Wastewater Treatment Facilities Plan

Big Lake Wastewater Treatment Facility

Big Lake, Minnesota

BIGLK 167307 | February 2, 2024

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February 2, 2024

RE: Big Lake Wastewater Treatment Facility
Wastewater Treatment Facilities Plan
Big Lake, Minnesota
SEH No. BIGLK 167307 4.00

Mr. Dan Childs
City of Big Lake
18999 County Road 14 NW
Big Lake, Minnesota 55309

Dear Mr. Childs:

This report evaluates the existing condition and 20-year design needs of the wastewater treatment facilities in the City of Big Lake. The current wastewater treatment facility has undergone recent improvements including solids conditioning and preliminary treatment, however there are other processes on site which age and condition are limiting the operation and performance of the facility. Projected growth in the community is contributing to an increase in flow and load demand which current facilities will be unable to meet. Individual improvement projects have contributed to a treatment system which would benefit from a unified control project allowing operation staff to monitor and control equipment from anywhere at the facilities. To address these concerns, several alternatives were considered and are presented in this report.

We would like to thank you for the opportunity to work in cooperation with your city staff to provide this evaluation and recommendation for future improvements at the wastewater treatment facilities.

Sincerely,

Jessica Hedin, PE
Project Manager (Lic. MN)

ejm
document1

Wastewater Treatment Facilities Plan

Big Lake Wastewater Treatment Facility
Big Lake, Minnesota

SEH No. BIGLK 167307

February 2, 2024

I hereby certify that this report was prepared by me or under my direct supervision, and that I am a duly Licensed Professional Engineer under the laws of the State of Minnesota.

Jessica Hedin, PE

Date: 2/2/2024 License No.: 41639

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Sartell, MN 56377-2485
320.229.4300

Executive Summary

The City of Big Lake initiated the preparation of this Facilities Plan for the wastewater treatment facility in order to address key concerns about the available treatment capacity given the need and demand for further development within the community. This report discusses the existing wastewater facilities, projected wastewater flow and load demands, future wastewater needs and costs of alternatives to meet those needs.

Projected flow and load demand for the design year of 2045 have been determined to be greater than those of the existing wastewater treatment plant basis of design and permitted flows. It is notable that current flows and loads are at or near the recommended design capacity for major treatment processes at the existing facility, however the facility is still reliably meeting effluent water quality limits. The current facility is a continuous discharge oxidation ditch with chemical phosphorus removal and aerobic digestion. Major treatment components were constructed in 1976, 1995, 2001, 2009, and 2019. The majority of biosolids stabilization and handling facilities were installed during major improvements in 1995 and 2009 projects, and the majority of liquid treatment process were installed during the 1976, 2001, and 2019 projects.

Recommended improvements to address additional treatment capacity also address capacity related operational limitations to allow for biological phosphorus removal and stabilization of biosolids to meet EPA 503 requirements for land application. The improvements include consideration for additional parameters of concern such as nitrate and nitrite, which are not included in the current discharge permit requirements. The considerations include accounting for additional facilities and building space should such limits be included in the discharge permit requirements; however, at that time additional equipment would still be required for treatment.

The recommended improvements include:

- Demolish abandoned-in-place old main lift station.
- Increase design capacity of main lift station and forcemain.
- Condition-based replacement of process equipment at the preliminary treatment building.
- Modifications of existing selector basin and oxidation ditches for Mobile Organic Biofilm activated sludge and biological phosphorus removal.
- Conversion of existing secondary clarifiers and construction of new secondary clarifiers.
- Replace existing coagulant feed equipment.
- Replace existing ultraviolet disinfection equipment and relocate to new Disinfection and Pumping Building.
- Replace existing effluent flow measurement and relocate to new Disinfection and Pumping Building.
- Dissolved air floatation thickening of waste sludge prior to digestion.
- Expand solids treatment capacity of existing aerobic digester by rehabilitating primary cell 1, constructing and additional primary cell 2, and converting liquid biosolids storage to secondary treatment cell 1.
- Replace mixing and aeration Waste Sludge Holding Tank, Aerobic Digester, and Liquid Biosolids Storage with diffused aeration and compressed aerated mixing.
- Convert existing Waste Sludge Storage Tank to sludge receiving station.

Executive Summary (continued)

- Condition-based replacement of process equipment at the biosolids dewatering building.
- Dewatered cake loadout and storage improvements.
- Administration Building condition improvements for staff facilities.
- Site improvements.
- New septage receiving.
- Disinfection and Pumping Building
- Construct new Disinfection and Pumping Building for new disinfection equipment, solids pumping, conditioning, thickening, chemical storage, site electrical, and generator controls.
- Construct new Blower Building for secondary treatment processes.

Discussion with the MPCA and USEPA regarding effluent limits included the preparation of an antidegradation review, triggered by the increase in treatment capacity. The recommended alternative is intended to meet the effluent water quality standards provided by the approved antidegradation review load limits for 5-day carbonaceous biochemical oxygen demand (cBOD5), total suspended solids (TSS), mercury, sulfate, and chlorides with the acceptance of load caps for total phosphorus (TP).

The total preliminary Engineer's opinion of estimated overall project capital cost including engineering and City administrative costs as bid in January 2024 is $47,502,000. The total estimated annual operation maintenance, and replacement costs for the facility is $816,000.

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Wastewater Treatment Facilities Plan

Big Lake Wastewater Treatment Facility

Prepared for City of Big Lake

1 Introduction

This Facility Plan has been prepared for the City of Big Lake (City) to aid the community in providing adequate wastewater treatment that meets current and future needs. The major drivers for improvements at Big Lake are to increase treatment capacity for current wastewater demand and to provide additional treatment capacity to continue development of the community. This plan evaluates the ability of the existing wastewater treatment facilities to meet projected flow and load demand and the ability to meet proposed effluent regulations as a result of the increases.

1.1 Planning Area

Figure 1 illustrates Big Lake's municipal boundary and location of major wastewater treatment facilities (WWTF). This figure was taken from the *City of Big Lake Comprehensive Plan, 2018*.

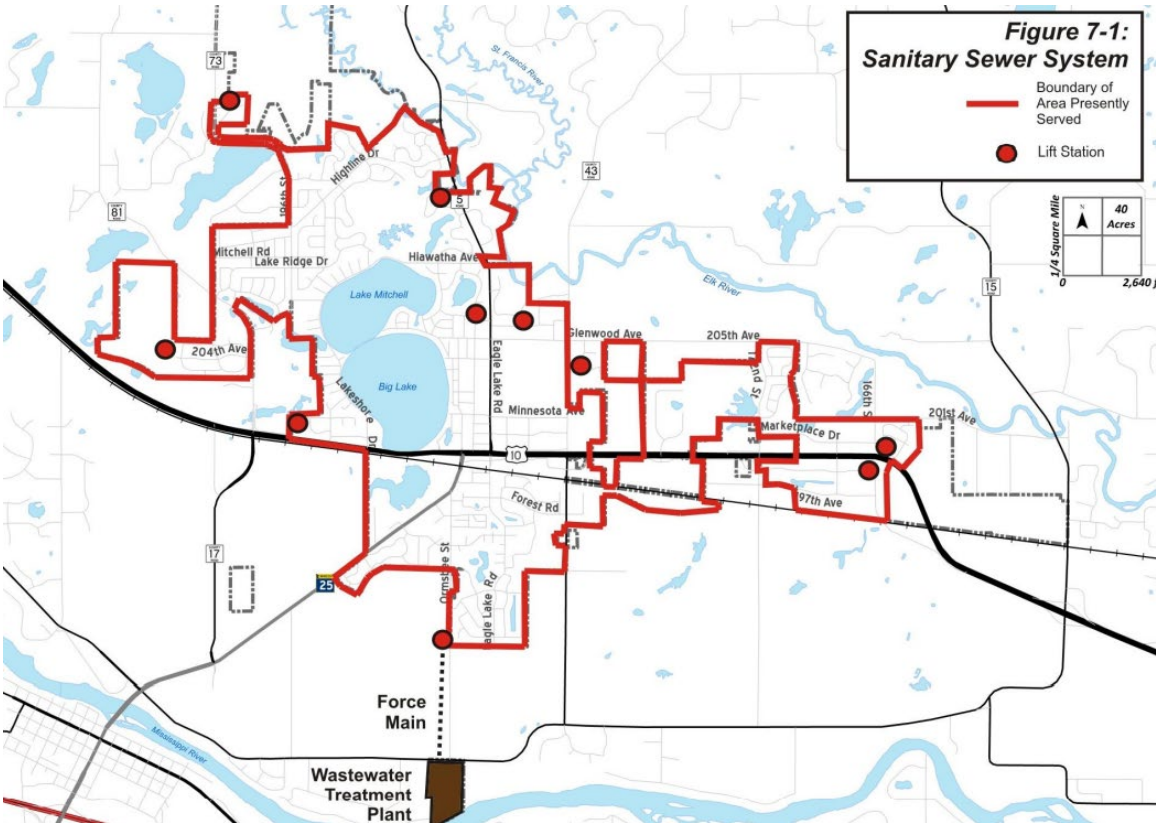

Figure 1 – Big Lake Wastewater Facilities

The Big Lake wastewater treatment facility provides sanitary sewer treatment service to the community of Big Lake. The sanitary sewer collection system directs wastewater flow to a main influent lift station located along County Road 68 approximately 1 mile north of the wastewater treatment facility.

