buildings, filters and pumping equipment. Although the facilities are well maintained, some are worn out, obsolete and parts are not available. Certain facilities are in need of replacement to maintain performance and reliability. The major areas needing improvements based on the condition assessment include:

- High service pumping
- Building structure in the 1931 section of the water plant (housing high service pumping and filters 1-4)
- Filters 1 through 4 piping and valves
- Chemical facilities (alum)

Water Demand Projections

Water demand forecasting is a critical element of the City's ability to plan for future water treatment plant capacity over the next 20 years. In addition, the forecast helps to support decisions on timing for renewal and replacement activities to ensure the long-term reliability of water plant operations for providing high quality finished water to the water plant service area. The water plant service area includes the City and the Southwest Michigan Regional Sanitary Sewer and Water Authority, which is comprised of the Lincoln Township, Royalton Township, and the St. Joseph Charter Township.

Exhibit ES-3 displays the probabilistic maximum day finished water demand forecast including a 1-in-10 year probability of a future major industrial customer for the water plant service area. Exhibit ES-4 displays the probabilistic maximum day finished water demand forecast including a 1-in-5 year probability of a future major industrial customer for the water plant service area.

The underlying data used in any forecast has a range of potential values which results in uncertainty in the estimation of future demand. The use of probabilistic methods allows for the recognition of this uncertainty while providing an estimate of a likely demand.

EXHIBIT ES-3

Maximum Day Finished Water Demand Forecast, 1-in-10 Year Probability of Future Major Industrial Customer, City of St. Joseph Water Plant Service Area

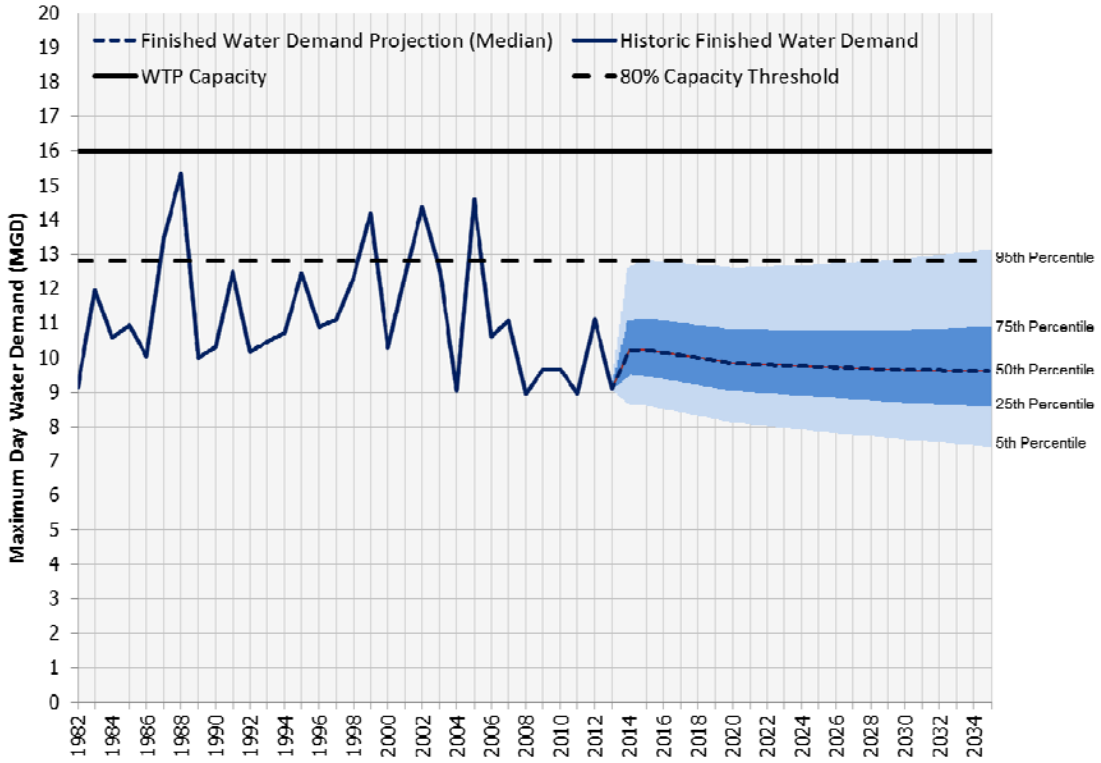
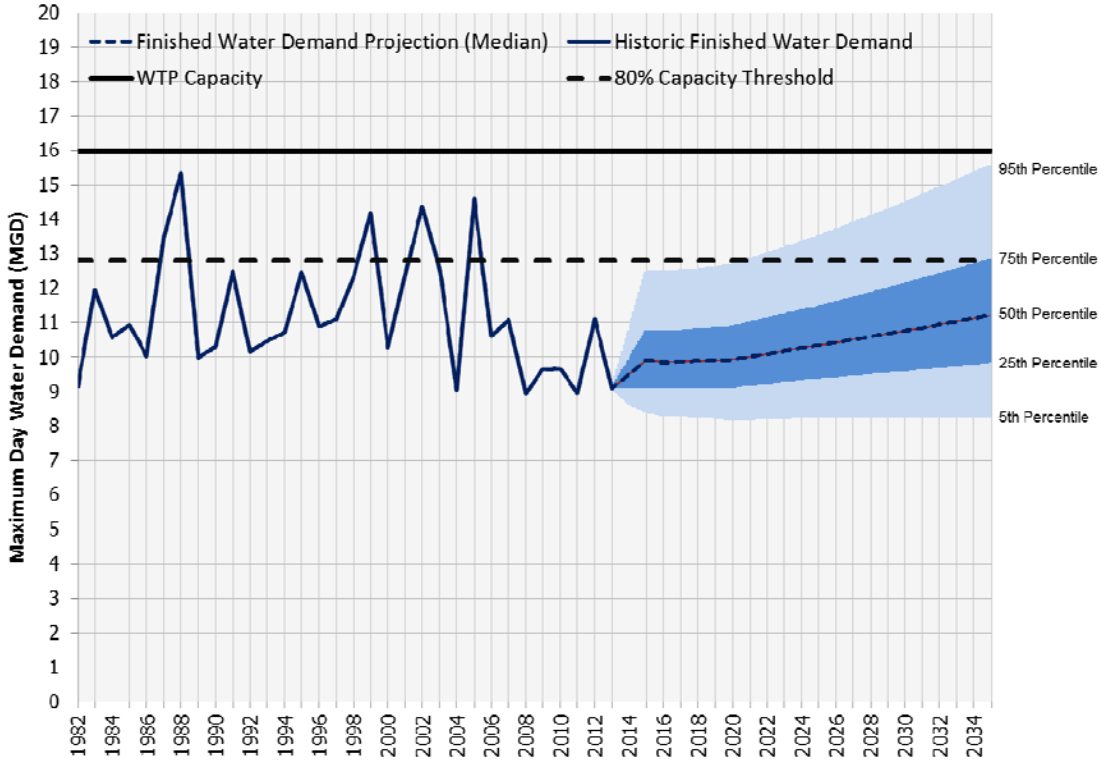


EXHIBIT ES-4

Maximum Day Finished Water Demand Forecast, 1-in-5 Year Probability of Future Major Industrial Customer, City of St. Joseph Water Plant Service Area



The water demand forecast indicates that:

- On average there is a relatively flat demand pattern into the future.
- The small potential for growth in demand in the service area is offset by Whirlpool's water use reductions and the long-term water conservation savings potential.
- There is not a high probability of a return to pre-2005 maximum day demand patterns; there are lower probability scenarios represented within the probabilistic forecast that indicate that maximum day demands could increase to the pre-2005 level later in the planning period.
- The forecast provides an indication that it is not a high probability scenario that the City's water plant will exceed its current capacity of 16 mgd over the next 20 years.

Based on the forecast results, and its associated uncertainty, it is in the best interest of the City to continue maintaining the water plant's 16 mgd capacity, ensuring long-term service reliability for all the demand scenarios in the water demand forecast. In addition, any future water plant improvements should consider future potential capacity expansion. If an individual treatment process is being rehabilitated and can be designed for expansion flexibility, the marginal investment to design this flexibility will provide a significant return in both time and money.

It is recommended that the City continue to annually monitor water demand and compare actual demands against the probabilistic forecast presented in this section. This will help the City continue to refine the forecast, and re-appraise decisions on timing of capital projects at the water plant.

Treatment Plant Process Assessment

Water quality produced by the City is very good and in compliance with all regulations. Given the age and condition of the water plant, there are a number of improvements that would enhance reliability, performance and safety. A summary of some of the major items include:

- The clarifier type is not optimum for alum coagulation of surface water, causing high turbidity to enter the filters and reduce performance during periods of variable raw water quality. In addition, the clarifier mechanisms have been assessed by others and are recommended to be replaced within 10 years due to corrosion and age. A more appropriate technology such as flocculation and plate settling would improve performance during variable raw water quality. This technology can be installed in the existing clarifier concrete basin to save money.
- The alum chemical storage and feed system is old and obsolete. Parts are not available for the alum feeders. It should be replaced with new equipment and building code issues addressed. New equipment will be more reliable, accurate, and spare parts are available. Building and safety codes can be addressed when new equipment is provided.
- The high service pump station is old and in poor condition. Some pumps, piping and valves are corroded and difficult to access. Pump suction piping is below the floor and inaccessible. The condition of this piping cannot be assessed and repair would be costly and time consuming. Pump suction hydraulics are poor and pumps need to be primed with a vacuum pump. This poor pump suction condition also limits storage in the reservoirs. There is potential for flooding due to corroded pipes, filter water located above the pumps, and the pump floor located below grade. Failure of this pump station would interrupt water service to customers. Flooding and loss of water service occurred in Benton Harbor, Michigan when a valve broke (1977), then a pipe broke (2007) in the pump station. This occurred when their pump station was much newer than St. Joseph's pump station. Replacement of this pump station should be considered in the next 10 years. Piping improvements from the filters, reservoirs and pump station would also be done to improve reliability and operations.

- The fluoride feed system (day tank and feed pumps) is in poor condition and should be replaced. Building code issues for ventilation and containment should be addressed. The fluoride storage system is relatively new and in good condition.
- The gas chlorine system needs upgrades to comply with codes, and a scrubber is recommended to protect against a chlorine leak. Converting to liquid sodium hypochlorite is recommended to improve safety.
- Given the many improvements needed in the old (1931) part of the plant, including building structure, hydraulics, pumps and filters, consideration should be given to increasing the capacity of the rest of the plant to maintain 16 mgd and retiring the old plant in the next 20 years, after a new high service pump station is built. The old part of the plant was constructed in 1931 and is effectively near the end of its useful life. Within the next 20 years, increasing O&M costs are likely to outpace the debt service costs associated with replacing this asset.

In planning for the future, new water treatment technologies may be needed to meet regulations or water quality goals. Potential improvements may include an ozone or ultraviolet light (UV) disinfection treatment system to provide safer, higher quality water while positioning for new regulations on disinfection byproducts, emerging contaminants or pathogens.

Finally, the City has one water plant for the entire service area. The water plant has been producing water for many years and is well operated and maintained. However, there is no backup water treatment plant or potable water supply in case of a disaster. Continuing to improve and upgrade this water plant is essential for maintaining excellent customer service. A formal Reliability Assessment can be performed, that is based partially on this work and other work such as a Vulnerability Assessment, to better quantify system reliability issues and potential mitigation. A best practice is to develop formal interconnection agreements with neighboring communities to share drinking water resources. However, a more formal technical analysis should be performed prior to capital investments in new interconnections.

Treatment Plant Capacity Assessment

Based on the water demand projections, adding capacity to the water plant is not a high priority. However, maintaining reliable capacity at 16 mgd is important. Based on the condition assessments and process evaluation, obtaining 16 mgd capacity from the 1974 and 1958 portions of the plant and retiring most of the 1931 portion of the plant is proposed.

The following overall plan is proposed for the water plant:

Phase 1

- Uprate filters 5-12 so they are approved to filter 16 mgd.
- Build a new high service pump station near the reservoirs
- Build a new sodium hypochlorite and fluoride storage facility near the plant entry way (reuse fluoride tanks). Renovate the gas chlorine storage room to a sodium hypochlorite/fluoride feed room.
- Replace alum storage tanks and build a containment curb. Place new alum day tanks and feed pumps where the fluoride storage is now.

Phase 2

- Revise Clarifiers 2 and 3 to flocculation basins with plate settlers that can treat 8 to 10 mgd each.

Phase 3

- Renovate chemical rooms upstairs (chlorine, fluoride, alum) for other uses (office, conference/training room or storage).

- Retire the old high service pump station in the existing water plant.
- Retire the old sedimentation basin that was part of the original 1931 water plant.
- Retire Clarifier 1 and filters 1-4 when the upgraded filters 5-12 and clarifiers 2 and 3 are successfully completed.
- Demolish the east part of the 1931 building
- Renovate the west part of the 1931 building for office, storage, equipment repair and access

Exhibit ES-5 shows a site plan with the existing water plant and proposed improvements.

EXHIBIT ES-5

Site Plan of Existing Water Plant and Proposed Improvements

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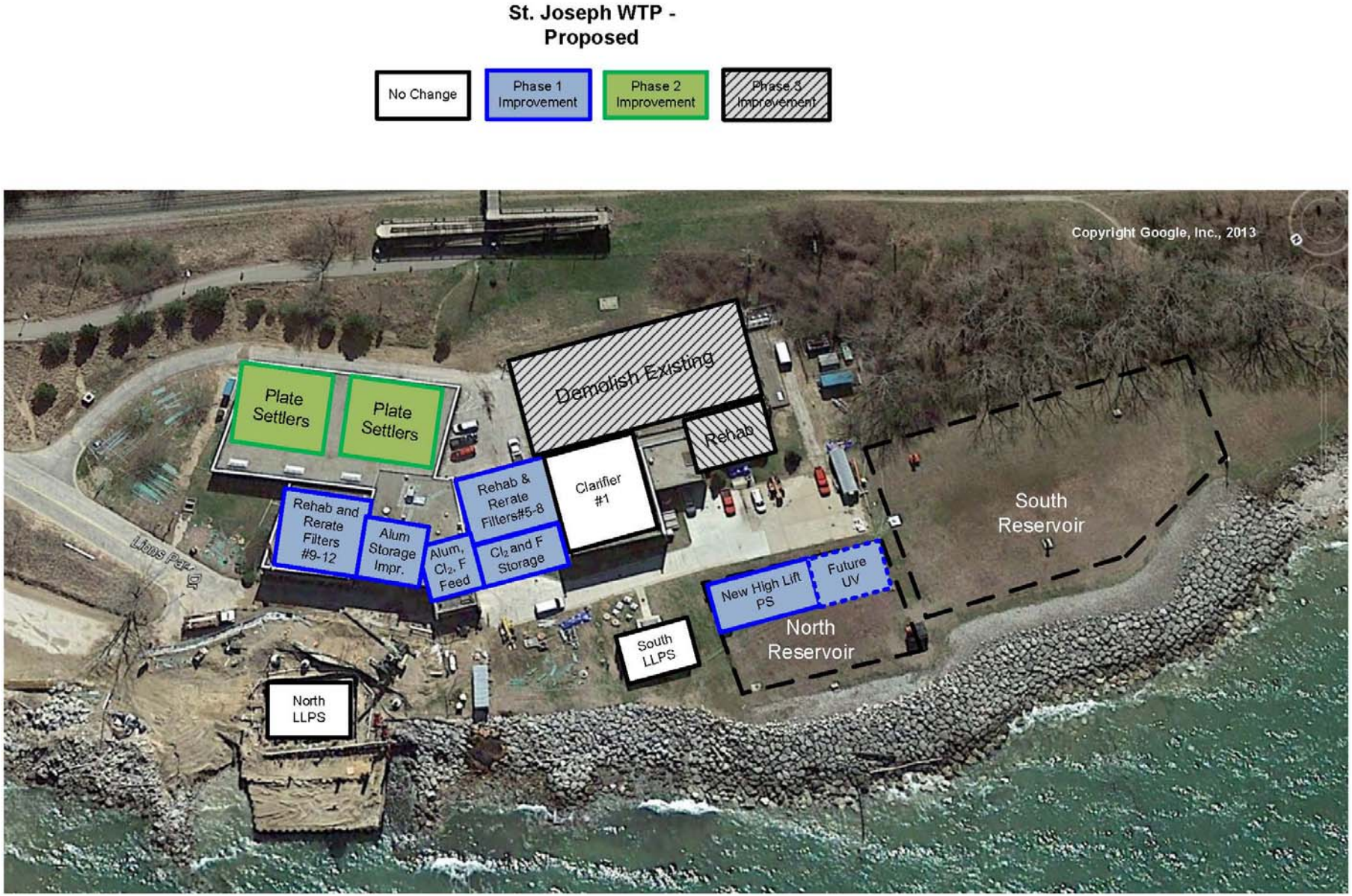
Site Plan of Existing Water Plant and Proposed Improvements



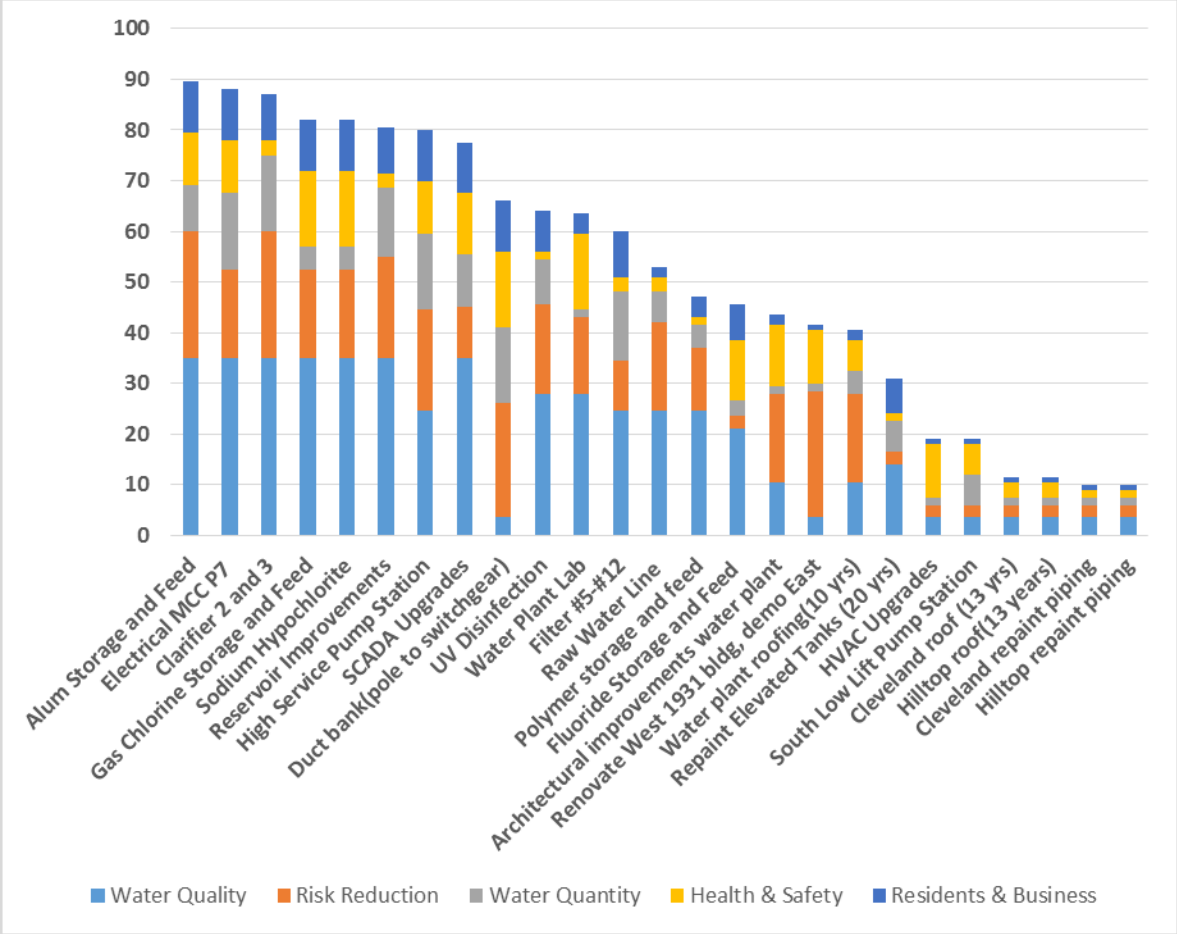
This overall plan for the water plant facilities provides the following benefits:

- The newest portions of the plant are upgraded and their useful life is extended.
- The oldest portions of the plant are retired, saving the cost of upgrading and maintaining them.
- Valuable space at the plant site is created for future use.
- The new facilities will be more reliable and better able to meet current and future drinking water regulations and goals.

Project Prioritization

Supply, treatment, and pumping projects were prioritized by benefit score so that projects with the highest benefit score received the greatest priority. The total benefit score for each of the projects is shown in Exhibit ES-6. Each bar represents a project, with its height equaling its total benefit. The colors within each bar represent the extent to which the project contributes to achieving each benefit criterion.

EXHIBIT ES-6
Total Benefit Scores of Supply, Treatment and Pumping Projects



Cost Estimates

Conceptual level construction cost estimates were prepared for each recommended project as shown in Exhibit ES-7. The total estimated construction cost of all projects is about $22 million.

EXHIBIT ES-7

Recommended Projects and Costs

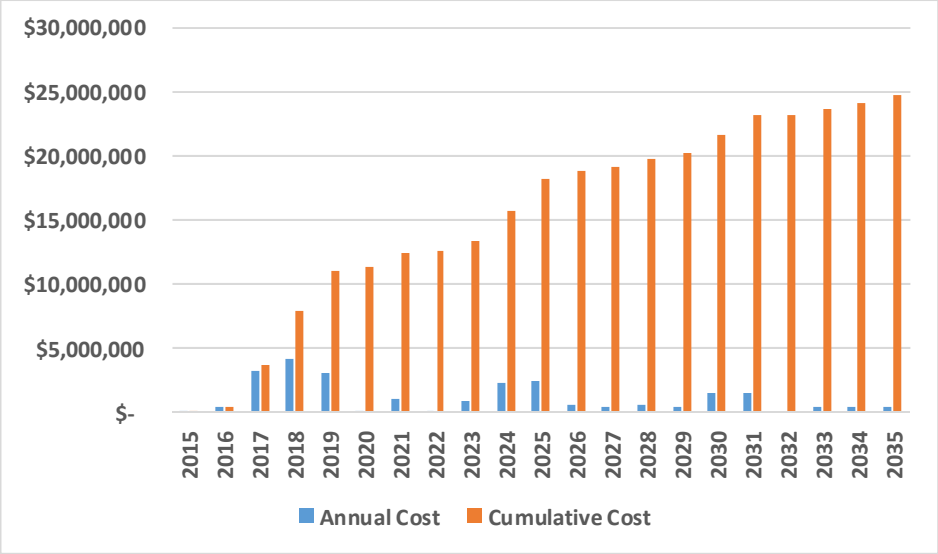
Project Number	Project Name	Description	Estimated Cost
1	New High Service Pump Station	Construct new high service pump station near existing reservoirs. Add new backwash pump and PRV from high service discharge line as a backup filter backwash source.	$4,300,000
2	Raw Water Line Improvements	Install flow meter on filter backwash recycle line and 30-inch raw water line. Extend backwash recycle line to north low lift pump station wet well. Limit filter backwash recycle rate to less than 10 percent of raw water flow with use of VFDs on backwash recycle pumps.	$200,000
3	Clarification Improvements	Retrofit Clarifier #2 and #3 into conventional flocculation and inclined plate settler basins with 8 mgd rated capacity each. Include new sludge removal mechanisms and flocculators in each basin. Automate flow split control between clarifiers.	$4,400,000
4	Filter #5-#12 Improvements	Perform filtration study to uprate filters to 16 mgd in filters #5-12. Replace filter #5-#8 control consoles. Increase size of 18” filter effluent pipe to 24”, connect to 30”. Assumes media replacement and surface wash modifications.	$900,000
5	Reservoir Improvements	Membrane cover and concrete repairs in reservoirs. Baffle reservoirs for better CT disinfection and water quality. Associated yard piping improvements to get water from filters to reservoirs with flexibility to go to either reservoir in series or parallel. Crack repair.	$1,800,000
6	Alum Storage and Feed Improvements	Replace alum bulk storage tanks and transfer pumps. Build containment around storage tank area. Add new alum day tanks and metering pumps where fluoride storage presently exists. Remove alum feed equipment in upper room and rehabilitate room for office or storage.	$400,000
7	Fluoride Storage and Feed Improvements	Build new fluoride storage tank enclosure near the gas chlorine storage room. Modify a portion of the chlorine gas storage room for fluoride day tanks and feed pumps. OR….build a new fluoride storage and feed facility with the HSPS. In either case, Re-use storage tanks and transfer pumps.	$300,000
8	Gas Chlorine Storage and Feed System Improvements	Install chlorine gas scrubber and other improvements to provide a safer gas chlorine facility. Provide flexibility to feed chlorine after clarification and post filtration. This project will only be done if a new sodium hypochlorite facility is not constructed.	$500,000
9	Sodium Hypochlorite	Install new sodium hypochlorite storage tanks in a new enclosure near the chlorine gas storage room. Modify a portion of the chlorine gas storage room for sodium hypochlorite day tanks and feed pumps.	$800,000
10	UV Disinfection	Add a new UV disinfection facility for a Cryptosporidium barrier. This facility could be integrated with the north reservoir and new high service pump station.	$3,000,000
11	HVAC Upgrades	Replace HVAC system in control room and office area. Install dehumidification units in pipe galleries.	$300,000
12	South Low Lift Pump Station Improvements	Replace MCC and switch gear, replace pump packing, replace traveling screen, replace isolation gate.	$500,000
13	SCADA Upgrades	Perform study and upgrade SCADA system.	$80,000

EXHIBIT ES-7
Recommended Projects and Costs

Project Number	Project Name	Description	Estimated Cost
14	Electrical MCC P7 replacement	Replace MCC P7 with new equipment	$400,000
15	New Polymer storage and feed system.	Provide an additional coagulant aid polymer system to improve turbidity.	$120,000
16	Replace gravel surfaced built up roofing on water plant in 10 years.	Replace at end of useful life.	$440,000
17	New utility duct bank from service pole to primary switchgear.	Improve safety and reliability.	$200,000
18	Renovate West portion of 1931 building and demo East section (after new pump station and filter upgrades done).	Demolish east section of 1931 building and nearby sedimentation basin. Renovate west section of 1931 building and build new wall.	$900,000
19	Door, Window, Skylight, handrail replacements. Concrete crack, wall and floor repair	Replace broken or inefficient windows and doors in the water plant. Add handrails for code compliance. Repair major concrete cracks. Painting.	$530,000
20	Cleveland Ave Booster Station roof replacement in 13 years.	Replace at end of useful life.	$35,000
21	Cleveland Ave Booster Station repaint piping.	Remove insulation and Repaint piping.	$10,000
22	Water Plant Lab Improvements	Upgrade HVAC, plumbing, countertops and cabinetry, electrical and instruments to maintain process control capability and regulatory compliance.	$400.000
23	Hilltop Rd. Booster Station roof replacement in 13 years.	Replace at end of useful life.	$35,000
24	Hilltop Rd. Booster Station repaint piping.	Remove insulation and Repaint piping.	$10,000
25	Repaint elevated tanks within 20 years	Repaint as normal maintenance	$1,500,000
26	Shoreline Protection	Stabilize shoreline from storms	$250,000

The annual and cumulative costs of all projects over the next 20 years, is shown in Exhibit ES-8.

EXHIBIT ES-8
Annual and Cumulative Cost of Projects



Implementation Plan

An implementation plan for the next 10 and 20 years was developed, based on the project ranking and other factors such as constructability and plant operations. Actual timing of projects will depend on financial resources and other factors. Some projects may be shifted sooner or later in the schedule, depending on future conditions and priorities.

The recommended implementation plan for all projects, by year, is shown in Exhibit ES-9. The project costs include 15% for engineering.

Safe drinking water is essential for public health and economic prosperity. Water supply and treatment infrastructure is expensive to build. If the St. Joseph water plant were replaced today with a new water plant, the capital cost could be around $50 million. Spending about $25 million over the next 20 years to maintain and improve this important asset provides good value to water customers.

This implementation plan should be re-visited each year and adjusted based on work completed, current issues and financial position.

EXHIBIT ES-9

SCIP Implementation Plan

Saint Joseph, Michigan

Legend:

Study	
Design	
Construction	

Project	Benefit Score	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034	2035	Total Project Cost ($M)	Cumulative Cost ($M)
Alum Storage and Feed	89.5			$ 60,000	$ 400,000																			$ 460,000	$ 460,000
Electrical MCC P7	88.0			$ 60,000	$ 400,000																			$ 460,000	$ 920,000
Clarifier 2 and 3	87.0										$ 660,000	$ 2,200,000	$ 2,200,000											$5,060,000	$ 5,980,000
Gas Chlorine Storage and Feed	82.0																								$ 5,980,000
Sodium Hypochlorite	82.0			$ 120,000	$ 400,000	$ 400,000																		$ 920,000	$ 6,900,000
Reservoir Improvements	80.5				$ 270,000	$ 900,000	$ 900,000																	$2,070,000	$ 8,970,000
High Service Pump Station	80.0				$ 645,000	$2,150,000	$ 2,150,000																	$4,945,000	$13,915,000
SCADA Upgrades	77.5					$ 12,000	$ 80,000																	$ 92,000	$14,007,000
Duct bank(pole to switchgear)	66.0				$ 30,000	$ 200,000																		$ 230,000	$14,237,000
UV Disinfection	64.0																$ 450,000	$ 1,500,000	$ 1,500,000					$3,450,000	$17,687,000
Water Plant Lab	63.5							$ 60,000	$ 400,000															$ 460,000	$18,147,000
Filter #5-#12	60.0		$30,000	$ 105,000	$ 450,000	$ 450,000																		$1,035,000	$19,182,000
Raw Water Line	53.0			$ 30,000	$ 200,000																			$ 230,000	$19,412,000
Polymer storage and feed	47.0										$ 18,000	$ 120,000												$ 138,000	$19,550,000
Fluoride Storage and Feed	45.5			$ 45,000	$ 150,000	$ 150,000																		$ 345,000	$19,895,000
Architectural improvements water plant	43.5							$ 79,500	$ 176,667	$ 176,667	$ 176,667													$ 609,500	$20,504,500
Renovate West 1931 bldg, demo East	41.5													$ 135,000	$ 450,000	$ 450,000								$1,035,000	$21,539,500
Water plant roofing(10 yrs)	40.5												$ 220,000	$ 220,000										$ 440,000	$21,979,500
Repaint Elevated Tanks (20 yrs)	31.0																				$ 500,000	$ 500,000	$ 500,000	$1,500,000	$23,479,500
HVAC Upgrades	19.0			$ 45,000	$ 300,000																			$ 345,000	$23,824,500
South Low Lift Pump Station	19.0							$ 75,000	$ 500,000															$ 575,000	$24,399,500
Cleveland roof (13 yrs)	11.5															$ 35,000								$ 35,000	$24,434,500
Hilltop roof(13 years)	11.5															$ 35,000								$ 35,000	$24,469,500
Cleveland repaint piping	10.0															$ 10,000								$ 10,000	$24,479,500
Hilltop repaint piping	10.0															$ 10,000								$ 10,000	$24,489,500
Shoreline Protection	Not Rated													$ 250,000											
Total Cost by Year			$30,000	$ 465,000	$3,245,000	$4,262,000	$ 3,130,000	$ 214,500	$ 1,076,667	$ 176,667	$ 854,667	$ 2,320,000	$ 2,420,000	$ 605,000	$450,000	$540,000	$ 450,000	$ 1,500,000	$1,500,000	$ -	$500,000	$500,000	$500,000		
Cumulative Cost			$30,000	$ 495,000	$3,740,000	$8,002,000	$11,132,000	$11,346,500	$12,423,167	$ 12,599,833	$ 13,454,500	$ 15,774,500	$18,194,500	$18,799,500	$19,249,500	$19,789,500	$20,239,500	$21,739,500	$23,239,500	$23,239,500	$23,739,500	$24,239,500	$24,739,500		
			2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034	2035		

Contents

Appendixes

Exhibits

Acronyms and Abbreviations

µg/L	micrograms per liter
AACE	Association for the Advancement of Cost Engineering
ACES	Asset Condition Evaluation System
AEP	American Electric Power
ATS	automatic transfer switch
City	City of Saint Joseph, Michigan
DBP	disinfection by-products
GAC	granular activated carbon
GPCD	gallons per capita day
gpm/sf	gallons per minute per square foot
HAA	haloacetic acids
HMI	human machine interface
HVAC	heating, ventilation, and air conditioning
IEEE	Institute of Electrical and Electronics Engineers
kV	kilovolt
LOS	level of service
LRTP	Long Range Transportation Plan
LT2	LT2ESWTR
MCC	motor control center
MCL	maximum contaminant level
MG	million gallons
mg/L	milligrams per liter
mgd	millions of gallons per day
mm	millimeters
NESC	National Electrical Safety Code
NTU	Nephelometric Turbidity Unit
O&M	operation and maintenance
OSB	Oriented Strand Board
PLC	programmable logic controller
psi	pounds per square inch
RMP	Risk Management Plan
SCADA	supervisory control and data acquisition
SCBA	self-contained breathing apparatus

SCIP	Strategic Capital Improvement Plan
SUVA	specific UV absorbance
TOC	total organic carbon
TTHM	total trihalomethanes
UV	ultraviolet
V	volt
VFD	variable frequency drive

SECTION 1

Introduction

1.1 Purpose

The City of Saint Joseph, Michigan (City) is being proactive in planning water system capital improvements to maintain excellent water service to its customers. This Strategic Capital Improvement Plan (SCIP) is intended to provide a roadmap for water system improvements needed in the next 10 and 20 years.

The water system improvement projects were determined, then ranked in order of highest benefit to water customers. Asset management principles of reducing risk to provide excellent customer service were used to develop and prioritize the recommended improvement projects. An implementation plan was developed for the orderly implementation of projects through the 20 year planning period.

1.2 Goals

The City established the following major goals for the SCIP:

- Provide a road map of improvements needed over the next 20 years to maintain excellent customer service.
- Anticipate the future water demands and drinking water regulations that need to be met.
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- Prioritize the projects that are identified based on benefits and accurate cost estimates.
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- Incorporate the concept of risk-based asset management throughout the decision making process.

1.3 Background

The City owns and operates a public water supply, treatment and distribution system which supplies potable water to customers in Berrien County, Michigan. The St. Joseph water plant serves a population of approximately 9,000 people located in the City of St. Joseph and about 24,000 people in neighboring communities including Lincoln Charter Township, Royalton Township and St. Joseph Charter Township. The water system is governed by the Water Services Joint Operating Board.

The City obtains its source water from Lake Michigan. The water is pumped from a low lift pump station at the shore of the lake, to the water plant nearby. The water plant has a design capacity of 16 million gallons per day (mgd). The treatment processes include alum coagulation, upflow solids contact clarification and filtration. Chlorine is added for disinfection and fluoride for dental health.

The distribution system serving these areas has water storage totaling 6.4 million gallons (MG) (3.5 MG elevated, 2.9 MG ground) and 2 booster pumping stations. Average daily water use is about 4 mgd. Maximum daily water use is around 10 mgd.

Like many Midwest water utilities, the City is addressing aging infrastructure and declining water use. This SCIP is intended to outline needed improvements to maintain a reliable, viable water utility for the next 20 years. Recommended improvements were ranked based on the following benefit criteria:

- Reduce the risk of asset failure to maintain reliable service to customers
- Enhance water quality
- Maintain water quantity

- Provide excellent customer service
- Enhance health and safety

1.4 Scope of Work

The scope of work is summarized in the following subsections. The SCIP was designed to be a living document that provides a prioritized list of improvements needed for the next 20 years of reliable service.

1.4.1 Task 1—Organize Asset Hierarchy

CH2M HILL worked closely with the City to create a high-level asset hierarchy to guide information management decisions. The hierarchy included major water system supply, treatment and pumping facilities. The asset hierarchy was augmented as needed to include logical groupings of subsystems in a family tree arrangement. The asset hierarchy formed the basis for documenting asset condition and the risk of the asset failing. It was used to prioritize current and future improvements.

1.4.2 Task 2—Establish Risk Criteria and Scoring System

CH2M HILL used risk as the basis for identifying and prioritizing rehabilitation and replacement projects. Since the risk of asset failure affects a utility's ability to meet its level of service, CH2M HILL reviewed the City's current performance measures, and developed level of service categories for consideration. Level of service categories relate directly to the mission and the strategic goals of the utility (e.g., regulatory compliance, water quality, water quantity, service delivery, etc.).

CH2M HILL worked with the City to better describe and diagnose the consequence and likelihood of asset failure. The information was used to determine level of risk, as described in the following subsections.

1.4.3 Task 3—Develop Asset Risk Assessment

CH2M HILL used the asset hierarchy and evaluation system developed in Tasks 1 and 2, along with the institutional knowledge of the City, to rank major assets and identify the highest risk assets.

The simple mathematical calculation used in the risk-based evaluation of assets is expressed as follows:

$$\text{risk} = \text{consequence of failure} \times \text{likelihood of failure}$$

In assessing risk, consequence and likelihood are defined and quantified separately, then combined to calculate the risk of a specific asset. Each asset is assigned a consequence number (1—minor consequence to 10—worst consequence) and a likelihood number (1—low likelihood of failure to 10—high likelihood of failure). An asset with a consequence score of 7 and a likelihood score of 4 would have an overall risk score of 28.

The City's highest risk facilities were identified for more detailed condition assessment. A final prioritized listing of high risk assets was agreed upon with the City.

1.4.4 Task 4—Condition Assessment

The condition assessment team evaluated the condition of the assets identified in Task 3 by direct observation. The teams also identified observable code and safety issues that are common throughout the industry; however, specific codes vary by state and local jurisdiction. The purpose of our work was to advise related to common practices and should not be considered a formal code audit or safety audit. Data from the observations were supplied to the City as part of the condition assessment deliverable. CH2M HILL provided digital photographs of the listed assets that rate greater (worse) than a condition rating of 3 (on a scale of 1 to 5).

1.4.5 Task 5—Water Demand Projections

CH2M HILL gathered available water system planning information and past water records to project future water demand. Various models were used to predict a range of water demands based on assumptions of future growth.

1.4.6 Task 6—Process and Capacity Assessment

Each unit process was evaluated for performance, capacity, reliability, redundancy, and ability to meet current and future regulations. Working with the City, CH2M HILL reviewed current and future treatment issues and concerns. CH2M HILL looked at water demand capacity scenarios and identified the improvements needed to address decreasing or increasing capacity.

The instrumentation and control and supervisory control and data acquisition (SCADA) system was evaluated to determine targeted areas for improvement.

1.4.7 Task 7—Identify and Prioritize Recommended Projects

Information obtained from previous tasks and the results of previous studies were brought together. A list of improvement projects was generated from the condition assessment results and the process and capacity assessment. The improvements were developed into projects that reduce risk and improve reliability and performance of water system facilities. Project benefit scoring criteria were established and weighted with the City so that the projects could be prioritized.

1.4.8 Task 8—Develop Costs, Schedule, Implementation Plan

Planning level cost estimates of the projects identified were developed using CH2M HILL historical cost databases. The prioritized projects and costs were combined to develop the implementation plan road map.

1.4.9 Task 9—Final Report

Task 9 documents the results of the facility condition assessment, process and capacity assessment, water demand projections and prioritized improvements into a final Strategic Capital Improvement Plan (SCIP). The SCIP is a living document that should be regularly updated. The City can continue condition assessment, asset management, and capital improvement prioritization from the deliverables in this project.

