Draft Engineering Report

Water Quality Improvement Project

Prepared for

Oak Creek Water and Sewer Utility

Oak Creek, Wisconsin

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SECTION 1

Introduction

1.1 Background

The Oak Creek Water and Sewer Utility (the Utility) provides retail drinking water service to the City of Oak Creek. Drinking water is sold wholesale to the City of Franklin as well as to the Caledonia Utility District.

The source of drinking water is Lake Michigan. A pump station near the lake conveys raw water to the Oak Creek water treatment plant. Water is treated in a conventional surface water treatment plant with a treatment process capacity of 35 million gallons per day (mgd). The filtered water passes through a baffled chlorine contact tank (CT tank) before being pumped to customers.

The original water treatment plant is 43 years old. Many facilities have original equipment, including the high lift pump station, electrical gear and CT tank. The water plant does not have any advanced treatment technologies beyond conventional coagulation, flocculation, settling, filtration and chlorine disinfection, but all current drinking water quality regulations are being met.

In a 2008 email, the Wisconsin Department of Natural Resources (WDNR) has stated that the CT tank does not meet current codes (NR 811), and that this must be addressed within 10 years (by 2018). In the 2012 WDNR Sanitary Survey of the water plant, these same non-compliant Code issues were included. WDNR recommended that ultraviolet light (UV) disinfection be considered in the 2012 Sanitary Survey. In the 2016 WDNR Sanitary Survey of the water plant, the WDNR gave the Utility until December 31, 2020 to correct the Code non-compliance issues of the CT tank.

There is no finished water storage at the water plant, which reduces water service reliability and increases operational complexity. It is highly unusual for a surface water treatment plant to have no storage, especially the size of the Oak Creek plant.

The primary drivers for this project include:

- Protection of public health. Nearly all other surface water treatment plants in Wisconsin have an advanced treatment barrier for pathogens such as *Cryptosporidium*. Oak Creek does not. In addition, the CT tank and high lift pump station wet well do not comply with WDNR Codes and present a public health risk.
- Improvement of customer service reliability. Lack of storage increases the chance of customer service interruption, especially when the plant is at reduced flows or out of service. No storage also reduces operational flexibility to optimize water quality and energy. Reliable pumps and electrical gear are also essential for maintaining customer service.
- Replacement of aging infrastructure. Some of the finished water pumps (high lift) are over 40 years old, beyond their expected useful life. High voltage electrical equipment is obsolete and spare parts are unavailable. This old electrical equipment does not meet current safety codes. These issues create reliability and safety concerns.

1.2 Project Description

An engineering study to evaluate water treatment plant deficiencies described above was completed in September 2014 (Chlorine Contact Tank and Storage Evaluation, CH2M HILL). The study describes the evaluation of alternatives to replace aging infrastructure (pumps, electrical equipment), protect public health (advanced treatment, replacement of original CT tank), and maintain customer service reliability (storage at the plant).

The engineering study recommended the following water treatment plant improvements:

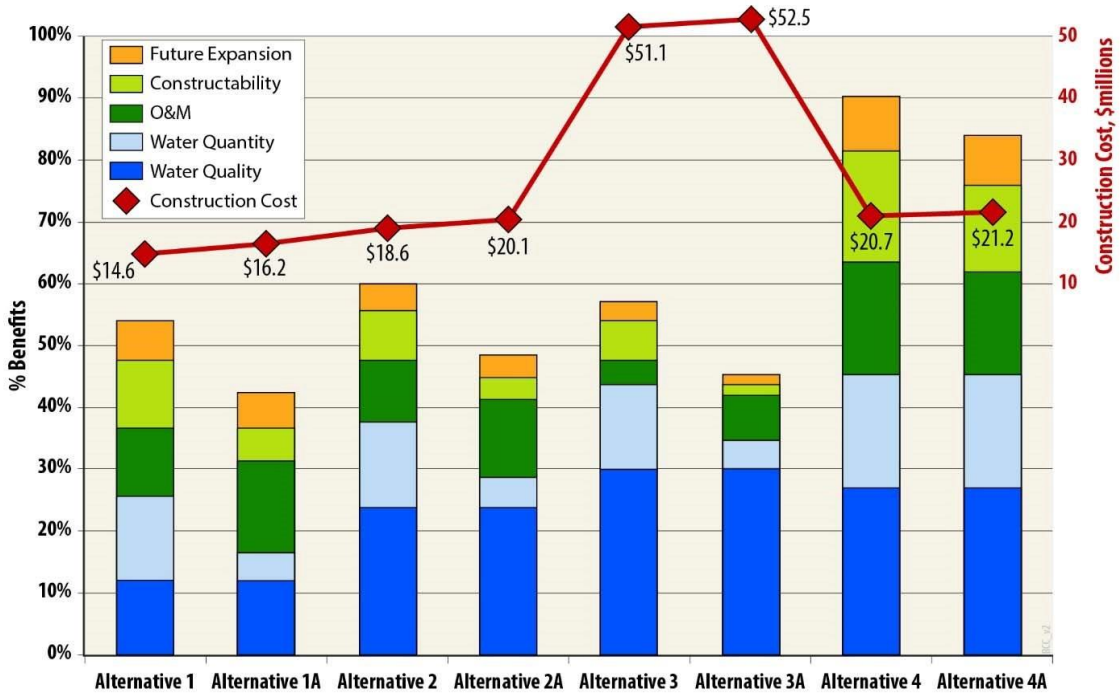
- A new above ground CT tank complying with WDNR Codes. This tank will replace the existing non-compliant CT tank that does not meet WDNR Codes, and perform double duty as a finished water storage tank.
- A new intermediate pump station (IPS) to convey filtered water to the new CT/storage tank. This pump station is required for the new CT/storage tank based on hydraulics and groundwater levels at the plant.
- A UV disinfection facility to provide a Cryptosporidium barrier for public health protection. The UV facility is integrated with the IPS to take advantage of the pumping hydraulics and provide a cost effective facility. In addition, using UV as an additional disinfectant allows the CT/storage tank to be smaller because it does not have to provide as much chlorine contact time. UV does not produce disinfection byproducts, and can help reduce the formation of chlorinated disinfection byproducts.
- A new high lift pump station (HLPS) to replace the existing 43-year-old pump station. A new HLPS would be required anyway with the new above ground CT/storage tank because the existing HLPS and pumps were not designed to work with above ground tanks. In addition, the existing HLPS wet well is below groundwater and not in compliance with WDNR Codes (similar issues as the old CT tank). The existing HLPS will be re-used as an electrical room, and some piping and valves will be re-used for backup filter backwashing.
- New electrical gear to replace aging, obsolete equipment that does not meet safety requirements.

Additional details for each of these facilities are provided in this report.

Since 2014, the initial size of the project was reduced from 30 mgd to 20 mgd based on a supplemental water demand study required by the Public Service Commission. This reduction in size does not change the project drivers, needs, or the relative costs and benefit ranking between the alternatives. Therefore, the recommendations in the Chlorine Contact Tank and Storage Evaluation report remain valid. A summary graph of costs and benefits from the Chlorine Contact Tank and Storage Evaluation report is shown in Exhibit 1-1. Alternative 4 was selected for this project because it provided significantly more benefits for the cost. Even if the Future Expansion criteria were eliminated, Alternative 4 would be the highest ranked alternative.

EXHIBIT 1-1

Alternatives Analysis Cost Benefit Summary

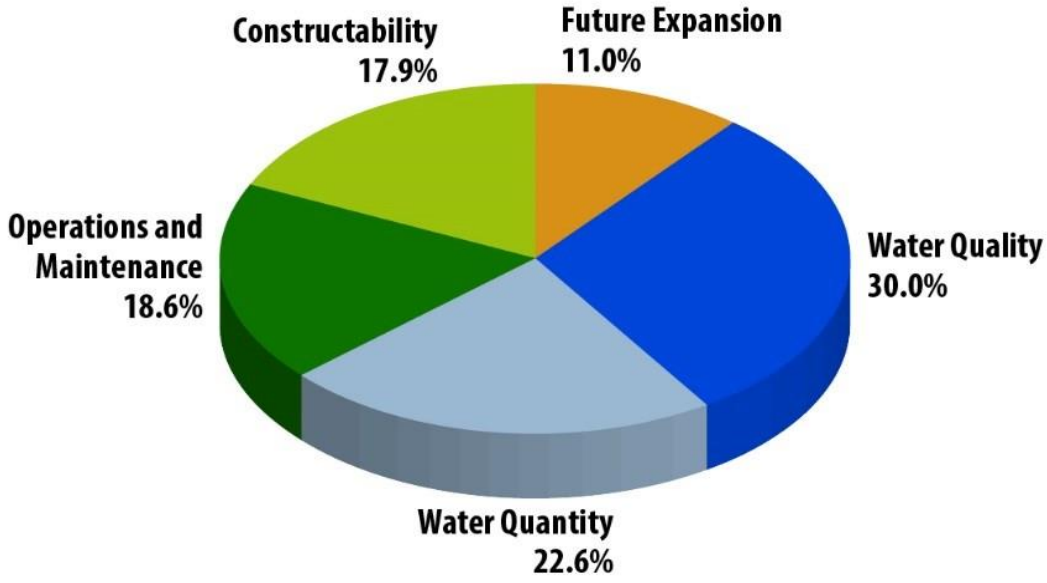


Team members from the Utility, CH2M, and WDNR determined the criteria to be used to evaluate the alternatives. The five criteria (benefits) used to compare alternatives are described below.