The 2021 estimated service population for Big Lake was 12,165 according to the Minnesota Demographic Center estimate. There are two significant industrial users as a part of the Big Lake wastewater collection system. One significant industrial user currently operates with a user agreement, while the other has been identified and a user agreement is under development. The facility previously accepted septage but recently had to discontinue it due to capacity issues. However, the city would like to reintroduce septage receiving in the future.

1.2 Historical, Archeological, Cultural, and Environmental Elements:

An Environmental Assessment Worksheet (EAW) is required by the MPCA as part of a facility plan for facilities increasing flow by more than 50% or by at least 200,000 gallons per day. The completed EAW can be found in Appendix B-1. As part of this planning step, the State requires information related to the presence of rare, endangered, or historic resources and/or landmarks.

The National Register for Historic Places was searched, and the State Historic Preservation Office was contacted for the planning area. The results of the search can be found in Appendix B-2. There are no historical, archeological, or cultural areas within the project boundaries. Adjacent properties are not anticipated to be adversely affected.

The Minnesota Department of Natural Resources was also contacted to determine if rare plant or animal species or other significant natural features exist near the project area. The National Heritage and Nongame Research Program database was also searched, and the results can be found in Appendix B-3. Any potential project at the wastewater treatment facility should have no impact on any natural features.

The Advisor Council on Historic Preservation as part of 36 CFR §800.16(f) provides guidance on the consolation of Section 106 participants. The consolation is intended to seek an active exchange of ideas and information between the municipality and other Section 106 participants. The consultation seeks consensus about what eligible or listed archaeological sites may be affected by an undertaking; why those properties are significant and of value, and to whom; and how any adverse effect to them might be avoided, minimized, or mitigated. The MPCA identifies Section 106 participants by county. The participants are identified based on the 11 federally recognized tribal entities in Minnesota. For Sherburne County the Section 106 participants include the Lower Sioux Indian Community. A copy of the Section 106 letter prepared for the proposed improvements and any feedback provided by Section 106 participants can be found in Appendix B-4.

Projects that convert farmland to non-agricultural use and are funded by a federal agency may be subject to the Farmland Protection Policy Act (FPPA). FPPA is implemented through the Natural Resources Conservation Service (NRCS). Generally, the agency's response to the solicitation of comments letter will identify if a proposed project is exempt from FPPA. Projects that are located entirely within a city's boundaries are not covered by FPPA, and no further action needs to be taken. Though the existing facility site is surrounded by agricultural land, there is not anticipated to be a reduction in agricultural land due to improvements.

There are no anticipated social justice issues as a result of recommended improvements at the facility. The increase in capacity will allow for further development within the City of Big Lake.

2 Regulatory Requirements

The Minnesota Pollution Control Agency (MPCA) has responsibility for determining the best uses of the State's waters and quality of effluent necessary to meet these uses. In accordance with this responsibility, they have defined seven water use "classes" and grouped all the State's waters into one or more of these classes. Each contains a list of substances or characteristics that must be met before the water is suitable for its designated use. This list of substances and their permissible concentrations are referred to as "water quality standards". These standards have been established after appropriate public hearings, have been approved by the U.S. Environmental Protection Agency (EPA).

Treated wastewater from the City of Big Lake's Wastewater Treatment Facility (WWTF) is continually discharged into the Mississippi River, which is classified as Class 1C, 2Bd, 3, 4A, 4B, 5, and 6 waters. The Mississippi River does not have a listed designation under Minnesota Rule 7050.0430. Such unlisted waters are given a 2B aquatic life and recreation classification. The definitions of these classifications follow:

- Class 1C: The quality of class 1C waters of the state shall be such that with treatment consisting of coagulation, sedimentation, filtration, storage, and chlorination, or other equivalent treatment processes, the treated water will meet both the primary (maximum contaminant levels) and secondary drinking water standards issued by the United States Environmental Protection Agency.
- Class 2Bd: The quality of class 2Bb surface waters shall be such as to permit the propagation and maintenance of a healthy community of cool or warm water aquatic biota, and their habitats. These waters shall be suitable for aquatic recreation of all kinds, including bathing, for which the waters may be usable. This class of surface water is also protected as a source of drinking water.
- Class 3: The quality of class 3 waters of the state must be such as to permit their use for industrial purposes to avoid severe fouling, corrosion, or scaling. If the standard in this part is exceeded in waters of the state that have the class 3 designation, it is considered indicative of a polluted condition that is actually or potentially deleterious, harmful, detrimental, or injurious with respect to the designated use. No sewage, industrial waste, or other wastes from point or nonpoint sources, treated or untreated, shall be discharged into or permitted by any person to gain access to any waters of the state classified for industrial purposes so as to cause any material impairment of their use as a source of industrial water supply.
- Class 4A: The quality of Class 4A waters of the state shall be such as to permit their use for irrigation without significant damage or adverse effects upon any crops or vegetation usually grown in the waters or area, including truck garden crops.
- Class 4B: The quality of Class 4B waters of the state shall be such as to permit their use by livestock and wildlife without inhibition or injurious effects.
- Class 5: The quality of Class 5 waters of the state shall be such as to be suitable for aesthetic enjoyment of scenery, to avoid any interference with navigation or damaging effects on property.

- Class 6: The quality of Class 6 waters may be under other jurisdictions and in other areas to which the waters of the state are tributary and may include any or all of the uses listed in Minnesota Rules parts 7050.0221 to 7050.0225, plus any other possible beneficial uses.

2.1 Effluent Standards

The Big Lake WWTF discharges wastewater in accordance with Minnesota National Pollutant Discharge Elimination System (NPDES) / State Disposal System (SDS) permit number MN0024295. A copy of the current permit is included in Appendix A-1. This permit became effective April 11, 2018, and expires May 31, 2023. The facility is currently a continuous discharge treatment system. Effluent concentration and mass limit standards set by the State for Mississippi River are summarized in Table 1.

Table 1 – 2018 NPDES/SDS Permit Effluent Water Quality Limitations

Parameter	Final Limit – Concentration	Final Limit - Mass	Limit Type	Effective Period
5-day Carbonaceous Biochemical Oxygen Demand ($cBOD_5$)	25 mg/L 40 mg/L	34.3 kg/day 54.9 kg/day	Calendar month average Max calendar week average	Jan-Dec Jan-Dec
Total Suspended Solids (TSS)	30 mg/L 45 mg/L	41.2 kg/day 61.7 kg/day	Calendar month average Max calendar week average	Jan-Dec Jan-Dec
Total Suspended Solids (TSS) removal	85%		Minimum calendar month average	Jan-Dec
pH	6.0 su 9.0 su		Calendar mo. minimum Calendar month maximum	Jan-Dec Jan-Dec
Fecal Coliform, MPN or membrane filter 44.5C	200 calendar month geometric mean		Organisms per 100 milliliter	Apr-Oct
Phosphorus, Total (as P)	Monitor only (once per week)		Calendar month average	Jan-Dec
Phosphorus, Total (as P)		1160 kg/year	12-month moving total	Jan-Dec
Nitrite Plus Nitrate, Total (as N)	Monitor only (once per quarter)		Calendar quarter average	Mar, Jun, Sep, Dec
Nitrogen, Ammonia, Total (as N)	Monitor only (once per month)		Calendar month average	Mar, Sep
Nitrogen, Kjeldahl, Total	Monitor only (once per quarter)		Calendar quarter average	Mar, Jun, Sep, Dec
Nitrogen, Total (as N)	Monitor only (once per quarter)		Calendar quarter average	Mar, Jun, Sep, Dec

Table 1 (Continued) – 2018 NPDES/SDS Permit Effluent Water Quality Limitations

Parameter	Final Limit – Concentration	Final Limit - Mass	Limit Type	Effective Period
Mercury, Dissolved (as Hg)	Monitor only (once per month)		Calendar month maximum	Jul
Mercury, Total (as Hg)	Monitor only (once per month)		Calendar month maximum	Jul
Total Suspended Solids (TSS), grab (Mercury)	Monitor only (once per month)		Calendar month maximum	Jul
Dissolved Oxygen	Monitor only (once per day)		Calendar month minimum	Jan-Dec
Solids, Total Dissolved (TSS)	Monitor only (once per month)		Calendar month average	Jan-Dec

2.2 Probable Future Limits

Based on the City's current flow and future growth of the community, the city of Big Lake will need to expand their current permitted flow capacity and request reissuance of their NPDES/SDS effluent limit permit as they are currently near treatment capacity at the facility. The City requested preliminary effluent limits from the Minnesota Pollution Control Agency (MPCA) based on the anticipated expanded flows. A copy of the preliminary effluent limits received from MPCA is included in Appendix A-2.