SECTION 2

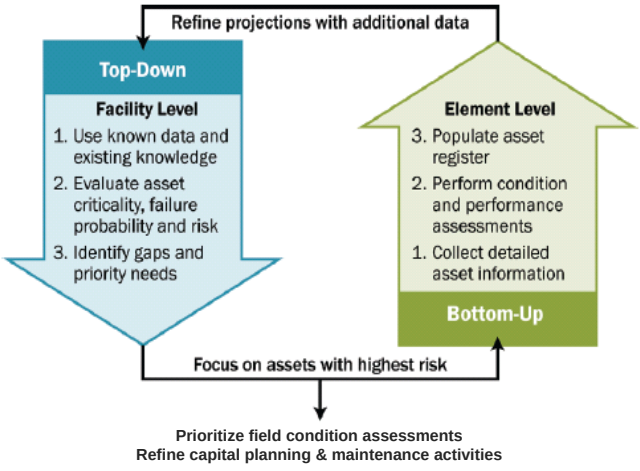
Risk Assessment Methodology

2.1 Introduction

To identify and prioritize investments for the City, a risk-based/top-down asset management approach was applied to the drinking water supply and treatment facilities. This approach focuses on evaluating the risks posed by potential asset failure by assessing the consequences of asset failure on the levels of service established by the utility, and the likelihood that an asset will fail. Assets found to have a risk higher than that determined to be acceptable are slated for further evaluation through onsite condition assessment, in-depth study, or both, or capital projects are developed to mitigate the risk to acceptable levels. The output of these evaluations may result in renewal or replacement of capital projects to mitigate risk to an acceptable level.

The evaluation of risk begins at the facility level and proceeds downward toward asset groups and individual assets based on an asset hierarchy. This is the "top-down" part of the approach. The advantages of the top-down method stem from the emphasis placed first on evaluating component assets of facilities and asset groups before proceeding to components of facilities and asset groups having less risk. Thus, resources are used in the order whereby they will achieve the most value. Exhibit 2-1 depicts the top-down method followed by more detailed investigations, such as onsite condition assessment. The detailed investigation is the "bottom-up" part of the approach.

EXHIBIT 2-1
Combining the Top-Down and Bottom-Up Asset Management Approaches



The risk-based/top-down approach begins with the establishment of a team of utility employees who are knowledgeable of and experienced with the facilities and assets designated for evaluation. The team, referred to as the "asset assessment team," establishes levels of service, creates the asset hierarchy, and scores the consequences and likelihood of asset failure to arrive at a relative risk ranking among the assets. Based on the results of the risk ranking, the team selects specific assets for more in-depth evaluation (i.e., onsite condition assessment). The team also provides guidance in determining capital renewal projects and the priority of the projects.

The following subsections describe the process undertaken for this SCIP in more detail.

2.2 Asset Assessment Team

To provide an effective foundation for the assessment of asset risk, and in fact for asset management in general, a team of City staff was established. The team, consisting of senior-level staff who are knowledgeable of the assets associated with the raw water supply infrastructure, the water plant, and the booster pumping system. This team also provided the information needed to create the asset hierarchy and evaluate the consequences and likelihood of asset failure based on their first-hand knowledge of the facilities.

The City asset assessment team consisted of operations, maintenance and management staff representatives. Exhibit 2-2 lists the team members. The team met multiple times over the course of preparing the SCIP to set levels of service, develop asset hierarchy, score assets for risk of failure, and select assets for onsite detailed condition assessment. The team also met to determine the criteria used to score and prioritize capital projects.

EXHIBIT 2-2
CITY Asset Assessment Team

Position	Name
Water Manager	Greg Alimenti
Maintenance Manager	Mark Thorton
Chief Operator	Shawn Orlasky

2.3 Levels of Service

Levels of service (LOS) are based on a utility's mission and service goals and are established at a utility level. Performance measures, on the other hand, are established at lower levels within the organization (e.g., business units) and are used to determine whether the LOS targets are being met. LOS can be qualitative and quantitative and must align with customer expectations. LOS must meet the following criteria (Association of Metropolitan Water Agencies 2007). Above all, they must be:

- Meaningful—provide a clear picture of performance to staff and stakeholders
- Measurable—either qualitatively or quantitatively
- Consistent—uniform and reproducible by others
- Useful—assist with improved management of utility
- Unique—specific enough to describe an attribute that is distinct from other LOS criteria

The SCIP team established the LOS categories and corresponding target values (Exhibit 2-3) on the basis of City operational standards and regulatory requirements, including customer and stakeholder considerations. External surveys and/or customer and stakeholder workshops were not utilized to develop the LOS levels established for this assessment. Once the LOS targets were established, the team assigned a weighting factor, or a relative measure of importance, to each LOS category. Then, the team developed an asset hierarchy and scoring matrixes for consequence and likelihood of failure of an asset.

EXHIBIT 2-3
Levels of Service

Water Quality Goals:

- Turbidity: ≤ 0.1 NTU Filtered; <2 NTU settled
- 1.5 mg/L chlorine residual at entry point of distribution system in the summer; >1.0 total chlorine residual throughout the distribution system
- Disinfection CT ratio: 2 or more
- DBPs: Less than half the MCL

Water Quantity Goals:

- 16 mgd maximum summer production capacity
- Pressure within 5 psi of normal static pressure at meter
- Very minor service interruptions.

Residents & Business Impact (Public Image) Goals:

- No social or economic impact on the community
- No reactive media coverage (any media coverage is a result of proactive announcements by Utility)
- <5 complaints per incident

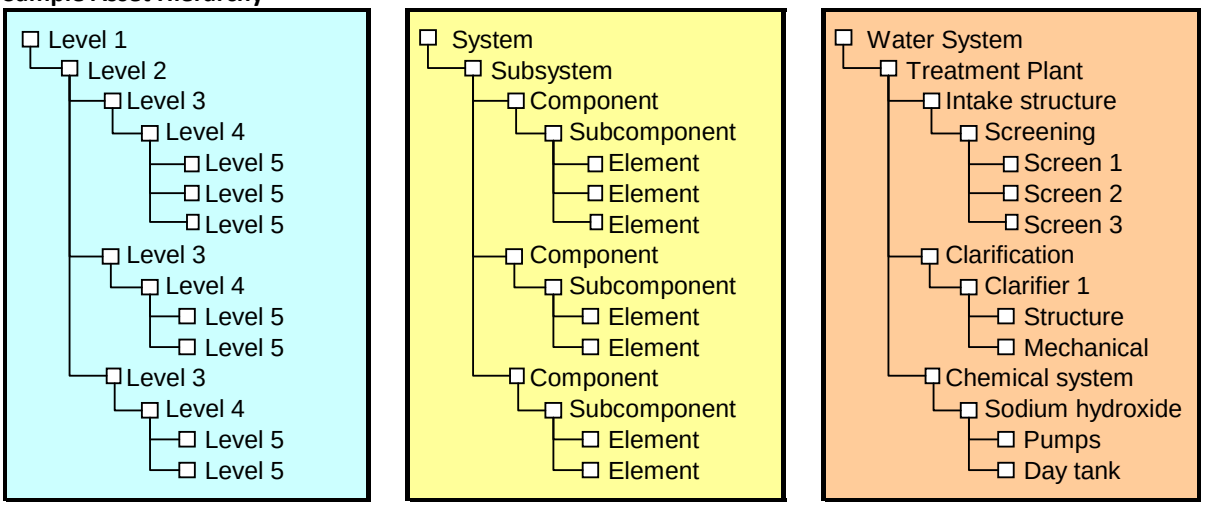
Health & Safety (Public & Employees) Goals:

- No injuries
- no unusual hazards
- No security issues

2.4 Asset Hierarchy

An asset hierarchy is a catalog of utility assets and how the assets are related. The relationships between assets are organized in a parent–child format (Exhibit 2-4). The parent–child relationship can be established based on location or function. An asset hierarchy does not need a complete inventory of all assets, but the hierarchy should be developed to a level at which data are consistent, typically the fourth (subcomponent) or fifth (element) levels. Initially, an asset hierarchy should use available information as its basis, including staff knowledge and data collected to date. As more detailed asset data are gathered over time (bottom-up activities), the hierarchy should be refined to ensure its accuracy.

EXHIBIT 2-4
Sample Asset Hierarchy



This SCIP team evaluated primarily vertical assets, such as the water treatment plant and booster pump stations. Each asset was discussed and placed in the overall asset hierarchy. Based on its collective knowledge of the system, the asset assessment team included some critical linear assets in the asset hierarchy, such as major water treatment plant yard piping.

Appendix A contains the full asset hierarchy. The SCIP team determined which assets should be developed to a fourth or fifth level of detail. Assets with low relative risk scores were not developed in more detail. This level of detail was regarded an acceptable starting point to assess where the greatest risks are in the water system. In the future, by using the iterative process recommended in *Implementing Asset Management: A Practical Guide,* risks can be evaluated and mitigated through data collection and reassessment of risks, making the asset hierarchy a living, dynamic tool.

2.5 Concept of Risk

Risk assessment is not only a crucial element in determining which assets must be addressed in capital planning but also a key attribute in a successful asset management program. Identifying the risk acceptable to a utility allows for balancing costs and maintaining LOS. A decision to keep costs low at any price results in adverse impacts to the LOS from failing infrastructure; a decision to provide an increased LOS with no regard to cost can result in inappropriate use of resources. Therefore, utilities must understand the risk associated with balancing service and cost.

Risk may be expressed as a function of the consequence and likelihood of an event. *Consequence* is the impact to different LOSs that results from an asset failure. For example, the consequence of a booster station failure could be insufficient pressure or insufficient water supply to customers. *Likelihood* of failure is the potential for an asset to fail. For example, an old, corroded pump would be more likely to fail than a new pump made from more reliable materials.

The simple mathematical calculation used in the risk-based evaluation of CITY's assets is:

$$\text{risk} = \text{consequence of failure} \times \text{likelihood of failure}$$

In assessing risk, consequence and likelihood are evaluated and described separately, then combined to calculate the risk of a specific asset. An asset that would have a low consequence associated with its failure but a high likelihood of failure could have a lower overall risk than an asset that has low risk but high consequence of failure. In some cases, paying more attention to an asset or a group of assets in good condition could be of greater importance, because their failure might result in highly undesirable consequences, such as serious injury or loss of life. The risk-based process allows a utility to establish a relative risk ranking for all assets that may result in the need to focus more attention on an asset or an asset group that is in relatively good condition but whose failure might result in highly undesirable consequences. A best practice is also to analyze the consequence of failure scores following an evaluation of the total risk score.

The likelihood of failure is typically the most subjective and unpredictable of the two components of the risk equation that is utilized by this assessment. However, renewal and replacement of assets in poor condition or with short remaining useful lives can improve the overall risk score. On the other hand, renewal and replacement of asset with high consequence scores do no substantially reduce overall risk with simple renewal or replacement with assets of like kind; in cases of high consequence, redesign of the system or redesign and improved specification are needed to change the consequence score.

Exhibit 2-5 shows the consequence matrix and scoring system used to evaluate City's assets. The consequences of the failure of an asset are expressed in terms of meeting the LOS categories. Those categories include maintaining excellent water quality, providing sufficient quantities of water, maintaining a positive public image, maintaining safe conditions for the public and City employees, and minimizing financial impacts to rate payers. Each category was weighted by the asset management team according to its importance in meeting City's goals. A numerical score, ranging from 1 to 10, was assigned to each category. For all categories, a score of 1 (negligible) was given to the LOS target. If the LOS target was still met after an asset failure, then the consequence of the failure on that particular LOS category was deemed negligible. For example, a health and safety LOS consequence received a score of 1 when no potential for injuries or adverse health effects associated with an asset failure was anticipated (i.e., the target LOS). Conversely, if the potential existed for loss of life as the result of an asset failure, the score for the severe consequence was 10.

Exhibit 2-6 is the likelihood matrix and scoring system used to evaluate utility assets. As with the consequence matrix, likelihood-of-failure categories were developed to characterize an asset's likelihood of failure. Physical condition, performance, operation and maintenance (O&M) protocols, and reliability were used to assess the likelihood, and scores ranging from 1 to 10 were assigned to each category of likelihood of failure. A score of 1 represents a negligible chance of failure. For example, a brand new pump would likely have a negligible chance of failure and would be given a score of 1 under physical condition. However, an old, corroded pump with a history of failures might be given a score of 10, indicating a high likelihood of failure. The weighting factor reflects the relative importance for each category in aiding City in meeting its goals.

The risk associated with each asset was quantified by multiplying the weighted consequence and likelihood scores to arrive at a relative risk score. The relative risk score was used to prioritize investments in City's assets to reduce risk to acceptable levels.

EXHIBIT 2-5
Consequence Matrix

	Consequence of Failure Levels by Category				
	Possible Scoring Values				
LOS (Category)	**Negligible = 1**	**Low = 4**	**Moderate = 7**	**Severe = 10**	**Weight**
Water Quality	• Compliance with primary drinking water standards • Turbidity: ≤ 0.1 NTU Filtered; <2 NTU settled • 1.5 mg/L chlorine residual at entry point of distribution system in the summer ; >1.0 total chlorine residual throughout the distribution system • Disinfection CT ratio: 2 or more • DBPs: Less than half the MCL	• Compliance with primary drinking water standards • Turbidity: >0.1, <0.2 filtered; >2, <5 NTU Settled • Chlorine residual within 0.5mg/L of goal • Disinfection CT ratio: 1.5-2 • DBPs: 50% to 60% of the MCL	• Challenged to maintain compliance with primary drinking water standards • Turbidity: >0.2, <0.3 filtered; >5, <10 NTU Settled • Chlorine residual within 1.0 mg/L of goal, but may have an isolated positive coliform test • Disinfection CT ratio: 1.3-1.5 • DBPs: 60% to 80% of the MCL	• Boil water notice must be issued due to quality issue or exceeding primary standard • Turbidity: >0.3 Filtered, >10 NTU Settled • Chlorine residual greater than 1.0 mg/L off of goal, or positive on a repeat coliform test • Disinfection CT ratio: <1.3 • • DBPs: > 80% of MCL	40%
Water Quantity	• 16 mgd maximum summer production capacity • Pressure within 5 psi of normal static pressure at meter • Very minor service interruption	• 14-15 mgd maximum summer production capacity • Pressure within 10 psi of normal static pressure at meter • Minor service interruption	• 13 mgd maximum summer production capacity • Pressure within 20 psi of normal static pressure at meter • Substantial but short term service interruption	• <13 mgd maximum summer production capacity • Static pressure less than 20 psi in a significant part of the system • Long term or extensive service interruption. Impact on fire protection • Loss of service to any “critical customer” (eg. hospital)	35%

EXHIBIT 2-5
Consequence Matrix

	Consequence of Failure Levels by Category				
	Possible Scoring Values				
LOS (Category)	**Negligible = 1**	**Low = 4**	**Moderate = 7**	**Severe = 10**	**Weight**
Residents & Business Impact (Public Image)	• No social or economic impact on the community • No reactive media coverage (any media coverage is a result of proactive announcements by Utility) • <5 complaints per incident	• Minor local collateral impact in the community • No adverse media coverage and service restored without public reaction • Routine reaction from elected official(s) • >5 but <10 complaints per incident	• Substantial but short-term collateral impact • Adverse media coverage due to public impact • Concerns expressed by elected officials • >10 but <20 complaints per incident	• Substantial and long-term collateral impact. • Widespread adverse media coverage • Public outcry of dissatisfaction with utility • Negative public comments by elected officials • >20 complaints per incident	10%
Health & Safety (Public & Employees)	• No injuries • Routine work; no unusual hazards • No security issues	• No lost-time injuries • One of the following: confined space entry, 480V circuit, >20ft. in height • Potential for minor security breach	• Minor injury with lost time • Two or more of the following: confined space entry, 480V circuit, >20ft. in height; Any acidic or caustic chemical • Security measures compromised. Moderate impact	• Major injury • Extreme unsafe condition (e.g. >480V) • Security measures compromised. Significant impact potential	15%

EXHIBIT 2-6
Likelihood Matrix

	Likelihood of Failure Levels by Category					
	Possible Scoring Values					
Category	**Negligible = 1**	**Minor = 3**	**Moderate = 5**	**Major = 7**	**Severe = 10**	**Norm Wt**
Physical Condition	• Condition Grade 1 - Very good/New • No corrective maintenance required	• Condition Grade 2 – Good • Few minor deficiencies and minimal corrective maintenance required	• Condition Grade 3 – Fair • Several minor deficiencies noted and corrective maintenance required	• Condition Grade 4 – Poor • Major deficiencies and significant corrective maintenance or rehabilitation required	• Condition Grade: 5-Very poor • Asset may be unserviceable, needs replacement or rehabilitation	50%
Performance (Operability/ Functionality)	• Able to meet all Levels-of-Service effectively & efficiently; right tool for the job • Common design for same application • Limited complexity in operation • Sized correctly to meet average and peak flow requirements	• Able to meet majority of Levels-of-Service effectively & efficiently; right tool for the job • Relatively simple design for application • Relatively limited complexity in operation • Sized correctly to meet average and peak flow requirements	• Able to meet most Levels of Service; inappropriate asset for application • Varied design for same application • Moderately complex to operate • Sufficient capacity to meet current average and peak flow requirements	• Able to meet some Levels of Service; requires excessive attention • Unique design or technology • Difficult to operate, requiring familiarity with that asset • Able to meet average day flow requirements but not peak demands	• Able to meet only a few Levels of Service; requires excessive attention • Unique design and/or limited staff experience • Very difficult to operate and/or requires several “work-arounds” • Unable to meet average and peak flow requirements	30%

EXHIBIT 2-6
Likelihood Matrix

Likelihood of Failure Levels by Category

	Possible Scoring Values					
Category	**Negligible = 1**	**Minor = 3**	**Moderate = 5**	**Major = 7**	**Severe = 10**	**Norm Wt**
Maintainability	• Easy to access • O&M Protocols in-place & relevant • Spare parts/material available in stock or same day • Standard tools and extensive institutional knowledge of assets	• Easy to access • O&M Protocols in-place & relevant • Spare parts/material available in one week • Standard tools and extensive institutional knowledge of assets	• Difficult to access, requires removal of other equipment to service • Dated or incomplete O&M Protocols & only partially relevant • Spare parts/material available within 1 to 2 weeks • Requires some specialized tools or only some institutional knowledge of assets	• Difficult to access; requires taking other equipment or another process off-line • Dated or incomplete O&M Protocols & only partially relevant • Spare parts/material availability 6 months to 1 year • Specialty contractor or limited institutional knowledge of assets	• Very difficult to access; requires taking more than one other process off-line • No O&M Protocols • Spare parts/material unavailable • Specialty contractor and no institutional knowledge of assets	20%

2.6 Asset Risk Quantification

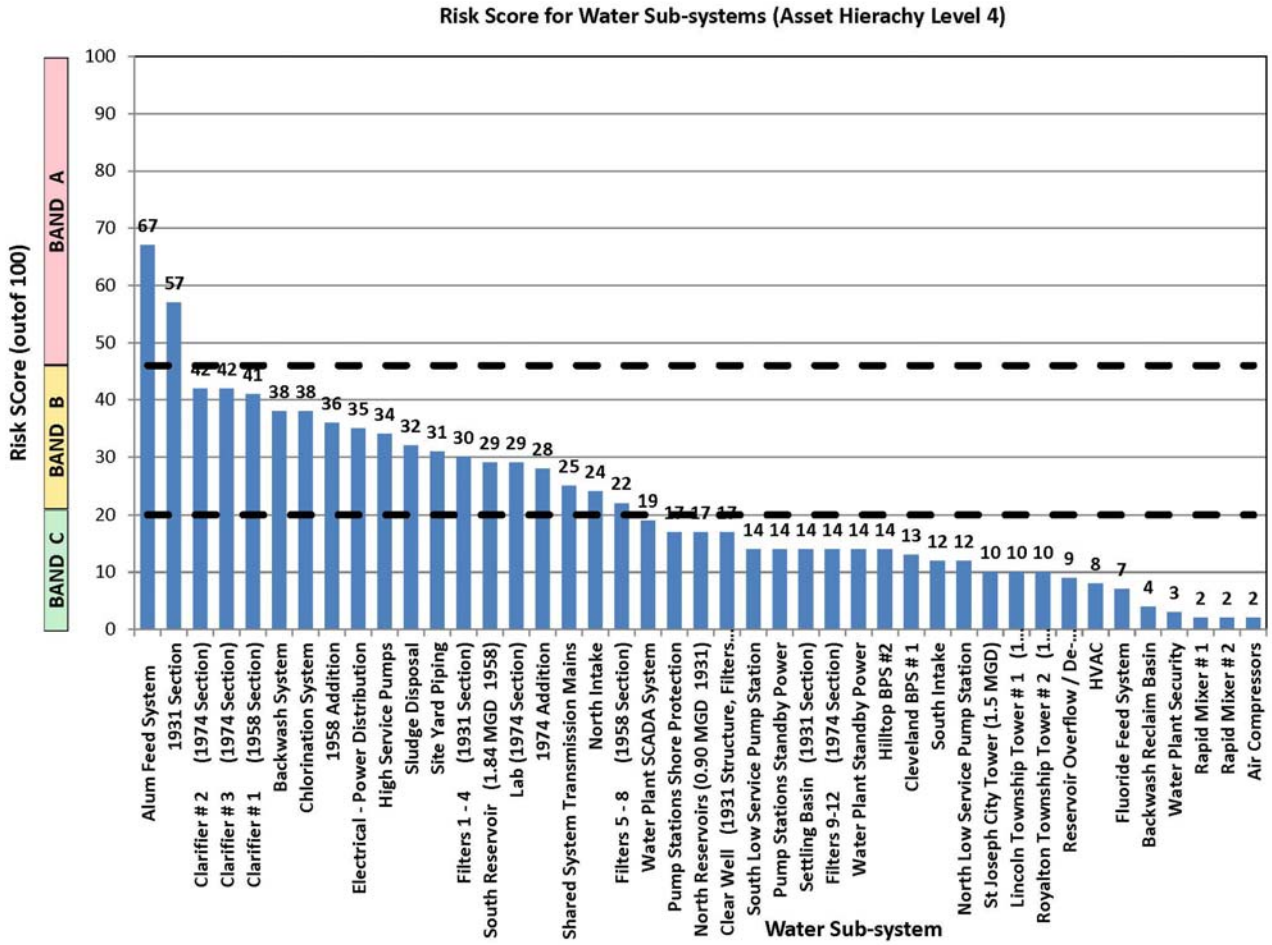
Consequence and likelihood scores were developed by the asset assessment team for each asset and recorded in an Excel asset risk spreadsheet model. As noted, relative risk score for each asset was calculated by multiplying the weighted consequence and likelihood scores defined by the asset assessment team for the asset in question. The risk-scoring process was used to help the City develop defensible numerical values to quantify risk and to prioritize options to mitigate risk. The scoring tool enabled the team to evaluate assets objectively and comprehensively.

Appendix A contains the asset hierarchy and risk-scoring spreadsheet developed during the project. It illustrates how an asset's overall consequence score was calculated by multiplying the weighting factors by each associated consequence score to get an overall consequence score, ranging from a low of 1 to a maximum of 10. Similarly, the likelihood-of-failure score was calculated by multiplying the weighting factors and the associated likelihood-of-failure score to get an overall likelihood score. The asset risk score, then, is the product of the consequence score multiplied by the likelihood of failure score, with 1 being the lowest possible score and 100 being the highest.

Exhibit 2-7 shows the results of the risk analysis for Level 4 assets, after likelihood scores were adjusted based on the condition assessment.

EXHIBIT 2-7

Relative Risk Scores of Level 4 Assets (Post Condition Assessment)



This robust risk-based analysis identified the following areas where risk was higher:

- Alum and chlorine chemical systems – condition, age and safety
- The old building (1931) – age and condition
- Clarification – performance and condition
- High Service and Backwash pumping systems – age, condition, flooding potential

These facilities were assessed in more detail during the Condition Assessment (see Section 3) and Process/Capacity assessment (Section 4). The results were used to develop and prioritize specific projects to improve reliability, performance and reduce risk (see Section 5).

SECTION 3

Condition Assessment

3.1 Overview

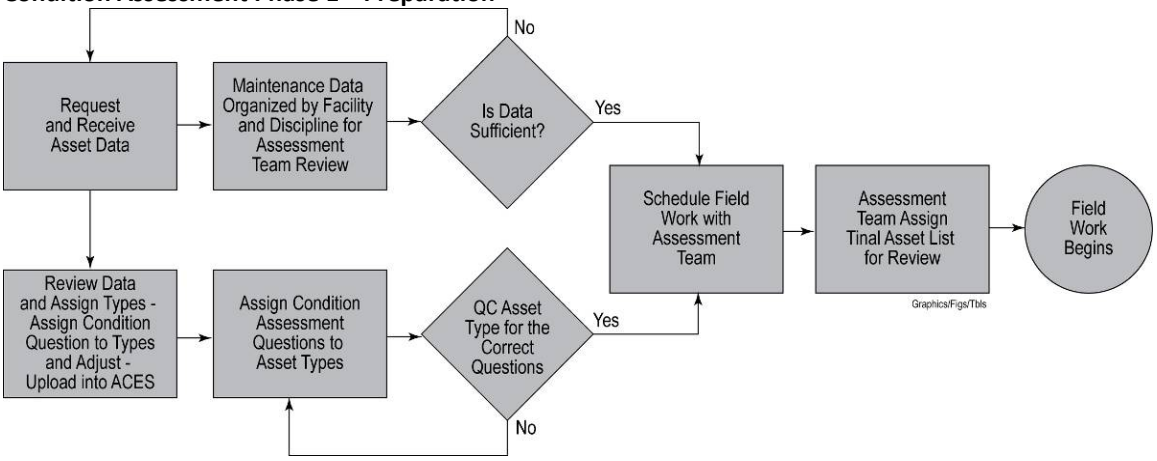
Based on the results from the asset risk assessment, condition assessments were performed on the City's higher risk assets. This evaluation was performed in conjunction with City O&M personnel. The field condition assessment team consisted of maintenance mechanics with mechanical and electrical expertise, along with architectural, structural and electrical experts. Findings from the condition assessment were incorporated in the City asset hierarchy and served as the basis for recommended projects.

The condition assessment process comprised three phases: Phase 1—Preparation, Phase 2—Field Assessment, and Phase 3—Quality Review.

Phase 1 encompasses data collection, data review, and software setup before deploying condition assessment teams to the field. Exhibit 3-1 depicts the Phase 1 process.

EXHIBIT 3-1

Condition Assessment Phase 1—Preparation

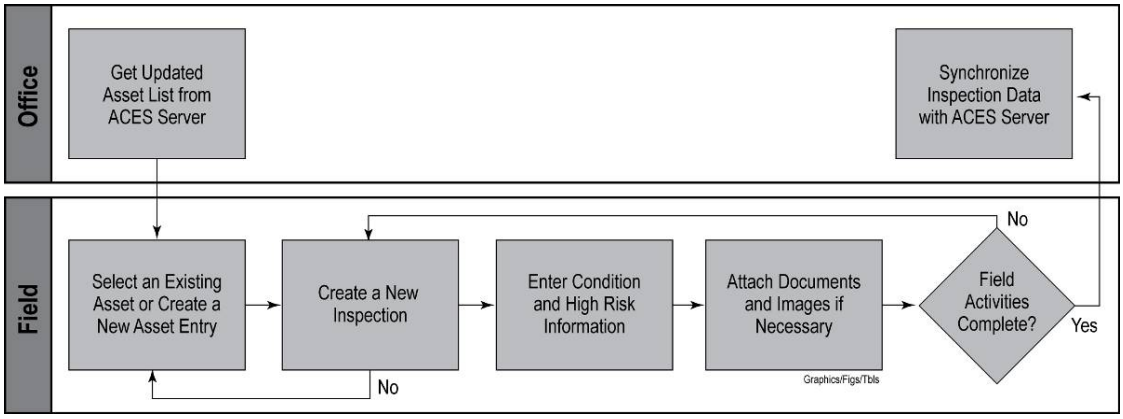


The assessment team gathered basic information about the assets to be inspected from City staff and preloaded it into CH2M HILL's Asset Condition Evaluation System (ACES) database, a reporting and data collection program for storing and analyzing asset condition and risk assessment information on all types of assets. The team used ACES when conducting field assessment work and input additional asset information gathered during the assessment process.

During Phase 2—Field Assessment, the team gathered field condition assessment information and photographs, and electronically uploaded the data to the main ACES server to provide the condition assessment personnel access to the same information. Exhibit 3-2 depicts the Phase 2 process.

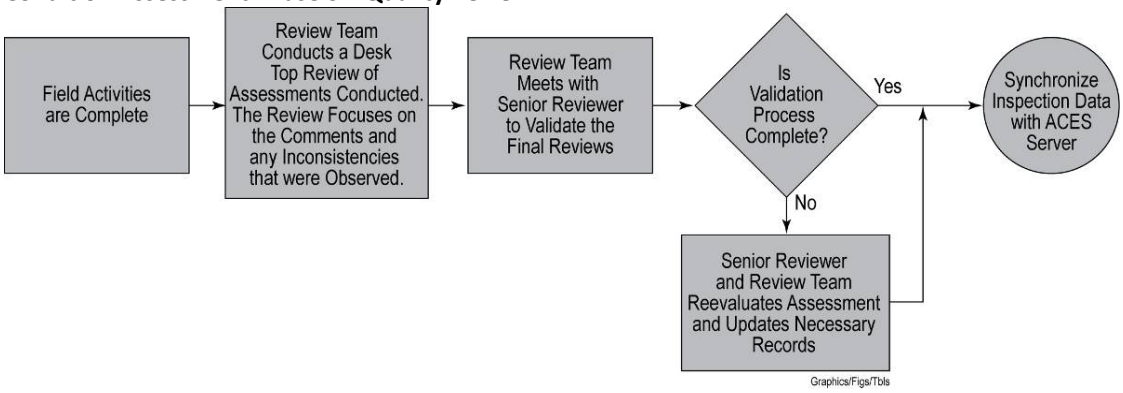
The team categorized each asset by type and assigned a series of questions and weights to each asset type to evaluate an asset's current condition.

EXHIBIT 3-2
Condition Assessment Phase 2—Field Assessment



During Phase 3—Quality Review, the assessment team performed a quality assurance/quality control review to verify that consistent ratings were assigned to the assets. The team updated condition ratings and comments to reflect additional information captured during the review. Exhibit 3-3 depicts the Phase 3 process.

EXHIBIT 3-3
Condition Assessment Phase 3—Quality Review



3.2 Mechanical Condition Assessment

Based on results from the risk analysis, the mechanical condition assessment focused on pump stations, filters 1-4 and the backwash system. Mechanical assets were evaluated in the following 9 asset type categories:

EXHIBIT 3-4
Asset Type Categories

Asset Types	Typical Life
COMPRESSOR-AIR	10
CONTROL PANEL	20
FILTER	10
MOTOR	30
PIPE	40
PUMP-CENT	20

EXHIBIT 3-4
Asset Type Categories

Asset Types	Typical Life
PUMP-VERT	15
VALVE	30
VFD	12

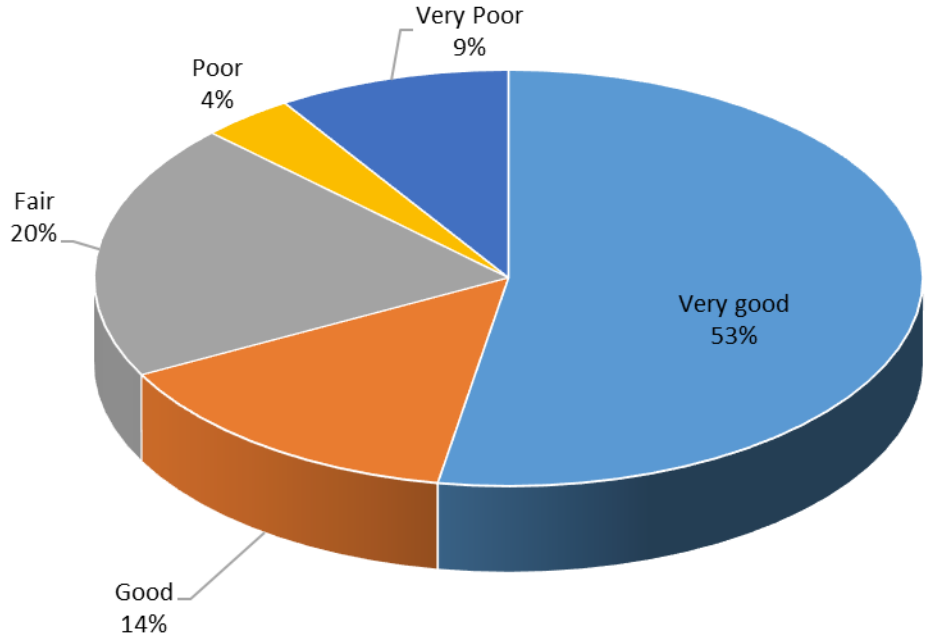
3.2.1 Physical Condition

A total of 55 assets were assessed within the water plant and two booster pump stations using the asset condition rating scale shown in Exhibit 3-5. Overall, 67 percent of the assessed assets were rated good or very good on the condition scale and 33% were rated fair, poor or very poor condition. Exhibit 3-6 presents the percentage of assets within each condition rating. Appendix B contains asset condition and risk scores for each asset evaluated.

EXHIBIT 3-5
Asset Condition Rating System

Asset Rating	Description of Condition
1	Very good. New or nearly new.
2	Good. Minor wear.
3	Fair. Major wear impacting level of service.
4	Poor. Unable to meet level of service life.
5	Very poor. Requires complete rehabilitation or replacement. Failed.

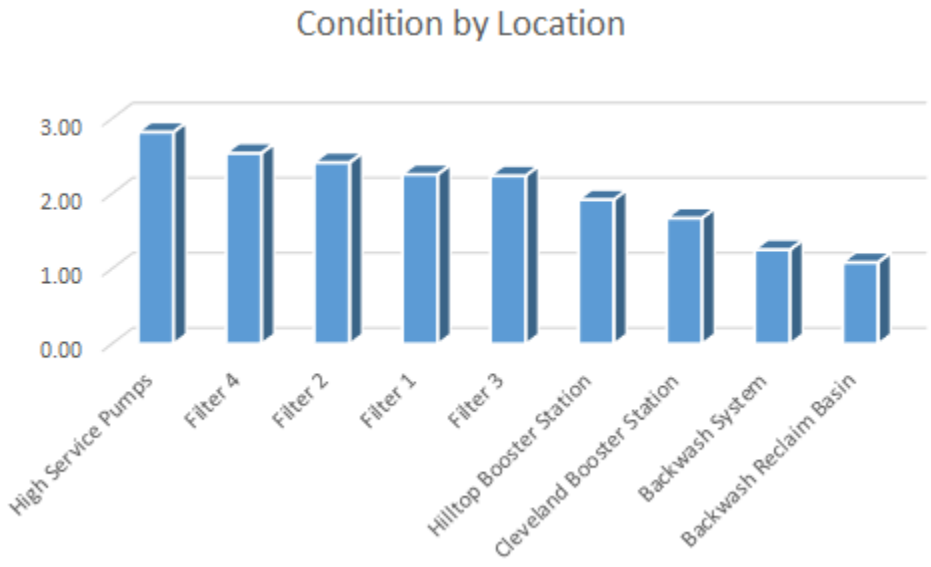
EXHIBIT 3-6
Percentage of Assets by Condition Rating



The asset scores were rolled up by facility or process area to calculate a total facility condition score. This roll-up score is an average of the condition scores of each asset within a specific location and ranges from

1 to 5. The score indicates the overall condition of the assets for a particular location. Exhibit 3-7 presents the process area roll-up condition scores. The process area with the highest condition score (poorest condition rating) is the High Service Pump Station with a score of 2.80.

EXHIBIT 3-7
Condition Rating Roll-Up Scores for Each Process Area (Score Range: 1 to 5)



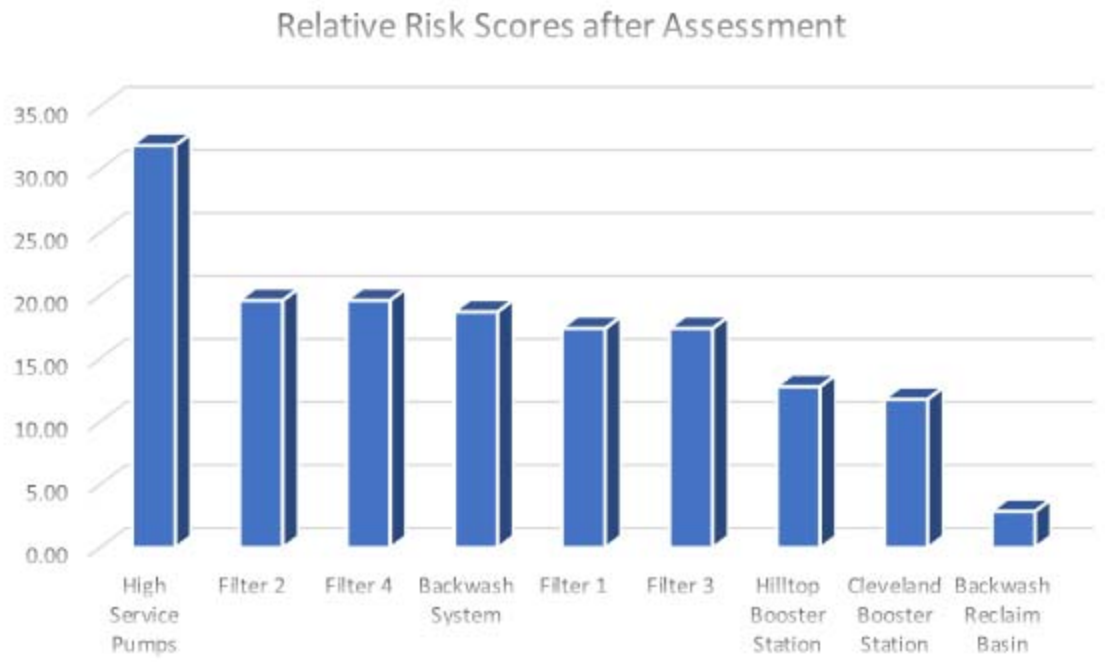
It should be noted that more critical assets associated with a location assets were not given a higher weight for deriving these scores. Appendix B contains the roll-up scores in detail, and each asset's field report form with a digital photo (if taken).

3.2.2 Relative Risk

The relative risks posed by asset failure were determined using a risk matrix based on industry standard practice during the past 6 years. Understanding the risk of asset failure is crucial to managing infrastructure maintenance and replacement effectively. Relative risk considers not only the physical condition of an asset, but other characteristics as well such as operations and performance. These characteristics can affect the likelihood of an asset failing to meet its intended purpose. Relative risk also considers the consequences that may result from an asset failing. In general, relative risk is the primary factor to be considered when prioritizing capital renewal (i.e., rehabilitation and replacement) investments as well as improvements to O&M protocols.

Relative risk scores can range from 0 to 100, with 100 being very high risk. The relative risk scores for the areas evaluated ranged between 3.00 and 31.90, based on the individual asset roll-up. The relative risk ranking for a location is determined by averaging the individual component assets risk scores. The High Service, Backwash Pumping, and Filters 1 through 4 received the highest relative risk scores ranging from 17.39 to 31.90. Exhibit 3-8 presents the relative risk scores for each area.

EXHIBIT 3-8
Relative Risk Scores by Process Area (Score Range: 0 to 100)



3.2.3 Summary and Conclusions

This condition assessment provides the City with a snapshot-in-time of the current condition of each asset evaluated at the facilities reviewed. The assessment incorporated a risk evaluation to provide information needed to make knowledgeable, fact-based investment decisions for developing a prioritized maintenance and replacement schedule at these facilities.

A summary of the findings from this condition assessment include the following:

- A total of 55 assets were assessed at the three locations.
- Overall, 67% percent of the assessed assets received a condition rating score of 1 or 2 (very good or good).
- 31% of the assets evaluated received a condition rating score of 3, 4, or 5 (fair, poor, or very poor).
- The high service pumps and filters 1 through 4 were in the worst condition.

3.2.4 General Observations

The piping in Filters 1 through 4 have significant support issues. Many of the larger pipe supports show significant corrosion and should be repaired quickly. A large amount of fittings and Dresser couplings also show a significant level of corrosion. The filter backwash trough support system for these filters is also heavily corroded and in need of repair.

The high service pump area has new motor controls and VFD's. However, it appears that the VFD cooling fans have no filters and are blowing dirty air into the enclosure instead of pulling air into the enclosure through filters. The booster stations visited also showed VFD ventilation issues.