- **Water Quality—**Improvement in water quality and public health protection. Meeting current and future drinking water regulations.
- **Water Quantity—** Elimination of hydraulic bottlenecks. The ability to provide increased capacity now or in the future for the current service area.
- **Operation and Maintenance—**Ease and complexity of O&M. Flexibility to take facilities off line. Improving the reliability of the water production system. Eliminating single points of failure.
- **Constructability—**Ease of construction and ability to keep the existing plant operational during construction. Number of tie-ins to existing facilities. Sequencing of construction required.
- **Future Expansion—** Land area available and ease of expanding facilities. The ability to provide increased capacity in the future for new customers not in the existing service area.

This same team then determined the importance of each of the criteria. The relative importance of each criteria is shown in Exhibit 1-2.

EXHIBIT 1-2
Alternatives Analysis Criteria Relative Importance



1.3 Project Goals

1.3.1 Water Quality

The Utility has always provided excellent water quality. Providing excellent water quality at reasonable rates is a goal of the Utility. Reaching the ”Excellence in Water Treatment” award in the American Water Works Association (AWWA) Partnership for Safe Water program is also a goal. This award signifies a fully optimized treatment plant.

This project improves water quality by eliminating an underground CT tank that does not meet WDNR codes and replacing it with an above ground CT/storage tank meeting all WDNR codes. The non-compliant Code issues include:

- Groundwater is above the bottom floor of the CT tank. NR 811.63 (4) requires that the tank floor be at least 2 feet above groundwater level.

- The piping leaving the CT tank and entering the existing HLPS is under pressure less than water at ground elevation, which would violate NR 811.37.
- There is no overflow, as required by Wisconsin Administrative code NR 811.64 (4).
- The tank roof is below grade. NR 811. 63 (6) requires that the roof be 2 feet above grade.
- The tank roof does not have a flexible membrane covering, per NR 811.64.10 (e).
- The tank cannot be taken out of service for inspection or repair without stopping water treatment, since all flow must go through the tank for disinfection. NR 810.14 requires inspection every 5 years, and the tank must be emptied and inspected at least once every 10 years.

The first three non-compliant Code issues above also apply to the existing HLPS wet well. Adding UV disinfection provides a *Cryptosporidium* barrier and second pathogen barrier to chlorine to better protect public health. Higher doses of UV can also be effective in destroying algal toxins.

1.3.2 Customer Satisfaction

Customer satisfaction is the ultimate goal of the Utility. This project will provide an additional pathogen barrier in UV, strengthen the chlorine disinfection barrier with new baffled CT/storage tank, and upgrade essential pumping and electrical facilities for increased reliability. Maintaining customer confidence, providing water at reasonable rates, and proactively communicating the value of water to the community is extremely important.

1.3.3 Operations and Maintenance

Equipment with high reliability and low maintenance is required to continue efficiently running the plant with minimal staff additions. The high lift pumping equipment for this project will replace older pumps with a smaller number of new pumps that will require less maintenance. The new above ground CT/storage tank will have fewer maintenance issues than the 43-year-old underground CT tank. The new CT/storage tank will also have the capability of being taken out of service for WDNR Code required inspections and maintenance. The old CT tank does not have this capability. An additional IPS and UV facility will add new equipment that must be operated and maintained.

1.3.4 Reliable Customer Service

No interruptions in water production is another goal of this project. Having usable storage at the water plant will provide much more reliability and operational flexibility if the treatment processes need to be shut down for a short period. During the 2008 water plant expansion project, the plant needed to be shut down for a short period of time to install critical pipes. This took months of planning, considerable cost and created high risk of service interruption. Providing storage at the water plant avoids these risk and cost issues. The new CT/storage tank will be designed so that it can be taken out of service for required WDNR inspections without shutting down the entire water plant. This was not possible with the old CT tank.