2.2.1 Antidegradation

Federal antidegradation regulations require states to adopt antidegradation policies and identify implementation procedures that maintain and protect existing uses, prevent unnecessary degradation of existing high-water quality, and maintain and protect the quality of waters identified for their outstanding value. The MPCA adopted new antidegradation rules that became effective November 21, 2016, and permit applications received after this date will need to comply with the new rules. This means if a community wants to increase the flow or load to the receiving stream, they must remain at or below the current permitted mass loading to that receiving stream.

With that being said, the antidegradation rules state that high water quality (i.e., quality above that which is required to support aquatic life and recreation) may be lowered, but only under the following specific conditions:

- The degradation is necessary.
- The degradation is important to accommodate important economic and social development.
- There is an opportunity for public participation and intergovernmental cooperation.
- All applicable state and federal water pollution control statutes and rules are achieved.

These conditions would have to be shown in an antidegradation review that would be prepared by the City and its engineers and be reviewed and approved by MPCA. An Antidegradation Review provides an avenue for cities to increase flow or loading without freezing mass loads. It

should be noted that a full antidegradation review must be completed and approved in order to determine the final limits for the selected option evaluated in a facility plan.

An Antidegradation Review is being prepared concurrently with the development and review of the facilities plan for Big Lake. The presumption of this facilities plan is the preliminary approval of the Antidegradation Review by the MPCA. An amendment to the facility plan will be prepared regarding any portion of the preliminary Antidegradation Review that has not been approved. A copy of the Antidegradation Review can be found in Appendix A-3 of this report. A copy of the preliminary approval letter furnished by the MPCA can also be found in Appendix A-4 of this report.

The MPCA provide preliminary approval for Antidegradation Review requests. Final approval is furnished by the United States Environmental protection Agency (USEPA) as part of the NPDES/SDS permit reissuance prior to construction. The presumption of this facilities plan is the final approval of the Antitradition Review by the USEPA. An amendment to the facility plan will be prepared regarding any portion of the final antidegradation review that has not been approved.

2.2.2 Preliminary Effluent Limits

Preliminary effluent limitations were provided as a response to the preliminary effluent request. They were developed by the MPCA in response to existing ambient water quality and consider the effects of impairment resulting in additional flows and loads as part of a facility expansion.

Refer to Appendix A-2 for the 2022 preliminary effluent limits request.

Since the request, the future flow and load demand has been re-evaluated considering the limitations of technology for treatment for the required effluent water quality concentration of parameters due to frozen mass limits.

The frozen mass limits provided by the MPCA were utilized to develop anticipated effluent water quality concentrations which can be met without the need for tertiary treatment and still meet most of the future anticipated flow and load capacity extended from development. The revised flow and load demands were the basis for determining parameters requested as part of the Antidegradation Review and will be sued for determining future capacity flow and load requirements for this facilities plan.

The Antidegradation Review and anticipated design year flow conditions were developed to:

- Accept the frozen mass limit and provide treatment for a flow capacity which has an effluent concentration of total phosphorus which is at or above 0.50 mg/L, the acceptable limit for biological phosphorus removal effluent water quality without tertiary treatment.
- Pursue Antidegradation Review for total suspended solids effluent calendar day average mass discharge of 82.7 kg/d (13.0 mg/L), which can reliably be achieved using secondary clarification without tertiary treatment. Antidegradation Review would also then include Mercury as a result of increase in total suspended solids load.
- Pursue Antidegradation Review for $cBOD_5$ effluent calendar day average mass discharge of 68.9 kg/d (10.8 mg/L), which can reliably be achieved using secondary clarification without tertiary treatment.
- Pursue Antidegradation Review for sulfate effluent mass limit with a concentration equivalent of 41.2 mg/L. The parameter is not achievable without tertiary treatment. A variance request would need to be prepared while source reduction is investigated.

- Pursue Antidegradation Review for chloride effluent mass limit with a concentration equivalent of 585 mg/L. The parameter is not achievable without tertiary treatment. A variance request would need to be prepared while source reduction is investigated.

Table 2 provides the anticipated effluent limit concentrations given the frozen mass limits furnished by the MPCA as part of the preliminary effluent limit request response.

Table 2 – 2022 Preliminary Effluent Limits for Continuous Discharge

Parameter	Requested Antidegradation Load Limits				Accepted PELR Load Caps			
	Concentration [1]		Mass		Concentration [1]		Mass	
	Value	Units	Value	Units	Value	Units	Value	Units
AWW Design Flow	1.682	mgd			1.682	mgd		
$cBOD_5$	10.8 [2]	mg/L	68.9	kg/d	34.4	kg/d	5.4	mg/L
TSS	13.0 [2]	mg/L	82.7	kg/d	41.2	kg/d	6.5	mg/L
TP	1.0 [3]	mg/L					1.0 [3]	mg/L
TP, 12 month rolling total	0.5	mg/L	1160	kg/yr	1160	kg/yr	0.5	mg/L
Mercury [4]	Monitor only				Monitor only			
Sulfate [5]	41.2	mg/L	262	kg/d	41.2	mg/L	130	kg/d
Chloride [6]	585	mg/L	3,726	kg/d	585	mg/L	1,854	kg/d
Fecal Coliform [7]	200	orgs/ 100ml					200	orgs/ 100ml
pH, minimum	6.0	su					6.0	su
pH. maximum	9.0	su					9.0	su

Notes

1. Calculated equivalent day average concentration required to meet mass limit, unless noted otherwise.
2. Requested equivalent day average concentration based on the current calculated equivalent day average concentration to meet current mass load limits.
3. Prescribed effluent concentration limit.
4. Mercury limits and antidegradation analysis of mercury loading would not be required if frozen TSS mass limits are accepted.
5. Load Caps and effluent limits have not been identified are part of the PELR. An anticipated effluent concentration limit of 10 mg/L is assumed based on the sulfate standard to protect the beneficial use of downstream waters. Calculated load caps based on the maximum of (2) samples taken in one month multiplied by the current average wet weather flow. Calculated load limit based on the maximum of (2) samples taken in one month multiplied by the design average wet weather flow.
6. Load Caps and effluent limits have not been identified are part of the PELR. An anticipated effluent concentration limit of 230 mg/L is assumed based on the protection of fish and other aquatic life. Calculated load caps based on the maximum of (3) samples taken in one month multiplied by the current average wet weather flow. Calculated load limit based on the maximum of (3) samples taken in one month multiplied by the design average wet weather flow.
7. The disinfection limits would be required all year to ensure protection of the ORVW and ensure protection of water at the metro drinking water intakes.

The table can be summarized by two groups:

- The antidegradation load limits correspond to the requests discharge mass load limit as part of the preliminary approval of the Antidegradation Review.
- The Load Caps correspond to the accepted mass load limit as indicated by the Preliminary Effluent Limit Request.

Either mass load is used to calculate and anticipated effluent water quality concentration, though a concentration limit may not be part of the limit requirements.

3 Flows and Loading

Historical influent and effluent data from discharge monitoring reports (DMRs) for the Big Lake Wastewater Treatment Facility (WWTF) for January 1, 2017 through February 28, 2022 were provided by the City. A summary of the DMR furnished by the City can be found in Appendix E-1 of this report. The following sections summarize the existing flows and loads to the WWTF.

The purpose of this memorandum is to evaluate the capacity of the current wastewater facilities to meet the anticipated design year flow and load demand. Each treatment process at the wastewater treatment facility (WWTF) was reviewed for suitability.

