SANITARY SEWER
LIFT STATION UPGRADE STUDY

TOWN OF WATERFORD
SANITARY DISTRICT NO. 1
RACINE COUNTY, WISCONSIN
JANUARY/2024

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INTRODUCTION

In 2023 the Town of Waterford Sanitary District No. 1 (District) conducted an assessment of their sanitary sewer collection system. The assessment focused on the hydraulic capacity of the system. No such capacity study has been conducted on the system since it was put on-line in 1988. The system provides a collection system for mostly residential development around Tichigan Lake. In general, the system collects and conveys sanitary sewerage from development on all sides of the lake and conveys it toward the southeast part of the lake. There are 20 lift stations in the District. Many lift stations are configured in a series fashion where sewage flows through multiple lift stations. The largest lift station is Lift Station 15, located at the southeast side of the District near a residential subdivision off Tamarack Trail. From this lift station, sewage is pumped through a 12-inch diameter force main to the Western Racine County Sanitary District wastewater treatment facility (WWTF). From this WWTF, the sewage discharged to the Fox River.

This study analyzes the lift stations that were identified in the previous assessment as not having enough hydraulic capacity. In addition to capacity considerations at the stations, this study outlines other improvements needed at the stations for improved site, mechanical, electrical/controls, architectural/structural, building and safety issues.

Figure 1 shows the sanitary sewer collection system components and sewersheds. Appendix A shows the detailed assessment sheets for each lift station.

The lift stations where additional capacity is required are stations 1, 2,6, 10 and 15. Each station has a duplex design using submersible pumps. The larger stations have a standby generator powered by natural gas. The description of each station and a brief condition assessment for site, mechanical, electrical/controls, architectural/structural, and building safety components is in the following section.

LIFT STATION DESCRIPTIONS

Lift Station 1

This station is located at the southwest part of the intersection of North Tichigan Road and Sunrise Drive. The station is on a parcel owned by the Town of Waterford. It has a 6 ft. diameter precast concrete wet well manhole and a 4 ft. diameter precast concrete valve manhole. The pump control panel is located adjacent to the wet well and outside. The force main is directed southwest from the wet well and is routed to the southwest along North Tichigan Road.

Figure 1 shows the site plan of this lift station.

Site – There is limited space to park on the site as there is no driveway. Utility trucks must park on the street and drive on the grass when pulling equipment out of the wet well or valve manhole. The control panel is located very close to the wet well. There is no lighting on site.

Mechanical – The check valves are newer. The gate valves are older and should be replaced. The sewage pumps are in satisfactory condition. The pumps use vortex impellers which reduce clogging but are less efficient. These are the only pumps in the District that have vortex impellers. The piping in the wet well and valve manhole has little paint and is corroded. The piping should be sand blasted and repainted.

Electrical/Controls –The control panel is located in a slight low spot on the site. The bottom of the control panel has not been patched due to corrosion as some of the other lift stations have been. Electrical utility service is 240v, 3 phase, 3 wire fused disconnect with no backup generator. The interior of the enclosure is clean and orderly. Enclosure is cooled by surface conduction. The pump motors are energized by direct-on-line contactors. One of the contractors has been replaced with a newer Allen-Bradley IEC style motor starter, the other is dated and likely obsolete. The PLC is an obsolete Allen-Bradley 1761-

main is directed east from the wet well and is routed to easterly under the lake to the Lift Station 10 tributary area.

Figure 3 shows the site plan of this lift station.

Site – Parking is at the end of the cul de sac off the side of the road. The wet well and valve manholes are located very close to the lake. The concrete structures are under the water surface. The generator building is located close to the street. There is no site lighting.

Mechanical - The check and gate valves are older and should be replaced. One gate valve does not close. The sewage pumps are in satisfactory shape. The piping in the wet well and valve manhole has little paint and is significantly corroded. The piping should be replaced. The 40-kW standby generator does not have that many hours on it considering its age of 34 years, but parts are no longer available. The generator is at the end of its effective service life.

Electrical/Controls - Electrical utility service is 240v, 2 phase, 3 wire fused disconnect with backup generator. The generator is rated 40kW, 120/240v, 125A. An added enclosure on the back houses "add a phase" capacitors to convert from two phase service to three phase. The interior of the enclosure is clean and orderly. Enclosure is cooled by surface conduction. The pump motors are energized by direct-on-line contractors. The PLC is an obsolete Allen-Bradley 1761-L10BWA. The SC2000 station controller and GE MDS SD radio modem appears to be in good working condition.