3.3 Architectural and Structural

The architectural and structural evaluation focused on the water treatment plant building, and the two booster pump stations.

3.3.1 Water Treatment Plant

Year Constructed: 1931, 1957 and 1974

Original 1931 Building: The east section of the original 1931 building that houses the high service pumps and filters 1-4 is severely deteriorated and should be demolished rather than re-built. The facilities housed in the east section would have to be duplicated elsewhere (high service pump station, electrical gear, filters 1-4). The thin concrete plank roof deck is crumbling and cracked at supports. Brick and plaster exterior walls are cracked and bricks are spalling. Piping is corroded from the high humidity. Interior concrete walls have cracks, spalled concrete, and leaks. Unprotected floor openings are in Suction Well and Low Lift Pump Pit without any fall protection. Ceilings and walls need painting, but paint will not last with continued cracking and deterioration. Window and louvers are deteriorated and need replacement.

The west section is in better shape than the east section and could be more cost effectively renovated. The Museum could be relocated, potentially in the southwest corner of the renovated west section of the 1931 building.

Roof: The roofing of the entire building was replaced in 1996 with a gravel surfaced built-up roof and appears to be in good condition. The clay tile roof over the center of the original 1931 roof is also in good condition. In 2 to 12 years, the gravel surfaced built-up roofing should be replaced. There are some leaks at the parapet flashings in the 1931 section of building that should be sealed.

Exterior Walls: The brick on the exterior of the 1974 and 1958 additions and the west section of 1931 is in good condition. There is a crack in brick wall at the corner of north storefront door in the 1974 addition, south side of 1958 Conditioning Basin Room, and corner of double door in 1958 Vestibule. Sealant and backer rod should be installed in the crack, which will allow for continued movement.

Insulation: Existing masonry walls have no insulation. The roof appears to have limited insulation.

Exposed Concrete Exterior Foundations: Most of the exposed concrete exterior foundation walls are in good condition. There are areas of spalling concrete foundation that need to be patched on the east side of the 1974 addition.

Exterior Entry: The exterior entry canopy is in good condition, except that the precast concrete soffit needs painting.

Interior Ceilings: Most of the painted concrete, painted plaster and gypsum board, and suspend acoustical tile ceilings in the 1974, 1958 and the west section of 1931 are in good shape. Water damage on acoustical tile ceilings in 1974 addition Control Room, Lab and Office. Replace damaged ceiling tiles after HVAC problems are corrected.

Interior Walls: Most of the interior masonry, concrete, plaster walls Wall tile in 1974 Men's Toilet is cracked and needs to be replaced. There are cracks and leaks in concrete walls that need sealing clarifier walls, including west wall of 1974 Upflow Clarifier No. 2 and north and west walls of 1958 filters. Epoxy injecting the cracks is suggested. Walls in the east section of the 1931 are severely deteriorated and cracked.

Floors: The terrazo floors are in good condition. Most of the exposed concrete floors are in good condition. The concrete floor by the overhead door of the chemical storage area has gouges in it and needs patching. Resilient flooring in the 1931 Janitor, Locker Room and Stair Hall is in bad condition and needs to be replaced.

Piping and Structural Steel Corrosion: Piping in the 1974 Clarifier Pipe Gallery and Filter Pipe Gallery and 1958 Filter Basement, Pipe Gallery, and Sludge Blow-Off Room is corroding and needs repainting. Add dehumidification units to help control the moisture that is causing the steel to corrode. Structural steel columns and beams in 1958 Filter Operating Room and Conditioning Basin Room are corroding and need repainting.

Doors: Most of the existing doors are in good condition. The aluminum storefront door on the north side of the 1974 addition is deteriorated and has been modified for dampers and screens. Replacing the aluminum storefront door and louver is recommended. The doors to the 1958 Filter Operating Room and Conditioning Basin Room are deteriorated and need replacement. Doors to the Shop and Museum off the 1958 Corridor are window glass, which do not meet code and need to be replaced.

Windows: Most of the windows in the 1974 and 1958 addition are in good condition. Three deteriorated and inefficient aluminum window walls in the 1974 addition need to be replaced. Insulated translucent panel and metal windows in the original 1931 building are severely deteriorated and energy inefficient. They need to be replaced.

Skylights: The skylights in the 1974 addition are in bad condition with cracks and holes. The skylights also do not have code required fall protection. The 1974 addition skylights should be replaced with insulated translucent panels that are rated for code required fall protection.

Security: Intrusion detection contacts and card readers are on the exterior doors.

HVAC: The 1974 addition upper level Chemical Feed Room and Chlorine Feed Room lack code required ventilation, see Code and Safety below. Moisture appears to be drawn in from basins and filters into the space above the ceilings of Control Room, Lab and Office in the 1974 addition. Suggest pressurizing the space above the ceiling to prevent moisture from being drawn in. Also, the space above the ceilings needs to be sealed from being connected to other rooms.

Lab: The lab should have a ventilating hood and upgraded HVAC system. Plumbing is old and water sampling needs to be revised for existing and new sample lines. Cabinets and countertops are old and outdated, with minimal space. New cabinets and countertops are recommended. Electrical outlets should be updated to current codes. Add new instruments for algae (microscope) and UV 254 on line for better process control.

Plumbing: Plumbing fixtures and piping outside the Lab appear to be in good condition.

Code and Safety Issues:

- The skylights in the 1974 are a fall protection safety hazard and should be replaced.
- North of the 1974 addition is a concrete overflow that has no code required fall protection. This structure should have guardrails added to the top of the walls to prevent falling into the overflow.
- The Chlorine Storage room is missing a code required sprinkler system, occupancy fire separation from the rest of the building, safety shower/eyewash, ventilation and air scrubber, and self-contained breathing apparatus (SCBA). Suggest providing new code compliant sodium hypochlorite system.
- The fluoride storage area is missing a code required separate ventilated room, sprinkler system, occupancy fire separation from the rest of the building, leak detection and safety shower/eyewash. Access into the fluoride containment requires climbing over a containment wall. Also, access to telephone equipment requires going through the fluoride containment. Suggest providing new code compliant fluoride storage.
- The alum storage area is missing code required containment for the volume of largest tank, leak detection and safety shower/eyewash. Also, some process pumps are located in the alum containment area. Suggest adding containment wall that excludes the process pumps.
- Upper level Chemical Feed Room and Chlorine Feed Room lack code required ventilation and safety shower/eyewashes. Chlorine Feed Room being used as a break room, and Control room being used as a conference room. Suggest moving chemical feed system out of the upper level freeing space for expanded locker rooms and break/conference room.
- Add code required handrails at the following locations: four Clarifier Basin stairs in 1974 addition, Filter Operating Room stairs in 1958 addition, wood platform and stairs in 1958 Filter Basement, ramps in the

north end of the Pipe Gallery and middle of Passage in 1958 addition, ramp in 1931 Pipe Gallery, and 2 exterior stairs to 1931 entry.

- Ramp in Passage is steeper than allowed by code along an egress route. Suggest replacing the ramp with new concrete ramp with 1:10 min. slope. Wood ramp at the bottom of stairs between 1958 and 1931 sections does not meet code and is a tripping hazard. Suggest removing the ramp. Switch and outlet covers are missing in the 1931 Locker Room.

A summary of the recommended architectural and structural project at the water plant are in Exhibit 3-9.

EXHIBIT 3-9
Water Treatment Plant Architectural/Structural Projects

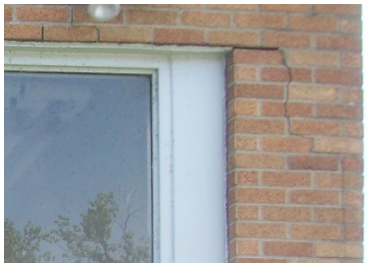
Project Name		Description of Project	Reason for Project
	Replace East Section of 1931 Building	Replace east section of existing 1931 building with a new pump station. Demolish existing east section of the 1931 building that houses the pumps and filters.	The east section of the 1931 building is severely deteriorated and would cost more to repair than to replace
	Renovate West Section of 1931 Building	Replace 4 existing windows with aluminum windows. Add new east concrete and masonry wall with 3 new aluminum windows. Renovate interior as required for new uses.	Windows are deteriorated and energy inefficient. Need to close off building with east wall after demolition
	Roofing Replacement	Replace gravel surfaced built-up roofing, insulation (R-30), vapor retarder and flashing in the next 2-12 years.	Roofing will be at the end of useful life and replacement will avoid leaks and damage to the building and contents.
	Seal Cracks in Brick	Install backer rod and sealant in cracks in brick wall at the corner of north storefront door in the 1974 addition, south side of 1958 Conditioning Basin Room, and corner of double door in 1958 Vestibule.	Crack in wall needs to be filled to help prevent water intrusion and further damage to wall

EXHIBIT 3-9

Water Treatment Plant Architectural/Structural Projects

Project Name		Description of Project	Reason for Project
	Patch 1974 Exterior Concrete Walls	Remove spalling concrete, clean rusted rebar and patch concrete exterior foundation walls on east wall.	Concrete deterioration need to be fixed to prevent further damage
	Repaint 1974 Entry Soffit	Repaint precast concrete soffit.	Paint peeling.
	1974 Ceilings	Pressurize and seal the space above ceilings to prevent moisture from being drawn in. After condensation and/or leaks have been repaired, replace water damaged ceiling tiles of the Control Room, Lab and Office in the 1974 addition	Moisture is damaging ceiling tiles and could mold
	1974 Cracked Tiles	Replace cracked wall tiles in Men's Toilet.	Tiles cracked.
	Seal 1974 and 1958 Concrete Wall Leaks	Epoxy inject cracks in concrete walls in the following areas: west wall of 1974 Upflow Clarifier No. 2, north and west walls of 1958 filters.	Seal leaks and prevent further damage to concrete
	Replace Resilient Flooring	Replace resilient flooring in 1931 Janitor, Locker Room and Stair Hall	Flooring at the end of useful life and peeling off walls.

EXHIBIT 3-9

Water Treatment Plant Architectural/Structural Projects

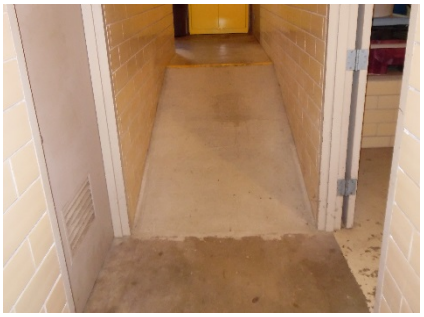
Project Name		Description of Project	Reason for Project
	Patch 1974 Concrete Floor	Concrete floor in by overhead door of Chemical Storage has gouges out it and need patching	Concrete deterioration need to be fixed to prevent further damage
	Piping and Structural Steel Corrosion	Paint piping in 1974 Clarifier Pipe Gallery and Filter Pipe Gallery and 1958 Filter Basement, Pipe Gallery, and Sludge Blow-Off Room. Add dehumidification units. Paint structural steel columns and beams in 1958 Filter Operating Room and Conditioning Basin Room.	Condensation causing pipe corrosion.
	Replace Doors and Louver	Replace 1974 north aluminum storefront door and louver, 1958 Filter Operating Room, Conditioning Basin Room, Shop, and Museum double doors.	Doors and frames are deteriorated and are not to code
	Replace 1974 Windows	Replace 3 aluminum window walls.	Original windows deteriorated and energy inefficient
	Replace 1974 Skylights	Replace 9 skylights with insulated translucent panel skylights	Skylights are cracked with holes, energy inefficient, and safety hazard

EXHIBIT 3-9

Water Treatment Plant Architectural/Structural Projects

Project Name		Description of Project	Reason for Project
	Overflow Handrail	Add 3’-6” high guardrail to concrete overflow walls.	Code required fall protection
	New Sodium Hypochlorite System	Replace existing chlorine system with new code compliant sodium hypochlorite system including sprinkler system, occupancy fire separation from the rest of the building, leak detection and safety shower/eyewash.	Chlorine room is dangerous and not code compliant
	New Fluoride Storage	Add new code compliant fluoride storage and feed room including sprinkler system, occupancy fire separation from the rest of the building, leak detection and safety shower/eyewash.	Fluoride system is dangerous and not code compliant
	Alum System Containment	Add alum containment wall for the volume of largest tank that excludes the process pumps. Add leak detection and safety shower/eyewash. Move Alum feed system to old fluoride containment and add safety shower/eyewash.	Alum system is not code compliant and a threat to process pumps
	Aluminum Handrail	Add aluminum handrails to the following : 4 Conditioning Basin stairs in 1974 addition, Filter Operating Room stairs in 1958 addition, wood platform and stairs in 1958 Filter Basement, ramps in the north end of the Pipe Gallery and middle of Passage in 1958 addition ramp in 1931 Pipe Gallery, and 2 exterior stairs to 1931 entry.	Code requirement for handrails on ramps and stairs

EXHIBIT 3-9
Water Treatment Plant Architectural/Structural Projects

Project Name		Description of Project	Reason for Project
	Ramps	Replace the ramp in 1958 Passage with new concrete ramp with 1:10 min. slope. Remove wood ramp at the bottom of stairs between 1958 and 1931 sections.	Ramp in Passage is steeper than allowed by code along an egress route. Wood ramp is a tripping hazard and does not meet code
	Water Plant Lab	Improve HVAC for new ventilation hood. Upgrade plumbing and water sampling. New cabinets and countertops. Upgrade electrical outlets. Add new instruments for algae, UV 254 on line.	Meet new building codes for labs. Improve sampling and water analysis.

3.3.2 Booster Station No. 1—Cleveland Avenue

Year Constructed: 2007

Roof: The original asphalt shingle roofing is in good condition, and there are no signs of leaking. The aluminum facial, soffit, gutters and downspouts are in good condition. Left front downspout discharges onto grade and is washing away soil. Add a concrete splashblock at the end of the downspout. The 1/2-inch OSB roof sheathing shown on the Record Drawings is not a long lasting material which will need to be replaced if damaged or deteriorated. There is no indication on the Record Drawings that ice and weather shield membrane was installed to prevent ice damming from causing water damage. In about 13 years, the roof should be replaced with new shingles, underlayment, ice and weather shield and exterior grade plywood sheathing.

Exterior Walls: The brick and block walls are in good condition. There are a number of issues with the design of the walls that could lead to future problems, however no signs of deterioration or damage were observed. The Record Drawings show the cavity walls with an air barrier (Tyvek) on the outside of the insulation, but no vapor barrier in the cavity. Therefore, the interior wall paint is serving as the vapor barrier. Through wall flashing is shown on the Record Drawings, but the weep hole spacing is 32 inches apart instead of the recommended 24 inches. The brick also extends below grade, which will likely lead to freeze thaw deterioration of the brick. There are no masonry control joints, which could lead to uncontrolled cracking of the walls.

Insulation: Overall, the building is well insulated. The Record Drawings show that above the ceiling there is R-38 fiberglass batt insulation with a vapor barrier. The exterior cavity walls have 1” rigid foam insulation according to the Record Drawings, which is only about R-5. The Record Drawings also show that the ungrouted concrete masonry cells are filled with foam insulation, and the inside of the concrete foundation walls have 2-inch by 2 feet rigid foam insulation, about R-10.

Interior: The unpainted concrete floors are in good condition. The painted masonry walls and gypsum board ceiling are in good condition.

Doors: Hollow metal doors are in good shape.

Windows: Glass block windows in good condition.

Piping and Equipment: The piping, motors and valves were covered with insulation that trapped in moisture and caused the steel to corrode. The insulation should be removed and piping and equipment be repainted.

Security: Intrusions detection contacts are on the exterior doors. The glass block windows are provided.

HVAC: The building unit heaters and exhaust fans appear to be in good condition.

Plumbing: The existing drains and service sink appear to be in good condition. No bathroom facilities are provided.

Code and Safety: Calcium Hypochlorite dry pellets stored in a separate room. The pellets are mixed with water in a tank. Calcium Hypochlorite is a Class 1 oxidizer, toxic and corrosive. The stored quantity needs to be limited to 500 pounds or ten 50 pound containers to avoid being classified as an H-4 Hazardous occupancy. An emergency shower and eyewash is being added by the City.

EXHIBIT 3-10
Booster Station No. 1 Projects

Project Name		Description of Project	Reason for Project
	Roof Replacement	In about 13 years, replace the roofing with new shingles, underlayment, ice and weather shield and exterior grade plywood sheathing.	Roofing will be at the end of useful life and replacement will avoid leaks and damage to the building and contents.
	Splashblock	Add concrete splashblock to end of downspout	Soil washing away at downspout discharge.
	Repaint Piping and Equipment	Remove insulation, clean off rust and surface prepare steel, and repaint with coating compatible with existing finish.	Piping and equipment rusting and corroding.
	Emergency Shower/ Eyewash	City is adding an emergency shower and eyewash.	Code requires an emergency shower/ eyewash near corrosive storage and handling.

3.3.3 Booster Station No. 2—Hilltop Road

Year Constructed: 2007

Roof: The original asphalt shingle roofing is in good condition, and there are no signs of leaking. The aluminum facial, soffit, gutters and downspouts are in good condition. The 1/2-inch OSB roof sheathing shown on the Record Drawings is not a long lasting material which will need to be replaced if damaged or deteriorated. There is no indication on the Record Drawings that ice and weather shield membrane was installed to prevent ice damming from causing water damage. In about 13 years, the roof should be replaced with new shingles, underlayment, ice and weather shield and exterior grade plywood sheathing.

Exterior Walls: The brick and block walls are in good condition. There are a number of issues with the design of the walls that could lead to future problems, however no signs of deterioration or damage were observed. The Record Drawings show the cavity walls with an air barrier (Tyvek) on the outside of the insulation, but no vapor barrier in the cavity. Therefore, the interior wall paint is serving as the vapor barrier. Through wall flashing is shown on the Record Drawings, but the weep hole spacing is 32 inches apart instead of the recommended 24 inches. The brick also extends below grade, which will likely lead to freeze thaw deterioration of the brick. There are no masonry control joints, which could lead to uncontrolled cracking of the walls.

Insulation: Overall, the building is well insulated. The Record Drawings show that above the ceiling there is R-38 fiberglass batt insulation with a vapor barrier. The exterior cavity walls have 1” rigid foam insulation according to the Record Drawings, which is only about R-5. The Record Drawings also show that the ungrouted concrete masonry cells are filled with foam insulation, and the inside of the concrete foundation walls have 2-inch by 2 feet rigid foam insulation, about R-10.

Interior: The unpainted concrete floors are in good condition. The painted masonry walls and gypsum board ceiling are in good condition.

Doors: Hollow metal doors are in good shape.

Windows: Glass block windows in good condition.

Piping and Equipment: The piping, motors and valves were covered with insulation that trapped in moisture and caused the steel to corrode. The insulation should be removed and piping and equipment be repainted.

Security: Intrusions detection contacts are on the exterior doors. The glass block windows are provided.

HVAC: The building unit heaters and exhaust fans appear to be in good condition.

Plumbing: The existing drains and service sink appear to be in good condition. No bathroom facilities are provided.

Code and Safety: Calcium Hypochlorite dry pellets stored in a separate room. The pellets are mixed with water in a tank. Calcium Hypochlorite is a Class 1 oxidizer, toxic and corrosive. The stored quantity needs to be limited to 500 pounds or ten 50 pound containers to avoid being classified as an H-4 Hazardous occupancy. An emergency shower and eyewash is being added by the City.

EXHIBIT 3-11
Booster Station No. 2 Projects

Project Name		Description of Project	Reason for Project
	Roof Replacement	In about 13 years, replace the roofing with new shingles, underlayment, ice and weather shield and exterior grade plywood sheathing.	Roofing will be at the end of useful life and replacement will avoid leaks and damage to the building and contents.
	Repaint Piping and Equipment	Remove insulation, clean off rust and surface prepare steel, and repaint with coating compatible with existing finish.	Piping and equipment rusting and corroding.
	Emergency Shower/ Eyewash	An emergency shower and eyewash is being added by the City.	Code requires an emergency shower/ eyewash near corrosive storage and handling.

3.3.4 City Water Tower

Year Constructed: 2010

Exterior Walls: Steel tank and concrete support structure are in good condition. The paint on the exterior guard posts is peeling off.

Interior: The unpainted concrete floors and wall are in good condition.

Doors: Hollow metal door and overhead roll-up door are in good shape.

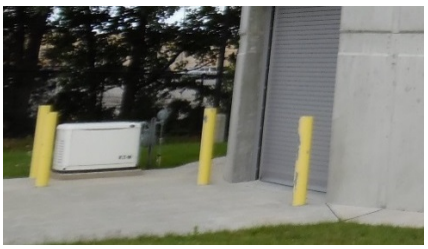
Security: Intrusions detection contacts are on the exterior doors.

HVAC: No heating or ventilating provided.

Plumbing: No drains, sinks or bathroom facilities are provided.

Code and Safety: No serious issues.

EXHIBIT 3-12
City Water Tower Projects

Project Name		Description of Project	Reason for Project
	Guard Post Painting	Remove loose paint, prepare, prime and paint 4 guard posts with paint compatible with existing paint over galvanized steel.	Paint peeling off.

3.3.5 Lincoln Tower Tank No. 1

Year Constructed: 2007

Exterior Walls: Steel tank and concrete support structure are in good condition.

Interior: The unpainted concrete floors and wall are in good condition.

Doors: Hollow metal door and overhead roll-up door are in good shape.

Security: Intrusions detection contacts are on the exterior doors.

HVAC: No heating or ventilating provided.

Plumbing: No drains, sinks or bathroom facilities are provided.

Code and Safety: No observed concerns.

EXHIBIT 3-13
Lincoln Tower Tank No. 1 Projects

Project Name	Description of Project	Reason for Project
	None	

3.3.6 Royalton Township Tower No. 2

Year Constructed: 2007

Exterior Walls: Steel tank and concrete support structure are in good condition.

Interior: The unpainted concrete floors and wall are in good condition.

Doors: Hollow metal door and overhead roll-up door are in good shape.

Security: Intrusions detection contacts are on the exterior doors.

HVAC: No heating or ventilating provided.

Plumbing: No drains, sinks or bathroom facilities are provided.

Code and Safety: No observed concerns.

EXHIBIT 3-14
Royalton Township Tower No. 2 Projects

Project Name	Description of Project	Reason for Project
	None	

3.4 Electrical Condition Assessment

The electrical condition assessment documents the findings and offers recommendations for improvements to the electrical distribution systems at the water treatment plant. An electrical audit was conducted by CH2M HILL with City staff on July 22 and 23, 2014.

The main focus points for the condition assessment are:

- Determine the condition of the electrical system and equipment.
- Assess the installation and arrangement of the electrical system.

3.4.1 Background

The water plant is served by a 12.47 kV, 3 phase, primary utility service originating from a radial aerial distribution primary line of American Electric Power (AEP) – Indiana/Michigan Power. This radial line has two selectable sources of power from the AEP utility aerial distribution system. The service enters the site at the southeast corner of the Plant. A transition from overhead to underground power lines is made at a terminal pole adjacent to the previous service transformers fenced area. The underground feeder terminates at the pad mounted, 15kV, and fused primary switchgear. The service is primary metered and the 12.47kV is distributed to two transformers as follows:

A. A 1500 kVA, 3 phase, 12.47kV primary with 480Y/277V secondary, pad mounted, oil filled transformer serves the Main Plant Service Electrical Equipment on the mezzanine in the High Service Pumping Area of water plant. This transformer has a primary feeder from a dedicated fused switches in the pad mounted service entrance primary switchgear. Secondary bus duct feeder serves an automatic transfer switch (ATS) in high service pump area. This transformer is located outdoors and adjacent to the pad mounted primary switchgear. Load side of ATS feeds MCC-HS which is the 480V distribution / motor VFD controllers line up in the high service pumping area. MCC-HS is the 480V distribution for the Main Plant. The peak demand on this transformer recorded on the electronic power meter at MCC-HS on 7/23/2014 was 716kW (calculated - 746kVA at a power factor of 96%). This equates to about 50% of the transformer full capacity.

B. A 500 kVA, 3 phase, 12.47kV primary with 480Y/277V secondary, pad mounted, oil filled, transformer that serves the shorewell pump station is fed with a primary feeders and dedicated fused switches in the pad mounted service entrance primary switchgear. This transformer is located outdoors and north of the water plant. The secondary feeder is routed underground to the SHOREWELL PUMP STATION into ATS-SW. Load side of ATS-SW feeds MCC-SW which is the 480V distribution / motor VFDs controller line up in the SW and the Low Service Pump Station MCC-P2. The peak demand on this transformer recorded on the SCADA system which obtains a reading from the electronic power meter at MCC-SW on 7/23/2014 was 384kW (calculated - 400kVA at a power factor of 96%). This equates to about 80% of the transformer full capacity. Note the instantaneous reading on this meter at about 11:30 am on 7/23/2014 was 161kVA (calculated - 146kW at a power factor of 90.5%).

3.4.2 Electrical Redundancy

ATS (at the high service pumping area) and ATS-SW have alternate sources using standby diesel engine-generators as follows:

A. An 800kW, 1000kVA @ 80% power factor, 480/277V, 3 phase, diesel engine-generator is the alternate electrical source for MCC-HS through ATS and has an underground feeder to the high service pump area. This outdoor engine-generator set is located south of the water plant.

B. A 500kW, 625kVA @ 80% power factor, 480/277V, 3 phase, diesel engine-generator is the alternate electrical source for MCC-SW through ATS-SW and has an underground feeder to the shorewell pump station. This outdoor engine-generator set is located north of the water plant and adjacent to the 500kVA transformer.

3.4.3 Recommended Improvements

A. The existing AEP aerial electric service conductors and terminal pole appear to be located closer to the high service pumping area of the water plant than is acceptable. The National Electrical does not apply to this installation since the conductors are utility owned and not included in the premise electrical system of the water plant. This installation is covered by the National Electrical Safety Code (NESC), IEEE C2. Table 124.1 of the NESC has the following dimensions required for these service conductors. Vertical clearance from objects below must be 2.69 meters (8 feet, 9 inches), horizontal clearance from objects at either side must be 1.02 meters (3 feet, 4 inches) and the guarded clearance from the conductor must be 101 millimeters (0 feet, 4 inches). Guarded means - covered, fenced, enclosed, or otherwise protected, by means of suitable covers or casings, barrier rails or screens, mats or platforms, designed to limit the likelihood, under normal conditions, of dangerous approach or accidental contact by persons or objects. Although the electrical service initially appeared to be unacceptable, it is within the standard required by the NESC.

   The City is concerned about maintenance of the outside high service pumping area, which cannot be accomplished because of the proximity of the service conductors. A new utility feeder installation underground from the pole at the top of the embankment to the pad mounted service entrance primary switchgear would be a permanent solution for this issue. Another option is to coordinate with AEP to temporarily cover a length of the service lines (guard them) from accidental contact from mobile or other equipment which may be used to make building repairs.

B. Two NEC code issues were noted in the audit at the shorewell pump station as follows:

   1. The working clearance required for ATS-SW does not meet NEC – 2011 section 110.26(A)(1). This section refers to TABLE 110.26(A)(1) which shows three conditions. This equipment has a junction box approximately 36 inches to the front of the ATS-SW. Therefore Condition 2 of the TABLE applies. The minimum distance from the junction box to the front of ATS-SW must be 3 feet and 6 inches.

      This condition must be corrected unless the authority having jurisdiction has given a written wavier to the NEC section requirements and accepted the installation. One option may be to install electrical insulation material to the ATS-SW side of the pullbox and write a standard procedure that ATS-SW not be open at the same time the box cover is removed for access to the pullbox. A second option is to relocate ATS-SW to be 3 feet and 6 inches or more distance from the pullbox.

      When the door is open on ATS-SW, access to egress is eliminated for anyone working on this equipment. Even if the 3 feet and 6 inches in front of the equipment were met, the equipment blocks egress while working on the equipment with the door open.

      A potential solution is to have the hinges of the ATS-SW door on the left side of the structure instead of the right side as one faces the ATS. Another potential solution is to change the hinge from a 90°swing to 180°swing.

   2. Dedicated electrical space above panel LPA is blocked by T-LPA. This is a violation of NEC – 2011 110.26(E)(1) which reserves the space for cables, raceways, cable trays or busway to and from the panelboard.

      This situation may be corrected by relocating the transformer. The new locations to be considered may be to the right of panel LPA or on the wall outside the electrical room in the process area.

C. MCC-P7, GE 7000 line MCC is approximately 40 years old and is approaching the end of useful service. Although GE 8000 line MCC parts are adaptable to the existing structure, costs for a new bucket will exceed the cost of a new MCC. Therefore, we recommend that the MCC be replaced with a new MCC. Procuring the new MCC could be open to acceptable manufacturers instead of restricting it to GE.

D. We recommend a single one-line electrical diagram be developed for the electrical system. Currently there are two documents that do not have correct equipment information, such as the standby diesel

generator for ATS in high service pump area. One diagram has a 500kW rating while it is rated at 800kW on another diagram. There is only a partial one-line diagram for MCC-P7 on both of the diagrams that are in record documents.

E. We recommend a single electrical analysis study be done for the entire plant. The two recent studies are not complete according to as built conditions in the plant. The study of 2011 only covers the shorewell pump station and 2009 covers the water plant. One study would confirm the total system coordination and the ARC Flash labels.

F. An equipment labeling system is recommended and should be developed to be consistent for all the electrical equipment in the plant. What is shown as MCC-1 on one one-line diagram is also shown as MCC-HS on another one-line diagram.

G. Cooling fans for the high service pumps numbers 2 and 3 variable frequency drives should be modified to circulate the cooling air through the filters in the front of the units. Present operations do not allow for the properly clean air because of the voids in the enclosures.

H. The high service pump motors vary in age. The antiquated pump motors should be studied to verify the application of VFDs are consistent with the VFD technology. Some of these motors may be required to be replaced with energy efficient, inverter duty and high power factor motors for better operating and conserving energy.

I. There are places in the high service pump station lower level that have wiring that is not enclosed in the proper boxes and raceway. Some of this wiring may be abandoned and some may be in use. For safety, all the exposed wiring should be investigated and either removed or enclosed in accordance with the NEC.

3.4.4 Summary

Most of the water plant electrical system has been maintained adequately for the conditions. Consideration should be given to update the electrical system in the high service pump area where open junction boxes were observed. The old electrical devices should be updated including the balanced of light fixtures and panelboards that are rusting from high humidity.

Electrical system demand loading on the service to the MCC-HS is well within the capacity of the transformer and standby generator. The load to ATS-SW is also within the capacity of transformer and standby generator serving the load. Both transformers allow the electrical system to expand. However, the standby generator will limit additional load to MCC-HS, and the 500kVA transformer is the limiting factor for shorewell pump station.

3.5 Instrumentation and Controls

The existing SCADA infrastructure (PLC control and PC-based SCADA) is fairly new (2009 to 2012 timeframe). The PLC systems control filtration (including turbidity monitoring) and pumping but not chemicals. There are three major computers that make up the SCADA system, two HMI servers – configured as stand-alone thick-type clients and one historian machine. The HMI software is Wonderware.

Instrumentation is reasonably up-to-date, with Hach turbidimeters (predominately 1720E), particle counters, Hach CL17 chlorine residual analyzers. Differential pressure flow meters on filter effluent flows could be updated, but as long as the flow sensor is in good shape, the pressure sensors can continue to be upgraded/replaced.

From discussion with plant staff, there were several areas in which the existing SCADA system could be improved:

1 The SCADA system requires frequent assistance from the System Integrator for routine tasks, such as restarting computers when SCADA appears to lock up. One specific complaint was that SCADA becomes

unstable too frequently and, combined with not having a SCADA procedure, makes instability and lock-ups more troublesome.

2 The plant has had some trouble with the radio telemetry system and has not been successful in searching for a low cost, easy-to-maintain alternative.

3 The general feeling is that three computers, with the potential for a fourth being added with the next set of filters, is excessive and can be reduced.

4 The chemical systems are not automated.

5 The time cycle for periodically evaluating hardware is roughly every 2-3 years for SCADA computer hardware, 3-4 years for major upgrades to SCADA computer software and 15 years for SCADA PLC hardware.

Recommendations for the issues identified are:

1 Require the System Integrator to provide a simple procedure for routine tasks, like rebooting and cold-starting the SCADA computers. Implement a “regular reboot” schedule where the SCADA machines are restarted on a routine basis (bi-weekly, monthly, etc.) at a time convenient for plant staff.

2 Perform a remote site evaluation to look at some available technologies, like packet-cellular, and the feasibility/cost of using them for backup communication to critical sites and primary communication to sites for which the existing radio system cannot be used.

3 Evaluate the existing SCADA system and architecture. Consider changing the system to a client-server architecture, with one or two SCADA servers and then thin clients that can quickly be replaced in the event of a failure. The system can be more easily expanded with simpler (thin-client) systems.

4 Connect chemical systems monitoring data back to SCADA. Connect controls for future use, but leave the system local or remote MANUAL, since that is the current mode of operation. Install a streaming current meter as a demonstration to see if it helps optimize coagulant dosing.

5 Implement a long-term plan to periodically evaluate SCADA components for upgrade and replacement.

SECTION 4

Water Demand Projections

Water demand forecasting is a critical element of the City of St. Joseph's (City) ability to plan for future water treatment plant capacity over the next 20 years. In addition, the forecast helps to support decisions on timing for renewal and replacement activities to ensure the long-term reliability of water plant operations for providing high quality finished water to the water plant service area. The water plant service area includes the City and the Southwest Michigan Regional Sanitary Sewer and Water Authority, which is comprised of the Lincoln Township, Royalton Township, and the St. Joseph Charter Township.

This section provides an overview of the water plant service area's historical water demand, the water demand forecast methodology and the forecast results.

4.1 Historical Water Demand

Past water demands of the City of St. Joseph and the township within the Southwest Michigan Regional Sanitary Sewer and Water Authority have been driven by a number factors including population, economic patterns, unit consumption, and industry. The annual demands have a strong seasonal pattern, with the peak monthly demands from June through September being driven primarily by irrigation. Exhibit 4-1 presents the historical maximum, average and minimum day finished water demand by month for the water plant service area from 1982 through 2013. This Exhibit displays the distinct seasonal pattern in the water plant service area's water demand.

Exhibit 4-2 presents the maximum day peaking factors for the water plant service area from 1982 through 2013, as well as a comparison of the annual average and maximum day finished water demands. A reduction in demand can be observed in this Exhibit starting in 2005 to 2008. This is the result of City instituting irrigation restrictions for the water plant service area as well as the loss of a major industrial customer, Bosch Foundry, which accounted for approximately 0.5 mgd of the water plant's annual demand. After 2008, the water demand pattern appears to stay relatively flat through 2013, not returning to pre-2005 levels.

Exhibit 4-3 presents the billed water consumption for the water service area from 2005 through 2013. Exhibit 4-4 presents the historic total system unit water demand in gallons per capita day (GPCD) for the entire water plant service area, as well as for the City and the townships of Lincoln, Royalton, and St. Joseph, from 2005 through 2013. These Exhibit show that even though the number of accounts has steadily increased, the volume of water used has decreased. This result is likely a product of the departure of a major industrial customer, reduced irrigation consumption, economic conditions as well as a general increase in efficiency of the City's customers.