3.1 Flow Definitions

The MPCA defines several flow conditions that are used to design process units. The existing system design and the capacities of existing process units reference the following flow conditions:

- **Average dry weather (ADW) flow**: ADW flow is defined as the flow that occurs during dry periods when the groundwater level is low or normal. This flow would include the normal sanitary sewer flows from homes, commercial establishments, public institutions, and any industrial facilities. This flow level normally becomes apparent in winter months (December, January, and February), when there is little to no inflow.
- **Average wet weather (AWW) flow:** AWW or peak month flow is the daily average flow for the 30 consecutive days with the highest precipitation for continuous dischargers. AWW of peak month flow is the daily average for the approximately 180 consecutive days between November 15 and May 15 and May 15 to November 15 for controlled dischargers.
- **Peak hourly wet weather (PHWW) flow:** PHWW is the peak flow during the peak hour of the day at a time when the groundwater is high and a five-year, one-hour storm event is occurring. For the City of New Germany, a five-year, one-hour storm event corresponds to a precipitation event of 1.7 inches in one hour (MPCA, 2019).
- **Peak Instantaneous Wet Weather (PIWW) flow:** PIWW is the peak instantaneous flow during the day at a time when the groundwater is high and a 25-year, one-hour storm even is occurring. For the City of New Germany, a 25-year, one-hour storm event corresponds to a precipitation event of 2.6 inches in one hour (MPCA, 2019).

3.2 Load Definitions

The MPCA refers to the Ten States Standards for design load determination. The Ten States Standards defines several load conditions that are used to design process units. The existing

system design and the capacities of existing process units reference the following flow conditions:

- **Design Average Load:** The design average load is generally the average of the load to be received for a continuous 12-month period for the design year, expressed as weight per day.
- **Design Maximum Month as Day Load:** The design maximum month as day load is the largest amount of load to be received for a continuous 30-day period for the design year, expressed as weight per day.
- **Design Maximum Day Load:** The design maximum day load is the largest amount of load to be received during a continuous 24-hour period, expressed as weight per day.

The design load for facilities having critical seasonal high loading periods (e.g., recreational areas, campuses, industrial facilities) shall be based on the average organic load to be received during the seasonal period.

The determination for projected design loads is calculated as follows:

$$\text{Design Load} = \text{Calculated Peaking Factor} \times \left[\left(\text{Design Per Capita Load} \times \text{Domestic Service Population} \right) + \left(\text{Actual Per Capita Load} \times \text{Commercial and Light Industrial REU} \right) \right] + \text{Industrial Load}$$

where,

- Calculated peaking factor is based on the reported DMR sampling data.
- Design per capita load is based on the larger of the calculated per capita loading based on the reported DMR sampling data minus industrial contribution, MPCA design minimums, or other reference values.
- Domestic service population is the projected service population for the design year.
- Actual per capita load is based on the reported DMR sampling data minus industrial contribution.
- Commercial and light industrial residential equivalent units (REU) is based upon the anticipated non-significant industrial user (SIU) / categorical industrial user (CIU) industrial growth and non-domestic growth converted to a population equivalent.
- Industrial load is based on the anticipated growth and planned additional capacity for SIUs and CIUs.

3.3 Planning Definitions

Review of the current flows and loads and the determination for future flow and load capacities can generally be divided into four planning categories. The categories can generally be described as follows:

- **Domestic Capacity:** The domestic capacity reflects the residential contribution of wastewater flows and loads for current and future capacities. The basis of current flows is associated with the Minnesota Demographic Center population projections for determination of current per capita flows and loads, and the population projection determined in this report for future flow and load capacity. At a minimum, the MPCA requires minimum flow and load per capita loadings for design of future capacities as discussed later in this report.

- **Commercial and Light Industrial Capacity:** The commercial and light industrial capacity reflects the non-domestic and non-SIU/CIU industrial contribution of wastewater flows and loads for current and future capacities. The current flows and loads are included in the per capita flow and load contribution determination. The future flow and load contribution is based on the approved comprehensive growth plan acreage identified for commercial and light industrial development. An assumed flow per acre based on land use is utilized and associated to a residential equivalent unit. The actual per capita load is then used based on the equivalent residential unit to determine a future load condition.
- **Industrial Capacity:** The industrial capacity reflects the identified significant industrial and categorical industrial users identified by the City. The basis of current flows and loads reflect the industrial suer agreements prepared by the City, and the future flow and load conditions reflect discussions between the industrial users and the City based on projected future wastewater generation.
- **In-Plant Recirculation Capacity:** The in-plant recirculation capacity reflects the flows and loads generated by recirculation waste streams generated by wastewater treatment. The recirculation capacity may include washdown water, decant, process drains, filtrate, and other treatment side streams. These side streams may reflect existing processes and be impacted by proposed alternatives. For the facility, the side stream flows and loads are introduced after influent flow measurements and sampling. Although treatment capacity for individual units will reflect in-plant recirculation capacity, the permitted facility design capacity review does not.

Refer to Figure 2 for the components of the design capacity planning definitions.

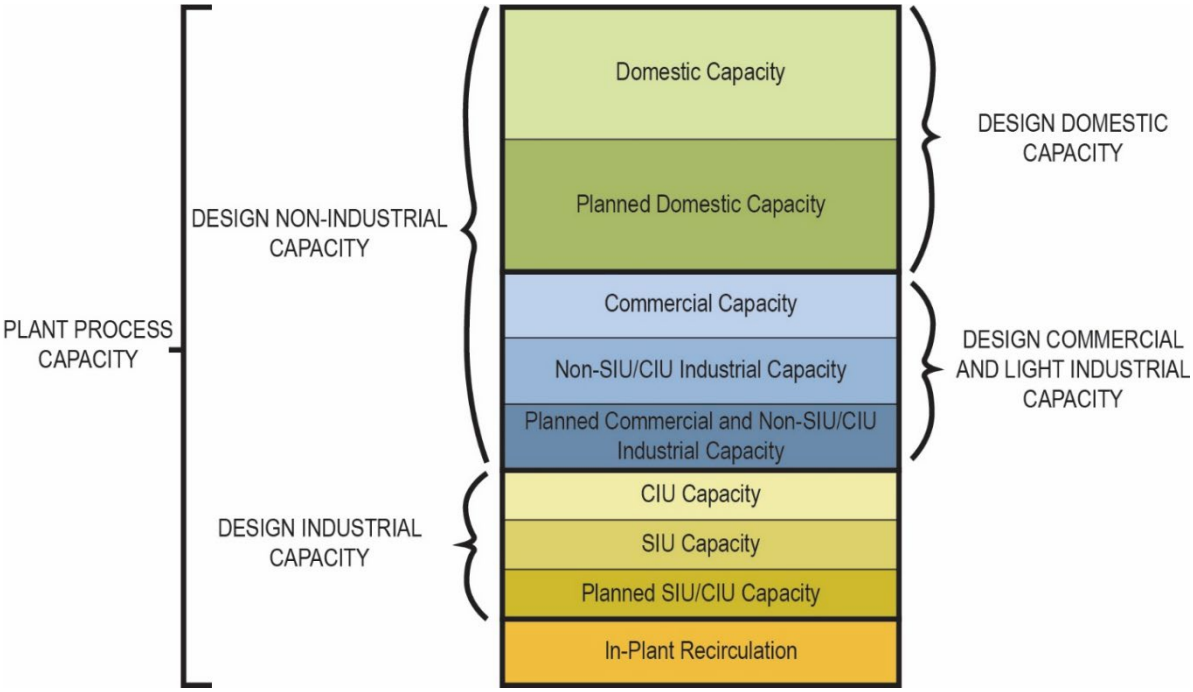

Figure 2 – Design Capacity Planning Definitions

3.4 Flow and Load Determination

A technical memorandum was prepared for the City of Big Lake dated March 20, 2023. The memorandum provides discussion and presents the determination for current and future flows and loads based on the DMR review period and definitions for flow, load, and planning. The technical memorandum can be found in Appendix C-1 of this report and was prepared using the MPCA Flow and Load Determination Guidance, which can be found in Appendix D-1 of this report.

The determinations of the technical memorandum can generally be summarized by the following:

- DMR data review does not indicate significant inflow to the wastewater treatment facility.
- DMR data review does not indicate significant infiltration to the wastewater treatment facility.
- A design year of 2045 was used for preparation of the facilities plan.
- An anticipated service population of 14,447 residence was used for preparation of the facilities plan.
- Additional treatment capacity was added for the anticipate flow and load demand due to expansion of the two identified significant industrial users, as well as for non-industrial, non-domestic development in accordance with the 2018 Comprehensive Growth Plan. The Comprehensive Growth Plan can be found in Appendix E-2 of this report.