Structural/Architectural - The wet well and valve manhole structures are in fair condition. The wet well concrete is spalling around the wall conduit penetrations and should be patched. The valve manhole has a small upper opening with a standard manhole casting. Groundwater sits in the bottom of the manhole.

The building vinyl siding has some light scrapes and damage and is in fair condition. The building roof and interior are in good condition.

Safety - The wet well access door does not contain a safety grate. The valve vault does not have an access door. If this structure is upgraded with a larger upper opening, a new access door with safety grate should be provided. Site lighting should be improved.

Lift Station 10

This station is located at the end of a cul du sac at North River Bay Road. The station is on an easement located by the property Owner at 6212 North River Bay Rd. The driveway to the lift station is shared with the resident driveway. The station has a 10 ft. diameter precast concrete wet well manhole and an 8 ft. x 8 ft. precast concrete valve manhole. The force main piping contains an auxiliary connection that allows for the connection of a trash pump discharge (drawing from the wet well) should there be a controls problem where the normal sewage pumps cannot be started. The exterior pump control panel is located adjacent to the wet well. The force main is directed southwest from the wet well and is routed to the southwest toward the lift station 10A sewershed.

A standby generator is provided in a wood framed, gable-roofed building near the wet well in a grass area. The building has an overhead door at one gable end.

The station was updated approximately three years ago with new wet well piping, a new larger valve manhole, and new force main piping.

Figure 4 shows the site plan of this lift station.

Site – The shared driveway was part of the replacement three years ago. The site drains towards the building and exterior control panel. The control panel is in a low spot.

Mechanical – The piping and valves are in good condition as they were replaced three years ago. The pumps are in fair condition. The 40-kW standby generator does not have that many hours on it considering its age of 34 years, but parts are no longer available. The generator is at the end of its effective service life.

Electrical/Controls – The pump control panel is located adjacent to the wet well and generator building. The panel is located in a low spot where water collects. The bottom of the panel legs has been patched. Electrical utility service is 240v, 3 phase, 3 wire with external disconnect or from backup generator. The generator is rated 40kW, 120/240v, 125A. Internal to the generator building is a small 120/240v panelboard. Pump control enclosure is cooled by surface conduction. The control enclosure interior is clean and orderly. The pump motors are energized by Allen Bradley IEC style direct-on-line motor starters. The SC2000 station controller and GE MDS SD radio modem appears to be in good working condition.

Structural/Architectural - The wet well and valve manhole structures are in good condition. The paint system on the piping is in good condition.

The building vinyl siding, roof and interior are in good condition.

Safety - Aside from water accumulation at the pump control panel due to its low spot, there are no major safety issues. The wet well access door does not contain a safety grate.

Lift Station 15

Lift station 15 is located off Tamarack Trail on Town-owned property. The station has a 10 ft. diameter precast concrete wet well manhole and an 8 ft. x 8 ft. precast concrete valve manhole. The pump control panel is located adjacent to the wet well. The force main is directed southwest from the wet well and is routed to the southwest toward the Western Racine County Sanitary District.

A standby generator is provided in a wood framed, gable-roofed building near the wet well in a grass area. The building has an overhead door at one gable end.

The pump control panel is located adjacent to the wet well.

The station was updated approximately three years ago with new wet well piping, a new larger valve manhole, and new force main piping at the station measuring 8-inch in diameter. The force main piping contains an auxiliary connection that allows for the connection of a trash pump discharge (drawing from the wet well) should there be a controls problem where the normal sewage pumps cannot be started.

A nitrate-containing liquid chemical product is injected in the force main when the sewage pumps are on. This product helps to prevent the formation of dissolved sulfides in the sewage, which can cause dissolved hydrogen sulfide in the force main outlet. Dissolved hydrogen sulfide can lead to corrosion of concrete structures such as manholes. Sulfuric acid is a byproduct of microbial-induced corrosion. The exterior nitrate system consists of a chemical tank, skid-mounted chemical pump, and controls.

Figure 5 shows the site plan of this lift station.