EXHIBIT 4-1

Historic Finished Water Demand Pattern, City of St. Joseph Water Plant Service Area

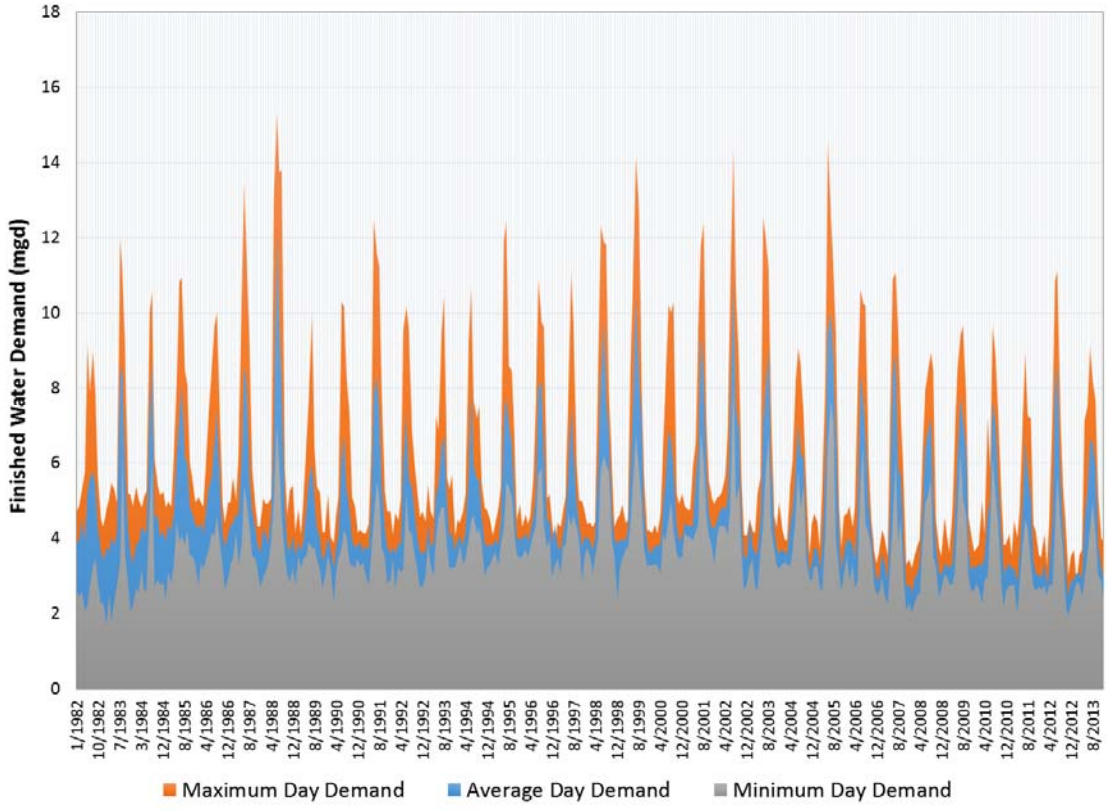


EXHIBIT 4-2

Historic Average Annual and Maximum Day Finished Water Demand, City of St. Joseph Water Plant Service

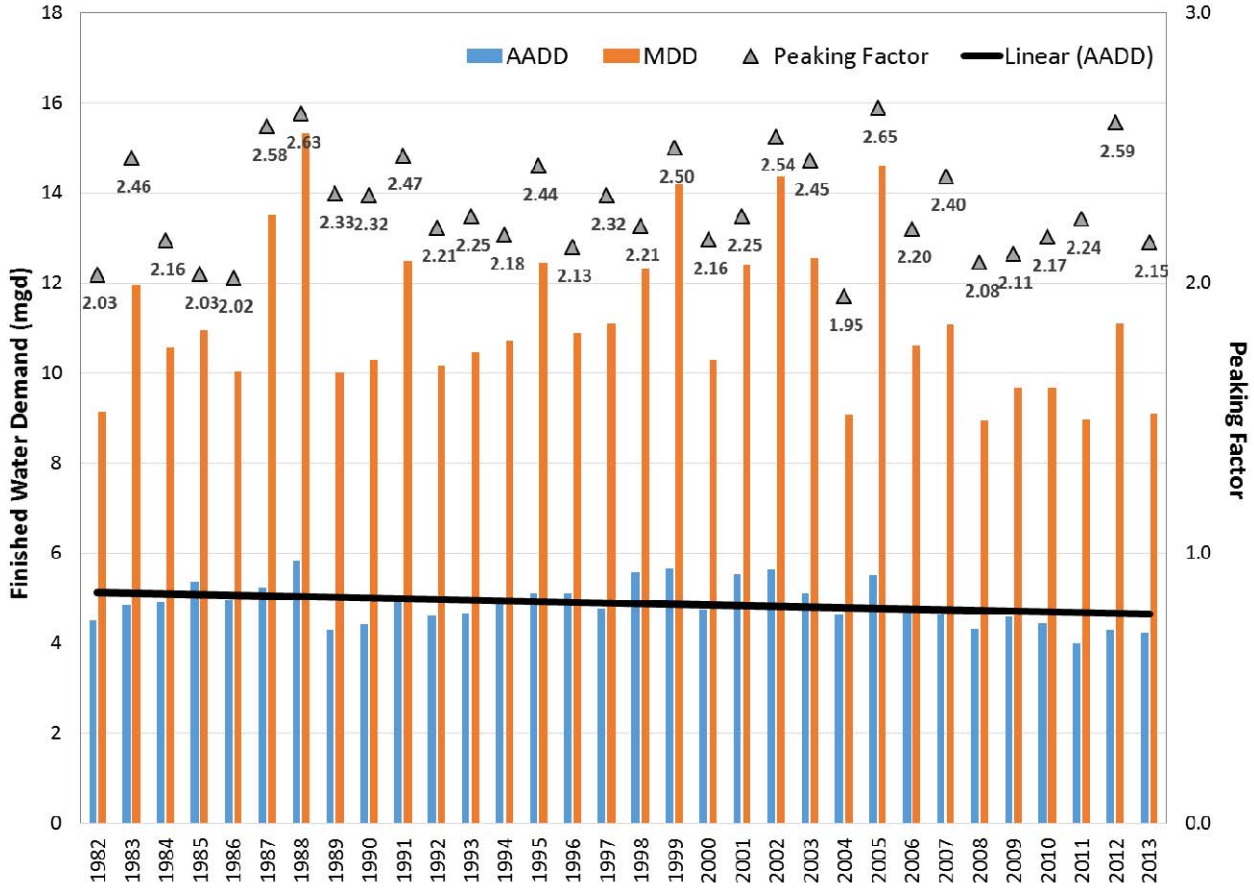


EXHIBIT 4-3

Historic Billed Water Consumption, City of St. Joseph Water Plant Service Area

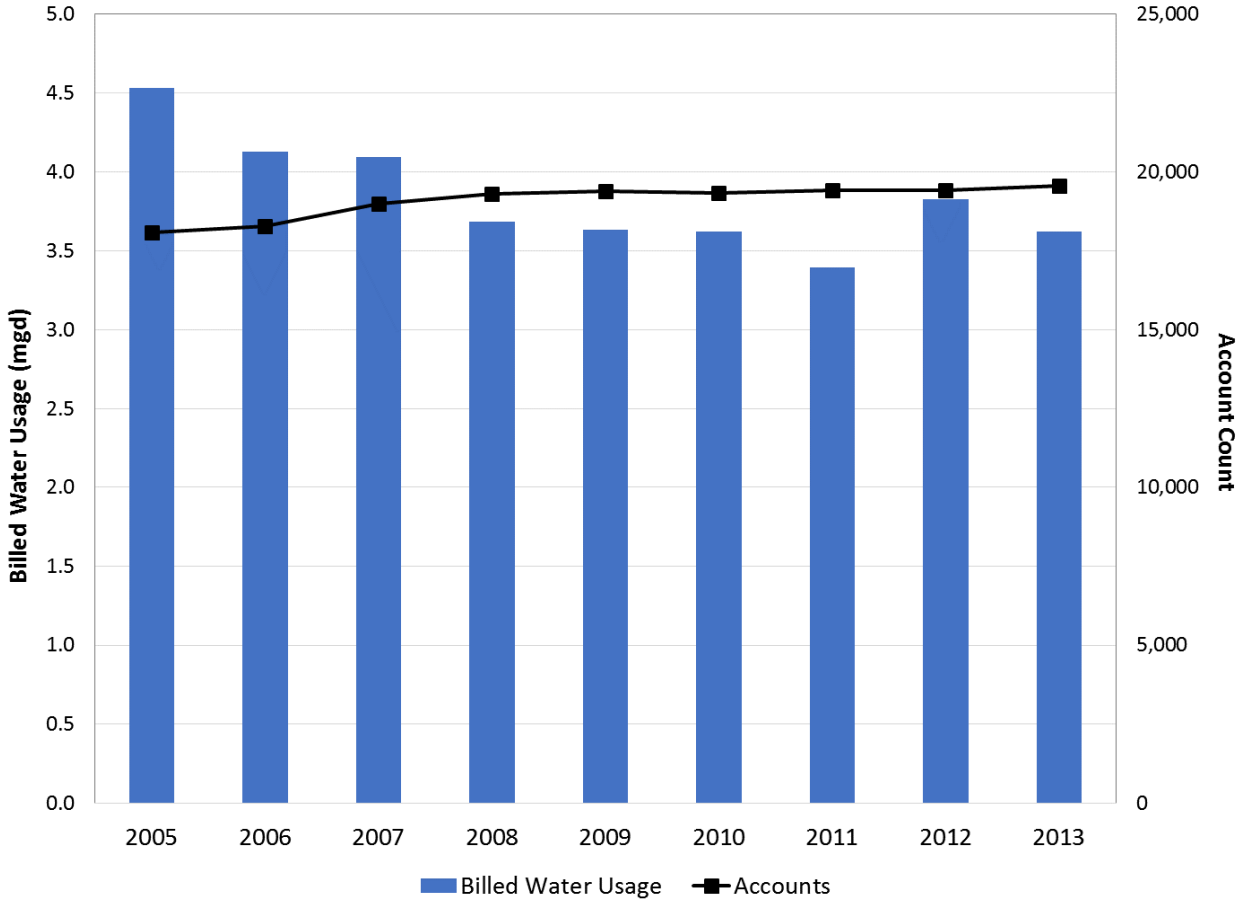
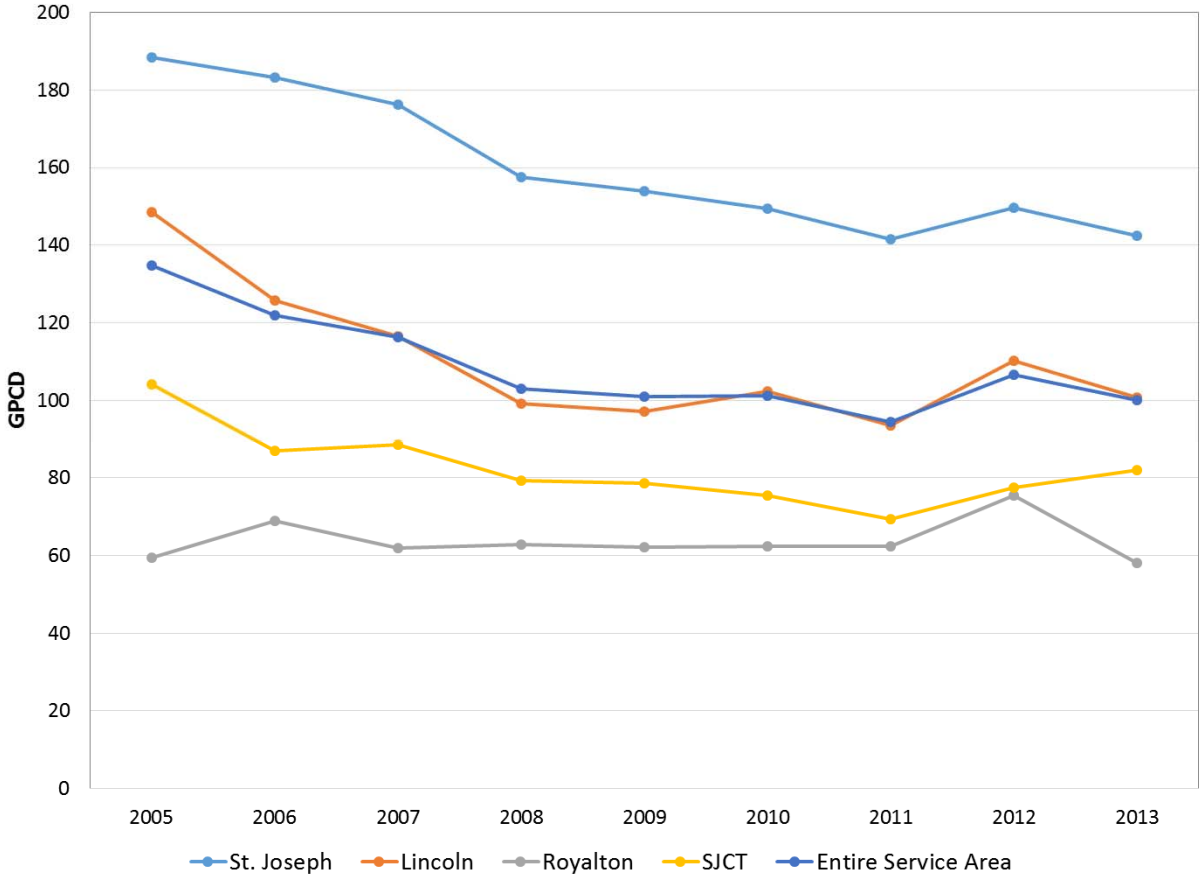


EXHIBIT 4-4

Historic Gallons Per Capita Day (GPCD), City of St. Joseph Water Plant Service Area



4.2 Future Water Demand Forecast

The water demand forecast is representative of the City's current programs and policies related to water service provision and are based on the assumption that they continue into the future. The following sections outline the forecast methodology and forecast results.

4.3 Forecast Methodology

4.4 Water Use and Planning Data Review

In support of the development of the water demand forecast the City's water plant finished water pumping (1982 through 2013) and water billing data (2005-2013) were reviewed. In addition a number of planning documents and data were reviewed and used to support the development of the forecast. These planning documents and data sources included:

- City of St. Joseph Comprehensive Plan
- Royalton Township Master Plan
- Lincoln Township Master Plan
- TwinCATS 2013-2040 Long Range Transportation Plan (LRTP)
- State of Michigan Population Reports
- City of St. Joseph Water System Reliability Reports
- City of St. Joseph Sanitary Survey Reports
- US Census/American Community Survey Data & Reports

The Royalton and Lincoln Township Master Plans, as well as the TwinCATS LRTP provided a projection of future population for the jurisdictions within the water plant's service area. These population projections were utilized for the forecast of future water demand, as discussed in the next section. In addition to the reviewed data, a number of conversation were conducted with City water plant staff, as well as local planners or managers from the townships and the planning staff from the Southwest Michigan Planning Council.

4.5 Deterministic Water Demand Forecast

Projected water plant service area water demands were developed for existing and future conditions based on population projections provided in the reviewed planning documents. A total system unit demand factor, by jurisdiction, was used with the population projections to develop projected water demand, which represents the future demand from residential, commercial, institutional and minor industrial customers. The potential for recruitment of major industrial customers was included in the forecast based on the probability of an industrial customer locating to service area over the 20-year planning period, further discussion on major industrial customers is included in the next section. In addition, projections of future non-revenue water and system operational requirements were included in the total future system finished water demand.

4.6 Probabilistic Water Demand Forecast

The starting point of a forecasting process is a deterministic projection methodology, which is based on a number of single fixed-point estimate assumptions and results in single estimate of future annual demands. The deterministic water demand forecast method for the City's water plant service area is overviewed in the preceding section.

Uncertainty is inherent in any forecast, the water demand for the water plant's service area over the next 20 years will be dependent on number of conditions that may vary from assumptions that are based on historical patterns. Therefore, using the deterministic forecast model developed based on the information described in the preceding section, probabilistic variables were integrated to represent a likely range of values instead of single fixed-point estimate assumptions. A Monte Carlo simulation technique was used to aid in estimating the magnitude and likelihood of an individual demand forecast. This methodology provides the ability to incorporate uncertainty into the water demand forecast, as well as understand the variability in the potential future demands. The factors that were integrated as probabilistic variables in the probabilistic water demand forecast model are:

- Growth rate
  - — By jurisdiction in the water plant service area.
- Unit water demand
  - — By jurisdiction in the water plant service area.
- Future major industrial growth
  - — Large volume water consuming industry
  - — Probability of a major industrial customer locating to the water plant service area
- Impact of drought conditions
  - — 1-in-10 year drought pattern
- Future water conservation
  - — Known reduction from Whirlpool's plans for grey water recycling

  - Future passive and active conservation savings potential
- System Factors
  - Non-revenue water
    - Percentage of total finished water demand
  - Maximum day peaking factors
    - Maximum day versus annual average daily demand

The above variables were used to identify the uncertainty related to the timing of and the cumulative water demand for the current water plant service area.

In addition to the variables listed above, there were two scenarios related to the recruitment of major industrial customers to the water plant service area that were reviewed. The intent of the scenario analysis was to analyze the total water demand for each scenario and define the influence of two probability scenarios:

- 1-in-10 year probability: 2 major industries locating to the service area in the 20 year forecast period.
- 1-in-5 year probability: 4 major industries locating to the service area in the 20 year forecast period.

The recruitment of major industrial customers not only has an effect from the water demand for the individual industry but also the correlated demand increase from additional population to support that industry.

4.6.1 Future Water Demand

Exhibit 4-5 displays the probabilistic annual average daily finished water demand forecast including a 1-in-10 year probability of a future major industrial customer for the water plant service area. Exhibit 4-6 displays the probabilistic annual average daily finished water demand forecast including a 1-in-5 year probability of a future major industrial customer for the water plant service area.

Exhibit 4-7 displays the probabilistic maximum day finished water demand forecast including a 1-in-10 year probability of a future major industrial customer for the water plant service area. Exhibit 4-8 displays the probabilistic maximum day finished water demand forecast including a 1-in-5 year probability of a future major industrial customer for the water plant service area. Exhibit 4-7 and 4-8 the City's current water plant capacity, 16 mgd, is identified, as well as the industry standard 80 percent capacity threshold to trigger the start of planning, permitting and engineering design activities for a water plant expansion. This threshold is a benchmark to ensure that enough time is provided for these activities, as well as the construction of the expansion, such that the expanded capacity is online in time for future water demands.

Exhibits 4-5 through 4-8 present five demand forecasts for each forecast; the 95th percentile, the 75th percentile, the 50th percentile (median), the 25th percentile and the 5th percentile forecast. The 50th percentile forecast represents a reasonable probability forecast, with equal chances of actual demand being above or below the forecast. The boundaries of the forecasts represent the cumulative effect of the less probable scenarios related to each of the various factors considered, which results in demands being much less likely to be above the 95th percentile or below the 5th percentile. That means that there is a 90 percent chance that demands will be somewhere in between these two extremes, and these ranges provide valuable perspective on the potential impacts of reliably meeting future treatment capacity needs. While we typically base long range planning on the 50th percentile forecast, the probabilistic forecast range is extremely valuable in informing the decision process related to the timing and size of capital projects.

EXHIBIT 4-5

Annual Average Daily Finished Water Demand Forecast, 1-in-10 Year Probability of Future Major Industrial Customer, City of St. Joseph Water Plant Service Area

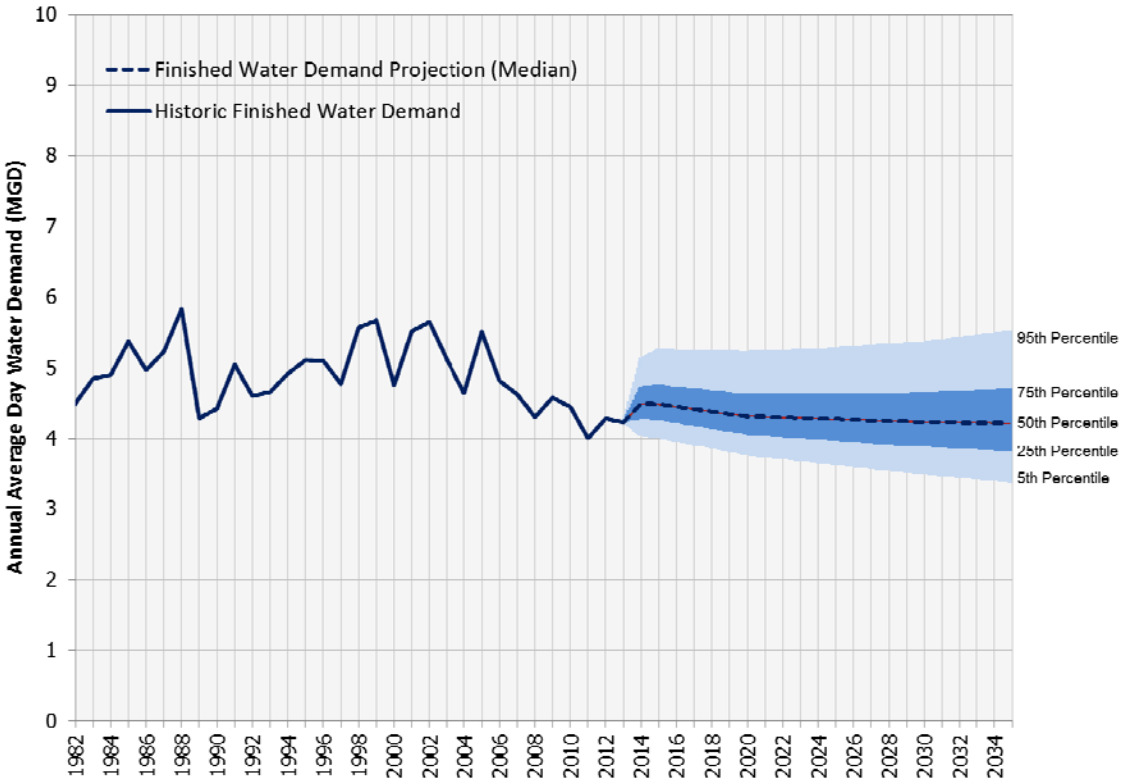


EXHIBIT 4-6

Annual Average Daily Finished Water Demand Forecast, 1-in-5 Year Probability of Future Major Industrial Customer, City of St. Joseph Water Plant Service Area

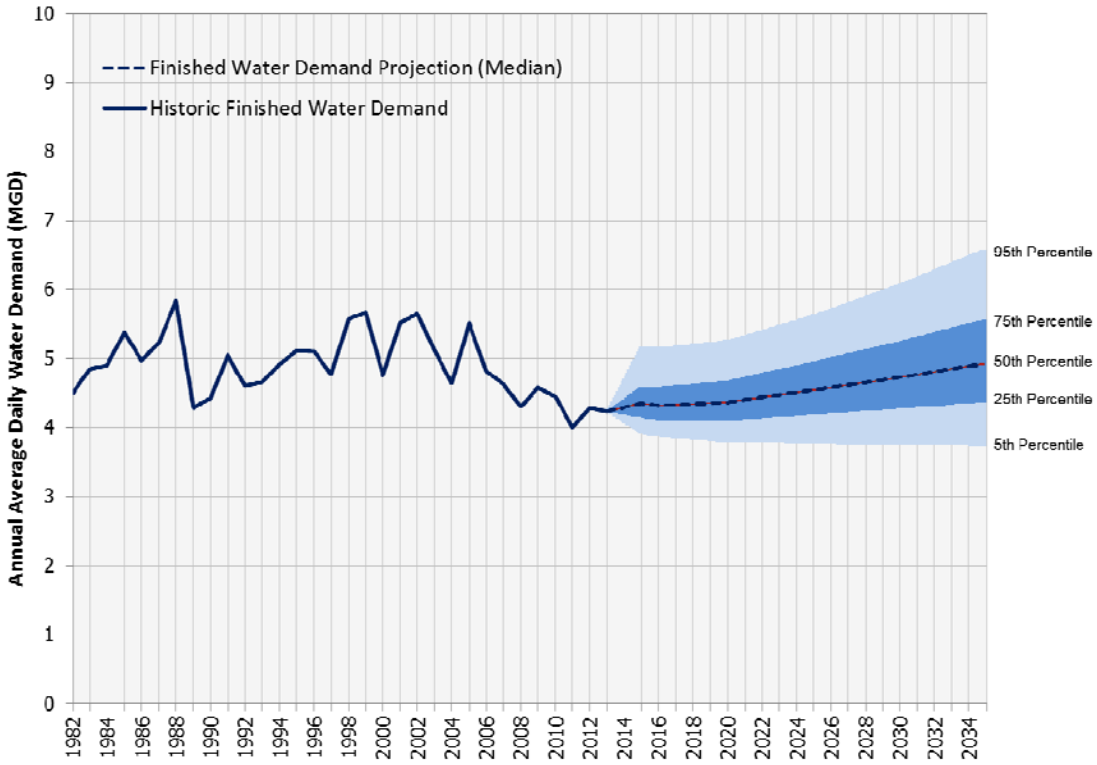


EXHIBIT 4-7

Maximum Day Finished Water Demand Forecast, 1-in-10 Year Probability of Future Major Industrial Customer, City of St. Joseph Water Plant Service Area

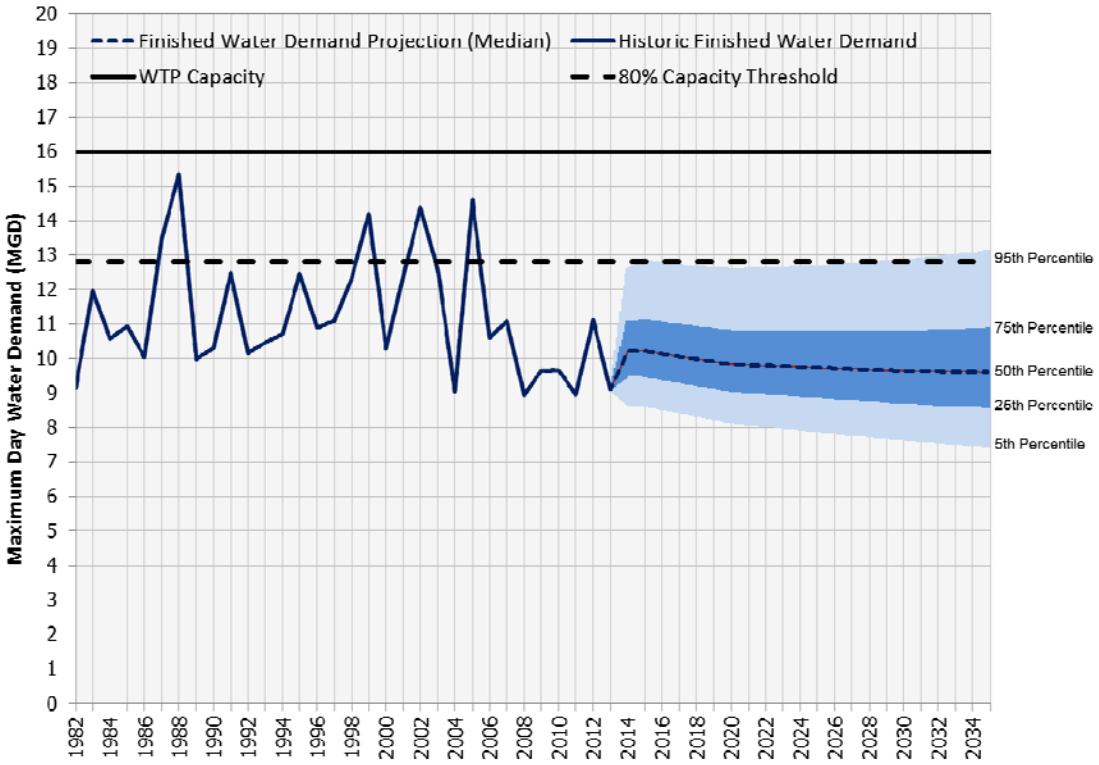
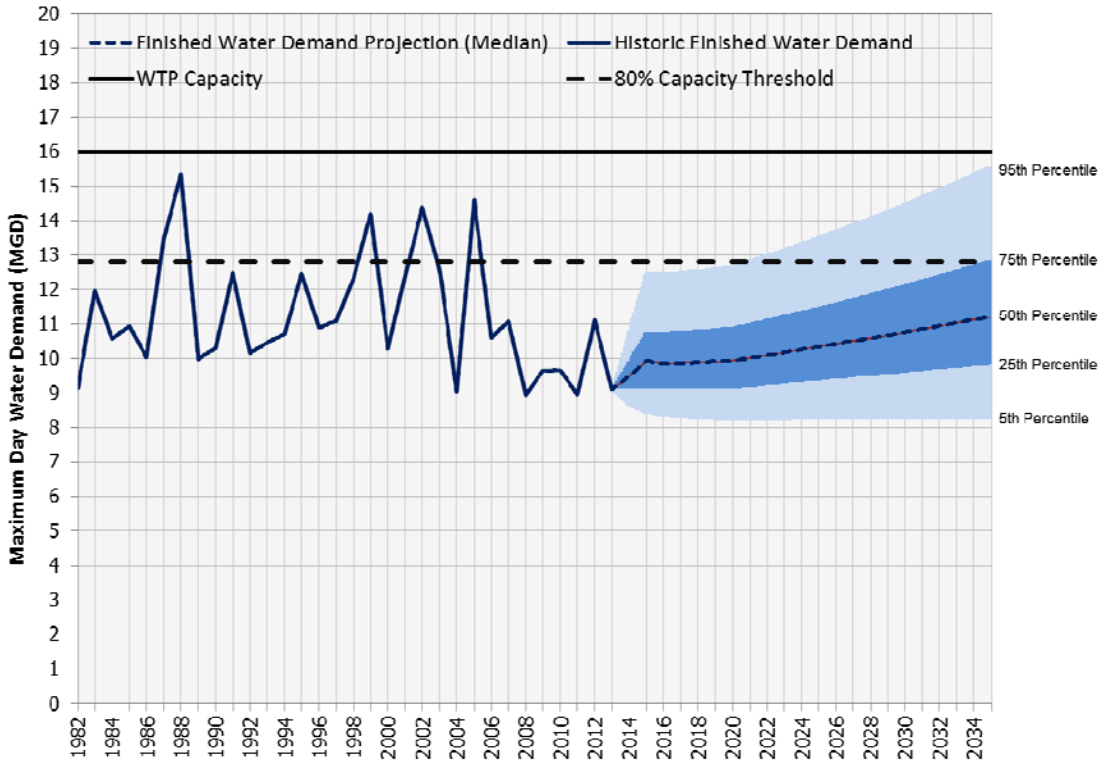


EXHIBIT 4-8

Maximum Day Finished Water Demand Forecast, 1-in-5 Year Probability of Future Major Industrial Customer, City of St. Joseph Water Plant Service Area



4.7 Summary and Conclusions

The following bullets summarize the data presented in the preceding section and provides some concluding thoughts:

- The underlying data used in any forecast has a range of potential values which results in uncertainty in the estimation of future demand. The use of probabilistic methods allows for the recognition of this uncertainty while providing an estimate of a likely demand.
- The forecasts presented in the preceding section identify the future uncertainty in water demand for the City's water plant service area. This information is extremely relevant to understanding the potential risks in water treatment capacity development decisions. For example, after planning, permitting design, and construction of a capital-intensive expansion is initiated, if demand grows slower than projected, significant rate increases for current customers may be needed to pay the debt service. Alternatively, if demand growth occurs faster than projected, capacity shortages could have an unintended economic impact on the water plant service area. Although both scenarios represent lower probability events, they represent scenarios on either end of the decision related to timing the development of new treatment capacity and are valuable to understand.
- The water demand forecast indicates that:
  - On average there is a relatively flat demand pattern into the future; there are a number of factors contributing to this but the flat growth rates through the planning period, as identified in the TwinCATS 2013-2045 LRTP, is a major one.
  - The small potential for growth in demand in the service area is offset by Whirlpool's water use reductions and the long-term water conservation savings potential.

  - There is not a high probability of a return to pre-2005 maximum day demand patterns; there are lower probability scenarios represented within the probabilistic forecast that indicate that maximum day demands could increase to the pre-2005 level later in the planning period.
  - The increase in probability of a major industry locating to the water plant service area increases the probability of the water demand increasing in the future (Exhibits 4-6 and 4-8), rather than following a more static pattern (Exhibit 4-5 and 4-7).
  - For both major industry recruitment scenarios, the forecast range intersects the 80 percent water plant capacity threshold. This capacity percentage is an industry standard threshold to initiate planning, permitting and engineering design for a capacity expansion. The City should be prepared to initiate these activities if actual water demands trend towards the upper range of the probabilistic forecast.
  - The forecast provides an indication that it is not a high probability scenario that the City's water plant will exceed its current capacity of 16 mgd over the next 20 years.

- Based on the forecast results, and its associated uncertainty, it is in the best interests for the City to continue to maintain the water plant's 16 mgd capacity to ensure long-term service reliability to be able to provide for all of the demand scenarios provided in the water demand forecast. In addition, any improvements completed at the water plant in the coming years should be done with an outlook to the future potential for a capacity expansion. If an individual treatment process is being rehabilitated and can be designed to be more flexible to allow expansion, the marginal investment to design this flexibility will provide a significant return on the savings the City could realize in the future both in time and money.
- It is recommended that the City continue to annually monitor water demand and compare actual demands against the probabilistic forecast presented in this section. This will help the City continue to refine the forecast, and allow for the re-appraisal of the decisions related to the timing of capital projects at the water plant.

SECTION 5

Process and Capacity Assessment

5.1 Source Water Quality

The St. Joseph water plant obtains its source water from Lake Michigan. Lake Michigan is a moderately hard, high quality water source, although water quality can be highly variable due to weather or limnologic conditions. Raw water turbidity is typically less than 5 nephelometric turbidity units (ntu), but can be over 80 ntu during major storm/wind events. Water quality (organics, turbidity) can also change if the St. Joseph River water is directed towards the Lake Michigan intake crib. Water temperature can vary rapidly due to thermal stratification and currents in the lake. Under these challenging treatment conditions, clarification and filtration processes can be adversely impacted and filter effluent turbidity may exceed the goal of 0.1 ntu. Plant staff are trained to modify treatment operations in response to such events and ensure filter effluent turbidity regulations are met.

Typical raw and finished water quality parameters are shown in Exhibit 5-1.

EXHIBIT 5-1
Typical Water Quality Parameters

	Raw Water		Finished Water	
	Typical	**Range**	**Typical**	**Range**
Hardness, mg/l $CaCO_3$	145	108-235	145	94-194
Turbidity, ntu	3	0.8-83	0.04	0.02-0.11
Alkalinity, mg/l $CaCO_3$	120	103-184	100	85-144
pH	8.4	7.8-8.8	7.4	7.1-7.9
TOC, mg/l	2.5	1.7-3.3	1.7	1.4-3.2
TTHM, µg/l	NA	NA	23	29-58
HAA, µg/l	NA	NA	45	24-87

The raw water hardness, TOC and finished water HAA values spike higher than some other Lake Michigan water plants. This could be from the influence of the St. Joseph river entering Lake Michigan near the water plant intake. With the potential for higher organics and disinfection byproducts, optimized coagulation and settling is important. Chlorinating the water forms chlorinated disinfection by-products (DBPs) like total trihalomethanes (TTHMs) and total haloacetic acids (HAAs). Historically, the City has remained below the Stage 2 Disinfectant and Disinfection By-Product limits for TTHMs and HAAs of 80 ug/L and 60 ug/L, respectively on a locational running annual average. However, elevated levels of HAAs have been detected in portions of the distribution system at certain times of the year and measures to reduce DBPs are prudent. Recently, a distribution system water sample had an HAA level of 105 ug/l.

The water plant does daily monitoring of TOC and UV 254 absorbance. Typical TOC removal is 15% to 20%. The raw water specific UV absorbance (SUVA) ranges from 0.8 to 1.5, which is relatively low for surface water but typical for Lake Michigan water. The low SUVA makes TOC removal with alum coagulation more difficult. The Stage 1 DBP Rule has requirements for TOC removal as follows:

EXHIBIT 5-2
Stage 1 DBP Rule TOC Removal Requirements

TOC (mg/L)	TOC Removal (%)		
	0 –60 mg/L of Alkalinity	>60 – 120 mg/L of Alkalinity	>120 mg/L of Alkalinity
2.0 – 4.0 mg/L	35.0%	25.0%	15.0%
4.0 – 8.0 mg/L	45.0%	35.0%	25.0%
> 8.0 mg/L	50.0%	40.0%	30.0%

St. Joseph would fall into the 15% to 25% TOC removal category, depending on raw water quality. This requirement would not always be met. However, the Stage 1 DBPR includes several exceptions to the requirement. These exceptions are often referred to as "off-ramps," and utilities that qualify for these off-ramps do not need to comply with the TOC removal requirements. These off-ramps are listed below.

- TOC < 2.0 mg/L in raw or treated water
- THMs < 40 μg/L and HAAs < 30 μg/L with chlorine as primary disinfectant
- TOC <4 mg/L and Alkalinity > 60 mg/L as $CaCO_3$ in raw water and THMs < 40 μg/L and HAAs < 30 μg/L or a financial commitment is made to meet 40/30 by the effective date
- Specific ultraviolet absorbency (SUVA) ≤ 2 L/mg-m in raw or treated water

St. Joseph would meet the SUVA $\leq$ 2 exception. The TOC and DBP exception would be met some of the time. Even though St. Joseph can comply with the TOC removal requirement because of low SUVA, increasing TOC removal will help reduce DBPs.

Lake Michigan is considered a Bin 1 water source per LT2ESWTR (LT2) *Cryptosporidium* monitoring requirements. As such, the conventional treatment process is sufficient to meet LT2 removal requirements for *Cryptosporidium* without additional treatment processes (e.g. UV disinfection). However, additional monitoring for Cryptosporidium is required in the future and higher levels could require additional treatment.

Algae blooms are becoming more frequent in the Great Lakes. Algae can cause taste and odor issues and release algal toxins. Historically, algae and algal toxin levels have been low in Lake Michigan. Routine monitoring for turbidity, TOC, UV 254, DBPs, algae and optimization of coagulant dose can reduce adverse water quality issues. The St. Joseph water plant continuously monitors TOC, so alum dose can be increased when TOC and UV 254 levels increase.

5.2 Raw Water Intake and Low Lift Pumping

The water plant has two raw water intakes. The north intake and low lift pump station were recently constructed and serve as the primary source of water for the plant. The new 48-inch intake pipe has an estimated hydraulic capacity of 40 mgd. The north pump station consists of two 12 mgd pumps and two 4 mgd pumps. The capacity is adequate for current and future water demands. The north pump station is in good condition with no major improvements required, although some sand accumulation in the 48-inch intake pipe has been observed.

The south intake and low lift pump station is much older and serves as a backup intake structure. The south intake consists of a 24-inch pipeline with an estimated hydraulic capacity of 18 mgd. The south pump station is in need of some improvements (e.g. new MCCs, switchgear, pump packing) in order to maintain its service as a reliable backup. The condition assessment section has additional information.

EXHIBIT 5-3
Photos of the North and South Low Lift Pump Stations

North Low Lift Pump Station	South Low Lift Pump Station
	
	

5.2.1.1 Recommendations

Improvements to the mechanical and electrical equipment in the south low lift pump station should be performed to ensure the pump stations remains as a viable backup. Additional details are in the Condition Assessment section of this report. Sand accumulation in the intake pipes should be removed periodically.

5.3 Rapid Mix

Aluminum sulfate (Alum) is used as the primary coagulant and is typically fed via an inline rapid mixer. A secondary feed point is available on the 30-inch raw water line. Spent filter backwash is recycled back to the raw water just upstream of the rapid mixers and alum feed point, but is not included in the plant's raw water flow. This can yield non-optimal coagulant dosing and may lead to clarifier upsets.

The two inline rapid mixers are 25 HP each. One serves as a backup unit. The rapid mixer motors are adequately sized to achieve recommended inline rapid mixing G-values greater than 1000 sec-1 over the full range of water temperatures.

EXHIBIT 5-4
Photos of the Inline Rapid Mix and Chemical Injection Points

Primary Alum Feed Point Into Rapid Mixer

Secondary Alum Feed Point Into 30-Inch Raw Water Main

Inline Rapid Mixers

Filter Backwash Recycle Line

Alum, fluoride and chlorine are injected within a short distance of the raw water pipe. It appears that the backup alum and chlorine lines are injected at mid-pipe level instead of the recommended location in the bottom quadrant of the pipe.

5.3.1 Recommendations

Recycling the filter backwash water to the North low lift pump station wet well would include this stream with the raw water flow measurement, improve blending with the raw water and reduce hydraulic surge. Filter backwash recycle should be metered to ensure the recycle rate does not exceed 10 percent of the total raw water flow and ensure that chemical dosing is based on total combined flow. The raw water line should have a flow meter to accurately measure flow for chemical dosing.

EXHIBIT 5-5
Issues and Recommendations for Rapid Mix

Issue	Recommendation
Filter backwash recycle flow not included in raw water flow.	Install flow meters on filter backwash recycle and 30-inch raw water line. Base raw water chemical dose on total combined flow. Limit filter backwash recycle rate to less than 10 percent of the total combined raw water flow.
Filter backwash recycle flow can surge the rapid mixing and clarification processes.	Recycle filter backwash back to the north low lift pump station wet well to allow for blending and equalization with low lift pumps.
Backup alum and chlorine lines are injected at mid-pipe level.	Move injection locations to the bottom quadrant of the pipe in accordance with Ten States Standards.

5.4 Flocculation/Clarification

After rapid mix, water flow is split manually between 3 flocculation/clarification processes using butterfly valves and differential pressure sensors. The flow split is not always equal to the clarifiers and can cause performance issues (higher turbidity). All three clarifiers are solids contact type units, with a solids contact/mixing zone in the center hood and radial effluent launders. Exhibit 5-6 shows one of these clarifiers when the basin was dewatered. The upper launders have been painted and their appearance is good. The lower level hood and sludge scraper arm have visible corrosion. An independent condition assessment by Dixon Engineering predicted about an additional 10 years life for the clarifiers.

EXHIBIT 5-6
Solids Contact Clarifier No. 2 Dewatered

This type of clarifier is typically utilized in lime softening plants where the high sludge density facilitates sludge settling and effluent water clarification. Due to the relatively low raw water turbidity levels, low alum sludge density and fluctuating water temperatures, these clarifiers are not ideally suited for Lake Michigan water. As mentioned previously, the clarifiers can experience upsets if water quality, flow rate or temperature changes rapidly or the solids concentration in the sludge blanket is not maintained adequately. This can cause very high turbidity levels going to the filters resulting in short filter runs and higher filtered water turbidity. During average water quality conditions and constant water temperature, these clarifiers can produce acceptable water quality.

Clarifier #1 was constructed in 1957 and has a rated capacity of 4 mgd at 1 gpm/sf and 2 hours of detention time. This clarifier is reported to work well, and cleaning is easier than Clarifiers #2 and #3 due to the floor slope.

An underground concrete sedimentation basin from the original 1931 plant construction remains in place downstream of clarifier #1 and upstream of filters #1-4. This buried concrete basin no longer functions as a sedimentation basin and a portion of the water just passes through it. Some additional disinfection CT is achieved as water passes through the basin. However, the old basin does not have a membrane covered roof, and vents/hatches do not meet current Michigan Department of Natural Resources codes to protect the water from contamination from surface water.

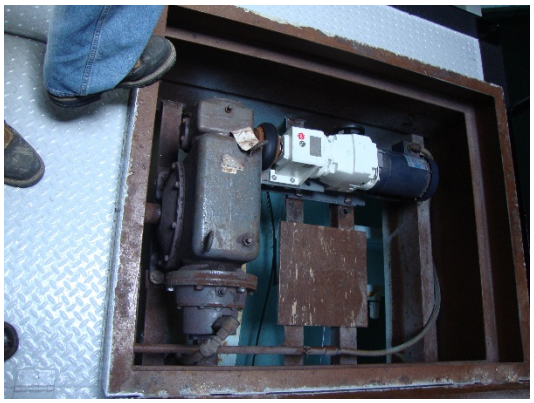
Clarifiers #2 and #3 were constructed in 1975 and have a rated capacity of 6 mgd at 0.9 gpm/sf and 2 hours of detention time. Ten States Standards recommends a maximum overflow rate of 0.5 gpm/sf and 4 hours of detention time for conventional flocculation/clarification processes, but allows for less conservative design criteria for solids contact clarifiers. As currently rated, total clarification capacity is 16 mgd total, and 10 mgd firm. This limits the plant capacity if one of the clarifiers is out of service for maintenance.

Sludge flows by gravity to a sludge holding tank and is pumped to a sanitary sewer. Total flow to the sewer is typically about 16,000 gallons per month. No major improvements are recommended to this system, beyond continued inspection and maintenance.