Table 3 summarizes the current flow demand for the wastewater treatment facility and Table 4 summarizes the current load demand for the wastewater treatment facility.

Table 3 – Current Combined Wastewater Flow Demand

Flow Condition	Value
Average Dry Weather (ADW), mgd	0.699
Calendar Average Day Flow (ADF), mgd	0.721
Average Wet Weather (AWW), mgd [1]	0.838
Maximum Calendar Day, mgd	1.208
Peak Hour Wet Weather (PHWW), mgd [2, 3]	2.204
Peak Instantaneous Wet Weather (PIWW), mgd [3]	2.204

Notes:

1. Day average flow for 30 consecutive highest flow days reported.
2. Instantaneous flow data unavailable. Peak determined using existing lift station pump capacity base on sewer flow rates.
3. Corresponds to a calendar day average to peak hourly wet weather peaking factor of 2.6, which is equal to the 10 States Standards for Wastewater Facilities (2014 Edition) recommendation of 2.6 based on service population.

Table 4 – Current Combined Wastewater Load Demand

Load Parameter	Calendar Day Average	Maximum Month as Day	Calendar Day Maximum
5-Day Carbonaceous Biochemical Oxygen Demand ($cBOD_5$), ppd [1]	2,141	3,679	7,386
Total Suspended Solids (TSS), ppd [2]	2,963	6,702	11,202
Total Phosphorus (TP), ppd [3]	47	75	107
Total Kjeldahl Nitrogen (TKN), ppd [4]	358	496	496

Notes

1. Non-Industrial portion of load parameter corresponds to a per capita loading rate of 0.10 ppcd.
2. Non-Industrial portion of load parameter corresponds to a per capita loading rate of 0.22 ppcd.
3. Non-Industrial portion of load parameter corresponds to a per capita loading rate of 0.003 ppcd.
4. Non-Industrial portion of load parameter corresponds to a per capita loading rate of 0.027 ppcd.

The anticipated flow and load demand at the design year are summarized in Table 5 and include consideration for:

- Projected domestic population demand,
- Anticipated significant industrial user demand, and
- Anticipated Non-industrial and non-domestic user demand.

Table 5 – Design Year Combined Wastewater Load Demand

Flow Condition	Value
Average Dry Weather (ADW), mgd	1.366
Calendar Average Day Flow (ADF), mgd	1.446
Average Wet Weather (AWW), mgd [1]	1.682
Peak Hour Wet Weather (PHWW), mgd [2, 3]	4.379
Peak Instantaneous Wet Weather (PIWW), mgd [2]	4.379

Load Parameter	Calendar Day Average	Maximum Month as Day	Calendar Day Maximum
5-Day Carbonaceous Biochemical Oxygen Demand ($cBOD_5$), ppd [4]	4,621	7,773	14,988
Total Suspended Solids (TSS), ppd [5]	5,465	12,227	19,984
Total Phosphorus (TP), ppd [6]	87	138	195
Total Kjeldahl Nitrogen (TKN), ppd [6]	562	894	894

Notes:

1. Corresponds to a flow rate of 62 gpcd for non-industrial users and 100 gpcd for domestic users.
2. Instantaneous flow data unavailable. PIWW determined using existing lift station pump capacity.
3. Corresponds to a calendar day average to peak hourly wet weather peaking factor of 2.6, which is equal to the 10 States Standards for Wastewater Facilities (2014 Edition) recommendation of 2.6 based on service population.
4. Corresponds to MPCA recommended minimum design value for parameter.
5. Corresponds to observed loading based on reported DMR sampling values.
6. Corresponds to Metcalf and Eddy recommended minimum design value for loading.

4 Existing Facilities

The City of Big Lake operates an extended aeration, oxidation ditch-type, activated sludge system at the municipal wastewater treatment facility for treatment of wastewater generated within the City. There are facilities for biological removal of phosphorus, however current load conditions do not allow for effective operation and phosphorus removal is achieved through chemical precipitation.

The facility operates/consists of:

- Main Influent Lift Station,
- Preliminary Treatment
  - (2) fine drum screens with washing and compaction equipment,
  - (1) vertex type grit removal system, grit pump, and grit classifier and washer,
  - (1) influent Parshall flume,
- Secondary Treatment
  - (1) two-cell selector tank,
  - (3) oxidation ditches for extended aeration activated sludge,
  - (3) chemical phosphorus precipitation feed system,
    - (3) peristaltic chemical feed pumps,
    - (3) bulk chemical storage tanks.
  - (3) secondary clarifiers,
- Finishing and Discharge
  - (2) ultraviolet disinfection trains, 2 banks each,
  - (1) outfall pipe.
- Biosolids Stabilization
  - (1) two cell waste sludge storage tank/ gravity thickener
  - (1) aerobic digester cell
  - (1) liquid biosolids storage cell
- Biosolids Dewatering
  - (2) liquid biosolids storage cells
  - (2) dewatering centrifuges
  - (1) dewatered biosolids cake storage bunker
  - (1) cake drier
  - (1) dried cake storage silo

The treatment facility has the ability to receive hauled septage and loadout biosolids as liquid, dewatered cake, or dried cake.

The treatment facility is located outside the continuous municipal boundary of Big Lake; however, the site is included as part of the municipality. Biosolids are currently disposed of to landfills, however the City maintains approved sites for land application. The current approved land application sites are under lease for solar power generation.

4.1 100 Year Floor Elevation

Facilities and improvements for the facility shall not be located in FEMA designated Zone A areas or lower elevations which may be impacted by overland flooding adjacent to Zone A areas.

Zone A is defined by FEMA as an area subject to inundation by the 1-percent-annual-chance flood event generally determined using approximate methodologies. Because detailed hydraulic analysis have not been performed, no Base Flood Elevations (BFEs) or flood depths are shown. Mandatory flood insurance purchase requirements and floodplain management standards apply.

Several state agencies govern activities in the flood plain:

- Under the Minnesota statewide floodplain management standards, local communities cannot allow development in the floodway that would cumulatively cause more than six inches increase in the height of the 199-year flood (MN DNR). Development normally allowed in the flood fringe provided that the buildings are placed on fill so that the lowest floor, including the basement, is above the 100-year flood level.
- Minnesota Building Code §6120.5800 requires public utility facilities within the floodplain to be designed to minimize increases in flood elevations and be compatible with existing local comprehensive floodplain development plans. Where failure or interruption of the public facility results in danger to the public health or safety, protection to the flood protection elevation shall be provided. The flood protection elevation is defined as an elevation one foot above the 100-year flood. The elevation of the lowest floor of a dwelling must be at or above the flood protection level. Local regulations will also require the access road elevation to within two feet of the flood protection elevation.
- MPCA design guidelines for wastewater treatment facilities require treatment plant structure and electrical and mechanical equipment to be protected from physical damage by the 100-year flood. Additionally, treatment plants should remain fully operational and accessible during the 25-year flood. These requirements apply to new construction and to existing facilities undergoing major modification.

If new facilities are constructed in the floodplain, hydraulic modeling and coordination with the Minnesota Department of Natural Resources (MN DNR) are required to confirm that the new facilities do not result in a flood elevation change more than six inches. To avoid this, it is recommended that any new facilities be located outside the 100-year flood elevation.

A copy of the Federal Emergency Management Agency (FEMA) National Flood Hazard Layer (NFHL) map number 27141C0365F for Sherburne County is included in Appendix B-5 of this report.

4.2 Wastewater Treatment Facilities

The wastewater treatment facility was originally constructed in 1976, with updates that occurred in 1995, 2001, 2009, and 2019. The current facility is designed and permitted to treat an average wet weather flow of 0.958 million gallons per day.

The facility is considered a Class A facility. This classification comes from Minnesota Administrative Rule 9400.0500, which defines a scoring system assigning facilities to Classes A, B, C, or D. With this classification, the facility must be operated by an operator who is certified to operate a Class A facility.

The following sections describe and summarize the capacities of each existing treatment unit. Any treatment unit, whether for liquid or solids, can limit the capacity of a wastewater treatment facility. As effluent limits change, so do the design criteria for the unit processes. The wastewater treatment components were analyzed against the current flows and load and the existing discharge permit. The capacity analysis used accepted design standards from the Recommended Standards for Wastewater Facilities (2014), often referred to as "Ten States Standards," the Fourth Edition of the Wastewater Engineering Treatment and Reuse text by Metcalf and Eddy (2003), and Water Environment Federation Manual of Practice No. 8.