Site – The wet well deck is in a light low spot. District staff report that not a lot of water enters the structure through the access hatch during rain events.

The general direction of drainage is to the east toward the building and wet well. A wetland is located to the east of the building.

The driveway has plenty of space and is off the road.

Mechanical - The piping and valves are in good condition as they were replaced three years ago. The pumps are in fair condition. The 50-kW standby generator does not have that many hours on it considering its age of 34 years, but parts are no longer available. The generator is at the end of its effective service life.

Electrical/Controls - Electrical utility service is 240v, 3 phase, 3 wire with external unfused disconnect or from backup generator. Generator is rated 40kW, 120/240v, 125A. Internal to the generator building is a small 120/240v panelboard. Pump control enclosure is cooled by a fan. The enclosure interior is clean and orderly. The pump motors are energized by Schnieder variable speed inverters. The SC2000 station controller and GE MDS SD radio modem appears to be in good working condition.

The control panel in the generator building does not have the necessary National Electric Code require 36-inches of working space clearance in front of it.

Structural/Architectural - The wet well and valve manhole structures are in good condition. The paint system on the piping is in good condition. The wet well access door is relatively small for the size of the structure.

The building roof and interior are in good condition. The building vinyl siding has some scrapes and damage and is in fair condition. The interior of the building does not have a lot of space around the generator, control panel, and electrical equipment. See the previous Electrical/Control item in this section.

Safety – There is little exterior site lighting. This could be improved for added safety at night. The National Electric Code clearances are not provided in front of the pump control panel. The wet well access door could be outfitted with a safety grate if it is replaced with a larger door to facilitate wet well maintenance and cleaning.

LIFT STATION EXISTING AND FUTURE REQUIRED CAPACITIES

The firm capacity of a lift station is the capacity without the largest pump in service. Since all the lift stations in the District are the duplex type with identical pumps, the firm capacity is the capacity with one pump operating. Wisconsin Administrative Code stipulates that the firm capacity of lift station should be enough covey the peak hour flow rates from the station. The firm capacity of each station was determined from draw down testing as part of the previous collection system study. The required peak hour capacity of each station was also determined from the previous collection system study. In summary, this capacity was determined from the existing peak hour flow rates, adding in the flow rates for imminent developments tributary to the lift stations and adding a safety factor of 5%. Table 1 shows the firm capacity of each station and the required peak hour capacity in gallons per minute (gpm).

Table 1 – Lift Station Flow Rates and Remaining Capacity

Lift Station No.	Firm Capacity (GPM)	Current Cumulative Peak Hour Flow Rate at Lift Stations (GPM)	Future Cumulative Peak Hour Flow Rate at Lift Stations (GPM)	Current Remaining Capacity (GPM)	Future Remaining Capacity (GPM)
1	113	97	167	16	**-54**
2	111	148	221	**-37**	**-110**
3	85	20	21	65	64
4	286	84	88	202	198
5	121	50	53	71	68
6	194	308	388	**-114**	**-194**
7	454	312	328	142	126
7A	64	38	40	26	24
8	98	62	65	36	33
9	339	250	263	89	76
10	564	860	968	**-296**	**-404**
10A	129	26	27	103	102
10B	76	34	36	42	40
11	110	40	42	70	68
12	120	83	88	37	32
13	174	11	11	163	163
14	168	27	29	141	139
14A	147	73	77	74	70
15	668	1336	1468	**-668**	**-800**
15A	124	6	6	118	118

LIFT STATION UPGRADE DESCRIPTIONS AND ALTERNATIVES

For lift stations 1 and 2, the additional capacity and required upgrades are not as extensive as the other stations. For these stations, a logical upgrade approach is identified. Alternatives are not presented for these stations.

The largest capacity upgrades are at stations 6, 10 and 15. The upgrades required for lift stations 6 and 10 are straight forward considering the existing lift station type and site conditions. Alternatives are not presented for these stations. Alternatives are presented for lift station 15 taking into account a 20-year net present value cost and non-economic factors such as ease of operation and maintenance (O&M), reliability and safety.

The District has a problem with pumps clogging from the many rags introduced to the collection system from household cleaning products. For any stations where pumps will be replaced, the District would like to use a specialty non-clog impeller or a chopper pump. The non-clog impeller would be a single vane backswept design specifically designed to pass rags. Our analysis includes a specialty non-clog pump impeller since grinder pumps are inefficient from an energy standpoint.