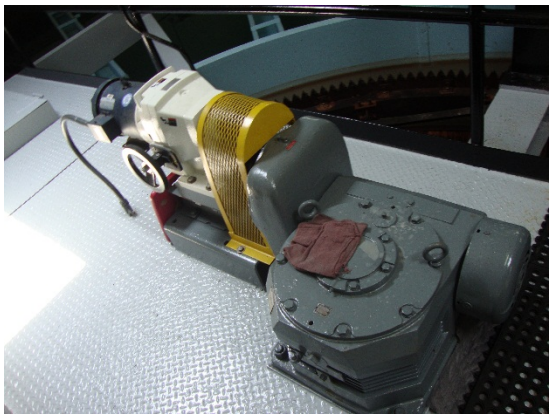
EXHIBIT 5-7
Photos of the Clarifiers

Clarifier #1

Clarifier #2 and #3



Clarifier 1 Scraper Drive Mechanism



Clarifier #2 Mixer

EXHIBIT 5-7
Photos of the Clarifiers

Old Underground Sedimentation Basin

Clarifer #2 and #3 Settled Water Pipe Gallery

5.4.1 Recommendations

Conventional flocculation basins followed by inclined plate settlers are a better clarification technology for Lake Michigan. Clarifiers #2 and #3 should be retrofit with horizontal flocculators, inclined plate settlers, and sludge removal mechanisms. The capacity of each clarifier can be increased to 8 mgd for a total capacity of 16 mgd with the two clarifiers. Clarifier 1 can remain as is for additional capacity when one of the other basins is out of service.

Flow split between the clarifiers should be automated to prevent uneven flow distribution. Piping from clarifiers 2 and 3 to the filters should be increased for additional hydraulic capacity.

The 1931 sedimentation basin should be abandoned in place and drained. This space could be used for a future treatment process (e.g. ozone contactor, filters).

EXHIBIT 5-8
Issues and Recommendations for Flocculation/Clarification

Issue	Recommendation
Solids contact clarifiers are not ideally suited for Lake Michigan water and firm clarification capacity is less than plant capacity.	Retrofit Clarifier #2 and #3 into flocculation and inclined plate settler basins with 8 mgd rated capacity each. Include new sludge removal mechanisms and flocculators in each basin.
Flow split between clarifiers is unevenly split at times.	Improve flow split control between clarifiers automatically using modulating valves and flow meters.
Sedimentation basin no longer provides treatment benefit (other than additional chlorine contact time).	Abandon the old sedimentation basins in place and save space for future treatment process.

5.5 Filtration

Settled water from the clarifiers is sent to three sets of four sand/anthracite filters (12 filters total). All filters have Leopold dual lateral plastic underdrains with a gravel-less IMS cap. All filters have 18 inches of 0.5 mm effective size sand under 12 inches 1.0 mm anthracite. All filters have surface wash (no air scour) and filter-to-waste capability.

Filters #1-4 were part of the original plant construction (1931), have an effective filtration area of 350 sf each. At a hydraulic loading rate of 2 gpm/sf, the total capacity is 4 mgd. The approved filtration rate is 3

gpm/sf for a total capacity of 6 mgd. However, the filters have not been operated at that rate. The piping and valves for Filters #1-4 are in poor condition due to the moist air conditions in the filter pipe gallery and their age. The filter controls are also old and obsolete. Flow measurement in these filters can be inaccurate due to venturi flowmeters not always being full of water. These four filters do not have filter to waste capability like the other 8 filters. Backwash troughs are showing signs of corrosion. The depth of water over the filter media is only about 4 feet. This may increase the potential for air binding, especially when headloss exceeds 4 ft and the water is cold.

Filters #5-8 have an effective filtration area of 350 sf each and have an approved 2 gpm/sf filtration rate. The total approved capacity of these four filters is 4 mgd. These filters have operated up to 2.85 gpm/sf. Filter piping and valves in Filters #5-#8 are generally in good condition, but the control consoles are older. These filters are reported to perform poorer than other filters for headloss and turbidity. The surface wash arms may not be at the optimum height above the media (2 inches) resulting in inadequate filter cleaning. Further investigation is needed to determine the performance issues with these filters. The depth of water over the filter media is about 6 feet.

Filters #9-12 have an effective filtration area of 484 sf each and have an approved 3 gpm/sf filtration rate for a total capacity of 8 mgd. These filters have been operated up to 4.33 gpm/sf. Filter piping and valves in Filters #9-#12 are generally in good condition and control consoles are new. The depth of water over the filter media is about 7.5 feet.

Total filtration capacity is about 16 mgd with all filters in service. Filter performance is typically excellent with combined filtered water turbidity around 0.05 ntu. Filter run times can exceed 100 hours, unit filter run volumes exceed 7,000 gal/sf, and filter washwater is less than 2% of total plant volume.

Backwashing is performed manually following a set procedure. Backwash water is supplied by dedicated backwash pumps in the high service pump room. Maximum backwash rate is about 14 gpm/sf. It is not known if backwash flowrate is adjusted with water temperature (i.e. Higher backwash rates in warm water).

Backwash waste is collected in a 100,000 gallon reclaim basin and recycled at 500 gpm with two constant speed pumps. The backwash reclaim basin may overflow if two filters are backwashed consecutively.

5.5.1 Recommendations

A study should be conducted to determine if Filters #5-#12 could be successfully operated and rated at 4 gpm/sf or higher. This would provide 16 mgd filtration capacity using existing infrastructure. Improvements to Filters #1-#4 would not be necessary and the cost of those improvements saved. As part of this study, any improvements to filters #5-#12 underdrains, media and backwashing to achieve the higher rate should be determined. Typically, less sand and more anthracite provide better filtration performance at higher rates. If new filter media is required, replacement of the anthracite media with granular activated carbon (GAC) should be considered for an additional taste and odor barrier and better organics removal to reduce DBPs. Chlorine disinfection would need to be moved downstream of filtration, and the impact on disinfection CT determined.

The 18-inch filter effluent line from Filters #5-#8 should be replaced with a 24-inch line and connected to the existing 30-inch pipe going to the finished water reservoirs. The older filter control panels on Filters #5-#8 should be replaced with new control panels and PLCs.

A backwash supply line should be installed from the high service distribution main through a pressure reducing valve. This will provide redundancy for the backwash pumps.

The filter backwash waste recycle pumps should be equipped with VFDs to adjust recycle flow rate and ensure the rate does not exceed 10% of the total raw water flow.

EXHIBIT 5-9

Photos of Existing Filters

Filters #5-8

Filter #11 Top View

Filter #5 Effluent Piping

Filter #11 Effluent Piping

Filter #11 and #12 Control Consule

Filter #11 and #12 Control Consule HMI

EXHIBIT 5-9
Photos of Existing Filters

Filter Backwash Recycle Pumps

Filter #11 and #12 Filter-to-Waste Lines

EXHIBIT 5-10
Issues and Recommendations for Filtration

Issue	Recommendation
Filters #1-#4 are in poor condition and upgrading them will cost money. Hydraulic capacity from clarification to Filters 1-4 are also limited.	Perform full-scale demonstration study to uprate Filters #5 - #12 to 4 gpm/sf, or about 16 mgd with one filter out of service. Upsize 18" FE pipe to 24", connect to existing 30" FE pipe to treated water reservoir.
Filter media may not be optimum for turbidity and organics removal at a higher rate.	Consider alternative filter media designs, including GAC for improved organics removal. The impact on disinfection needs to be factored into the study.
Filter controls for Filters #5-8 are old.	Replace filter consoles for filters #5-#8 with new, updated systems.
The backwash water supply lacks redundancy.	Add pressure reducing valve off of the high pressure distribution main as a backup backwash supply.
Backwash recycle rate is constant and may exceed 10% recycle rule.	Add variable frequency drive to backwash recycle pumps to control rate of recycle. For example, at 3 mgd plant flow, recycle rate should not exceed 210 gpm.

5.6 Disinfection and Finished Water Storage

5.6.1 Disinfection

The water plant must provide at least 4-log removal/inactivation of viruses, 3-log removal/inactivation of Giardia, and 3-log removal/inactivation of Cryptosporidium to comply with the Surface Water Treatment Rule and LT2 requirements. Conventional sedimentation and filtration processes provide 2-log removal credit for viruses, 2.5-log removal credit for Giardia, and 3-log removal credit for Cryptosporidium. The remaining 2-log credit for viruses and 0.5-log credit for Giardia must be achieved with disinfection.

Currently, free chlorine is the primary (and secondary) disinfectant. Chlorine is fed at the raw water as well as to the clarifier influent to provide adequate chlorine contact time through the plant. After filtration, chlorinated water flows through the 0.9 million gallon (MG) north and 1.8 MG south finished water reservoirs. These reservoirs provide additional chlorine contact time as well as water storage for the finished water pumps. The north reservoir is baffled with flexible curtains.

The 0.9 MG north reservoir was baffled with a flexible curtain wall to improve chlorine contact time and reduce stagnation. The 1.8 MG south reservoir does not have extensive baffling beyond a divider wall. As water level in the finished water reservoirs varies, so does chlorine contact time. Hydraulics and chlorine contact time calculations are complicated and may not be captured accurately for all operating conditions.

The yard piping does not allow flexibility to operate one or both reservoirs in series or parallel, and some valves are inoperable, making isolation of one reservoir not possible.

If a portion of the reservoirs were baffled for good chlorine contact (baffle factor of 0.6) all the required CT for 0.5-log Giardia could be met in the reservoirs. For example, a 0.5 MG volume of chlorine contact could provide 0.5-log Giardia inactivation at a plant flowrate of 16 mgd, water temperature of 0.5 degrees Celsius, pH 7.5 and 2 mg/l chlorine residual. This would allow the chlorine application point to be moved downstream of clarification or filtration to reduce DBPs.

5.6.2 Storage Volume

There is no specific storage volume required at water treatment plants. Some suggested guidelines say total system storage should be average day demand, plus 25% for emergency, plus fire flow. For St. Joseph, this total storage would be approximately 13 MG. Current system storage capacity is 6.4 MG. Another rule of thumb for water storage at water plants is 8 hours storage at average day demand (1.3 MG for St. Joseph) or 20% of the plant capacity (3.2 MG for St. Joseph). The current storage volume of 2.7 MG is between those rules of thumb.

The minimum water level in the reservoirs must remain above 6 feet to prevent cavitation in the finished water pumps, therefore the available storage volume is only around 1.1 MG. In addition, volume needed for chlorine contact cannot be counted as usable storage.

Both of the reservoirs are located below grade but above the groundwater level. The vents are not 24 inches above grade, as recommended per 10 States Standards (para.7.09.d.). There is no membrane cover over the roofs. The south reservoir was inspected in 2014 by Dixon Engineering and found to be in good overall condition and only minor cracks to repair.

5.6.3 Disinfection Byproducts

As discussed in the Water Quality section, St. Joseph has historically met the Stage 2 DDBP rule requirements for chlorinated DBPs. During challenging water treatment conditions, elevated TOC concentrations in the raw water coupled with feeding chlorine at the raw water intake for zebra mussel control could increase DBP levels. HAA levels have exceeded standards for one quarter, but not for a running quarterly average. Reducing organics through enhanced coagulation, biological filtration, or GAC can reduce DBPs. The first step would be enhancing coagulation and moving the point of chlorination downstream of clarification, making sure that disinfection requirements could be met.

EXHIBIT 5-11

Photos of Existing Finished Water Reservoirs and Hatches

0.9 MG Reservoir (foreground) 1.8 MG Reservoir(background)

Vent Structure on 0.9 MG Reservoir

5.6.3.1 Recommendations

The south reservoir should be baffled specifically for chlorine disinfection. Flow through the north reservoir should take advantage of the existing baffling to maximize chlorine contact. About 0.5 MG of baffled chlorine contact should provide adequate disinfection for 16 mgd at cold water temperatures. Although this disinfection volume will reduce the usable storage, the new pump station will improve hydraulics so more of the reservoirs can be used for storage.

The yard piping needs to be modified so that all the filtered water can flow through the south, then north reservoirs in series, bypass the south reservoir, or bypass the north reservoir. The new high service pump station should have capability to pump from either the north or south reservoir. Yard piping modifications will eliminate the current problems with inoperable valves and inability to isolate reservoirs.

In addition, the house water pipe comes into the plant in one location to serve the entire plant. This house water serves many critical functions including chlorine eductors and eyewash and safety showers. A second, redundant house water line should be installed. The current house water line broke in 2013 and there was not backup while the pipe was being fixed.

Providing adequate disinfection in the reservoirs will allow the primary chlorination point to be moved downstream of clarification. Chlorine can still be added to the intake for zebra mussel control, but only enough to control the mussels. Moving the primary chlorination point downstream of clarification will reduce DBPs because clarification removes many of the organics that form DBPs with chlorine. In the future, if GAC filtration is deemed advantageous for additional organics removal, chlorine can be moved downstream of filtration and still meet disinfection regulations, while further reducing DBPs.

A UV disinfection system could provide all the required disinfection for *Giardia* and *Cryptosporidium*. This would provide an additional treatment barrier for *Giardia*, *Cryptosporidium* and other pathogens. The reservoir volume needed for disinfection could also be greatly reduced, providing more usable storage on site. The UV disinfection system could be retrofit inside of the north reservoir to save space and fit within the existing hydraulic profile. These modifications could be done when the new high service pump station is designed. A new building above the UV reactors would be required to house electrical/control panels and provide access to the UV reactors and piping. Yard piping around the finished water reservoirs would need to be modified to accommodate the new flow scheme.

If additional disinfection, oxidation and organics removal are needed in the future, for pathogens or emerging contaminants, ozone could be combined with GAC filtration. The area where the old 1931 sedimentation basins are currently located could be used for ozone without the need to buy more land or provide additional pumping.

EXHIBIT 5-12
Issues and Recommendations for Disinfection and Storage

Issue	Recommendation
The reservoirs cannot be isolated due to yard piping.	Revise yard piping so that all the filtered water can flow through the south, then north reservoirs in series, bypass the south reservoir, or bypass the north reservoir.
No backup house water line.	Add a redundant house water line off the high service discharge piping.
Chlorine CT is difficult to measure and track with the current flow patterns. DBPs can be elevated at times.	Baffle a portion of the north and south reservoirs specifically for CT. This will allow chlorine to be moved downstream, reducing DBPs. It will also set up the plant for future GAC installation in the filters, if needed.
The existing reservoirs do not comply with all the standards for buried reservoirs.	Upgrade reservoir vents, roofs, overflows during the baffling project.

EXHIBIT 5-12
Issues and Recommendations for Disinfection and Storage

Issue	Recommendation
Reservoir usable storage is lost because of high service pump hydraulics.	Construct a new high service pump station near the reservoirs with vertical turbine pumps to eliminate the hydraulic issues.
Reservoir usable storage is lost to chlorine contact time requirements. There is no second pathogen disinfection barrier.	Set up the reservoir and high service pump station project for future installation of UV disinfection. UV disinfection can greatly reduce volume needed for CT, and provide another pathogen barrier for current and future pathogens. If needed in the future, ozone can be installed where the old sedimentation basin is located.

5.7 High Service Pumping

The high service pump station consists of five pumps with nominal capacity at 220 ft TDH as follows:

- Pump #1 = 7 MGD
- Pump #2 = 3 MGD
- Pump #3 = 5.1 MGD
- Pump #4 = 5 MGD
- Pump #5 = 5 MGD

Total pump station capacity is 25 MGD and firm capacity is 18.1 MGD. The pumps rely on a vacuum assisted priming system to prevent cavitation, especially when the water level in the finished water reservoir drops. The vacuum priming system was recently replaced and reportedly functioning well. The pumps have been re-built in the past 4 years as follows:

High Service Pump #1
New Pump and Motor: 1996
Rebuilt Pump 2/11/13

High Service Pump # 2
Original Pump from 1931 (Rebuilt 6-27-07)
New Motor Installed 4-12-95

High Service Pump # 3
Original Pump from 1931 (Rebuilt 6-26-12)
New Motor 10-28-14

High Service Pump # 4
Pump and Motor 1958
Rebuild pump and motor 5-26-11

High Service Pump # 5
Pump and Motor 1958
Rebuilt pump and motor 3/25/10

Although the pumps have been re-built, some pumps have parts that are over 80 years old. The piping and valves are also old with visible corrosion. A recent observation of one pump suction line indicated significant corrosion and tuberculation. See Mechanical and Electrical condition assessment for more details.

The suction piping for most of the pumps is below the floor of the pump station and inaccessible. The condition of this piping is unknown. Some of the piping that is exposed is corroded and in poor condition. Failure of this suction piping would be difficult, costly and time consuming to repair.

The pump station is below grade and subject to flooding from the outside or from filters 1-4 that are adjacent to the pumps. In addition, the pump suction hydraulics require the reservoirs to have at least 6 feet

of water, reducing usable storage in these reservoirs by nearly half. Loss of water service could occur if the pump station was out of service. Flooding and loss of water service occurred in Benton Harbor, Michigan in 1997 when a valve in the plant broke.

5.7.1 Shared Transmission Mains

The shared transmission mains are ductile iron and about 40 years old. Soil conditions are mostly sand with some clay. These transmission mains do not have a history of breaks. Typical useful life on ductile iron water mains is 80 to 100 years. Therefore, major replacement of these water mains is not anticipated in the next 20 years.

EXHIBIT 5-13
Photos of High Service Pumps

Pump Suction Line

Automatic Priming System

High Service Pump Station

Vertical Turbine Pumps

Horizontal Split Case Pump

Pump Can for Vertical Turbine Pump

EXHIBIT 5-13
Photos of High Service Pumps

5.7.2 Recommendations

This pump station building and equipment is over 80 years old and in poor condition. Some pumps and motors have been replaced and rebuilt recently and maintenance is ongoing. The suction piping conditions are poor (priming required and piping corrosion observed). The pump station is also below grade and subject to flooding.

Replacement of the pump station with a new pump station near the reservoirs is recommended.

EXHIBIT 5-14
Issues and Recommendations for Finished Water Pumping

Issue	Recommendation
High Service Pumps rely on priming system to prevent cavitation. Pump station is old and showing wear. Pump station is subject to flooding. Pump station hydraulics require at least 6 feet of water in reservoirs, reducing usable storage.	Construct new above grade high service pump station to eliminate these vulnerabilities and increase reliable pumping/storage capacity.

5.8 Chemical Storage and Feed Systems

5.8.1 Alum

Alum is stored in two 8,000 gallon, FRP bulk storage tanks. Transfer pumps deliver alum upstairs to rotodip feeders, which serve both as a day tanks and feed rate controllers. Exhibit 5-15 provides photos of the existing alum system components.

EXHIBIT 5-15
Photos of Existing Alum System

Rotodip Feeders

Bulk Storage Tanks

Primary Alum Feed Point Into Rapid Mixer

Secondary Alum Feed Point Into 30-Inch Raw Water Main

The alum dose is set based on raw water turbidity, temperature, UVT, and flow rate. The average dose of alum is about 17 mg/L, the maximum is about 25 mg/L. The bulk storage tanks are sufficiently sized to provide more than 120 days of storage at average flow and dose. The rotodip feeders have a 30 gph capacity, which is greater than required.

The alum storage tanks are over 40 years old and beyond their predicted useful life. The alum storage area does not have containment and several critical pumps are nearby. The rotodip feeders are obsolete and spare parts are not available.

5.8.1.1 Recommendations

A new alum system is recommended to meet current chemical system standards, improve accuracy, and reduce O&M requirements. New bulk tanks, transfer pumps, day tanks, metering pumps, and flow meters are recommended. A containment curb should be installed around the bulk storage tanks and transfer pumps. The alum day tanks and metering pumps could be placed where the existing fluoride storage system is currently located. Fluoride is recommended to be moved as well (see below). In addition, a flow meter should be added to the raw water line to ensure accuracy of the alum feed. Exhibit 5-16 summarizes issues with the existing alum system.

EXHIBIT 5-16
Issues and Recommendations for the Existing Alum System

Issue	Recommendation
Bulk storage tanks are approaching the end of their useful life.	Replace with 2 – 7,000 gal, FRP bulk storage tanks. Install new ultrasonic level indication.
Bulk storage area does not have any secondary containment for spills	Install containment curb around tank and coat with epoxy liner.
Alum transfer pumps are approaching the end of their useful life.	Replace with 2 – 10 gpm centrifugal or hose pumps.
Rotodip feeders are old and inaccurate.	Replace with 3 – 20 gph metering or hose pumps. Install 2 – 150 gallon day tanks on weigh scales.

5.8.2 Fluoride

Fluoride is added to drinking water, in accordance with scientific and dental guidelines, to promote public health by preventing tooth decay. An 18 percent solution of hydrofluosilicic acid (fluoride) is stored in two bulk storage tanks and metered into the treatment process by a feed pump and associated piping. The fluoride dose is set at 1.0 mg/L to meet regulations.

EXHIBIT 5-17
Photos of Existing Fluoride System

Bulk Storage Tanks and Transfer Pumps

Day Tank and Metering Pumps

5.8.2.1 Recommendations

The existing bulk storage tanks and transfer pumps are relatively new and in good condition, but do not meet building code requirements (see Architectural condition assessment). The fluoride feed system is old and has minimal containment. This system also does not meet current codes.

A new fluoride storage and feed system is recommended. A new fluoride bulk tank storage area outside the main plant entrance could be constructed. The existing tanks and pumps can be moved to that area. If chlorine gas is replaced with sodium hypochlorite, the chlorine storage room could be converted into a fluoride feed room. If chlorine gas remains, a new fluoride storage and feed facility could be constructed with the new high service pump station.

When alum and fluoride feed areas are removed from the upstairs, those rooms can be remodeled for office, conference or training purposes.

Exhibit 5-18 summarizes issues with the existing fluoride system.

EXHIBIT 5-18
Issues and Recommendations for the Existing Fluoride System

Issue	Recommendation
The day tank the metering pumps are in poor condition and the room does meet code.	Replace with new facilities in a new code compliant room.
The storage tanks and transfer pump area does not meet current building codes.	Move equipment to a new code compliant room.
Fluoride is fed at the 30-inch raw water line.	A post-filtration injection point should be utilized to reduce loss of fluoride residual through treatment process. Utilize an online fluoride analyzer to continuously monitor fluoride residual and prevent overfeeding.

5.8.3 Chlorine

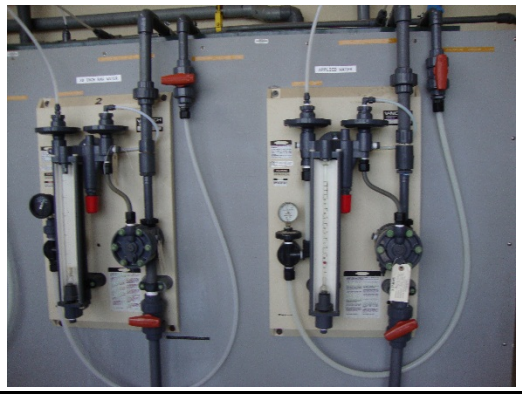
Chlorine may be added to several points in the plant including the intake, 30-inch raw water line, or post-filtration. Disinfection credit for 0.5- log Giardia and 2.0-log virus inactivation is achieved from the summation of chlorine contact time across several plant processes. A small amount of free chlorine is fed at the raw water intake for zebra mussel control.

Gas chlorine is stored in 1-ton cylinders in a secured room. The gas storage room is in adequate condition, but does not meet building code requirements (see Architectural Condition Assessment). The City maintains a Risk Management Plan (RMP) for gas chlorine, but no chlorine gas scrubber is installed. Chlorine gas is fed under vacuum into water using Wallace and Tiernen V-notch chlorinators. The typical dose to achieve the desired free chlorine residual is 3.5 mg/L. This equates to about 30 days of active chlorine storage at average day water demand. Additional storage is provided with standby gas cylinders. Regulated disinfection by-products are typically not an issue since organic levels are relatively low. At times, the St. Joseph River influences the raw water intake. This can increase the chlorine demand and generate higher levels of DBPs.

EXHIBIT 5-19
Photos of Existing Chlorine System

Gas chlorine 1-ton cylinders

V-notch chlorinators



5.8.3.1 Recommendations

The existing 1-ton gas chlorine cylinders are located at ground level adjacent to a public beach. Due to the potential for public exposure in the event of a major release of chlorine, a chlorine gas scrubber should be installed if chlorine gas is maintained.

Alternatively, a sodium hypochlorite (bleach or liquid chlorine) system should be installed to reduce the public health risk. Design criteria for a sodium hypochlorite system are shown below. The storage tanks

could be located near the plant entrance by the fluoride tanks, and the day tanks and feed pumps in the chlorine storage room. Separate rooms would be required for hypochlorite and fluoride storage and feed.

The old chlorine gas feed room upstairs can be remodeled into office, conference or training room space.

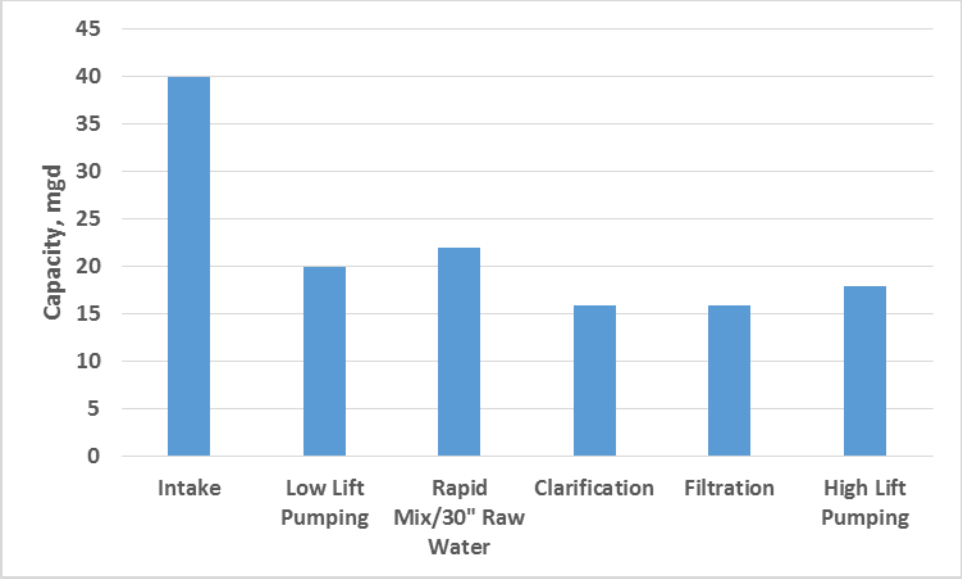
EXHIBIT 5-20
Issues and Recommendations for the Existing Fluoride System

Issue	Recommendation
1-ton chlorine gas cylinders pose a health and safety risk for operators and public.	Install a new sodium hypochlorite system.

5.9 Plant Capacity

An evaluation of existing plant capacity was conducted. Capacity of individual processes are shown in Exhibit 5-21. All treatment processes can meet the 16 mgd capacity, with clarification and filtration right at the 16 mgd capacity. There are some hydraulic issues getting water to clarifier No. 1 and Filters 1-4. Improvements to the plant piping and flow splitting are required to improve the situation.

EXHIBIT 5-21
Water Treatment Process Capacity



Based on the water demand projections, adding capacity to the water plant is not a high priority. However, maintaining reliable capacity at 16 mgd is important. Based on the condition assessments and process evaluation, obtaining 16 mgd capacity from the 1974 and 1958 portions of the plant and retiring most of the 1931 portion of the plant is proposed.

The following overall plan is proposed for the water plant:

Phase 1

- Uprate filters 5-12 so they are approved for 16 mgd.
- Build a new high service pump station near the reservoirs
- Build a new sodium hypochlorite and fluoride storage facility near the plant entry way (reuse fluoride tanks).
- Renovate the gas chlorine storage room to a sodium hypochlorite/fluoride feed room.
- Replace alum storage tanks and build a containment curb.

- Place new alum day tanks and feed pumps where the fluoride storage is now.

Phase 2

- Revise Clarifiers 2 and 3 to flocculation basins with plate settlers that can treat 8 to 10 mgd each.

Phase 3

- Renovate chemical rooms upstairs (chlorine, fluoride, alum) for other uses (office space, instrument repair or storage).
- Retire the old high service pump station in the 1931 Building.
- Retire the old sedimentation basin that was part of the 1931 water plant.
- Retire Clarifier 1 and filters 1-4 when the upgraded filters 5-12 and clarifiers 2 and 3 are successfully completed.
- Demolish the east part of the 1931 building
- Renovate the west part of the 1931 building for office, storage, equipment repair and access

Exhibit 5-22 shows a site plan with the existing facilities and proposed improvements.

This overall plan for the water plant facilities provides the following benefits:

- The newest portions of the plant are upgraded and their useful life is extended.
- The oldest portions of the plant are retired, saving the cost of upgrading and maintaining them.
- Valuable space at the plant site is created for future use.
- The new facilities will be more reliable and better able to meet current and future drinking water regulations and goals.

EXHIBIT 5-22

Site Plan of Existing Water Plant and Proposed Improvements

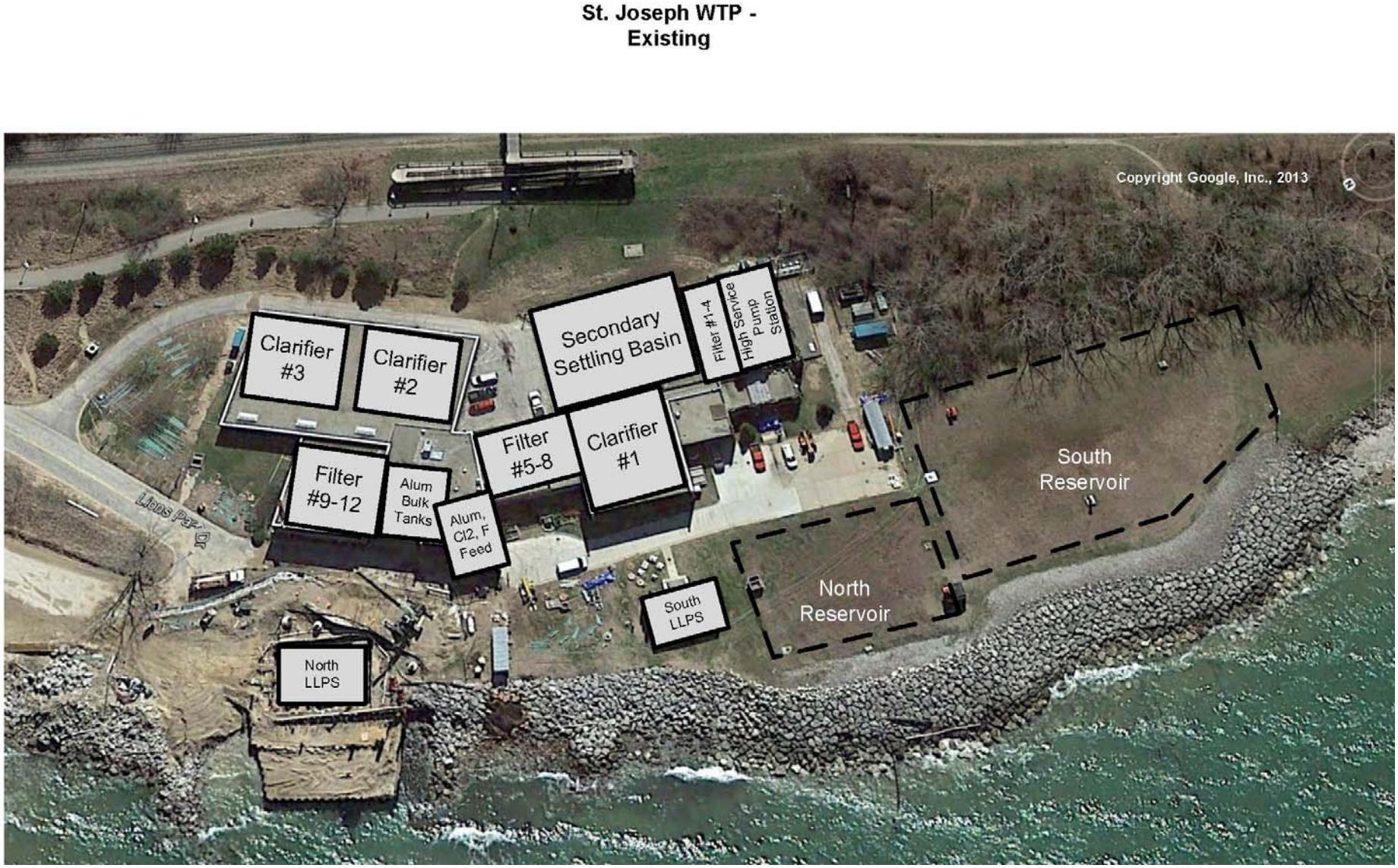
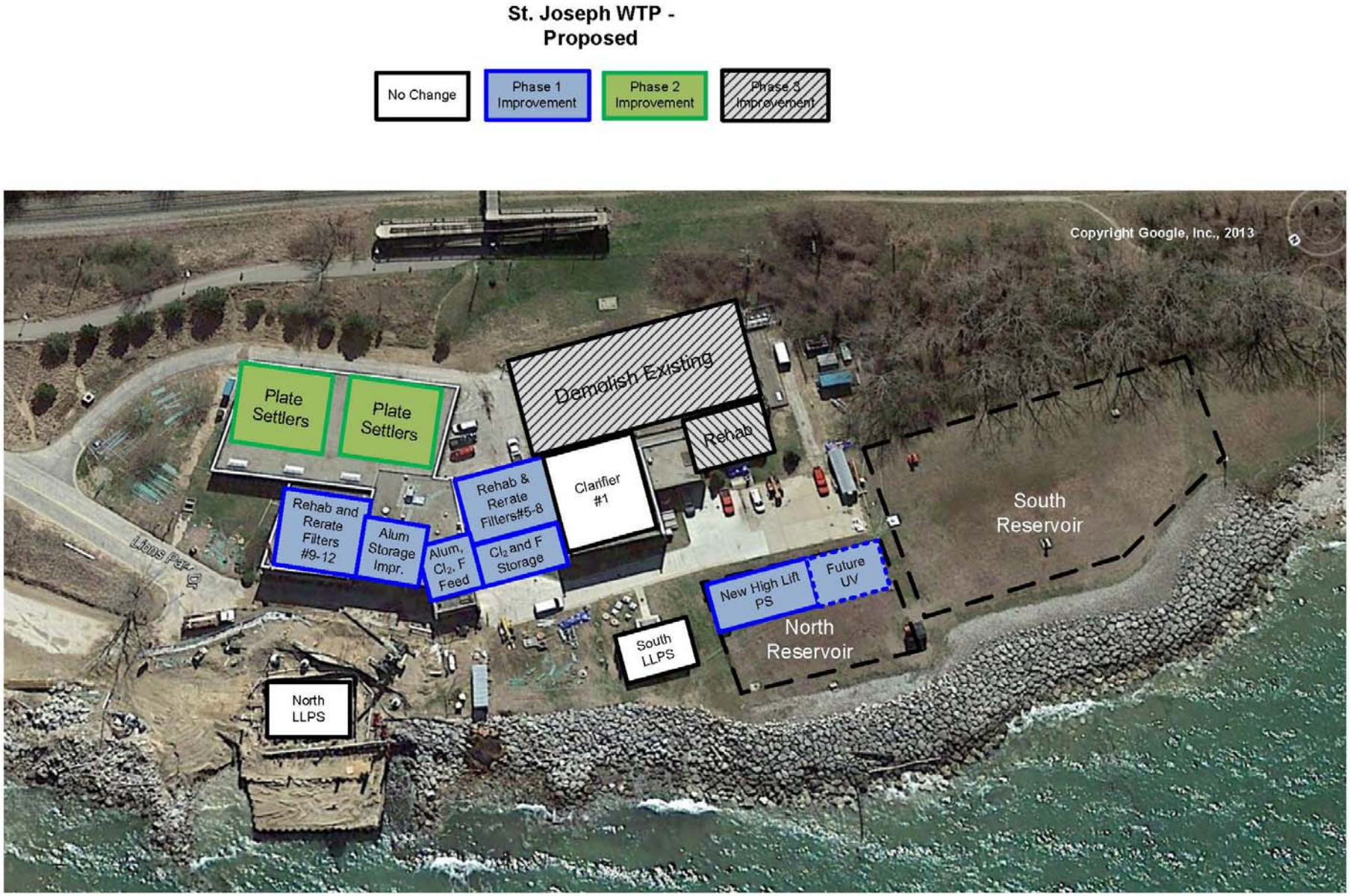


EXHIBIT 5-22

Site Plan of Existing Water Plant and Proposed Improvements



SECTION 6

Prioritize Projects

6.1 Project List

Based on the condition assessments and process study, the projects in Exhibit 6-1 are recommended.

EXHIBIT 6-1
List of Recommended Projects

Project Number	Project Name	Description
1	**New High Service Pump Station**	Construct new high service pump station near existing reservoirs. Add new backwash pump and PRV from high service discharge line as a backup filter backwash source.
2	**Raw Water Line Improvements**	Install flow meter on filter backwash recycle line and 30-inch raw water line. Extend backwash recycle line to north low lift pump station wet well. Limit filter backwash recycle rate to less than 10 percent of raw water flow with use of VFDs on backwash recycle pumps.
3	**Clarification Improvements**	Retrofit Clarifier #2 and #3 into conventional flocculation and inclined plate settler basins with 8 mgd rated capacity each. Include new sludge removal mechanisms and flocculators in each basin. Automate flow split control between clarifiers.
4	**Filter #5-#12 Improvements**	Perform filtration study to uprate filters to 16 mgd in filters #5-12. Replace filter #5-#8 control consoles. Increase size of 18” filter effluent pipe to 24”, connect to 30”.
5	**Reservoir Improvements**	Membrane cover and concrete repairs in reservoirs. Baffle reservoirs for better CT disinfection and water quality. Associated yard piping improvements to get water from filters to reservoirs with flexibility to go to either reservoir in series or parallel. Crack repair.
6	**Alum Storage and Feed Improvements**	Replace alum bulk storage tanks and transfer pumps. Build containment around storage tank area. Add new alum day tanks and metering pumps where fluoride storage presently exists. Remove alum feed equipment in upper room and rehabilitate room for office or storage.
7	**Fluoride Storage and Feed Improvements**	Build new fluoride storage tank enclosure near the gas chlorine storage room. Modify a portion of the chlorine gas storage room for fluoride day tanks and feed pumps. OR….build a new fluoride storage and feed facility with the HSPS. In either case, Re-use storage tanks and transfer pumps.
8	**Gas Chlorine Storage and Feed System Improvements**	Install chlorine gas scrubber and other improvements to provide a safer gas chlorine facility. Provide flexibility to feed chlorine after clarification and post filtration. This project will only be done if a new sodium hypochlorite facility is not constructed.
9	**Sodium Hypochlorite**	Install new sodium hypochlorite storage tanks in a new enclosure near the chlorine gas storage room. Modify a portion of the chlorine gas storage room for sodium hypochlorite day tanks and feed pumps.
10	**UV Disinfection**	Add a new UV disinfection facility for a Cryptosporidium barrier. This facility could be integrated with the north reservoir and new high service pump station.
11	**HVAC Upgrades**	Replace HVAC system in control room and office area. Install dehumidification units in pipe galleries.
12	**South Low Lift Pump Station**	Replace MCC and switch gear, replace pump packing, replace traveling screen,

EXHIBIT 6-1
List of Recommended Projects

Project Number	Project Name	Description
	Improvements	replace isolation gate.
13	**SCADA Upgrades**	Update SCADA system and provide documentation for operations.
14	**Electrical MCC P7 replacement**	Replace MCC P7 with new equipment
15	**New Polymer storage and feed system.**	Provide an additional coagulant aid polymer system to improve turbidity.
16	**Replace gravel surfaced built up roofing on water plant in 10 years.**	Replace at end of useful life.
17	**New utility duct bank from service pole to primary switchgear.**	Improve safety and reliability.
18	**Renovate West portion of 1931 building and demo East section (after new pump station and filter upgrades done).**	Demolish east section of 1931 water plant building and sedimentation basin. Renovate west section of 1931 building. Build new wall on east end of west section.
19	**Door, Window, Skylight, handrail replacements. Concrete crack, wall and floor repair**	Replace broken or inefficient windows and doors in the water plant. Add handrails for code compliance. Repair major concrete cracks.
20	**Cleveland Ave Booster Station roof replacement in 13 years.**	Replace at end of useful life.
21	**Cleveland Ave Booster Station repaint piping.**	Repaint as part of normal maintenance.
22	**Water Plant Lab Improvements**	Upgrade HVAC, plumbing, countertops and cabinetry, and instruments to maintain process control capability and regulatory compliance.
23	**Hilltop Rd. Booster Station roof replacement in 13 years.**	Replace at end of useful life.
24	**Hilltop Rd. Booster Station repaint piping.**	Repaint as part of normal maintenance.
25	**Repaint three elevated tanks within 20 years**	Normal maintenance on elevated tanks.
26	**Shoreline Protection**	Stabilize shoreline from storms

6.2 Prioritization Methodology

To prioritize the recommended projects and studies, a decision-analysis methodology that is based on industry guidance and best practices (American Water Works Association Research Foundation 2001) was used. The process is described as follows:

1. Identify and weight benefit criteria that will be used to evaluate candidate projects.
2. Develop an objective scoring system that can be used to measure the contribution of projects toward meeting the defined goals
3. Score the projects based on their ability to meet goals.