The condition of existing structures which may require improvements are also identified in the following sections. Costs for these improvements are presented as part of treatment alternatives in Section 5 of this report as needed. Much of the equipment treatment is near or beyond their useful lifespan. Typically, equipment has a useful lifespan of 15 to 20 years. Thus, it is timely for the City to proactively plan for replacement and rehabilitation so that funds are available when the equipment can no longer meet its intended use. The equipment has served its intended use and the City staff has done a good job maintaining the equipment over the years.

Typically, structures at wastewater treatment facilities have useful lives of 50 to 75 years. Most of the structures appear to be in serviceable condition but are showing their age. All structures should be examined by a structural engineer prior to a design and construction project.

4.3 Capacity and Condition Evaluation

A technical memorandum was prepared for the City of Big Lake dated March 30, 2023. The memorandum provides discussion and presents the determination for capacity and considerations for condition of current wastewater treatment facilities and equipment. The technical memorandum can be found in Appendix C-2 of this report and was prepared using a condition assessment matrix, which can be found as an attachment to the technical memorandum appendix.

The determination of the technical memorandum is generally be summarized in the following sections, organized by treatment process.

4.3.1 Conveyance

Old Main Lift Station

Condition Related Concerns:

- Lift Station is abandoned-in-place and could be removed.

Main Lift Station

Condition Related Concerns:

- Interior process piping, equipment, and architectural coatings.
- Existing forcemain relief valves are no longer serviceable.
- Automatic controls including programmable logic controllers (PLCs) with human machine interface (HMI) displays for remote control and monitoring.

Capacity Related Concerns:

- 20 HP submersible pumps are likely insufficient.
- 43 HP high flow submersible pumps are likely insufficient.
- 8-inch forcemain will likely be undersized based on high flow pump operation.
- 12-inch high flow forcemain may be reused for regular flow.
- A new forcemain will likely need to be furnished to economically meet wastewater flow demand. A phasing approach is recommended to meet minimum flow velocity at startup of new equipment.

4.3.2 Preliminary Treatment

Preliminary Treatment Building

Condition Related Concerns:

- Replace influent screens with system suitable for recommended secondary treatment alternative.
- Add redundant grit pump.
- Replace grit classify and washer cyclone.
- Electric unit heaters.
- Makeup air unit.
- Plumbing piping, fittings, hangers, and accessories.
- Interior process piping, equipment, and architectural coatings.
- Automatic controls including programmable logic controllers (PLCs) with human machine interface (HMI) displays for remote control and monitoring.
- Automatic sampler.
- Influent flow measurement instrumentation.
- Exterior personnel and overhead doors.

4.3.3 Secondary Treatment

Selector Basin

Condition Related Concerns:

- Minor concrete repair on concrete cover.
- Process piping and flow control gates were installed in 2001 and near the end of useful life.
- Electrical, controls, and instrumentation were installed in 2001 and near the end of useful life.
- Add instrumentation to monitor oxidation reduction potential (ORP) for process control.
- Mixers operate continuously. Remote controls and communication to SCADA would allow for process monitoring and the potential for a more efficient operating scheme.
- Current mixers were installed in 2001 and experience ragging issues. Mixers are new end of useful life. Replace mixers with non-ragging type mixers.

Capacity Related Concerns:

- Insufficient treatment volume for recommended hydraulic retention time at anticipated flow demand.

Oxidation Ditch General

Capacity Related Concerns:

- Insufficient treatment volume for recommended organic loading rate at current and anticipated load demand.

Oxidation Ditch 1

Condition Related Concerns:

- Control building roof is original to 1976 and should be replaced.
- Surface aerator is original to 1976 and is at the end of its useful life.
- Piping and valves are original to 1976 and are at the end of their useful life.
- Existing surface aerators are brush rotor type and have exceeded their useful life. During summer months, aerator is unable to maintain a DO in the basins of 2 mg/L.
- Surface aerator runs at constant speed. Replacing constant speed starters with variable speed will allow for dissolved oxygen control in the basins.
- Electrical, controls, and instrumentation were installed in 2001 and near the end of useful life. Include automatic controls to allow for adjustment of aerator speed based on DO measurement in basin.
- Control building is original to 1976. Exterior brick requires repair. HVAC equipment and controls are at the end of their useful life.

Oxidation Ditch 2

Condition Related Concerns:

- Surface aerator runs at constant speed. Replacing constant speed starters with variable speed will allow for dissolved oxygen control in the basins.
- Existing surface aerators are brush rotor type and have exceeded their useful life. During summer months, aerator is unable to maintain a DO in the basins of 2 mg/L.
- Electrical, controls, and instrumentation were installed in 2001 and near the end of useful life. Include automatic controls to allow for adjustment of aerator speed based on DO measurement in basin.

Secondary Clarifiers

Condition Related Concerns:

- Fiberglass Reinforced Plastic (FRP) covers are original to 2001 and leak. Doors freeze shut during winter months. Exhaust fans have exceeded useful life. Covers, doors, dormers, lighting, and HVAC equipment should be replaced.
- Existing clarifier mechanism and access bridges are original to 2001 and have reached the end of their useful life. Replace clarifier mechanisms and access bridges in each clarifier.
- Slide gates at influent splitter structure are original to 2001 and have reached the end of their useful life. Replace slide gates at influent splitter structure.

- Telescopic control valves for sludge draw-off are difficult to control. Alternative method for sludge removal which can be operated per tank should be considered.
- Electrical, controls, and instrumentation were installed in 2001 and near the end of useful life. Include level indicators to monitor sludge blanket in each basin.
- Blast and recoat existing clarifier launderers and top of sidewalls.

Capacity Related Concerns:

- Insufficient treatment volume for recommended solids loading rate and hydraulic loading rate at anticipated flow and load demand.

Chemical Feed

Condition Related Concerns:

- Existing structure is a wood timber walled structure covered in gypsum board. Not suitable for wet work environments.
- Current chemical feed pumps are oversized for coagulant demand and unable to turn down for cost effective phosphorus control.
- Current chemical feed pumps discharge into a common chemical feed header. Piping does not allow for even flow of coagulant to oxidation ditches.
- Existing chemical feed is limited to oxidation ditch effluent boxes. Consider addition of alternative coagulant feed locations at oxidation ditches influent structures and secondary clarifier influent splitter structure.
- Electrical, controls, and instrumentation were installed in 2001 and near the end of useful life. Include level indicator for chemical fill in bulk chemical storage tanks.

4.3.4 Finishing and Discharge

Administration Building (Disinfection and Effluent Flow Measurement)

Condition Related Concerns:

- The roof is original to 1976 and requires replacement.
- Interior and exterior architectural coatings are original to 1976 and should be replaced.
- Repair of exterior CMU walls is required to provide water-tight seal for joint cracks.
- Existing hydronic piping and equipment is failing and requires replacement.
- Raw sludge piping running through the administrative building requires clean air exchanges to avoid hazardous classification of the building space. Separate or re-route raw sludge piping from remainder of administrative building.
- Automatic controls including programmable logic controllers (PLCs) with human machine interface (HMI) displays for remote control and monitoring. Current controls cannot modulate lamp intensity.
- Interior and exterior architectural coatings are original to 1976 and should be replaced.
- Egress occupancy requirements are likely exceeded from lower level.

Capacity Review

- Replace ultraviolet disinfection system with an appropriately sized disinfection system.

- Relocate disinfection to a standalone building to better control work environment and conditions. Relocation to reduce the required amount of conditioning equipment and allow for proper maintenance and operation of equipment.
- Replace effluent measurement with reliable, and accessible system.

Discharge and Outfall

- No condition or capacity related concerns identified.

4.3.5 Biosolids Stabilization

Waste Sludge Storage

Condition Related Concerns:

- Roof of blower room is original to 1976 and should be replaced.
- Interior and exterior architectural coatings are original to 1976 and should be replaced.
- Repair of exterior CMU walls is required to provide water-tight seal for joint cracks.
- Existing fiberglass covers are at end of serviceable life.
- Mixing blowers are located in Administration Building and area at the end of serviceable life.
- Coarse bubble differs are at the end of serviceable life.
- Electrical, controls, and instrumentation were installed in 1995 and near the end of useful life. Include level indictors for each storage cell.
- Existing floating decanter is not serviceable preventing thickening in holding tank. Rectangular tanks are not ideal for gravity thickening.
- Submersible sludge transfer pumps are at the end of serviceable life.
- Submersible supernatant transfer pumps are at the end of serviceable life.
- There is local demand to receiving of sludge from other communities. Operating staff would like the ability to receive solids directly to holding tank for feed to aerobic digesters.