Lift Station 1

Additional capacity is required at the station. The existing pump rate based on draw down testing is 110 gpm with 5 Hp pump motors. The anticipated required pump condition is 167 gpm at 52 ft. TDH. It is assumed that this pump condition can be met by replacing the pump impeller. At the worst case, the pump would be replaced.

Other updates required at the station include select pump control components, new shut off valves, and wet well and valve manhole piping recoating.

L10BWA. The SC2000 station controller and GE MDS SD radio modem appears to be in good working condition.

Structural/Architectural – The wet well structure is in good condition. The valve manhole has a small upper opening with a standard manhole casting. Groundwater sits in the bottom of the manhole. The valve manhole structure is in fair condition.

Relieved

Safety – Aside from poor lighting at the site and utility truck street parking when at the site, there are no major safety issues. The wet well access door does not contain a safety grate. The valve vault does not have an access door. If this structure is upgraded with a larger upper opening, a new access door with safety grate should be provided.

Lift Station 2

This station is located in the road right of way along North Tichigan Road. It has a 6 ft. diameter precast concrete wet well manhole and a 4 ft. diameter precast concrete valve manhole. The pump control panel is located adjacent to the wet well and outside. The force main is directed southwest from the wet well and is routed to the southwest along North Tichigan Road. This station accepts from its tributary area as well the tributary area of Lift Station 1.

Figure 2 shows the site plan of this lift station.

Site – Parking is on the expanded gravel shoulder in the road in the right-of-way. The control panel is located very close to the wet well. The panel is located in a low spot. There is no lighting on site.

Mechanical - The check valves are newer. The gate valves are older and should be replaced. The sewage pumps are in satisfactory shape. The piping in the wet well and valve manhole has little paint and is corroded. The piping should be sand blasted and repainted.

Electrical/Controls - The control system has a plug-in receptacle for a portable generator. The bottom of the control panel has been patched as it sits in a low spot on the site. The sewer Superintendent reports that the control panel gets very hot which causes control and electrical problems. Electrical utility service is 240v, 3 phase, 3 wire, unfused disconnect with no backup generator. The interior of the enclosure is clean and orderly with newer components. The enclosure is cooled by surface conduction. A terminal block located at the bottom middle of the back panel appears to have visual indication of overheating. The pump motors are energized by Allen-Bradley IEC style motor starter direct-on-line motor starters. The PLC is an obsolete Allen-Bradley 1761-L10BWA. The SC2000 station controller and GE MDS SD radio modem appears to be in good working condition.

Structural/Architectural - The wet well and valve manhole structures are in fair condition. The wet well concrete is spalling around the wall conduit penetrations and should be patched. The valve manhole has a small upper opening with a standard manhole casting. Groundwater sits in the bottom of the manhole.

Safety - Aside from poor lighting and water accumulation at the pump control panel due to its low spot, there are no major safety issues. The wet well access door does not contain a safety grate. The valve vault does not have an access door. If this structure is upgraded with a larger upper opening, a new access door with safety grate should be provided.

Lift Station 6

This station is located in an easement at 6519 Willow Court. It has an 8 ft. diameter precast concrete wet well manhole and a 4 ft. diameter precast concrete valve manhole located near the lake. A standby generator is provided in a wood framed, gable-roofed building near Willow Court. The building has an overhead door at one gable end. The pump control panel is located adjacent to the building. The force

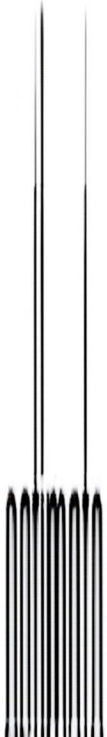
The capital cost estimate for these upgrades is $68,000. Appendix A shows the details of this cost estimate.

Lift Station 2

Additional capacity is required at the station. The existing pump rate based on draw down testing is 111 gpm with 5 Hp pump motors. The anticipated required pump condition is 221 gpm at 96 ft. TDH.

Other updates required at the station include select pump control components including a new programmable logic controller, new shut off valves, and wet well and valve manhole piping recoating.

The capital cost estimate for these upgrades is $151,000. Appendix A shows the details of this cost



APPENDIX A
COST ESTIMATES