4. Consider costs and benefits to develop a prioritized list of projects and implementation plan
5. Document the capital improvement project decision process in a manner that can be readily reviewed and understood by both internal and external stakeholders

In accordance with the ISO 55000 asset management guide, the SCIP team chose five criteria by which each project were to be evaluated. The following guidelines were followed in selecting the criteria:

- **Cost not included.** Criteria should not include cost; cost of the projects and studies will be considered after the total benefit of each project and study is determined.
- **Comprehensive.** Criteria should cover key goals for improvement.
- **Linked to values.** Criteria should be linked to the utility's values and articulate what is important for the utility to accomplish.
- **Non-redundant.** Criteria should not address overlapping aspects of utility performance. Redundant criteria will result in "double-counting" for that particular aspect in the scoring process.
- **Independent.** Accomplishing one criterion should not be dictated by any other criterion.

The criteria selected by the SCIP team are:

1. Water Quality
2. Risk reduction of assets
3. Water Quantity
4. Residents and business impacts
5. Health and safety

For each selected criterion, four "levels" of performance were defined, and a numeric value assigned to each (Exhibit 6-2). These numeric values and the definitions for each criterion form the basis for "scoring" the projects. Using this common scoring system provides a basis for comparing and making trade-offs between competing objectives.

Realizing that each benefit criterion may not be equally important to the goals of the utility, the SCIP team ranked the five criteria and assigned relative weightings. The result of this weighting exercise is shown in Exhibit 6-3. Each project was scored against each benefit criterion using the matrix show in Exhibit 6-2 and weighted as shown in Exhibit 6-3.

EXHIBIT 6-2
Evaluation Criteria Levels of Performance

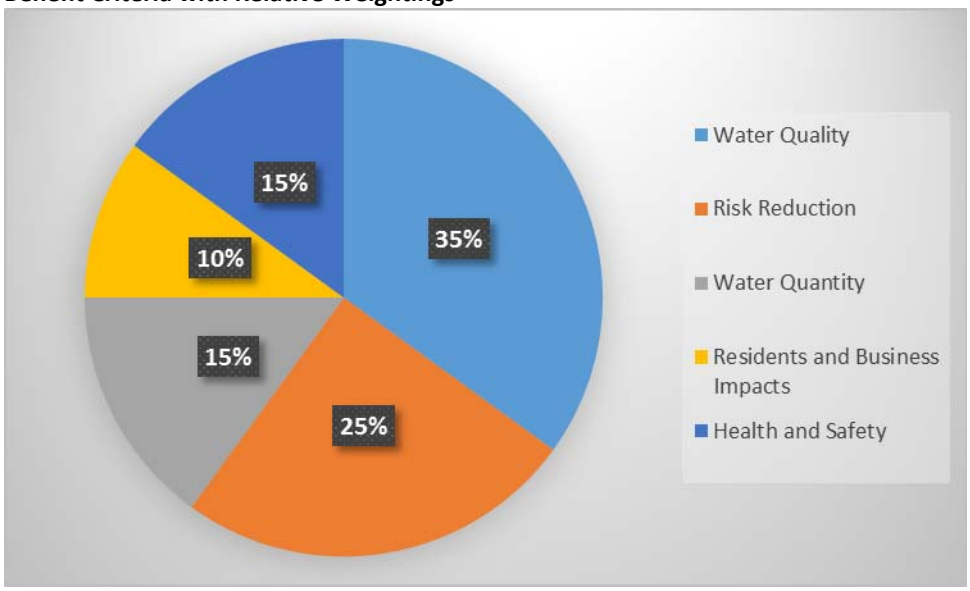
Criteria	Scoring Values				Weight
	Poor = 1	Fair = 4	Good = 7	Excellent = 10	
Water Quality • Turbidity: ≤ 0.1 NTU Filtered; <2 NTU settled • 1.5 mg/L chlorine residual at entry point of distribution system in the summer ; >1.0 total chlorine residual throughout the distribution system • Disinfection CT ratio: 2 or more • DBPs: Less than half the MCL	Project does not improve water quality	Project slightly improves ability to meet one or more water quality goals.	Project needed to meet one water quality goal. Not needed to meet a drinking water regulation.	Project needed to meet more than one water quality goals, or needed to meet a drinking water regulation.	35%
Risk Reduction Reduce the risk of asset failure and inability to meet water service goals.	Project reduces risk score from 19 or less to an acceptable level.	Project reduces risk score from 20 to 29 to an acceptable level.	Project reduces risk score from 30 to 39 to an acceptable level.	Project reduces risk score from 40 or more to an acceptable level.	25%
Water Quantity 16 mgd maximum summer production capacity, Pressure within 5 psi of normal static pressure at meter, very minor service interruptions.	Project does not improve water quantity	Project slightly improves ability to meet one or more water quantity goals.	Project needed to meet one or more water quantity goals	Project need to avoid any of the following • <13 mgd maximum summer production capacity • Static pressure less than 20 psi in a significant part of the system • Long term or extensive service interruption. Impact on fire protection • Loss of service to any “critical customer” (eg. hospital)	15%

EXHIBIT 6-2
Evaluation Criteria Levels of Performance

Criteria	Scoring Values				Weight
	Poor = 1	Fair = 4	Good = 7	Excellent = 10	
Residents & Business Impact (Public Image) • No social or economic impact on the community • No reactive media coverage (any media coverage is a result of proactive announcements by Utility) • <5 complaints per incident	Project does not improve service to Residents or Businesses.	Project slightly improves service to Residents and Businesses.	Project needed to meet one of the goals.	Project needed to avoid any of the following: • Substantial and long-term collateral impact. • Widespread adverse media coverage • Public outcry of dissatisfaction with utility • Negative public comments by elected officials • 20 complaints per incident	10%
Health & Safety (Public & Employees) • No injuries • no unusual hazards • No security issues	Project does not improve Health and Safety	Project slightly improves health and safety.	Project significantly improves health and safety in one area (electrical hazards, chemicals, security, building code)	Project significantly improves health and safety in two or more areas (electrical hazards, chemicals, security, building code)	15%

EXHIBIT 6-3

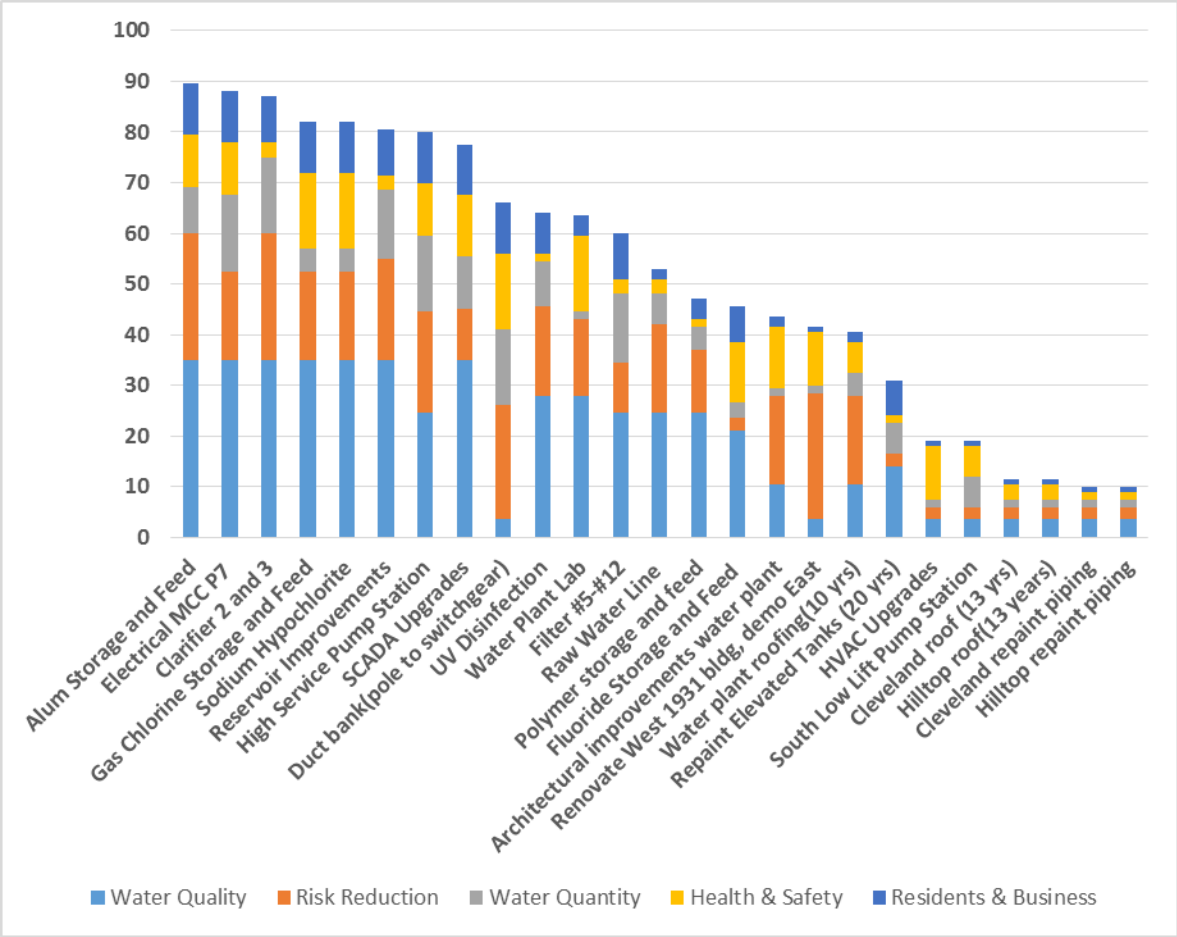
Benefit Criteria with Relative Weightings



6.3 Prioritized Projects

Projects were identified through the condition assessment and process evaluation tasks. Through this process, 25 projects were identified. Projects were prioritized by benefit score so that projects with the highest benefit score received the greatest priority. The total benefit of each project is shown in Exhibit 6-4. Each bar represents a project, with its height equaling its total benefit. The colors within each bar represent the extent to which the project contributes to achieving each benefit criterion.

EXHIBIT 6-4
Total Benefit Scores of Projects



6.4 Cost Estimates

Conceptual level construction cost estimates (Association for the Advancement of Cost Engineering [AACE] Class 5; +100/-50 percent) in 2014 dollars were developed for each project. Cost estimates were prepared on the basis of information available at the time of the estimate to guide in comparing alternatives. Detailed engineering design has not been done. The final cost estimate of any project will depend on market conditions, site conditions, final project scope, schedule and other variable factors. As a result, final project costs will vary from the estimates presented here. Total costs include contractor mobilization, insurance, bonds, and other overhead costs.

Total construction costs include 20% for contractor markups and 30% contingency.

Exhibit 6-5 summarizes the estimated project construction costs.

EXHIBIT 6-5

Estimated Project Construction Costs

Project Number	Project Name	Description	Estimated Cost
1	New High Service Pump Station	Construct new high service pump station near existing reservoirs. Add new backwash pump and PRV from high service discharge line as a backup filter backwash source.	$4,300,000
2	Raw Water Line Improvements	Install flow meter on filter backwash recycle line and 30-inch raw water line. Extend backwash recycle line to north low lift pump station wet well. Limit filter backwash recycle rate to less than 10 percent of raw water flow with use of VFDs on backwash recycle pumps.	$200,000
3	Clarification Improvements	Retrofit Clarifier #2 and #3 into conventional flocculation and inclined plate settler basins with 8 mgd rated capacity each. Include new sludge removal mechanisms and flocculators in each basin. Automate flow split control between clarifiers.	$4,400,000
4	Filter #5-#12 Improvements	Perform filtration study to uprate filters to 16 mgd in filters #5-12. Replace filter #5-#8 control consoles. Increase size of 18” filter effluent pipe to 24”, connect to 30”. Assumes media replacement and surface wash modifications.	$900,000
5	Reservoir Improvements	Membrane cover and concrete repairs in reservoirs. Baffle reservoirs for better CT disinfection and water quality. Associated yard piping improvements to get water from filters to reservoirs with flexibility to go to either reservoir in series or parallel. Crack repair.	$1,800,000
6	Alum Storage and Feed Improvements	Replace alum bulk storage tanks and transfer pumps. Build containment around storage tank area. Add new alum day tanks and metering pumps where fluoride storage presently exists. Remove alum feed equipment in upper room and rehabilitate room for office or storage.	$400,000
7	Fluoride Storage and Feed Improvements	Build new fluoride storage tank enclosure near the gas chlorine storage room. Modify a portion of the chlorine gas storage room for fluoride day tanks and feed pumps. OR….build a new fluoride storage and feed facility with the HSPS. In either case, Re-use storage tanks and transfer pumps.	$300,000
8	Gas Chlorine Storage and Feed System Improvements	Install chlorine gas scrubber and other improvements to provide a safer gas chlorine facility. Provide flexibility to feed chlorine after clarification and post filtration. This project will only be done if a new sodium hypochlorite facility is not constructed.	$500,000
9	Sodium Hypochlorite	Install new sodium hypochlorite storage tanks in a new enclosure near the chlorine gas storage room. Modify a portion of the chlorine gas storage room for sodium hypochlorite day tanks and feed pumps.	$800,000
10	UV Disinfection	Add a new UV disinfection facility for a Cryptosporidium barrier. This facility could be integrated with the north reservoir and new high service pump station.	$3,000,000
11	HVAC Upgrades	Replace HVAC system in control room and office area. Install dehumidification units in pipe galleries.	$300,000
12	South Low Lift Pump Station Improvements	Replace MCC and switch gear, replace pump packing, replace traveling screen, replace isolation gate.	$500,000
13	SCADA Upgrades	Update SCADA system and provide documentation for operations.	$80,000
14	Electrical MCC P7 replacement	Replace MCC P7 with new equipment	$400,000

EXHIBIT 6-5
Estimated Project Construction Costs

Project Number	Project Name	Description	Estimated Cost
15	New Polymer storage and feed system.	Provide an additional coagulant aid polymer system to improve turbidity.	$120,000
16	Replace gravel surfaced built up roofing on water plant in 10 years.	Replace at end of useful life.	$440,000
17	New utility duct bank from service pole to primary switchgear.	Improve safety and reliability.	$200,000
18	Renovate West portion of 1931 building and demo East section (after new pump station and filter upgrades done).	Demolish east section and secondary clarifier. Renovate west section and build new wall.	$900,000
19	Door, Window, Skylight, handrail replacements. Concrete crack, wall and floor repair	Replace broken or inefficient windows and doors in the water plant. Add handrails for code compliance. Repair major concrete cracks. Painting.	$530,000
20	Cleveland Ave Booster Station roof replacement in 13 years.	Replace at end of useful life.	$35,000
21	Cleveland Ave Booster Station repaint piping.	Remove insulation and Repaint piping.	$10,000
22	Water Plant Lab Improvements	Upgrade HVAC, plumbing, countertops and cabinetry, electrical and instruments to maintain process control capability and regulatory compliance.	$400.000
23	Hilltop Rd. Booster Station roof replacement in 13 years.	Replace at end of useful life.	$35,000
24	Hilltop Rd. Booster Station repaint piping.	Remove insulation and Repaint piping.	$10,000
25	Repaint elevated tanks within 20 years	Repaint as normal maintenance	$1,500,000
26	Shoreline Protection	Stabilize shoreline from storms	$250,000

SECTION 7

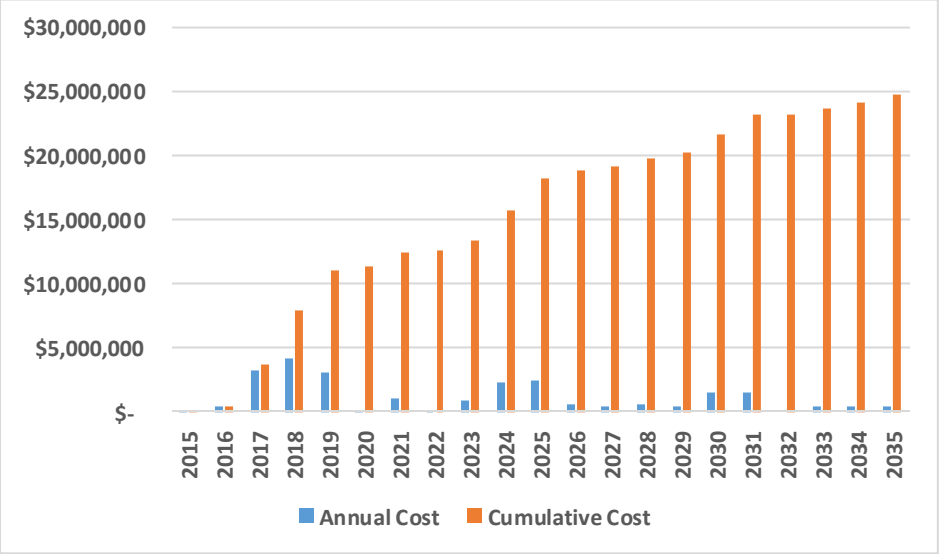
Implementation Plan

7.1 General Intent

The general intent of the implementation plan is to execute projects with higher benefit scores sooner, when possible. Exhibit 7-1 shows the annual and cumulative construction costs of the prioritized projects over the next 20 years.

EXHIBIT 7-1

Cumulative Construction Cost of Prioritized Projects



7.2 Implementation

Although the general intent is to execute projects with higher benefits sooner, projects need to be constructed in a logical manner, taking into consideration constructability and plant operational requirements. In addition, projects with high capital costs, such as new clarification basins, need to be implemented so as to minimize rate impacts. Some projects may get shifted in the schedule to avoid too many expenditures in any given year. Conditions and priorities may change over time and adjustments can be made. This implementation plan should be reviewed yearly and new developments incorporated.

A three phase plan was presented in section 4.9 to construct improvements in a logical manner, considering operation of the existing plant, constructability, benefits and costs. This plan was used as a roadmap to develop the more detailed implementation plan shown in Exhibit 7-2. Project costs include 15% for engineering.

EXHIBIT 7-2

SCIP Implementation Plan

Saint Joseph, Michigan

Legend:

Study	
Design	
Construction	

Project	Benefit Score	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034	2035	Total Project Cost ($M)	Cumulative Cost ($M)
Alum Storage and Feed	89.5			$ 60,000	$ 400,000																			$ 460,000	$ 460,000
Electrical MCC P7	88.0			$ 60,000	$ 400,000																			$ 460,000	$ 920,000
Clarifier 2 and 3	87.0										$ 660,000	$ 2,200,000	$ 2,200,000											$5,060,000	$ 5,980,000
Gas Chlorine Storage and Feed	82.0																								$ 5,980,000
Sodium Hypochlorite	82.0			$ 120,000	$ 400,000	$ 400,000																		$ 920,000	$ 6,900,000
Reservoir Improvements	80.5				$ 270,000	$ 900,000	$ 900,000																	$2,070,000	$ 8,970,000
High Service Pump Station	80.0				$ 645,000	$2,150,000	$ 2,150,000																	$4,945,000	$13,915,000
SCADA Upgrades	77.5					$ 12,000	$ 80,000																	$ 92,000	$14,007,000
Duct bank(pole to switchgear)	66.0				$ 30,000	$ 200,000																		$ 230,000	$14,237,000
UV Disinfection	64.0																$ 450,000	$ 1,500,000	$ 1,500,000					$3,450,000	$17,687,000
Water Plant Lab	63.5							$ 60,000	$ 400,000															$ 460,000	$18,147,000
Filter #5-#12	60.0		$30,000	$ 105,000	$ 450,000	$ 450,000																		$1,035,000	$19,182,000
Raw Water Line	53.0			$ 30,000	$ 200,000																			$ 230,000	$19,412,000
Polymer storage and feed	47.0										$ 18,000	$ 120,000												$ 138,000	$19,550,000
Fluoride Storage and Feed	45.5			$ 45,000	$ 150,000	$ 150,000																		$ 345,000	$19,895,000
Architectural improvements water plant	43.5							$ 79,500	$ 176,667	$ 176,667	$ 176,667													$ 609,500	$20,504,500
Renovate West 1931 bldg, demo East	41.5													$ 135,000	$ 450,000	$ 450,000								$1,035,000	$21,539,500
Water plant roofing(10 yrs)	40.5												$ 220,000	$ 220,000										$ 440,000	$21,979,500
Repaint Elevated Tanks (20 yrs)	31.0																				$ 500,000	$ 500,000	$ 500,000	$1,500,000	$23,479,500
HVAC Upgrades	19.0			$ 45,000	$ 300,000																			$ 345,000	$23,824,500
South Low Lift Pump Station	19.0							$ 75,000	$ 500,000															$ 575,000	$24,399,500
Cleveland roof (13 yrs)	11.5															$ 35,000								$ 35,000	$24,434,500
Hilltop roof(13 years)	11.5															$ 35,000								$ 35,000	$24,469,500
Cleveland repaint piping	10.0															$ 10,000								$ 10,000	$24,479,500
Hilltop repaint piping	10.0															$ 10,000								$ 10,000	$24,489,500
Shoreline Protection	Not Rated													$ 250,000											
Total Cost by Year			$30,000	$ 465,000	$3,245,000	$4,262,000	$ 3,130,000	$ 214,500	$ 1,076,667	$ 176,667	$ 854,667	$ 2,320,000	$ 2,420,000	$ 605,000	$450,000	$540,000	$ 450,000	$ 1,500,000	$1,500,000	$ -	$500,000	$500,000	$500,000		
Cumulative Cost			$30,000	$ 495,000	$3,740,000	$8,002,000	$11,132,000	$11,346,500	$12,423,167	$ 12,599,833	$ 13,454,500	$ 15,774,500	$18,194,500	$18,799,500	$19,249,500	$19,789,500	$20,239,500	$21,739,500	$23,239,500	$23,239,500	$23,739,500	$24,239,500	$24,739,500		
			2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034	2035		

Safe drinking water is essential for public health and economic prosperity. Water supply and treatment infrastructure is expensive to build. If the St. Joseph water plant were replaced today with a new water plant, the capital cost could be around $50 million. Spending about $25 million over the next 20 years to maintain and improve this important asset provides good value to water customers.

This implementation plan should be re-visited each year and adjusted based on work completed, current issues and financial position.

Appendix A
Asset Hierarchy

City of St. Joseph
Risk Analysis
Water Utility System

Risk Analysis WTR-ave
11/3/2014

Risk Event			CONSEQUENCE						LIKELIHOOD					OVERALL		
Asset Hierarchy Level 3	Asset Hierarcy Level 4		Water Quality	Water Quantity	Residents & Business Impact (Public Image)	Health & Safety (Public & Employees)	Consequence Score	Consequence Rank	Physical Condition	Performance (Operability/ Functionality)	Maintainability	Likelihood Score	Likelihood Rank	**RISK SCORE**	**RISK RANK**	Comments
		Weight	0.40	0.35	0.10	0.15			0.50	0.30	0.20					
Water System Supply Intakes	North Intake		7	10	7	10	8.500	6	1	3	7	2.800	31	**24**	18	More vulnerable to WQ issues, only produce 9-10 mgd with N Intake out
Water System Supply Intakes	South Intake		1	1	1	10	2.350	35	3	7	7	5.000	13	**12**	32	0
Lake Pump Stations	North Low Service Pump Station		7	10	7	10	8.500	6	1	1	3	1.400	40	**12**	31	0
Lake Pump Stations	South Low Service Pump Station		1	1	1	10	2.350	35	5	7	7	6.000	3	**14**	27	Switchgear and traveling screens in bad shape
Lake Pump Stations	Pump Stations Standby Power		1	10	10	10	6.400	15	1	1	7	2.200	35	**14**	28	Oversized
Lake Pump Stations	Pump Stations Shore Protection		7	10	7	10	8.500	6	1	3	3	2.000	38	**17**	21	Failure will result in failure of the NLSPS, new rock
Rapid Mix	Rapid Mixer # 1		1	1	1	4	1.450	41	1	1	3	1.400	40	**2**	42	Redundant system (Rapid Mix #1 & #2)
Rapid Mix	Rapid Mixer # 2		1	1	1	4	1.450	41	1	1	3	1.400	40	**2**	42	Redundant system (Rapid Mix #1 & #2)
Sedimentation/Flocculation	Clarifier # 1 (1958 Section)		10	10	7	7	9.250	4	5	3	5	4.400	18	**41**	5	0
Sedimentation/Flocculation	Clarifier # 2 (1974 Section)		7	7	7	7	7.000	13	7	5	5	6.000	3	**42**	3	Metal corrosion, vulnerable to upset
Sedimentation/Flocculation	Clarifier # 3 (1974 Section)		7	7	7	7	7.000	13	7	5	5	6.000	3	**42**	3	Metal corrosion, vulnerable to upset
Sedimentation/Flocculation	Settling Basin (1931 Section)		4	1	1	4	2.650	33	7	3	5	5.400	10	**14**	24	Received water from Clarifier #1
Filtration	Filters 1 - 4 (1931 Section)		4	10	7	1	5.950	20	7	3	3	5.000	13	**30**	13	Controls in poor condition, Old media and under drains
Filtration	Filters 5 - 8 (1958 Section)		1	10	7	1	4.750	24	5	5	3	4.600	16	**22**	19	0
Filtration	Filters 9-12 (1974 Section)		7	10	7	1	7.150	12	1	3	3	2.000	38	**14**	25	New under drains and controls (2012)
Filtration	Backwash System		10	10	10	4	9.100	5	5	1	7	4.200	20	**38**	6	Old pumps, 4-6 weeks for rebuild (redundancy in system)
Filtration	Backwash Reclaim Basin		1	1	4	4	1.750	40	3	1	3	2.400	33	**4**	39	Permit for overflow to lake
Chemical Systems	Chlorination System		10	10	10	7	9.550	1	5	3	3	4.000	22	**38**	7	0
Chemical Systems	Alum Feed System		10	10	10	7	9.550	1	7	7	7	7.000	1	**67**	1	0
Chemical Systems	Fluoride Feed System		1	1	4	7	2.200	37	3	3	3	3.000	30	**7**	38	New tanks and pumps
High Service Pumping	High Service Pumps		1	10	10	10	6.400	15	6	3	7	5.300	12	**34**	10	Pump have been rebuilt in the last 5 years (4 of 5 pumps)
Finished Water Reservoirs	North Reservoirs (0.90 MGD 1931)		4	1	4	4	2.950	31	5	7	5	5.600	7	**17**	22	Isolation valves do not work
Finished Water Reservoirs	South Reservoir (1.84 MGD 1958)		7	4	4	4	5.200	22	5	7	5	5.600	7	**29**	15	Isolation valves do not work
Finished Water Reservoirs	Clear Well (1931 Structure, Filters 1-4)		4	1	4	4	2.950	31	5	7	5	5.600	7	**17**	22	Valve issues
Finished Water Reservoirs	Reservoir Overflow / De-Chlorination System		1	1	1	7	1.900	38	5	5	3	4.600	16	**9**	36	0
Solids Handling	Sludge Disposal		10	10	10	7	9.550	1	3	3	5	3.400	26	**32**	11	Gravity feed to sewer sump and pumped to sanitary system
Water Treatment Plant Structure	1931 Section		10	7	7	7	8.200	9	8	5	7	6.900	2	**57**	2	0
Water Treatment Plant Structure	1958 Addition		10	7	7	7	8.200	9	5	3	5	4.400	18	**36**	8	0
Water Treatment Plant Structure	1974 Addition		10	7	7	7	8.200	9	3	3	5	3.400	26	**28**	16	0

City of St. Joseph
Risk Analysis
Water Utility System

Risk Analysis WTR-ave
11/3/2014

Risk Event			CONSEQUENCE						LIKELIHOOD					OVERALL		
Asset Hierarchy Level 3	Asset Hierarcy Level 4		Water Quality	Water Quantity	Residents & Business Impact (Public Image)	Health & Safety (Public & Employees)	Consequence Score	Consequence Rank	Physical Condition	Performance (Operability/ Functionality)	Maintainability	Likelihood Score	Likelihood Rank	**RISK SCORE**	**RISK RANK**	Comments
		Weight	0.40	0.35	0.10	0.15			0.50	0.30	0.20					
Water Treatment Plant Structure	Lab (1974 Section)		7	1	7	7	4.900	23	7	5	5	6.000	3	**29**	14	Lab and sampling equipment
Water Treatment Plant Structure	HVAC		1	1	1	7	1.900	38	3	5	5	4.000	22	**8**	37	0
Water Treatment Plant Structure	Electrical - Power Distribution		1	10	10	10	6.400	15	5	5	7	5.400	10	**35**	9	Switchgear is new, P-7 old
Water Treatment Plant Structure	Air Compressors		1	1	1	1	1.000	43	3	1	3	2.400	33	**2**	41	1 new compressor, 1 old compressor
Water Treatment Plant Structure	Water Plant Standby Power		1	10	10	10	6.400	15	1	1	7	2.200	35	**14**	28	Plant generator
Water Treatment Plant Structure	Water Plant SCADA System		4	4	7	7	4.750	24	3	5	5	4.000	22	**19**	20	If fails - lack of knowledge in distribution system (tank levels, system)
Water Treatment Plant Structure	Water Plant Security		1	1	4	10	2.650	34	1	1	1	1.000	43	**3**	40	New gates, installing code readers and cameras in next couple of months.
Water Treatment Plant Site	Site Yard Piping		1	10	10	10	6.400	15	5	3	7	4.800	15	**31**	12	0
Booster Pump Stations	Cleveland BPS # 1		1	7	7	7	4.600	26	3	1	5	2.800	31	**13**	30	Pumps 6 years old
Booster Pump Stations	Hilltop BPS #2		1	4	7	7	3.550	28	3	5	5	4.000	22	**14**	26	0
Water Towers	St Joseph City Tower (1.5 MGD)		1	7	7	7	4.600	26	1	1	7	2.200	35	**10**	35	0
Water Towers	Lincoln Township Tower # 1 (1 MGD)		1	4	4	7	3.250	29	3	1	7	3.200	28	**10**	33	Authority towers, built in 2007/2008, recoated last year (coatings issue)
Water Towers	Royalton Township Tower # 2 (1 MGD)		1	4	4	7	3.250	29	3	1	7	3.200	28	**10**	33	Authority towers, built in 2007/2008, recoated last year (coatings issue)
Water Towers	Shared System Transmission Mains		1	10	10	7	5.950	20	5	1	7	4.200	20	**25**	17	Old pipe, all valves working

Appendix B
Condition Assessment Details

St. Joseph Asset Condition Assessment Report

Asset Description	**Booster Pump 1**	System	**Distribution**
Asset Type	**PUMP-CENT**	Location	**Cleveland Booster Station**
Asset ID	**1185**	Inspection Date	**7/23/2014**
Comments	**1270 rpm**	Flag	

Question	Overriding?	Answer		NA	Flag	Answer Comment
Absence of Cavitation		1	Yes			
Absence of Leaks		1	Yes			
Accessibility		1	Open, Easy Access			
All Components		1	Yes			
All Safety Features Present		1	Yes			
Bearings	Yes	1	Excellent			10 BDU inner, 7 BDU outter
Check Valve		1	Opens, Closes, Seats, No Defects			
Corrosion - Metal		2	Minor Corrosion			
Corrosion - Visible Coating Condition		2	Minor Damage			
Gauges Operational		1	Yes			
Isolation Valves Operational		1	Yes			
Lubrication OK at Inspection		1	Yes			
Mounting		1	Securely mounted, well supported			
Obsolescence		1	Current, Supported			
Packing Gland		2	Normal			
Pipe Alignment		1	Straight			
Vibration by ISO Class	Yes	1	Green			

Condition Category	Condition Grade 1 - Very good/New		
Condition Score	1.12	Consequence Score	4.90
Risk Score	8.82	Likelihood Score	1.80

Photo	Photo Comment
	

St. Joseph Asset Condition Assessment Report

Asset Description	**Booster Pump Motor 1**	System	**Distribution**
Asset Type	**MOTOR**	Location	**Cleveland Booster Station**
Asset ID	**1190**	Inspection Date	**7/23/2014**
Comments	**1,270 rpm**	Flag	

Question	Overriding?	Answer		NA	Flag	Answer Comment
Acceptable Noise		1	Yes			
Acceptable Oil/Grease	Yes	1	Yes			
Acceptable Smell or Heat		1	Yes			
All Components		1	Yes			
All Safety Features Present		1	Yes			
Bearings	Yes	3	Moderate Wear			101 BDU inner, 132 BDU outter
Coating Condition		1	Virtually No Defects			
Corrosion - Metal		1	Like New			
Mounting		1	Securely mounted, well supported			
Obsolescence		1	Current, Supported			
Oil Level Within Range				X		
Vibration by ISO Class	Yes	1	Green			.015 in/sec inner. .015 in/sec outter

Condition Category	Condition Grade 3 - Fair		
Condition Score	3.00	Consequence Score	4.90
Risk Score	18.62	Likelihood Score	3.80

Photo	Photo Comment
	

St. Joseph Asset Condition Assessment Report

Asset Description	**Booster Pump VFD 1**	System	**Distribution**
Asset Type	**VFD**	Location	**Cleveland Booster Station**
Asset ID	**1191**	Inspection Date	**7/23/2014**
Comments		Flag	

Question	Overriding?	Answer		NA	Flag	Answer Comment
Acceptable Noise		1	Yes			
Acceptable Smell or Heat		1	Yes			
Accessibility		1	Open, Easy Access			
Adequate Ventilation		1	Yes			
Air Filter		1	Excellent			
All Safety Features Present		1	Yes			
Corrosion - Metal		1	Like New			
Display/Indicator Ok		1	Yes			
Good Housekeeping		1	Yes			
Installation/Accessibility/Enclosure		1	Excellent			
Obsolescence		1	Current, Supported			

Condition Category	Condition Grade 1 - Very good/New		
Condition Score	1.00	Consequence Score	4.90
Risk Score	8.82	Likelihood Score	1.80

Photo	Photo Comment
	

St. Joseph Asset Condition Assessment Report

Asset Description	**Booster Pump 2**	System	**Distribution**
Asset Type	**PUMP-CENT**	Location	**Cleveland Booster Station**
Asset ID	**1186**	Inspection Date	**7/23/2014**
Comments	**1267 rpm**	Flag	

Question	Overriding?	Answer		NA	Flag	Answer Comment
Absence of Cavitation		1	Yes			
Absence of Leaks		1	Yes			
Accessibility		1	Open, Easy Access			
All Components		1	Yes			
All Safety Features Present		1	Yes			
Bearings	Yes	1	Excellent			10 BDU inner, 7 BDU outter
Check Valve		1	Opens, Closes, Seats, No Defects			
Corrosion - Metal		2	Minor Corrosion			
Corrosion - Visible Coating Condition		2	Minor Damage			
Gauges Operational		1	Yes			
Isolation Valves Operational		1	Yes			
Lubrication OK at Inspection		1	Yes			
Mounting		1	Securely mounted, well supported			
Obsolescence		1	Current, Supported			
Packing Gland		2	Normal			
Pipe Alignment		1	Straight			
Vibration by ISO Class	Yes	1	Green			.023 in/sec inner. .012 in/sec outter

Condition Category	Condition Grade 1 - Very good/New		
Condition Score	1.12	Consequence Score	4.90
Risk Score	8.82	Likelihood Score	1.80

Photo	Photo Comment
	

St. Joseph Asset Condition Assessment Report

Asset Description	**Booster Pump Motor 2**	System	**Distribution**
Asset Type	**MOTOR**	Location	**Cleveland Booster Station**
Asset ID	**1188**	Inspection Date	**7/23/2014**
Comments	**1,267 rpm**	Flag	

Question	Overriding?	Answer		NA	Flag	Answer Comment
Acceptable Noise		1	Yes			
Acceptable Oil/Grease	Yes	1	Yes			
Acceptable Smell or Heat		1	Yes			
All Components		1	Yes			
All Safety Features Present		1	Yes			
Bearings	Yes	3	Moderate Wear			254 BDU inner, 250 BDU outter
Coating Condition		1	Virtually No Defects			
Corrosion - Metal		1	Like New			
Mounting		1	Securely mounted, well supported			
Obsolescence		1	Current, Supported			
Oil Level Within Range				X		
Vibration by ISO Class	Yes	1	Green			.023 in/sec inne, .012 in/sec outter

Condition Category	Condition Grade 3 - Fair		
Condition Score	3.00	Consequence Score	4.90
Risk Score	18.62	Likelihood Score	3.80

Photo	Photo Comment
	

St. Joseph Asset Condition Assessment Report

Asset Description	**Booster Pump VFD 2**	System	**Distribution**
Asset Type	**VFD**	Location	**Cleveland Booster Station**
Asset ID	**1192**	Inspection Date	**7/23/2014**
Comments		Flag	

Question	Overriding?	Answer		NA	Flag	Answer Comment
Acceptable Noise		1	Yes			
Acceptable Smell or Heat		1	Yes			
Accessibility		1	Open, Easy Access			
Adequate Ventilation		1	Yes			
Air Filter		1	Excellent			
All Safety Features Present		1	Yes			
Corrosion - Metal		1	Like New			
Display/Indicator Ok		1	Yes			
Good Housekeeping		1	Yes			
Installation/Accessibility/Enclosure		1	Excellent			
Obsolescence		1	Current, Supported			

Condition Category	Condition Grade 1 - Very good/New		
Condition Score	1.00	Consequence Score	4.90
Risk Score	8.82	Likelihood Score	1.80

Photo	Photo Comment
	

St. Joseph Asset Condition Assessment Report

Asset Description	**Booster Pump 3**	System	**Distribution**
Asset Type	**PUMP-CENT**	Location	**Cleveland Booster Station**
Asset ID	**1187**	Inspection Date	**7/23/2014**
Comments	**1180 rpm**	Flag	

Question	Overriding?	Answer		NA	Flag	Answer Comment
Absence of Cavitation		1	Yes			
Absence of Leaks		1	Yes			
Accessibility		1	Open, Easy Access			
All Components		1	Yes			
All Safety Features Present		1	Yes			
Bearings	Yes	1	Excellent			14 BDU inner, 31 BDU outter
Check Valve		1	Opens, Closes, Seats, No Defects			
Corrosion - Metal		3	Pitting And Some Metal Loss			
Corrosion - Visible Coating Condition		3	Damaged			
Gauges Operational		1	Yes			
Isolation Valves Operational		1	Yes			
Lubrication OK at Inspection		1	Yes			
Mounting		1	Securely mounted, well supported			
Obsolescence		1	Current, Supported			
Packing Gland		2	Normal			
Pipe Alignment		1	Straight			
Vibration by ISO Class	Yes	1	Green			.023 in/sec inner, .010 in/sec outter

Condition Category	Condition Grade 1 - Very good/New		
Condition Score	1.19	Consequence Score	4.90
Risk Score	8.82	Likelihood Score	1.80

Photo	Photo Comment
	Corrosion

St. Joseph Asset Condition Assessment Report

Asset Description	**Booster Pump Motor 3**	System	**Distribution**
Asset Type	**MOTOR**	Location	**Cleveland Booster Station**
Asset ID	**1189**	Inspection Date	**7/23/2014**
Comments	**1,180 rpm**	Flag	

Question	Overriding?	Answer		NA	Flag	Answer Comment
Acceptable Noise		1	Yes			
Acceptable Oil/Grease	Yes	1	Yes			
Acceptable Smell or Heat		1	Yes			
All Components		1	Yes			
All Safety Features Present		1	Yes			
Bearings	Yes	3	Moderate Wear			123 BDU inner, 112 BDU outter
Coating Condition		1	Virtually No Defects			
Corrosion - Metal		1	Like New			
Mounting		1	Securely mounted, well supported			
Obsolescence		1	Current, Supported			
Oil Level Within Range				X		
Vibration by ISO Class	Yes	1	Green			.020 in/sec inner, .019 in/sec outter