Sludge Control Building

Condition Related Concerns:

- Roof of control building is original to 1995 and should be replaced.
- Roof of aerobic digester is original to 1995 and should be replaced.
- Interior and exterior architectural coatings are original to 1995 and should be replaced.
- Minor concrete repair is likely required on interior walls of aerobic digester.
- HVAC equipment is original to 1995 and should be replaced.
- Evaluate options to fully draw-down contents of aerobic digester and biosolids storage. Currently a few feet remain in tank with requirements manually installing trash pump.
- Electrical, controls, and instrumentation were installed in 1995 and near the end of useful life. Include level indictors for each treatment tank. Include ORP and DO instrumentation for aerobic digester.
- Blowers are original to 1995 and should be replaced.
- Coarse bubble diffused aeration equipment is aerobic digester and biosolids storage tank are original to 1995 and should be replaced.

- Boiler and recirculation pumps for heating aerobic digester are not used and at serviceable life. Equipment should be removed.
- Current biosolids storage is not covered to maintain water temperature during winter months.
- Exterior personnel doors need replacement.

Capacity Review

- Aerobic digester capacity is likely exceeded at anticipated flow and load demand.
- Liquid biosolids storage capacity requires weekly dewatering at future flow and load demand.

4.3.6 Biosolids Dewatering

Biosolids Conditioning Building

Condition Related Concerns:

- The air conditioning unit for the electrical room has exceeded its useful service life and requires replacement.
- Radiant heat boiler controls are not reliable and should be replaced.
- Plant PLC panel is no longer serviceable and should be replaced.
- Centrifuge liquid sludge feed pumps are approaching the end of serviceable life.
- Centrifuges are near major overhaul. It is anticipated that the PLC panels for the centrifuges will be recommended for replacement at this time. The VFD drive for centrifuge #1 should be replaced.
- Central odor control system requires media replacement. Location of media tank obstructs service of process equipment and should be relocated.
- Provide provisions for cake biosolids storage in addition to the dried biosolids silo.
- Alternate cake loadout should be improved to reduce spillage of cake between load out. Currently the loadout is just a horizontal plain end pipe.
- No eyewash located near polymer chemical feed and storage equipment for dewatering centrifuges.
- No shower at facility for washdown after exposure to wastewater or sludge.

4.3.7 Other Considerations

Administration Building

Condition Related Concerns:

- The roof is original to 1976 and requires replacement.
- Existing conditioning system consists of a boiler original to 1976 and an air conditioning unit which does not operate. The HVAC system should be replaced with a forced air and central conditioning system for the administration building, separate from process rooms.
- Raw sludge piping running through the administrative building requires clean air exchanges to avoid hazardous classification of the building space. Separate or re-route raw sludge piping from remainder of administrative building.
- Automatic controls including programmable logic controllers (PLCs) with human machine interface (HMI) displays for remote control and monitoring should come back to the

administration building supervisory control and data acquisition (SCADA) system for the entire facility. System should include a data logging historian, remote controls, and monitoring for all treatment processes.

- The existing lavatory and shower facilities house process monitoring equipment and are non-functional.
- Interior and exterior architectural coatings are original to 1976 and should be replaced.
- Repair of exterior CMU walls is required to provide water-tight seal for joint cracks.

Site

Condition Related Concerns:

- Relocate UV disinfection to separate, purpose-built structure.
- Relocate RAS/WAS piping and controls to separate structure.
- Relocate septage receiving, increase accessibility, capacity, and include the ability to meter and measure flows.
- Add card access and motorized gate with security camera to main drive of facility. Provide capability of issuing access cards to septage haulers.
- Replace backup generator with appropriately size unit.
- Run new fiber communications to all treatment building and equipment.

5 Alternative Evaluation

A technical memorandum was prepared for the City of Big Lake dated May 3, 2023. The memorandum provides discussion and presents the alternatives considered for improvements at the wastewater treatment facility. The technical memorandum can be found in Appendix C-3 of this report. Manufacturers and vendors were solicited for major equipment items. These costs reflect the opinion of probable costs at the time of preparation of this report. Probable costs are likely to change between preparation of the facility plan and bidding of improvements.

The following is a summary of process-centric major improvements recommended at the facility. Where appropriate, alternatives were considered on the basis of economic and non-economic factors, where are discussed in greater detail as part of the technical memorandum.

Liquid Treatment Processes:

Conveyance:

- Demolish abandoned old main lift station.
- Increase design capacity of main lift station.
- Add additional forcemain to preliminary treatment.

Preliminary Treatment:

- Replace influent fine screening and compacting equipment.
- Replace grit classifying and washing cyclone and add redundant grit pump.

Secondary Treatment:

- Replace existing selector basin mixers and baffle.
- Expand selector basin hydraulic capacity for biological phosphorus removal.

- Expand secondary treatment organic capacity:
  - Alternative 1 – Additional extended aeration oxidation ditches, brush aerated.
  - Alternative 2 – Modification of existing oxidation ditches for IFAS.
  - Alternative 3 – Modifications of existing oxidation ditches for MOB.
- Expand secondary clarifier hydraulic and solids capacity:
  - Alternative 1 – Rehabilitation and expansion of existing secondary clarifiers.
  - Alternative 2 – Conversion of existing and construction of new secondary clarifiers.
- Replace existing waste and return activated sludge pumps and structure at a proposed Disinfection and Pumping Building.
- Replace existing coagulant feed equipment.
  - Alternative 1 – Rehabilitate existing chemical storage building.
  - Alternative 2 – Relocate to new Disinfection and Pumping Building.

Finishing and Discharge:

- Replace existing ultraviolet disinfection equipment and relocate to new Disinfection and Pumping Building.
- Replace existing effluent flow measurement and relocate to new Disinfection and Pumping Building.

Solid Treatment Processes:

Biosolids Stabilization:

- Provide waste sludge and scum thickening prior to aerobic digestion:
  - Alternative 1 – Gravity thickening.
  - Alternative 2 – Dissolved air floatation thickening.
- Expand solids treatment capacity of existing aerobic digester, replace existing aeration equipment and diffusers with selected mixing and aeration alternative:
  - Alternative 1 – Single primary, two-stage aerobic digestion.
  - Alternative 2 – Dual primary, two-stage aerobic digestion.
- Evaluate mixing and aeration alternatives for Waste Sludge Holding Tank, Aerobic Digester, and Liquid Biosolids Storage:
  - Alternative 1 – Diffused aeration and mixing.
  - Alternative 2 – Diffused aeration, compressed aerated mixing.
  - Alternative 3 – Jet aeration and mixing.
- Centralized sludge and biosolids aeration at Biosolids Control Building.
- Convert existing Waste Sludge Storage Tank to sludge receiving station.

Biosolids Dewatering:

- Replace centrifuge controls and drives.
- Replace centrifuge feed pumps.
- Relocate odor control equipment.
- Furnish emergency eyewash and lavatory shower.
- Replace vertical shaftless screw conveyor.

- Provide permanent gate and controls for dewatered biosolids loadout.
- Provide covered dewatered cake biosolids storage facilities.

Other Considerations

Administration Building

- Replace HVAC with forced air.
- Demolish equipment from lower level, fill lower level, convert upper level of process room to maintenance garage, bathroom, hydration station, and shower facilities.
- New PLC and SCADA system.
- Replace backup generator with sufficiently sized unit in all-weather enclosure.

Site

- New fiber communications.
- Replace site lighting.
- Replace site asphalt.
- Replace site stormwater system as needed.
- Replace and relocate septage receiving.
- Replace front gate with motor-operated gate, card scanner, and camera.

Disinfection and Pumping Building

- Construct new multi-purpose process building on south side of site for:
  - Ultraviolet disinfection equipment (lower level)
  - Effluent flow measurement (lower level)
  - WAS and RAS pumping (lower level)
  - Other process specific pumping requirements based on alternatives (lower level)
  - Chemical storage and feed (upper level, as applicable to alternatives)
  - Electrical equipment and south site generator (upper level)
  - Electrical equipment and generator (upper level)

Blower Building

- Construct new blower building near secondary treatment for:
  - Blower equipment, valves, piping.
  - Controls, instrumentation, and power.

6 Summary of Recommended Alternative

A technical memorandum was prepared for the City of Big Lake dated May 3, 2023. The memorandum provides discussion and presents the recommended alternative for improvements at the wastewater treatment facility. The technical memorandum can be found in Appendix C-3 of this report.