The new electrical equipment and backup generator will improve reliability and the ability to continuously provide potable water. With a second backup natural gas generator at the water plant, the water plant can produce 20 mgd using both generators (about 2 megawatts (MW) of power) in the event of a power outage. If additional backup electrical generation capacity is needed in the future when water demands are higher, another generator needs to be added.

Buried piping connecting water plant facilities is more reliable with this project, as existing single points of failure are eliminated. This also avoids a plant shut down for repairs.

1.3.5 Water Demand Projections

Several water demand projections were completed in 2015 and 2016. As ordered by the Public Service Commission (PSC), a water demand study was completed in 2016 (CDM Smith). This study estimated a maximum day water demand of up to 22 mgd in year 2040 for the current service area, and a maximum day demand of up to 35 mgd in year 2040 if a new customer (Waukesha, WI) were to purchase Oak Creek water.

1.3.6 Water Plant Capacity

This project does not increase water plant treatment or pumping capacity. Pre-treatment and filtration capacity will remain at 35 mgd, based on WDNR approval of increased rates through the treatment processes in 2011. The proposed pumping capacity in this project of 20 mgd is less than the current high lift pumping capacity of about 22 mgd. The new facilities in this project are designed for expansion up to 36 mgd to meet future water demands by replacing all pumps with larger pumps, and adding one new IPS pump, one new HLPS pumps and one UV reactor.

This project is about public health protection, safety and reliable customer service through replacement of aging infrastructure.

1.3.7 Regulatory and Future Considerations

The goal is to meet all regulations during and after this project. Sampling requirements of the Long-Term 2 Enhanced Surface Water Treatment Rule may affect disinfection requirements, depending on *Cryptosporidium* sampling results. The addition of UV disinfection will provide an additional *Cryptosporidium* barrier and position the Utility to meet potential stricter disinfection or disinfection byproduct regulations. All but one other Lake Michigan water utility in Wisconsin has implemented a *Cryptosporidium* barrier, and that utility is planning to install a *Cryptosporidium* barrier.

The new CT/storage tank will be baffled and able to provide chlorine contact time to meet current disinfection regulations. It can also serve as backup disinfection in case the UV facility is out of service.

Potential future water quality issues may include algal toxins, contaminants of emerging concern, new or lower disinfection byproducts and future regulated microorganisms. The U.S. Environmental Protection Agency (USEPA) Candidate Contaminant List contains some of these items. The Utility is well positioned to deal with future water quality regulations with the following provisions built into the water plant design:

- Provisions to add ozone as a strong oxidant for organic contaminants and taste and odor.
- Provisions to add granular activated carbon (GAC) in the existing filters or adsorb organics.
- Provisions to increase UV dose in the future by adding more lamps or additional reactors.

1.4 Permits

The following permits will be applied for:

- WDNR permit to construct
- PSC permit to construct
- Oak Creek Planning Commission approval
- Oak Creek Building permits including stormwater control, plumbing, electrical, fire protection, and building codes.

Detailed descriptions of the building codes are in Sections 4.4, 5.2 and 8.4 of this report.

The project construction site is in areas that have been previously disturbed. There are no endangered or threatened species. There are no archeological or historical resources on the construction site.

Contaminated soil was discovered on a portion of the site during the geotechnical investigation. A WDNR approved plan to handle this soil is incorporated into the design documents.

1.5 Schedule

Construction contract documents are planned to be ready for review by WDNR and PSC in February, 2017. Once a contract is awarded to a construction contractor, construction is anticipated to take about 2.5 years. There is a specific sequence of construction that needs to be followed to maintain customer water service, including building new facilities and making them operational before certain rehabilitation work on the

existing high lift pump station is done. Construction of the new facilities (Intermediate pump station, UV disinfection, CT/storage tank, high lift pump station) can proceed without interrupting production of water from the existing plant. Once the new facilities are constructed and operational, the existing high lift pump station can be renovated and the remainder of the electrical gear installed in the old high lift pump station building. A detailed construction sequence is in the contract documents.

When the new facilities are operational, the existing CT tank can be taken out of service and pipes into and out of the tank will be capped.

The construction sequence opportunity provided by this project significantly reduces the risk of water contamination and interruption of customer service typically associated with these types of water plant construction projects. These constructability benefits were considered in the cost/benefit analysis of alternatives.

Even with the schedule and constructability benefits this project provides, the schedule will be tight to comply with the WDNR deadline of December 31, 2020 to correct the Code non-compliance issues.

1.5.1 Funding

The primary funding mechanism will be Wisconsin Safe Drinking Water Loans and revenue bonds. The goal is to provide the necessary water plant facilities to meet objectives within established budgets to minimize the impacts on water rates.