Condition Category	Condition Grade 3 - Fair		
Condition Score	3.00	Consequence Score	4.90
Risk Score	18.62	Likelihood Score	3.80

Photo	Photo Comment
	

St. Joseph Asset Condition Assessment Report

Asset Description	**Booster Pump VFD 3**	System	**Distribution**
Asset Type	**VFD**	Location	**Cleveland Booster Station**
Asset ID	**1193**	Inspection Date	**7/23/2014**
Comments		Flag	

Question	Overriding?	Answer		NA	Flag	Answer Comment
Acceptable Noise		1	Yes			
Acceptable Smell or Heat		1	Yes			
Accessibility		1	Open, Easy Access			
Adequate Ventilation		1	Yes			
Air Filter		1	Excellent			
All Safety Features Present		1	Yes			
Corrosion - Metal		1	Like New			
Display/Indicator Ok		1	Yes			
Good Housekeeping		1	Yes			
Installation/Accessibility/Enclosure		1	Excellent			
Obsolescence		1	Current, Supported			

Condition Category	Condition Grade 1 - Very good/New		
Condition Score	1.00	Consequence Score	4.90
Risk Score	8.82	Likelihood Score	1.80

Photo	Photo Comment
	

St. Joseph Asset Condition Assessment Report

Asset Description	**PIPE**	System	**Distribution**
Asset Type	**PIPE**	Location	**Cleveland Booster Station**
Asset ID	**1194**	Inspection Date	**7/23/2014**
Comments		Flag	

Question	Overriding?	Answer		NA	Flag	Answer Comment
Absence of Leaks		1	Yes			
Coating Condition		2	Minor Defects			
Corrosion - Metal		2	Minor Corrosion			
Flange Bolt Condition		2	Normal			
Instrumentation Operational		1	Yes			
Insulation Condition		1	Good			
Pipe Alignment		1	Straight			
Pipe Labeling/Color		1	Labeled And Color Coded			
Support		1	Properly Supported			

Condition Category	Condition Grade 1 - Very good/New		
Condition Score	1.33	Consequence Score	4.90
Risk Score	8.82	Likelihood Score	1.80

St. Joseph Asset Condition Assessment Report

Asset Description	**Booster Pump 1**	System	**Distribution**
Asset Type	**PUMP-CENT**	Location	**Hilltop Booster Station**
Asset ID	**1178**	Inspection Date	**7/23/2014**
Comments	**1780 rpm**	Flag	

Question	Overriding?	Answer		NA	Flag	Answer Comment
Absence of Cavitation		1	Yes			
Absence of Leaks		1	Yes			
Accessibility		1	Open, Easy Access			
All Components		1	Yes			
All Safety Features Present		1	Yes			
Bearings	Yes	1	Excellent			0 BDU
Check Valve		1	Opens, Closes, Seats, No Defects			
Corrosion - Metal		2	Minor Corrosion			
Corrosion - Visible Coating Condition		2	Minor Damage			
Gauges Operational		1	Yes			
Isolation Valves Operational		1	Yes			
Lubrication OK at Inspection		1	Yes			
Mounting		1	Securely mounted, well supported			
Obsolescence		1	Current, Supported			
Packing Gland		2	Normal			
Pipe Alignment		1	Straight			
Vibration by ISO Class	Yes	1	Green			.023 in/sec inner, .013 in/sec outter

Condition Category	Condition Grade 1 - Very good/New		
Condition Score	1.12	Consequence Score	3.25
Risk Score	9.75	Likelihood Score	3.00

Photo	Photo Comment
	
	

St. Joseph Asset Condition Assessment Report

Asset Description	**Booster Pump Motor 1**	System	**Distribution**
Asset Type	**MOTOR**	Location	**Hilltop Booster Station**
Asset ID	**1180**	Inspection Date	**7/23/2014**
Comments		Flag	

Question	Overriding?	Answer		NA	Flag	Answer Comment
Acceptable Noise		1	Yes			
Acceptable Oil/Grease	Yes	5	No			Based on BDU values
Acceptable Smell or Heat		1	Yes			
All Components		1	Yes			
All Safety Features Present		1	Yes			
Bearings	Yes	3	Moderate Wear			225 BDU inner, 188 BDU otter
Coating Condition		1	Virtually No Defects			
Corrosion - Metal		1	Like New			
Mounting		1	Securely mounted, well supported			
Obsolescence		1	Current, Supported			
Oil Level Within Range				X		
Vibration by ISO Class	Yes	1	Green			.095 in/sec inner. .100 in/sec outter

Condition Category	Condition Grade: 5-Very poor		
Condition Score	5.00	Consequence Score	3.25
Risk Score	24.38	Likelihood Score	7.50

Photo	Photo Comment
	

St. Joseph Asset Condition Assessment Report

Asset Description	**Booster Pump VFD 1**	System	**Distribution**
Asset Type	**VFD**	Location	**Hilltop Booster Station**
Asset ID	**1182**	Inspection Date	**7/23/2014**
Comments		Flag	

Question	Overriding?	Answer		NA	Flag	Answer Comment
Acceptable Noise		1	Yes			
Acceptable Smell or Heat		1	Yes			
Accessibility		1	Open, Easy Access			
Adequate Ventilation		1	Yes			
Air Filter		1	Excellent			
All Safety Features Present		1	Yes			
Corrosion - Metal		1	Like New			
Display/Indicator Ok		1	Yes			
Good Housekeeping		1	Yes			
Installation/Accessibility/Enclosure		1	Excellent			
Obsolescence		1	Current, Supported			

Condition Category	Condition Grade 1 - Very good/New		
Condition Score	1.00	Consequence Score	3.25
Risk Score	9.75	Likelihood Score	3.00

Photo	Photo Comment
	

St. Joseph Asset Condition Assessment Report

Asset Description	**Booster Pump 2**	System	**Distribution**
Asset Type	**PUMP-CENT**	Location	**Hilltop Booster Station**
Asset ID	**1179**	Inspection Date	**7/23/2014**
Comments	**1780 rpm**	Flag	

Question	Overriding?	Answer		NA	Flag	Answer Comment
Absence of Cavitation		1	Yes			
Absence of Leaks		1	Yes			
Accessibility		1	Open, Easy Access			
All Components		1	Yes			
All Safety Features Present		1	Yes			
Bearings	Yes	1	Excellent			0 BDU
Check Valve		1	Opens, Closes, Seats, No Defects			
Corrosion - Metal		2	Minor Corrosion			
Corrosion - Visible Coating Condition		2	Minor Damage			
Gauges Operational		1	Yes			
Isolation Valves Operational		1	Yes			
Lubrication OK at Inspection		1	Yes			
Mounting		1	Securely mounted, well supported			
Obsolescence		1	Current, Supported			
Packing Gland		2	Normal			
Pipe Alignment		1	Straight			
Vibration by ISO Class	Yes	1	Green			.023 in/sec inner. .015 in/sec outter

Condition Category	Condition Grade 1 - Very good/New		
Condition Score	1.12	Consequence Score	3.25
Risk Score	9.75	Likelihood Score	3.00

Photo	Photo Comment
	
	

St. Joseph Asset Condition Assessment Report

Asset Description	**Booster Pump Motor 2**	System	**Distribution**
Asset Type	**MOTOR**	Location	**Hilltop Booster Station**
Asset ID	**1181**	Inspection Date	**7/23/2014**
Comments	**Safety issue with poor connection to motor junction box**	Flag	

Question	Overriding?	Answer		NA	Flag	Answer Comment
Acceptable Noise		1	Yes			
Acceptable Oil/Grease	Yes	1	Yes			
Acceptable Smell or Heat		1	Yes			
All Components		5	No			Conduit not sealed to motor junction box
All Safety Features Present		5	No			Conduit not sealed to motor junction box
Bearings	Yes	3	Moderate Wear			138 BDU inner. 312 BDU outter
Coating Condition		1	Virtually No Defects			
Corrosion - Metal		1	Like New			
Mounting		1	Securely mounted, well supported			
Obsolescence		1	Current, Supported			
Oil Level Within Range				X		
Vibration by ISO Class	Yes	1	Green			.153 in/sec inner, ,035 in/sec outter

Condition Category	Condition Grade 3 - Fair		
Condition Score	3.00	Consequence Score	3.25
Risk Score	16.25	Likelihood Score	5.00

Photo	Photo Comment
	Conduit not sealed in motor junction box. Safety issue

St. Joseph Asset Condition Assessment Report

Asset Description	**Booster Pump VFD 2**	System	**Distribution**
Asset Type	**VFD**	Location	**Hilltop Booster Station**
Asset ID	**1183**	Inspection Date	**7/23/2014**
Comments		Flag	

Question	Overriding?	Answer		NA	Flag	Answer Comment
Acceptable Noise		1	Yes			
Acceptable Smell or Heat		1	Yes			
Accessibility		1	Open, Easy Access			
Adequate Ventilation		1	Yes			
Air Filter		1	Excellent			
All Safety Features Present		1	Yes			
Corrosion - Metal		1	Like New			
Display/Indicator Ok		1	Yes			
Good Housekeeping		1	Yes			
Installation/Accessibility/Enclosure		1	Excellent			
Obsolescence		1	Current, Supported			

Condition Category	Condition Grade 1 - Very good/New		
Condition Score	1.00	Consequence Score	3.25
Risk Score	9.75	Likelihood Score	3.00

Photo	Photo Comment
	

St. Joseph Asset Condition Assessment Report

Asset Description	**Piping System**	System	**Distribution**
Asset Type	**PIPE**	Location	**Hilltop Booster Station**
Asset ID	**1184**	Inspection Date	**7/23/2014**
Comments		Flag	

Question	Overriding?	Answer		NA	Flag	Answer Comment
Absence of Leaks		1	Yes			
Coating Condition		2	Minor Defects			
Corrosion - Metal		1	Like New			
Flange Bolt Condition		2	Normal			
Instrumentation Operational		1	Yes			
Insulation Condition		1	Good			
Pipe Alignment		1	Straight			
Pipe Labeling/Color		1	Labeled And Color Coded			
Support		1	Properly Supported			

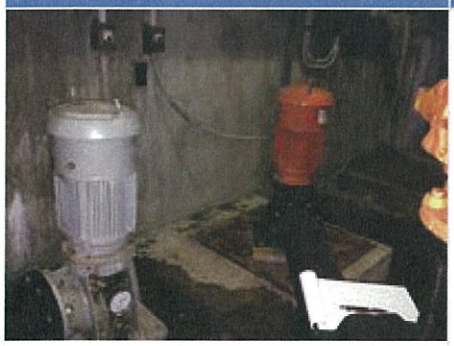
Condition Category	Condition Grade 1 - Very good/New		
Condition Score	1.22	Consequence Score	3.25
Risk Score	9.75	Likelihood Score	3.00

St. Joseph Asset Condition Assessment Report

Asset Description	**B.W. Reclaim Pump # 1**	System	**Water Treatment Plant**
Asset Type	**PUMP-CENT**	Location	**Backwash Reclaim Basin**
Asset ID	**1101**	Inspection Date	**7/22/2014**
Comments	**Packing has excessive leaking. Pump rebuilt in Novemebr 2010**	Flag	

Question	Overriding?	Answer		NA	Flag	Answer Comment
Absence of Cavitation		1	Yes			
Absence of Leaks		5	No			Excessive paking leakage
Accessibility		2	Semi Restricted Access			
All Components		1	Yes			
All Safety Features Present		1	Yes			
Bearings	Yes	1	Excellent			
Check Valve		1	Opens, Closes, Seats, No Defects			
Corrosion - Metal		1	Like New			
Corrosion - Visible Coating Condition		1	Like New			
Gauges Operational		1	Yes			
Isolation Valves Operational		1	Yes			
Lubrication OK at Inspection		1	Yes			
Mounting		1	Securely mounted, well supported			
Obsolescence		1	Current, Supported			
Packing Gland		3	Maintenance Overdue			Excessive leaking
Pipe Alignment		1	Straight			
Vibration by ISO Class	Yes	1	Green			

Condition Category	Condition Grade 1 - Very good/New		
Condition Score	1.27	Consequence Score	2.05
Risk Score	2.87	Likelihood Score	1.40

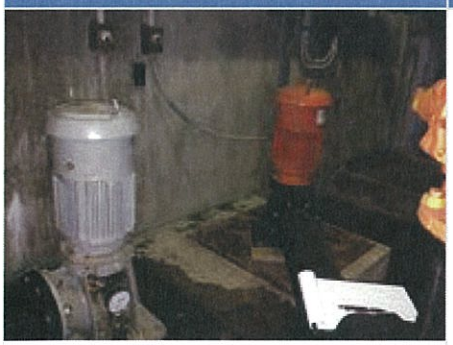
Photo	Photo Comment
	

St. Joseph Asset Condition Assessment Report

Asset Description	**B.W. Reclaim Pump # 1 Motor**	System	**Water Treatment Plant**
Asset Type	**MOTOR**	Location	**Backwash Reclaim Basin**
Asset ID	**1102**	Inspection Date	**7/22/2014**
Comments		Flag	

Question	Overriding?	Answer		NA	Flag	Answer Comment
Acceptable Noise		1	Yes			
Acceptable Oil/Grease	Yes	1	Yes			
Acceptable Smell or Heat		1	Yes			
All Components		1	Yes			
All Safety Features Present		1	Yes			
Bearings	Yes	1	Excellent			
Coating Condition		1	Virtually No Defects			
Corrosion - Metal		1	Like New			
Mounting		1	Securely mounted, well supported			
Obsolescence		1	Current, Supported			
Oil Level Within Range				X		
Vibration by ISO Class	Yes			X		

Condition Category	Condition Grade 1 - Very good/New		
Condition Score	1.00	Consequence Score	2.05
Risk Score	2.87	Likelihood Score	1.40

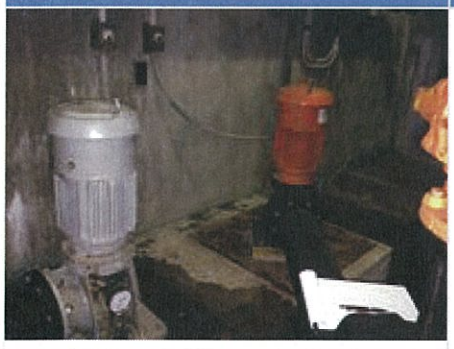
Photo	Photo Comment
	

St. Joseph Asset Condition Assessment Report

Asset Description	**B.W. Reclaim Pump # 2**	System	**Water Treatment Plant**
Asset Type	**PUMP-CENT**	Location	**Backwash Reclaim Basin**
Asset ID	**1103**	Inspection Date	**7/22/2014**
Comments	**1800 rpm. Rebuilt in December 2006**	Flag	

Question	Overriding?	Answer		NA	Flag	Answer Comment
Absence of Cavitation		1	Yes			
Absence of Leaks		1	Yes			
Accessibility		1	Open, Easy Access			
All Components		1	Yes			
All Safety Features Present		1	Yes			
Bearings	Yes	1	Excellent			
Check Valve		1	Opens, Closes, Seats, No Defects			
Corrosion - Metal		2	Minor Corrosion			
Corrosion - Visible Coating Condition		2	Minor Damage			
Gauges Operational		1	Yes			
Isolation Valves Operational		1	Yes			
Lubrication OK at Inspection		1	Yes			
Mounting		1	Securely mounted, well supported			
Obsolescence		1	Current, Supported			
Packing Gland		1	Excellent			
Pipe Alignment		1	Straight			
Vibration by ISO Class	Yes	1	Green			

Condition Category	Condition Grade 1 - Very good/New		
Condition Score	1.08	Consequence Score	2.05
Risk Score	2.87	Likelihood Score	1.40

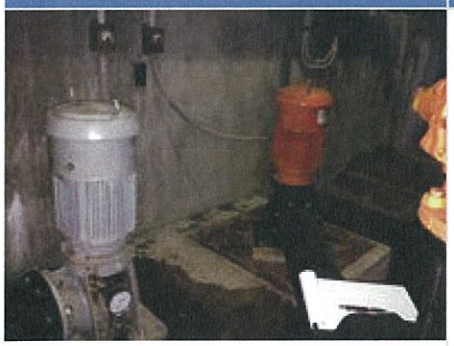
Photo	Photo Comment
	

St. Joseph Asset Condition Assessment Report

Asset Description	**B.W. Reclaim Pump # 2 Motor**	System	**Water Treatment Plant**
Asset Type	**MOTOR**	Location	**Backwash Reclaim Basin**
Asset ID	**1104**	Inspection Date	**7/22/2014**
Comments		Flag	

Question	Overriding?	Answer		NA	Flag	Answer Comment
Acceptable Noise		1	Yes			
Acceptable Oil/Grease	Yes	1	Yes			
Acceptable Smell or Heat		1	Yes			
All Components		1	Yes			
All Safety Features Present		1	Yes			
Bearings	Yes	1	Excellent			
Coating Condition		1	Virtually No Defects			
Corrosion - Metal		1	Like New			
Mounting		1	Securely mounted, well supported			
Obsolescence		1	Current, Supported			
Oil Level Within Range				X		
Vibration by ISO Class	Yes			X		

Condition Category	Condition Grade 1 - Very good/New		
Condition Score	1.00	Consequence Score	2.05
Risk Score	2.87	Likelihood Score	1.40

Photo	Photo Comment
	

St. Joseph Asset Condition Assessment Report

Asset Description	**B.W. Pump # 1 Pump**	System	**Water Treatment Plant**
Asset Type	**PUMP-CENT**	Location	**Backwash System**
Asset ID	**1095**	Inspection Date	**7/22/2014**
Comments	**Small oil leak on inboard bearing. Appears to be coming from drain plug. Rebuilt in May 2000.**	Flag	

Question	Overriding?	Answer		NA	Flag	Answer Comment
Absence of Cavitation		1	Yes			
Absence of Leaks		1	Yes			
Accessibility		1	Open, Easy Access			
All Components		1	Yes			
All Safety Features Present		1	Yes			
Bearings	Yes	1	Excellent			.012 in/sec inboard, .018 in/sec outboard
Check Valve		1	Opens, Closes, Seats, No Defects			
Corrosion - Metal		2	Minor Corrosion			
Corrosion - Visible Coating Condition		2	Minor Damage			
Gauges Operational		1	Yes			
Isolation Valves Operational		1	Yes			
Lubrication OK at Inspection		5	No			Small oil leak at drain plug, inner bearing
Mounting		1	Securely mounted, well supported			
Obsolescence		1	Current, Supported			
Packing Gland		2	Normal			
Pipe Alignment		1	Straight			
Vibration by ISO Class	Yes	1	Green			inner .012 in/sec, outter .018 in/sec

Condition Category	Condition Grade 1 - Very good/New		
Condition Score	1.27	Consequence Score	8.50
Risk Score	18.70	Likelihood Score	2.20

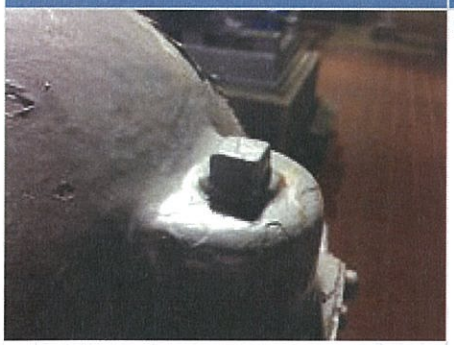
Photo	Photo Comment
	Oil on pump pedistal

St. Joseph Asset Condition Assessment Report

Asset Description	**B.W. Pump # 1 Motor**	System	**Water Treatment Plant**
Asset Type	**MOTOR**	Location	**Backwash System**
Asset ID	**1094**	Inspection Date	**7/22/2014**
Comments	**Old (1931) motor that is low effeciency. 1800 rpm**	Flag	

Question	Overriding?	Answer		NA	Flag	Answer Comment
Acceptable Noise		1	Yes			
Acceptable Oil/Grease	Yes	1	Yes			
Acceptable Smell or Heat		1	Yes			
All Components		1	Yes			
All Safety Features Present		1	Yes			
Bearings	Yes	1	Excellent			0 BDU both ends
Coating Condition		1	Virtually No Defects			
Corrosion - Metal		1	Like New			
Mounting		1	Securely mounted, well supported			
Obsolescence		3	Not Current, Support Available			
Oil Level Within Range		1	Yes			
Vibration by ISO Class	Yes	1	Green			.010 in/sec outter, .005 in/sec inner

Condition Category	Condition Grade 1 - Very good/New		
Condition Score	1.17	Consequence Score	8.50
Risk Score	18.70	Likelihood Score	2.20

Photo	Photo Comment
	Bearing fill plug is still painted over
	Older motor (1931)

St. Joseph Asset Condition Assessment Report

Asset Description	**B.W. Pump # 1 (VFD)**	System	**Water Treatment Plant**
Asset Type	**VFD**	Location	**Backwash System**
Asset ID	**1093**	Inspection Date	**7/23/2014**
Comments	**No cooling fans for VFD. Line reactor cooling only.**	Flag	

Question	Overriding?	Answer		NA	Flag	Answer Comment
Acceptable Noise		1	Yes			
Acceptable Smell or Heat		1	Yes			
Accessibility		1	Open, Easy Access			
Adequate Ventilation		5	No			
Air Filter		1	Excellent			
All Safety Features Present		1	Yes			
Corrosion - Metal		1	Like New			
Display/Indicator Ok		1	Yes			
Good Housekeeping		1	Yes			
Installation/Accessibility/Enclosure		1	Excellent			
Obsolescence		1	Current, Supported			

Condition Category	Condition Grade 1 - Very good/New		
Condition Score	1.36	Consequence Score	8.50
Risk Score	18.70	Likelihood Score	2.20

Photo	Photo Comment
	

St. Joseph Asset Condition Assessment Report

Asset Description	**B.W. Pump # 2 Pump**	System	**Water Treatment Plant**
Asset Type	**PUMP-CENT**	Location	**Backwash System**
Asset ID	**1098**	Inspection Date	**7/22/2014**
Comments	**Pump rebuilt in December 2006**	Flag	

Question	Overriding?	Answer		NA	Flag	Answer Comment
Absence of Cavitation		1	Yes			
Absence of Leaks		1	Yes			
Accessibility		1	Open, Easy Access			
All Components		1	Yes			
All Safety Features Present		1	Yes			
Bearings	Yes	1	Excellent			0 BDU both bearings
Check Valve		1	Opens, Closes, Seats, No Defects			
Corrosion - Metal		2	Minor Corrosion			
Corrosion - Visible Coating Condition		2	Minor Damage			
Gauges Operational		1	Yes			
Isolation Valves Operational		1	Yes			
Lubrication OK at Inspection		1	Yes			
Mounting		1	Securely mounted, well supported			
Obsolescence		1	Current, Supported			
Packing Gland		2	Normal			
Pipe Alignment		1	Straight			
Vibration by ISO Class	Yes	1	Green			.023in/sec inner, .032 in/sec outter

Condition Category	Condition Grade 1 - Very good/New		
Condition Score	1.12	Consequence Score	8.50
Risk Score	18.70	Likelihood Score	2.20

Photo	Photo Comment
	

St. Joseph Asset Condition Assessment Report

Asset Description	**B.W. Pump # 2 Motor**	System	**Water Treatment Plant**
Asset Type	**MOTOR**	Location	**Backwash System**
Asset ID	**1097**	Inspection Date	**7/22/2014**
Comments	**1800 rpm.**	Flag	

Question	Overriding?	Answer		NA	Flag	Answer Comment
Acceptable Noise		1	Yes			
Acceptable Oil/Grease	Yes	1	Yes			
Acceptable Smell or Heat		1	Yes			
All Components		1	Yes			
All Safety Features Present		1	Yes			
Bearings	Yes	2	Minor Wear			50 BDU inner, 43 BDU outter
Coating Condition		1	Virtually No Defects			
Corrosion - Metal		1	Like New			
Mounting		1	Securely mounted, well supported			
Obsolescence		3	Not Current, Support Available			
Oil Level Within Range		1	Yes			
Vibration by ISO Class	Yes	1	Green			.043 in/sec inner. .032 in/sec outter

Condition Category	Condition Grade 1 - Very good/New		
Condition Score	1.25	Consequence Score	8.50
Risk Score	18.70	Likelihood Score	2.20

St. Joseph Asset Condition Assessment Report

Asset Description	**B.W. Pump # 2 (VFD)**	System	**Water Treatment Plant**
Asset Type	**VFD**	Location	**Backwash System**
Asset ID	**1096**	Inspection Date	**7/23/2014**
Comments	**No cooling fans for VFD. Line reactor cooling only.**	Flag	

Question	Overriding?	Answer		NA	Flag	Answer Comment
Acceptable Noise		1	Yes			
Acceptable Smell or Heat		1	Yes			
Accessibility		1	Open, Easy Access			
Adequate Ventilation		5	No			
Air Filter		1	Excellent			
All Safety Features Present		1	Yes			
Corrosion - Metal		1	Like New			
Display/Indicator Ok		1	Yes			
Good Housekeeping		1	Yes			
Installation/Accessibility/Enclosure		1	Excellent			
Obsolescence		1	Current, Supported			

Condition Category	Condition Grade 1 - Very good/New		
Condition Score	1.36	Consequence Score	8.50
Risk Score	18.70	Likelihood Score	2.20

Photo	Photo Comment
	No cooling fans for VFD. Line reactor cooling only.

St. Joseph Asset Condition Assessment Report

Asset Description	**Filter 1 Underdrains and media**	System	**Water Treatment Plant**
Asset Type	**FILTER**	Location	**Filter 1**
Asset ID	**1048**	Inspection Date	**7/22/2014**
Comments	**Trough supports are severly corroded. New spray bars and piping.**	Flag	

Question	Overriding?	Answer		NA	Flag	Answer Comment
Absence of Leaks		1	Yes			
All Components		1	Yes			
Conduit and Supports		5	Very Poor			Trough supports are severly corroded.
Corrosion - Concrete		2	Staining			
Corrosion - Metal		5	Severe Pitting			Trough supports are severly corroded.
Installation/Accessibility		1	Installed properly, easy to access			
Media Depth and Condition		1	Good Condition And Depth			New media
Meeting Production Efficiency		1	Meeting Production Efficiency			
Water Lines		1	Excellent			

Condition Category	Condition Grade 2 - Good		
Condition Score	2.00	Consequence Score	5.35
Risk Score	16.05	Likelihood Score	3.00

Photo	Photo Comment
	Typical of all trough supports

St. Joseph Asset Condition Assessment Report

Asset Description	**Filter 1 Valves**	System	**Water Treatment Plant**
Asset Type	**VALVE**	Location	**Filter 1**
Asset ID	**1046**	Inspection Date	**7/22/2014**
Comments	**Includes all valves on Filter 1**	Flag	

Question	Overriding?	Answer		NA	Flag	Answer Comment
Absence of Leaks		1	Yes			
Actuator		2	Minor Leaks			
Corrosion - Metal		3	Pitting And Some Metal Loss			
Flange Bolt Condition		5	Significant Corrosion, Missing Bolts			
Functional		1	Fully Opens/Closes, Without Assistance			
Pipe Alignment		1	Straight			
Support		5	Inadequate Support			Main support corroded
Valve Isolates (Holds)		1	Yes			

Condition Category	Condition Grade 2 - Good		
Condition Score	2.38	Consequence Score	5.35
Risk Score	16.05	Likelihood Score	3.00

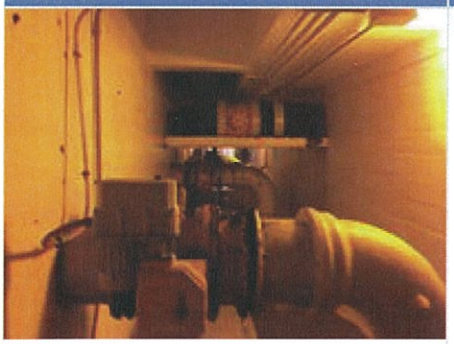
Photo	Photo Comment
	Typical corrosion on valve flanges. Older actuator
	Main support corroded

St. Joseph Asset Condition Assessment Report

Asset Description	**Filter 1 Piping**	System	**Water Treatment Plant**
Asset Type	**PIPE**	Location	**Filter 1**
Asset ID	**1047**	Inspection Date	**7/22/2014**
Comments	**Corrosion on flanges**	Flag	

Question	Overriding?	Answer		NA	Flag	Answer Comment
Absence of Leaks		1	Yes			
Coating Condition		3	Moderate Defects			
Corrosion - Metal		5	Severe Pitting			
Flange Bolt Condition		5	Significant Corrosion, Missing Bolts			
Instrumentation Operational		1	Yes			Very old instrumentation. Very little new
Insulation Condition				X		
Pipe Alignment		1	Straight			
Pipe Labeling/Color		1	Labeled And Color Coded			
Support		5	Inadequate Support			

Condition Category	Condition Grade 3 - Fair		
Condition Score	2.75	Consequence Score	5.35
Risk Score	21.40	Likelihood Score	4.00

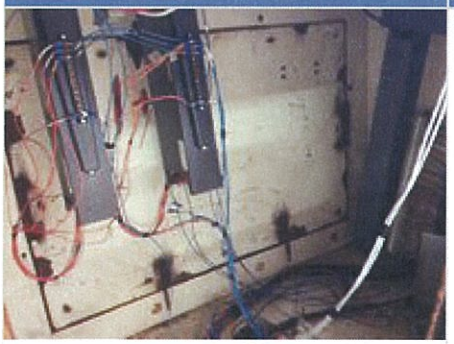
Photo	Photo Comment
	Corrosion at flanges. Typical

St. Joseph Asset Condition Assessment Report

Asset Description	**Filter 1 and 2 Control Panel**	System	**Water Treatment Plant**
Asset Type	**CONTROL PANEL**	Location	**Filter 1**
Asset ID	**1045**	Inspection Date	**7/22/2014**
Comments	**Older panel. Obsolete controls**	Flag	

Question	Overriding?	Answer		NA	Flag	Answer Comment
Acceptable Noise		1	Yes			
Acceptable Smell or Heat		1	Yes			
Access Doors		2	Normal			
All Components		1	Yes			
All Safety Features Present		1	Yes			
Control Lamps		2	Good			
Control Switches		1	Excellent			
Corrosion - Metal		2	Minor Corrosion			
Good Housekeeping		5	No			Dust and debris
Installation/Accessibility		2	Installed properly, minor access obstructions			
Obsolescence		3	Not Current, Support Available			

Condition Category	Condition Grade 2 - Good		
Condition Score	1.91	Consequence Score	5.35
Risk Score	16.05	Likelihood Score	3.00

Photo	Photo Comment
	Poor wire labeling, debris
	No wire labeling and debris

St. Joseph Asset Condition Assessment Report

Asset Description	**Filter 2 Underdrains and media**	System	**Water Treatment Plant**
Asset Type	**FILTER**	Location	**Filter 2**
Asset ID	**1052**	Inspection Date	**7/22/2014**
Comments	**Trough supports severly corroded. New spray bar and piping**	Flag	

Question	Overriding?	Answer		NA	Flag	Answer Comment
Absence of Leaks		1	Yes			
All Components		1	Yes			
Conduit and Supports		5	Very Poor			Trough supports severly corroded.
Corrosion - Concrete		2	Staining			
Corrosion - Metal		5	Severe Pitting			Trough supports severly corroded.
Installation/Accessibility		1	Installed properly, easy to access			
Media Depth and Condition		1	Good Condition And Depth			
Meeting Production Efficiency		1	Meeting Production Efficiency			
Water Lines		1	Excellent			

Condition Category	Condition Grade 2 - Good		
Condition Score	2.00	Consequence Score	5.35
Risk Score	16.05	Likelihood Score	3.00

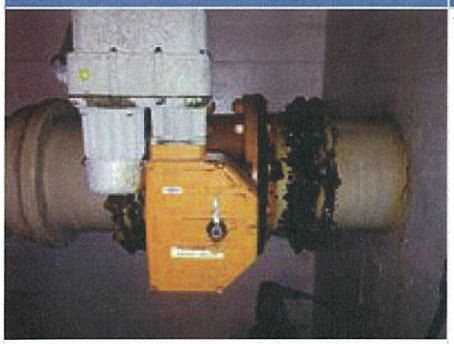
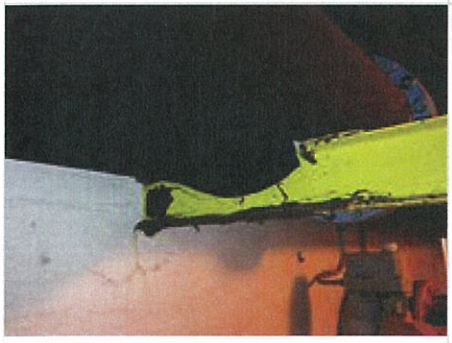
Photo	Photo Comment
	Typical of all trough supports

St. Joseph Asset Condition Assessment Report

Asset Description	**Filter 2 Valves**	System	**Water Treatment Plant**
Asset Type	**VALVE**	Location	**Filter 2**
Asset ID	**1050**	Inspection Date	**7/22/2014**
Comments	**Corrosion at flanges. Very old actuators**	Flag	

Question	Overriding?	Answer		NA	Flag	Answer Comment
Absence of Leaks		1	Yes			
Actuator		5	Failure Imminent			Old actuators
Corrosion - Metal		3	Pitting And Some Metal Loss			
Flange Bolt Condition		5	Significant Corrosion, Missing Bolts			
Functional		1	Fully Opens/Closes, Without Assistance			
Pipe Alignment		1	Straight			
Support		5	Inadequate Support			Main pipe support
Valve Isolates (Holds)		1	Yes			

Condition Category	Condition Grade 3 - Fair		
Condition Score	2.75	Consequence Score	5.35
Risk Score	21.40	Likelihood Score	4.00

Photo	Photo Comment
	Typical condition
	Main support corroded

St. Joseph Asset Condition Assessment Report

Asset Description	**Filter 2 Piping**	System	**Water Treatment Plant**
Asset Type	**PIPE**	Location	**Filter 2**
Asset ID	**1051**	Inspection Date	**7/22/2014**
Comments	**Main pipe support corroded**	Flag	

Question	Overriding?	Answer		NA	Flag	Answer Comment
Absence of Leaks		1	Yes			
Coating Condition		2	Minor Defects			
Corrosion - Metal		3	Pitting And Some Metal Loss			
Flange Bolt Condition		5	Significant Corrosion, Missing Bolts			
Instrumentation Operational		1	Yes			Very old
Insulation Condition				X		
Pipe Alignment		2	Minor Deviation			
Pipe Labeling/Color		1	Labeled And Color Coded			
Support		5	Inadequate Support			Main support corroded

Condition Category	Condition Grade 3 - Fair		
Condition Score	2.50	Consequence Score	5.35
Risk Score	21.40	Likelihood Score	4.00

Photo	Photo Comment
	Instrumentation old.
	

St. Joseph Asset Condition Assessment Report

Asset Description	**Filter 3 Underdrains and media**	System	**Water Treatment Plant**
Asset Type	**FILTER**	Location	**Filter 3**
Asset ID	**1056**	Inspection Date	**7/22/2014**
Comments	**Trough supports severly corroded. New spray bar and piping**	Flag	

Question	Overriding?	Answer		NA	Flag	Answer Comment
Absence of Leaks		1	Yes			
All Components		1	Yes			
Conduit and Supports		5	Very Poor			Trough supports severly corroded.
Corrosion - Concrete		2	Staining			
Corrosion - Metal		5	Severe Pitting			Trough supports severly corroded.
Installation/Accessibility		1	Installed properly, easy to access			
Media Depth and Condition		1	Good Condition And Depth			
Meeting Production Efficiency		1	Meeting Production Efficiency			
Water Lines		1	Excellent			

Condition Category	Condition Grade 2 - Good		
Condition Score	2.00	Consequence Score	5.35
Risk Score	16.05	Likelihood Score	3.00

Photo	Photo Comment
	Typical of all supports

St. Joseph Asset Condition Assessment Report

Asset Description	**Filter 3 Valves**	System	**Water Treatment Plant**
Asset Type	**VALVE**	Location	**Filter 3**
Asset ID	**1054**	Inspection Date	**7/22/2014**
Comments	**Heavy corrosion on flanges and very old actuators**	Flag	

Question	Overriding?	Answer		NA	Flag	Answer Comment
Absence of Leaks		1	Yes			
Actuator		3	Moderate Leaks			
Corrosion - Metal		5	Severe Pitting			
Flange Bolt Condition		5	Significant Corrosion, Missing Bolts			
Functional		1	Fully Opens/Closes, Without Assistance			
Pipe Alignment		1	Straight			
Support		1	Properly Supported			
Valve Isolates (Holds)		1	Yes			

Condition Category	Condition Grade 2 - Good		
Condition Score	2.25	Consequence Score	5.35
Risk Score	16.05	Likelihood Score	3.00

Photo	Photo Comment
	Typical condition

St. Joseph Asset Condition Assessment Report

Asset Description	**Filter 3 Piping**	System	**Water Treatment Plant**
Asset Type	**PIPE**	Location	**Filter 3**
Asset ID	**1055**	Inspection Date	**7/22/2014**
Comments	**Main pipe suppots corroded**	Flag	

Question	Overriding?	Answer		NA	Flag	Answer Comment
Absence of Leaks		1	Yes			
Coating Condition		2	Minor Defects			
Corrosion - Metal		5	Severe Pitting			
Flange Bolt Condition		5	Significant Corrosion, Missing Bolts			
Instrumentation Operational		1	Yes			Very old
Insulation Condition				X		
Pipe Alignment		1	Straight			
Pipe Labeling/Color		1	Labeled And Color Coded			
Support		5	Inadequate Support			

Condition Category	Condition Grade 3 - Fair		
Condition Score	2.62	Consequence Score	5.35
Risk Score	21.40	Likelihood Score	4.00

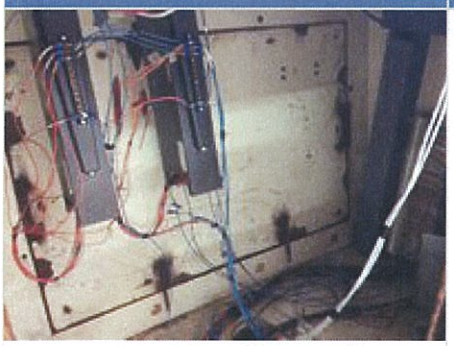
Photo	Photo Comment
	MAin support corroded

St. Joseph Asset Condition Assessment Report

Asset Description	**Filter 3 and 4 Control Panel**	System	**Water Treatment Plant**
Asset Type	**CONTROL PANEL**	Location	**Filter 3**
Asset ID	**1053**	Inspection Date	**7/22/2014**
Comments	**Old and antiquated controls.**	Flag	

Question	Overriding?	Answer		NA	Flag	Answer Comment
Acceptable Noise		1	Yes			
Acceptable Smell or Heat		1	Yes			
Access Doors		2	Normal			
All Components		1	Yes			
All Safety Features Present		1	Yes			
Control Lamps		2	Good			
Control Switches		1	Excellent			
Corrosion - Metal		2	Minor Corrosion			
Good Housekeeping		5	No			Dust and debris
Installation/Accessibility		2	Installed properly, minor access obstructions			
Obsolescence		5	Obsolete, Not Supported			

Condition Category	Condition Grade 2 - Good		
Condition Score	2.09	Consequence Score	5.35
Risk Score	16.05	Likelihood Score	3.00

Photo	Photo Comment
	Dust and debris
	

St. Joseph Asset Condition Assessment Report

Asset Description	**Filter 4 Underdrains and media**	System	**Water Treatment Plant**
Asset Type	**FILTER**	Location	**Filter 4**
Asset ID	**1060**	Inspection Date	**7/22/2014**
Comments	**Trough supports severly corroded. New spray bar and piping**	Flag	

Question	Overriding?	Answer		NA	Flag	Answer Comment
Absence of Leaks		1	Yes			
All Components		1	Yes			
Conduit and Supports		5	Very Poor			Trough supports severly corroded.
Corrosion - Concrete		2	Staining			
Corrosion - Metal		5	Severe Pitting			Trough supports severly corroded.
Installation/Accessibility		1	Installed properly, easy to access			
Media Depth and Condition		1	Good Condition And Depth			
Meeting Production Efficiency		1	Meeting Production Efficiency			
Water Lines		1	Excellent			

Condition Category	Condition Grade 2 - Good		
Condition Score	2.00	Consequence Score	5.35
Risk Score	16.05	Likelihood Score	3.00

Photo	Photo Comment
	Typical off all supports

St. Joseph Asset Condition Assessment Report

Asset Description	**Filter 4 Valves**	System	**Water Treatment Plant**
Asset Type	**VALVE**	Location	**Filter 4**
Asset ID	**1058**	Inspection Date	**7/22/2014**
Comments	**Flange corrosion heavy, wery old actuators**	Flag	

Question	Overriding?	Answer		NA	Flag	Answer Comment
Absence of Leaks		1	Yes			
Actuator		5	Failure Imminent			Very old
Corrosion - Metal		5	Severe Pitting			
Flange Bolt Condition		5	Significant Corrosion, Missing Bolts			
Functional		1	Fully Opens/Closes, Without Assistance			
Pipe Alignment		1	Straight			
Support		5	Inadequate Support			Main pipe support corroded
Valve Isolates (Holds)		1	Yes			

Condition Category	Condition Grade 3 - Fair		
Condition Score	3.00	Consequence Score	5.35
Risk Score	21.40	Likelihood Score	4.00

Photo	Photo Comment
	Typical valve and actuator condition

St. Joseph Asset Condition Assessment Report

Asset Description	**Filter 4 Piping**	System	**Water Treatment Plant**
Asset Type	**PIPE**	Location	**Filter 4**
Asset ID	**1059**	Inspection Date	**7/22/2014**
Comments		Flag	

Question	Overriding?	Answer		NA	Flag	Answer Comment
Absence of Leaks		1	Yes			
Coating Condition		2	Minor Defects			
Corrosion - Metal		5	Severe Pitting			Flanges
Flange Bolt Condition		5	Significant Corrosion, Missing Bolts			
Instrumentation Operational		1	Yes			Very old
Insulation Condition				X		
Pipe Alignment		1	Straight			
Pipe Labeling/Color		1	Labeled And Color Coded			
Support		5	Inadequate Support			Main pipe supports corroded

Condition Category	Condition Grade 3 - Fair		
Condition Score	2.62	Consequence Score	5.35
Risk Score	21.40	Likelihood Score	4.00

Photo	Photo Comment
	Main pipe support corroded

St. Joseph Asset Condition Assessment Report

Asset Description	**High Service Pump # 1 (7 MGD) Pump**	System	**Water Treatment Plant**
Asset Type	**PUMP-CENT**	Location	**High Service Pumps**
Asset ID	**1136**	Inspection Date	**7/22/2014**
Comments	**Pump rebuilt in August 2003**	Flag	

Question	Overriding?	Answer		NA	Flag	Answer Comment
Absence of Cavitation		1	Yes			
Absence of Leaks		1	Yes			
Accessibility		2	Semi Restricted Access			
All Components		1	Yes			
All Safety Features Present		1	Yes			
Bearings	Yes	1	Excellent			12 BDU inner. 28 BDU outter
Check Valve		1	Opens, Closes, Seats, No Defects			
Corrosion - Metal		2	Minor Corrosion			
Corrosion - Visible Coating Condition		2	Minor Damage			
Gauges Operational		1	Yes			
Isolation Valves Operational		1	Yes			
Lubrication OK at Inspection		1	Yes			
Mounting		1	Securely mounted, well supported			
Obsolescence		1	Current, Supported			
Packing Gland		2	Normal			
Pipe Alignment		1	Straight			
Vibration by ISO Class	Yes	1	Green			.052 in/sec inner, .071 in/sec outter

Condition Category	Condition Grade 1 - Very good/New		
Condition Score	1.15	Consequence Score	6.85
Risk Score	19.18	Likelihood Score	2.80

Photo	Photo Comment
	

St. Joseph Asset Condition Assessment Report

Asset Description	**High Service Pump # 1 (7 MGD) Motor**	System	**Water Treatment Plant**
Asset Type	**MOTOR**	Location	**High Service Pumps**
Asset ID	**1135**	Inspection Date	**7/22/2014**
Comments	**Bearings sound bad (ultrasonic) and have high BDU numbers. No grease zerk on units. Not clear if these are sealed bearings or not.**	Flag	

Question	Overriding?	Answer		NA	Flag	Answer Comment
Acceptable Noise		5	No			Bearing noise high
Acceptable Oil/Grease	Yes	1	Yes			
Acceptable Smell or Heat		1	Yes			
All Components		1	Yes			
All Safety Features Present		1	Yes			
Bearings	Yes	4	Major Wear			119 BDU inner, 82 BDU otter
Coating Condition		1	Virtually No Defects			
Corrosion - Metal		1	Like New			
Mounting		1	Securely mounted, well supported			
Obsolescence		1	Current, Supported			
Oil Level Within Range				X		
Vibration by ISO Class	Yes	1	Green			.040 in/sec inner, .043 in/sec outter

Condition Category	Condition Grade 4 - Poor		
Condition Score	4.00	Consequence Score	6.85
Risk Score	39.73	Likelihood Score	5.80

Photo	Photo Comment
	

St. Joseph Asset Condition Assessment Report

Asset Description	**High Service Pump # 1 (7 MGD) VFD**	System	**Water Treatment Plant**
Asset Type	**VFD**	Location	**High Service Pumps**
Asset ID	**1134**	Inspection Date	**7/23/2014**
Comments	**No cooling for VFD. Line reactor cooling only.**	Flag	

Question	Overriding?	Answer		NA	Flag	Answer Comment
Acceptable Noise		1	Yes			
Acceptable Smell or Heat		1	Yes			
Accessibility		1	Open, Easy Access			
Adequate Ventilation		5	No			
Air Filter		1	Excellent			
All Safety Features Present		1	Yes			
Corrosion - Metal		1	Like New			
Display/Indicator Ok		1	Yes			
Good Housekeeping		1	Yes			
Installation/Accessibility/Enclosure		1	Excellent			
Obsolescence		1	Current, Supported			

Condition Category	Condition Grade 1 - Very good/New		
Condition Score	1.36	Consequence Score	6.85
Risk Score	19.18	Likelihood Score	2.80

St. Joseph Asset Condition Assessment Report

Asset Description	**High Service Pump # 2 (3 MGD) Pump**	System	**Water Treatment Plant**
Asset Type	**PUMP-CENT**	Location	**High Service Pumps**
Asset ID	**1139**	Inspection Date	**7/22/2014**
Comments	**1726 rpm Rebuilt in June 2007**	Flag	

Question	Overriding?	Answer		NA	Flag	Answer Comment
Absence of Cavitation		1	Yes			
Absence of Leaks		1	Yes			
Accessibility		1	Open, Easy Access			
All Components		1	Yes			
All Safety Features Present		1	Yes			
Bearings	Yes	1	Excellent			0 BDU inner, 24 BDU outter
Check Valve		1	Opens, Closes, Seats, No Defects			
Corrosion - Metal		2	Minor Corrosion			
Corrosion - Visible Coating Condition		2	Minor Damage			
Gauges Operational		1	Yes			
Isolation Valves Operational		1	Yes			
Lubrication OK at Inspection		1	Yes			
Mounting		1	Securely mounted, well supported			
Obsolescence		1	Current, Supported			
Packing Gland		2	Normal			
Pipe Alignment		1	Straight			
Vibration by ISO Class	Yes	1	Green			.031 in/sec inner. .025 in/sec outter

Condition Category	Condition Grade 1 - Very good/New		
Condition Score	1.12	Consequence Score	6.85
Risk Score	19.18	Likelihood Score	2.80

Photo	Photo Comment
	

St. Joseph Asset Condition Assessment Report

Asset Description	**High Service Pump # 2 (3 MGD) Motor**	System	**Water Treatment Plant**
Asset Type	**MOTOR**	Location	**High Service Pumps**
Asset ID	**1138**	Inspection Date	**7/22/2014**
Comments	**1726 rpm. Appears to have bad bearings based on BDU readings**	Flag	

Question	Overriding?	Answer		NA	Flag	Answer Comment
Acceptable Noise		5	No			Bearings have high noise (ultrasonic)
Acceptable Oil/Grease	Yes	5	No			Based on bearing noise and BDU
Acceptable Smell or Heat		1	Yes			
All Components		1	Yes			
All Safety Features Present		1	Yes			
Bearings	Yes	5	Failure Imminent			174 BDU inner, 148 BDU outter
Coating Condition		1	Virtually No Defects			
Corrosion - Metal		1	Like New			
Mounting		1	Securely mounted, well supported			
Obsolescence		1	Current, Supported			
Oil Level Within Range				X		
Vibration by ISO Class	Yes	1	Green			.038 in/sec inner, .024 in/sec outter

Condition Category	Condition Grade: 5-Very poor		
Condition Score	5.00	Consequence Score	6.85
Risk Score	50.00	Likelihood Score	7.30

Photo	Photo Comment
	

St. Joseph Asset Condition Assessment Report

Asset Description	**High Service Pump # 2 (3 MGD) VFD**	System	**Water Treatment Plant**
Asset Type	**VFD**	Location	**High Service Pumps**
Asset ID	**1137**	Inspection Date	**7/23/2014**
Comments	**No cooling for VFD. Line reactor cooling only.**	Flag	

Question	Overriding?	Answer		NA	Flag	Answer Comment
Acceptable Noise		1	Yes			
Acceptable Smell or Heat		1	Yes			
Accessibility		1	Open, Easy Access			
Adequate Ventilation		5	No			
Air Filter		1	Excellent			
All Safety Features Present		1	Yes			
Corrosion - Metal		1	Like New			
Display/Indicator Ok		1	Yes			
Good Housekeeping		1	Yes			
Installation/Accessibility/Enclosure		1	Excellent			
Obsolescence		1	Current, Supported			

Condition Category	Condition Grade 1 - Very good/New		
Condition Score	1.36	Consequence Score	6.85
Risk Score	19.18	Likelihood Score	2.80

St. Joseph Asset Condition Assessment Report

Asset Description	**High Service Pump # 3 (4 MGD) Pump**	System	**Water Treatment Plant**
Asset Type	**PUMP-CENT**	Location	**High Service Pumps**
Asset ID	**1142**	Inspection Date	**7/22/2014**
Comments	**Apparent bearing issue based on BDU numbers. rpm 1800. Pump rebuilt in June 2012**	Flag	

Question	Overriding?	Answer		NA	Flag	Answer Comment
Absence of Cavitation		1	Yes			
Absence of Leaks		1	Yes			
Accessibility		1	Open, Easy Access			
All Components		1	Yes			
All Safety Features Present		1	Yes			
Bearings	Yes	4	Major Wear			115 BDU inner, 102 BDU outter
Check Valve		1	Opens, Closes, Seats, No Defects			
Corrosion - Metal		2	Minor Corrosion			
Corrosion - Visible Coating Condition		2	Minor Damage			
Gauges Operational		1	Yes			
Isolation Valves Operational		1	Yes			
Lubrication OK at Inspection		1	Yes			
Mounting		1	Securely mounted, well supported			
Obsolescence		1	Current, Supported			
Packing Gland		5	Failure Imminent			No room for tightening left
Pipe Alignment		1	Straight			
Vibration by ISO Class	Yes	1	Green			.032 in/sec inner, .036 in/sec outter

Condition Category	Condition Grade 4 - Poor		
Condition Score	4.00	Consequence Score	6.85
Risk Score	39.73	Likelihood Score	5.80

Photo	Photo Comment
	

St. Joseph Asset Condition Assessment Report

Asset Description	**High Service Pump # 3 (4 MGD) Motor**	System	**Water Treatment Plant**
Asset Type	**MOTOR**	Location	**High Service Pumps**
Asset ID	**1141**	Inspection Date	**7/22/2014**
Comments	**1800 rpm.**	Flag	

Question	Overriding?	Answer		NA	Flag	Answer Comment
Acceptable Noise		1	Yes			
Acceptable Oil/Grease	Yes	1	Yes			
Acceptable Smell or Heat		1	Yes			
All Components		1	Yes			
All Safety Features Present		1	Yes			
Bearings	Yes	3	Moderate Wear			36 BDU inner, 57 BDU outter
Coating Condition		1	Virtually No Defects			
Corrosion - Metal		1	Like New			
Mounting		1	Securely mounted, well supported			
Obsolescence		3	Not Current, Support Available			Old motor
Oil Level Within Range		1	Yes			
Vibration by ISO Class	Yes	3	Orange			.168 in/sec inner, .207 in/sec outter

Condition Category	Condition Grade 3 - Fair		
Condition Score	3.00	Consequence Score	6.85
Risk Score	32.88	Likelihood Score	4.80

Photo	Photo Comment
	

St. Joseph Asset Condition Assessment Report

Asset Description	**High Service Pump # 3 (4 MGD) VFD**	System	**Water Treatment Plant**
Asset Type	**VFD**	Location	**High Service Pumps**
Asset ID	**1140**	Inspection Date	**7/23/2014**
Comments	**No cooling for VFD. Line reactor cooling only.**	Flag	

Question	Overriding?	Answer		NA	Flag	Answer Comment
Acceptable Noise		1	Yes			
Acceptable Smell or Heat		1	Yes			
Accessibility		1	Open, Easy Access			
Adequate Ventilation		5	No			
Air Filter		1	Excellent			
All Safety Features Present		1	Yes			
Corrosion - Metal		1	Like New			
Display/Indicator Ok		1	Yes			
Good Housekeeping		1	Yes			
Installation/Accessibility/Enclosure		1	Excellent			
Obsolescence		1	Current, Supported			

Condition Category	Condition Grade 1 - Very good/New		
Condition Score	1.36	Consequence Score	6.85
Risk Score	19.18	Likelihood Score	2.80

Photo	Photo Comment
	No cooling fans for VFD. Line reactor cooling only.

St. Joseph Asset Condition Assessment Report

Asset Description	**High Service Pump # 4 (5 MGD) Pump**	System	**Water Treatment Plant**
Asset Type	**PUMP-VERT**	Location	**High Service Pumps**
Asset ID	**1145**	Inspection Date	**7/22/2014**
Comments	**1720 rpm. Pump rebuilt May 2102**	Flag	

Question	Overriding?	Answer		NA	Flag	Answer Comment
Absence of Leaks		1	Yes			
Acceptable Noise		1	Yes			
Acceptable Oil/Grease	Yes	1	Yes			
Air Relief Valve		1	Excellent			
All Components		1	Yes			
All Safety Features Present		1	Yes			
Bearings	Yes	1	Excellent			
Corrosion - Metal		2	Minor Corrosion			On can
Installation		1	Excellent			
Isolation Valve		1	Excellent			
Obsolescence		1	Current, Supported			
Packing Gland/Mechanical Seal		2	Normal			Very little room left for tightening
Piping/Connections		1	No Leaks, Straight, Supported			

Condition Category	Condition Grade 1 - Very good/New		
Condition Score	1.15	Consequence Score	6.85
Risk Score	19.18	Likelihood Score	2.80

Photo	Photo Comment
	Packing gland almost homed out

St. Joseph Asset Condition Assessment Report

Asset Description	**High Service Pump # 4 (5 MGD) Motor**	System	**Water Treatment Plant**
Asset Type	**MOTOR**	Location	**High Service Pumps**
Asset ID	**1144**	Inspection Date	**7/22/2014**
Comments	**Appears to be water in the upper bearing oil reservoir. (Sapponification). Motor rebuilt May 2012.**	Flag	

Question	Overriding?	Answer		NA	Flag	Answer Comment
Acceptable Noise		1	Yes			
Acceptable Oil/Grease	Yes	5	No			Upper bearing saponnification
Acceptable Smell or Heat		1	Yes			
All Components		1	Yes			
All Safety Features Present		1	Yes			
Bearings	Yes	1	Excellent			38 BDU lower, 35 BDU upper
Coating Condition		1	Virtually No Defects			
Corrosion - Metal		1	Like New			
Mounting		1	Securely mounted, well supported			
Obsolescence		1	Current, Supported			
Oil Level Within Range		1	Yes			
Vibration by ISO Class	Yes	1	Green			.038 in/sec lower, .048 in/sec upper

Condition Category	Condition Grade: 5-Very poor		
Condition Score	5.00	Consequence Score	6.85
Risk Score	50.00	Likelihood Score	7.30

Photo	Photo Comment
	Sapponification

St. Joseph Asset Condition Assessment Report

Asset Description	**High Service Pump # 5 (5 MGD) Pump**	System	**Water Treatment Plant**
Asset Type	**PUMP-VERT**	Location	**High Service Pumps**
Asset ID	**1148**	Inspection Date	**7/22/2014**
Comments	**Pump could be run due to failed VFD. Partially evaluated**	Flag	

Question	Overriding?	Answer		NA	Flag	Answer Comment
Absence of Leaks				X		
Acceptable Noise				X		
Acceptable Oil/Grease	Yes	1	Yes			
Air Relief Valve		1	Excellent			
All Components		1	Yes			
All Safety Features Present		1	Yes			
Bearings	Yes			X		
Corrosion - Metal		2	Minor Corrosion			
Installation		1	Excellent			
Isolation Valve		1	Excellent			
Obsolescence		1	Current, Supported			
Packing Gland/Mechanical Seal				X		
Piping/Connections				X		

Condition Category	Condition Grade 1 - Very good/New		
Condition Score	1.12	Consequence Score	6.85
Risk Score	19.18	Likelihood Score	2.80

Photo	Photo Comment
	

St. Joseph Asset Condition Assessment Report

Asset Description	**High Service Pump # 5 (5 MGD) Motor**	System	**Water Treatment Plant**
Asset Type	**MOTOR**	Location	**High Service Pumps**
Asset ID	**1147**	Inspection Date	**7/22/2014**
Comments	**Could not run unit due to failed VFD. Motor rebuilt June 2012**	Flag	**Partially Evaluated**

Question	Overriding?	Answer		NA	Flag	Answer Comment
Acceptable Noise				X		
Acceptable Oil/Grease	Yes	1	Yes			
Acceptable Smell or Heat				X		
All Components		1	Yes			
All Safety Features Present		1	Yes			
Bearings	Yes			X		
Coating Condition		1	Virtually No Defects			
Corrosion - Metal		1	Like New			
Mounting		1	Securely mounted, well supported			
Obsolescence		1	Current, Supported			
Oil Level Within Range		1	Yes			
Vibration by ISO Class	Yes			X		

Condition Category	Condition Grade: 5-Very poor		
Condition Score	5.00	Consequence Score	6.85
Risk Score	50.00	Likelihood Score	7.30

Photo	Photo Comment
	

St. Joseph Asset Condition Assessment Report

Asset Description	**Vacuum Primer**	System	**Water Treatment Plant**
Asset Type	**COMPRESSOR-AIR**	Location	**High Service Pumps**
Asset ID	**1152**	Inspection Date	**7/22/2014**
Comments		Flag	

Question	Overriding?	Answer		NA	Flag	Answer Comment
Absence of Leaks		1	Yes			
Acceptable Noise		1	Yes			
Acceptable Smell or Heat		1	Yes			
Acceptable Vibration		1	Yes			
Air Dryer/Water Trap Operational		1	Operational, Good Condition			
Air Filter		1	Excellent			
All Components		1	Yes			
All Safety Features Present		1	Yes			
Control Gauges		1	Excellent			
Control Switches		1	Excellent			
Corrosion - Metal		1	Like New			
Mounting		1	Securely mounted, well supported			
Obsolescence		1	Current, Supported			
Pipe Alignment		1	Straight			
Piping/Connections		1	No Leaks, Straight, Supported			

Condition Category	Condition Grade 1 - Very good/New		
Condition Score	1.00	Consequence Score	6.85
Risk Score	19.18	Likelihood Score	2.80

Photo	Photo Comment
	

location	# Roll Up	location Total Weight	location Condition Score	location Total Score	location Consequence	location Likelihood
Backwash Reclaim Basin	4	4	1.09	2.87	2.05	1.40
Asset ID	**Asset Description**	**Attribute Weight**	**Condition Score**	**Total Score**	**Consequence**	**Likelihood**
1101	B.W. Reclaim Pump # 1	1	1.269	2.87	2.05	1.4
1103	B.W. Reclaim Pump # 2	1	1.077	2.87	2.05	1.4
1102	B.W. Reclaim Pump # 1 Motor	1	1	2.87	2.05	1.4
1104	B.W. Reclaim Pump # 2 Motor	1	1	2.87	2.05	1.4
Backwash System	6	6	1.25	18.70	8.50	2.20
Asset ID	**Asset Description**	**Attribute Weight**	**Condition Score**	**Total Score**	**Consequence**	**Likelihood**
1093	B.W. Pump # 1 (VFD)	1	1.364	18.7	8.5	2.2
1096	B.W. Pump # 2 (VFD)	1	1.364	18.7	8.5	2.2
1095	B.W. Pump # 1 Pump	1	1.269	18.7	8.5	2.2
1097	B.W. Pump # 2 Motor	1	1.25	18.7	8.5	2.2
1094	B.W. Pump # 1 Motor	1	1.167	18.7	8.5	2.2
1098	B.W. Pump # 2 Pump	1	1.115	18.7	8.5	2.2
Cleveland Booster Station	10	10	1.68	11.76	4.90	2.40
Asset ID	**Asset Description**	**Attribute Weight**	**Condition Score**	**Total Score**	**Consequence**	**Likelihood**
1188	Booster Pump Motor 2	1	3	18.62	4.9	3.8
1189	Booster Pump Motor 3	1	3	18.62	4.9	3.8
1190	Booster Pump Motor 1	1	3	18.62	4.9	3.8
1194	PIPE	1	1.333	8.82	4.9	1.8
1187	Booster Pump 3	1	1.192	8.82	4.9	1.8
1185	Booster Pump 1	1	1.115	8.82	4.9	1.8
1186	Booster Pump 2	1	1.115	8.82	4.9	1.8
1191	Booster Pump VFD 1	1	1	8.82	4.9	1.8
1192	Booster Pump VFD 2	1	1	8.82	4.9	1.8
1193	Booster Pump VFD 3	1	1	8.82	4.9	1.8
Filter 1	4	4	2.26	17.39	5.35	3.25
Asset ID	**Asset Description**	**Attribute Weight**	**Condition Score**	**Total Score**	**Consequence**	**Likelihood**
1047	Filter 1 Piping	1	2.75	21.4	5.35	4
1046	Filter 1 Valves	1	2.375	16.05	5.35	3
1048	Filter 1 Underdrains and media	1	2	16.05	5.35	3
1045	Filter 1 and 2 Control Panel	1	1.909	16.05	5.35	3
Filter 2	3	3	2.42	19.62	5.35	3.67
Asset ID	**Asset Description**	**Attribute Weight**	**Condition Score**	**Total Score**	**Consequence**	**Likelihood**
1050	Filter 2 Valves	1	2.75	21.4	5.35	4
1051	Filter 2 Piping	1	2.5	21.4	5.35	4
1052	Filter 2 Underdrains and media	1	2	16.05	5.35	3
Filter 3	4	4	2.24	17.39	5.35	3.25
Asset ID	**Asset Description**	**Attribute Weight**	**Condition Score**	**Total Score**	**Consequence**	**Likelihood**
1055	Filter 3 Piping	1	2.625	21.4	5.35	4
1054	Filter 3 Valves	1	2.25	16.05	5.35	3
1053	Filter 3 and 4 Control Panel	1	2.091	16.05	5.35	3
1056	Filter 3 Underdrains and media	1	2	16.05	5.35	3
Filter 4	3	3	2.54	19.62	5.35	3.67
Asset ID	**Asset Description**	**Attribute Weight**	**Condition Score**	**Total Score**	**Consequence**	**Likelihood**
1058	Filter 4 Valves	1	3	21.4	5.35	4
1059	Filter 4 Piping	1	2.625	21.4	5.35	4
1060	Filter 4 Underdrains and media	1	2	16.05	5.35	3
High Service Pumps	14	14	2.55	29.70	6.85	4.34
Asset ID	**Asset Description**	**Attribute Weight**	**Condition Score**	**Total Score**	**Consequence**	**Likelihood**
1138	High Service Pump # 2 (3 MGD) Motor	1	5	50.005	6.85	7.3
1144	High Service Pump # 4 (5 MGD) Motor	1	5	50.005	6.85	7.3
1147	High Service Pump # 5 (5 MGD) Motor	1	5	50.005	6.85	7.3
1135	High Service Pump # 1 (7 MGD) Motor	1	4	39.73	6.85	5.8
1142	High Service Pump # 3 (4 MGD) Pump	1	4	39.73	6.85	5.8
1141	High Service Pump # 3 (4 MGD) Motor	1	3	32.88	6.85	4.8
1134	High Service Pump # 1 (7 MGD) VFD	1	1.364	19.18	6.85	2.8
1137	High Service Pump # 2 (3 MGD) VFD	1	1.364	19.18	6.85	2.8
1140	High Service Pump # 3 (4 MGD) VFD	1	1.364	19.18	6.85	2.8
1136	High Service Pump # 1 (7 MGD) Pump	1	1.154	19.18	6.85	2.8
1145	High Service Pump # 4 (5 MGD) Pump	1	1.154	19.18	6.85	2.8
1148	High Service Pump # 5 (5 MGD) Pump	1	1.125	19.18	6.85	2.8
1139	High Service Pump # 2 (3 MGD) Pump	1	1.115	19.18	6.85	2.8
1152	Vacuum Primer	1	1	19.18	6.85	2.8
Hilltop Booster Station	7	7	1.92	12.77	3.25	3.93
Asset ID	**Asset Description**	**Attribute Weight**	**Condition Score**	**Total Score**	**Consequence**	**Likelihood**
1180	Booster Pump Motor 1	1	5	24.375	3.25	7.5
1181	Booster Pump Motor 2	1	3	16.25	3.25	5
1184	Piping System	1	1.222	9.75	3.25	3

location		# Roll Up	location Total Weight	location Condition Score	location Total Score	location Consequence	location Likelihood
1178	Booster Pump 1		1	1.115	9.75	3.25	3
1179	Booster Pump 2		1	1.115	9.75	3.25	3
1182	Booster Pump VFD 1		1	1	9.75	3.25	3
1183	Booster Pump VFD 2		1	1	9.75	3.25	3

Asset Type **PUMP-VERT**

Question	Condition Weight	Overriding?	Answer	
Absence of Leaks	1.00			
			1	Yes
			5	No
Acceptable Noise	1.00			
			1	Yes
			5	No
Acceptable Oil/Grease	1.00	Yes		
			1	Yes
			5	No
Air Relief Valve	1.00			
			1	Excellent
			3	Maintenance Required
			5	Failure Imminent
All Components	1.00			
			1	Yes
			5	No
All Safety Features Present	1.00			
			1	Yes
			5	No
Bearings	1.00	Yes		
			1	Excellent
			2	Minor Wear
			3	Moderate Wear
			4	Major Wear
			5	Failure Imminent
Corrosion - Metal	1.00			
			1	Like New
			2	Minor Corrosion
			3	Pitting And Some Metal Loss
			4	Significant Metal Loss
			5	Severe Pitting
Installation	1.00			
			1	Excellent
			2	Normal
			3	Minor Obstruction
			4	Moderate Obstruction
			5	Severe Obstruction
Isolation Valve	1.00			
			1	Excellent
			2	Minor Defects But Will Isolate
			3	Moderate Deterioration
			4	Major Maintenance Required
			5	Inadequate Or Failure Imminent

Question	Condition Weight	Overriding?	Answer	
Obsolescence	1.00			
			1	Current, Supported
			3	Not Current, Support Available
			5	Obsolete, Not Supported
Packing Gland/Mechanical Seal	1.00			
			1	Excellent
			2	Normal
			3	Maintenance Overdue
			4	Maintenance Required
			5	Failure Imminent
Piping/Connections	1.00			
			1	No Leaks, Straight, Supported
			2	No Leaks, Minor Deviation
			3	Seepage At Joints, Minor Deviation
			4	Some Leaks At Runs And Joints
			5	Failure Imminent

Asset Type **VALVE**

Question	Condition Weight	Overriding?	Answer	
Absence of Leaks	1.00			
			1	Yes
			5	No
Actuator	1.00			
			1	Excellent
			2	Minor Leaks
			3	Moderate Leaks
			4	Major Leaks
			5	Failure Imminent
Corrosion - Metal	1.00			
			1	Like New
			2	Minor Corrosion
			3	Pitting And Some Metal Loss
			4	Significant Metal Loss
			5	Severe Pitting
Flange Bolt Condition	1.00			
			1	Like New
			2	Normal
			3	Minor Corrosion
			4	Moderate Corrosion
			5	Significant Corrosion, Missing Bolts
Functional	1.00			
			1	Fully Opens/Closes, Without Assistance
			2	Fully Opens/Closes With Some Assistance
			3	Opens/Closes With Extra Assistance, May Not Hold
			4	Requires Additional Tools To Open/Close, Leaks
			5	Siezed, Binded
Pipe Alignment	1.00			
			1	Straight
			2	Minor Deviation
			3	Moderate Deviation
			4	Major Deviation
			5	Severe Deviation
Support	1.00			
			1	Properly Supported
			3	Minor Adjustments Needed
			5	Inadequate Support
Valve Isolates (Holds)	1.00			
			1	Yes
			5	No

Asset Type **VFD**

Question	Condition Weight	Overriding?	Answer	
Acceptable Noise	1.00			
			1	Yes
			5	No
Acceptable Smell or Heat	1.00			
			1	Yes
			5	No
Accessibility	1.00			
			1	Open, Easy Access
			2	Semi Restricted Access
			3	Restricted Access
			4	Very Difficult To Access
			5	Extremely Difficult To Access
Adequate Ventilation	1.00			
			1	Yes
			5	No
Air Filter	1.00			
			1	Excellent
			2	Slight Accumulation
			3	Partially Clogged
			4	Significant Accumulation
			5	Inadequate, Failure Imminent
All Safety Features Present	1.00			
			1	Yes
			5	No
Corrosion - Metal	1.00			
			1	Like New
			2	Minor Corrosion
			3	Pitting And Some Metal Loss
			4	Significant Metal Loss
			5	Severe Pitting
Display/Indicator Ok	1.00			
			1	Yes
			5	No
Good Housekeeping	1.00			
			1	Yes
			5	No
Installation/Accessibility/Enclosure	1.00			
			1	Excellent
			2	Good
			3	Minor Problems
			4	Major Problems
			5	Inaccessible
Obsolescence	1.00			
			1	Current, Supported

Question	Condition Weight	Overriding?	Answer	
			3	Not Current, Support Available
			5	Obsolete, Not Supported

Asset Type **COMPRESSOR-AIR**

Question	Condition Weight	Overriding?	Answer	
Absence of Leaks	1.00			
			1	Yes
			5	No
Acceptable Noise	1.00			
			1	Yes
			5	No
Acceptable Smell or Heat	1.00			
			1	Yes
			5	No
Acceptable Vibration	1.00			
			1	Yes
			5	No
Air Dryer/Water Trap Operational	1.00			
			1	Operational, Good Condition
			3	Operational. Some Repairs Needed
			5	Non-Operational
Air Filter	1.00			
			1	Excellent
			2	Slight Accumulation
			3	Partially Clogged
			4	Significant Accumulation
			5	Inadequate, Failure Imminent
All Components	1.00			
			1	Yes
			5	No
All Safety Features Present	1.00			
			1	Yes
			5	No
Control Gauges	1.00			
			1	Excellent
			2	Good
			3	Operational
			4	Failure Eminent
			5	Failure
Control Switches	1.00			
			1	Excellent
			3	Installed, Minor Problem
			5	Not Functional/Missing
Corrosion - Metal	1.00			
			1	Like New
			2	Minor Corrosion
			3	Pitting And Some Metal Loss

Question	Condition Weight	Overriding?	Answer	
			4	Significant Metal Loss
			5	Severe Pitting
Mounting	1.00			
			1	Securely mounted, well supported
			2	Well mounted, but some hardware loose or missing
			3	Minor issues with mounting or support
			4	Requires Maintenance
			5	Improperly mounted or not secured
Obsolescence	1.00			
			1	Current, Supported
			3	Not Current, Support Available
			5	Obsolete, Not Supported
Pipe Alignment	1.00			
			1	Straight
			2	Minor Deviation
			3	Moderate Deviation
			4	Major Deviation
			5	Severe Deviation
Piping/Connections	1.00			
			1	No Leaks, Straight, Supported
			2	No Leaks, Minor Deviation
			3	Seepage At Joints, Minor Deviation
			4	Some Leaks At Runs And Joints
			5	Failure Imminent

Asset Type **CONTROL PANEL**

Question	Condition Weight	Overriding?	Answer	
Acceptable Noise	1.00			
			1	Yes
			5	No
Acceptable Smell or Heat	1.00			
			1	Yes
			5	No
Access Doors	1.00			
			1	Excellent
			2	Normal
			3	Requires Maintenance
			4	Requires Extensive Maintenance
			5	Failure Imminent
All Components	1.00			
			1	Yes
			5	No
All Safety Features Present	1.00			
			1	Yes
			5	No
Control Lamps	1.00			
			1	Excellent
			2	Good
			3	Operational
			4	Failure Imminent
			5	Failure
Control Switches	1.00			
			1	Excellent
			3	Installed, Minor Problem
			5	Not Functional/Missing
Corrosion - Metal	1.00			
			1	Like New
			2	Minor Corrosion
			3	Pitting And Some Metal Loss
			4	Significant Metal Loss
			5	Severe Pitting
Good Housekeeping	1.00			
			1	Yes
			5	No
Installation/Accessibility	1.00			
			1	Installed properly, easy to access
			2	Installed properly, minor access obstructions
			3	Minor installation problems, minor access obstructions
			4	Minor installation problems, access obstructed

Question	Condition Weight	Overriding?	Answer	
			5	Improperly installed, access obstructed
Obsolescence	1.00			
			1	Current, Supported
			3	Not Current, Support Available
			5	Obsolete, Not Supported

Asset Type **FILTER**

Question	Condition Weight	Overriding?	Answer	
Absence of Leaks	1.00			
			1	Yes
			5	No
All Components	1.00			
			1	Yes
			5	No
Conduit and Supports	1.00			
			1	Very Good
			2	Good
			3	Average
			4	Poor
			5	Very Poor
Corrosion - Concrete	1.00			
			1	Like New Condition
			2	Staining
			3	Exposed Aggregate
			4	Spalling/Exposed Steel
			5	Severe Spalling/Corrosion
Corrosion - Metal	1.00			
			1	Like New
			2	Minor Corrosion
			3	Pitting And Some Metal Loss
			4	Significant Metal Loss
			5	Severe Pitting
Installation/Accessibility	1.00			
			1	Installed properly, easy to access
			2	Installed properly, minor access obstructions
			3	Minor installation problems, minor access obstructions
			4	Minor installation problems, access obstructed
			5	Improperly installed, access obstructed
Media Depth and Condition	1.00			
			1	Good Condition And Depth
			3	Moderate Condition Or Depth
			5	Dirty Or Loss Of Media
Meeting Production Efficiency	1.00			
			1	Meeting Production Efficiency
			3	Frequently Not Meeting Production Efficiency
			5	Unable To Meet Production Efficiency
Water Lines	1.00			
			1	Excellent
			3	Maintenance Required
			5	Failure Imminent

Asset Type **MOTOR**

Question	Condition Weight	Overriding?	Answer	
Acceptable Noise	1.00			
			1	Yes
			5	No
Acceptable Oil/Grease	1.00	Yes		
			1	Yes
			5	No
Acceptable Smell or Heat	1.00			
			1	Yes
			5	No
All Components	1.00			
			1	Yes
			5	No
All Safety Features Present	1.00			
			1	Yes
			5	No
Bearings	1.00	Yes		
			1	Excellent
			2	Minor Wear
			3	Moderate Wear
			4	Major Wear
			5	Failure Imminent
Coating Condition	1.00			
			1	Virtually No Defects
			2	Minor Defects
			3	Moderate Defects
			4	Significant Defects
			5	Complete Coating Failure
Corrosion - Metal	1.00			
			1	Like New
			2	Minor Corrosion
			3	Pitting And Some Metal Loss
			4	Significant Metal Loss
			5	Severe Pitting
Mounting	1.00			
			1	Securely mounted, well supported
			2	Well mounted, but some hardware loose or missing
			3	Minor issues with mounting or support
			4	Requires Maintenance
			5	Improperly mounted or not secured
Obsolescence	1.00			
			1	Current, Supported
			3	Not Current, Support Available
			5	Obsolete, Not Supported

Question	Condition Weight	Overriding?	Answer	
Oil Level Within Range	1.00			
			1	Yes
			5	No
Vibration by ISO Class	1.00	Yes		
			1	Green
			3	Orange
			5	Red

Asset Type **PIPE**

Question	Condition Weight	Overriding?	Answer	
Absence of Leaks	1.00			
			1	Yes
			5	No
Coating Condition	1.00			
			1	Virtually No Defects
			2	Minor Defects
			3	Moderate Defects
			4	Significant Defects
			5	Complete Coating Failure
Corrosion - Metal	1.00			
			1	Like New
			2	Minor Corrosion
			3	Pitting And Some Metal Loss
			4	Significant Metal Loss
			5	Severe Pitting
Flange Bolt Condition	1.00			
			1	Like New
			2	Normal
			3	Minor Corrosion
			4	Moderate Corrosion
			5	Significant Corrosion, Missing Bolts
Instrumentation Operational	1.00			
			1	Yes
			5	No
Insulation Condition	1.00			
			1	Good
			3	Minor Damage
			5	Failure Imminent
Pipe Alignment	1.00			
			1	Straight
			2	Minor Deviation
			3	Moderate Deviation
			4	Major Deviation
			5	Severe Deviation
Pipe Labeling/Color	1.00			
			1	Labeled And Color Coded
			3	Some Missing Labels Or Not Color Coded
			5	Not Labeled, Not Color Coded
Support	1.00			
			1	Properly Supported
			3	Minor Adjustments Needed
			5	Inadequate Support

Asset Type **PUMP-CENT**

Question	Condition Weight	Overriding?	Answer	
Absence of Cavitation	1.00			
			1	Yes
			5	No
Absence of Leaks	1.00			
			1	Yes
			5	No
Accessibility	1.00			
			1	Open, Easy Access
			2	Semi Restricted Access
			3	Restricted Access
			4	Very Difficult To Access
			5	Extremely Difficult To Access
All Components	1.00			
			1	Yes
			5	No
All Safety Features Present	1.00			
			1	Yes
			5	No
Bearings	1.00	Yes		
			1	Excellent
			2	Minor Wear
			3	Moderate Wear
			4	Major Wear
			5	Failure Imminent
Check Valve	1.00			
			1	Opens, Closes, Seats, No Defects
			3	Opens, Closes, Seats, Minor Defects
			5	Opens, Closes, Leaks, Doesn't Seat
Corrosion - Metal	1.00			
			1	Like New
			2	Minor Corrosion
			3	Pitting And Some Metal Loss
			4	Significant Metal Loss
			5	Severe Pitting
Corrosion - Visible Coating Condition	1.00			
			1	Like New
			2	Minor Damage
			3	Damaged
			4	Significant Damage
			5	Severely Damaged
Gauges Operational	1.00			
			1	Yes
			5	No

Question	Condition Weight	Overriding?	Answer	
Isolation Valves Operational	1.00			
			1	Yes
			5	No
Lubrication OK at Inspection	1.00			
			1	Yes
			5	No
Mounting	1.00			
			1	Securely mounted, well supported
			2	Well mounted, but some hardware loose or missing
			3	Minor issues with mounting or support
			4	Requires Maintenance
			5	Improperly mounted or not secured
Obsolescence	1.00			
			1	Current, Supported
			3	Not Current, Support Available
			5	Obsolete, Not Supported
Packing Gland	1.00			
			1	Excellent
			2	Normal
			3	Maintenance Overdue
			4	Maintenance Required
			5	Failure Imminent
Pipe Alignment	1.00			
			1	Straight
			2	Minor Deviation
			3	Moderate Deviation
			4	Major Deviation
			5	Severe Deviation
Vibration by ISO Class	10.00	Yes		
			1	Green
			3	Orange
			5	Red