In addition to those capacity and condition related improvements identified in Section 5 of this report, the following alternatives are summarized below:

- Secondary Treatment
  - Selector Basin: Alternative 3 – Single train with an additional selector cell for increased capacity
  - Biological Treatment: Alternative 3 – Conversion of the three existing oxidation ditches for Mobile Organic Biofilm (MOB) biological phosphorus removal
  - Secondary Sedimentation: Alternative 2 – Replacement of existing clarifier basins
  - Chemical Feed: Alternative 2 – Replacement and relocation of coagulant feed storage and equipment
- Biosolids Stabilization
  - Sludge and Biosolids Mixing: Alternative 2 – Diffused aeration and compressed air mixing
  - Waste Sludge and Scum Thickening: Alternative 2 – Dissolved air flotation thickening
  - Aerobic Digestion: Alternative 2 – Two-cell primary aerobic digestion and conversion of sludge storage for secondary aerobic digestion.

6.1 CWRF Cost and Effectiveness Additional Monetary Discussion

The Clean Water Revolving Fund (CWRF) Program recommends the inclusion of discussion regarding energy conservation, renewable opportunities, asset management, and conservation planning to facilities planning documents. The following sections will discuss opportunities and constraints pertaining to CWRF planning.

6.1.1 Asset Management

The existing treatment facility for Big Lake consists of a main influent lift station, activate sludge treatment with chemical phosphorus removal, and aerobic digestion with the ability to provide finished biosolids as liquid, dewatered cake, or dried cake.

Once improvements are completed, a new or modified asset management plan will need to be developed by the community in conjunction with input from the operating staff. The goal of the asset management plan is to operate the wastewater system at its lowest life-cycle cost to reclaim wastewater before it is recycled back into the environment.

The costs associated with proactive management to operate, maintain, repair, and replace physical parts and asset of the recommended treatment alternative are included in the alternative evaluations and represented in the preliminary engineer's opinion of cost 20-year present value.

As a requirement of the facility's NPDES/SDS discharge permit, a site-specific operations and maintenance manual will be prepared for the City. The manual includes guidance information for the City to develop an asset management plan for their facility.

Major assets for the recommended alternative include, but are not limited to:

- Conveyance System
  - Manholes, services, piping, ect.
  - Sanitary lift stations pumps, instrumentation, and control equipment.

- Preliminary Treatment
  - Screening screens, washer, compactor, instrumentation, and controls equipment.
  - Grit removal drive, pumps, classifying, and control equipment.
  - Influent flow measurement, instrumentation, and sampling.
- Secondary Treatment
  - Selector basins mixing and instrumentation.
  - Biological treatment mixing, aeration, instrumentation, and control equipment.
  - Secondary clarifier mechanisms, instrumentation, pumps, and control equipment.
  - Chemical feed pumps, instrumentation, and control equipment.
- Finishing and Discharge
  - Ultraviolet Disinfection banks, instrumentation, and control equipment.
  - Effluent flow measurement, instrumentation, and sampling.
- Biosolids Stabilization
  - Waste sludge and scum thickening and storage mixing, mechanisms, instrumentation, pumps, and control equipment.
  - Aerobic digester mixing, aeration, instrumentation, and control equipment.
- Biosolids Dewatering
  - Liquid sludge storage mixing, instrumentation, pumps, and control equipment.
  - Dewatering centrifuges, pumps, instrumentation, chemical feed equipment, and controls.
  - Dewatered biosolids conveyance, storage, instrumentation, load out, and control equipment.
  - Drier equipment, pumps, instrumentation, conveyance, load out, and control equipment.
- Non-process control and support equipment for all facilities on site, which can include, but are not limited to:
  - Mechanical HVAC and plumbing equipment.
  - Architectural safety and occupancy equipment.
  - Electrical controls, backup power, and distribution equipment.
  - Structural buildings.
  - Site improvements, paving, and stormwater control structures.

6.1.2 Energy Conservation

Energy conservation from wastewater treatment can come in multiple forms.

A significant portion of energy costs of treatment works is a result of lighting and HVAC operation. To this end, high efficiency lighting, such as LED, lighting control schemes, photocells, timers, and occupancy sensors will be evaluated during design to provide a lighting plan which allows for safe operation of the treatment works and minimizes energy consumption. HVAC controls including programmable thermostats, night setbacks, high efficiency equipment, premium efficiency motors, and exhaust air heat recovery will be provided where appropriate for operations.

Motor control centers provide electrical distribution to major equipment at a treatment facility. The control center amperage draw is monitored to track equipment efficacy and diagnose potentially loose connections. Abnormal amperage draws are identified with automatic controls to notify operators of excess energy consumption by equipment above normal conditions.

Equipment motors, whether pumping or operating drives, are another source of energy consumption. Premium efficiency motors, variable speed pumping or drives, and proper forcemain sizing to manage head conditions are all integrated into design to provide energy efficient operation.

Consideration of treatment alternatives included those treatment processes which include controls and programming that minimize equipment operation and energy use.

6.1.2.1 Renewable Energy

The existing facility and recommended alternative include aerobic digestion, which does not generate or capture biogas. Therefore, biogas utilization is not an opportunity at the facility.

Thermal energy recovery from wastewater is another renewable opportunity. For the community, large uncovered extended aeration activated sludge basins contribute to lower-than typical wastewater temperatures which reduces the amount of heat recovery which can be utilized. During design, consideration for thermal recovery using process storage tanks will be considered, however the size of retention tanks and use of detention tanks limits applicability for recovery.

Solar and wind generation at the wastewater facility can also be utilized to generate renewable energy. The preliminary engineer's opinion of capital cost for the project creates an economic burden for the community as shown through calculations recommended by the US EPA and characterized in the antidegradation review (see Appendix A-3). If funding is available, solar and wind generation will be considered during design.

6.1.3 Water Reuse and Metering

The current facility does not have plant effluent pumps, service, or demand. The facility and proposed recommended alternative will require potable water for a variety of uses including lavatory facilities, general cleanup, screen washing, and pump seals. The facility does have a potable water system which includes a water meter to track water consumption and assist in diagnosing operating conditions which may contribute to excessive water consumption.

The largest water consumption process at the facility is associated with the biosolids dryer. The furnished equipment was not supplied with plant effluent water for cooling, and therefore is unlikely suitable for plant effluent use. The next largest water use is wash water for screening, which is a challenging single use application due to the water demand being high flow for a short duration. The result is large effluent pumps, expansion tanks, and water piping for a relatively small volume of water utilized.

Water reuse for yard hydrants is another period activity which may utilize a large volume of water infrequently. The preliminary engineer's opinion of capital cost for the project creates and economic burden for the community as shown through calculations recommended by the US EPA and characterized in the antidegradation review (see Appendix A-3). If funding is available, water reuse will be considered during design.

6.1.3.1 Water Efficient Devices

Recommended improvements include rehabilitation of the Preliminary Treatment Building and Biosolids Conditioning Building. These structures are likely the primary use of potable water on site. The Administration Building and Biosolids Conditioning Building include lavatory facilities (sink, toilet, and/or shower). All facilities will have a variety of hose bibs for general cleaning inside and outside of the buildings. Fixtures provided for these buildings will be water efficient in accordance with EPA high-efficiency recommendations.

Pump seal water is typically provided on solids handling pumps at wastewater facilities. The seal water assists in extending the life of the pump seal and assist in lubricating the seal, improving pump efficiency. A pump seal without flow control can consume 20-30 gallons per minute of potable water. Flow control for pump seals in the form of isolation valve, regulators, and solenoids valves reduce total flow to the pump seal as well as isolate seal water completely so water is not being delivered when the pump is not operating.

6.1.3.2 Water Audits and Conservation Planning

As a requirement of the facility's NPDES/SDS discharge permit, a site-specific operations and maintenance manual will be prepared for the City. The manual includes guidance information for the City to develop water consumption benchmarks through water audits. Once a benchmark is developed, monitoring of water consumption through the site water meter can be utilized to conduct ongoing audits and assist in water conservation through identification of excessive water consumption.

6.1.4 Building, Benchmark, and Beyond Sustainable Building

The B3 Sustainable Building 2030 (SB 2030) Energy Standard is a progressive energy conservation program designed to significantly reduce the energy and carbon in Minnesota commercial, institutional, and industrial buildings. Based on the national Architecture 2030 program, SB 2030 has been tailored to the needs of Minnesota buildings. The SB 2030 Energy Standard for all projects beginning design between 2010 and 2014 was set at 60 percent below that of an average building. In 2015, the standard became 70 percent better, and in 2020 80 percent better. The SB 2030 Energy Standard is required on all projects that receive general obligation bond funding from the State of Minnesota.

A critical aspect of the SB 2030 Energy Standards is that the actual energy performance is reported in a way that allows for direct verification of the building's energy use after construction is complete and the building is occupied and operated under real-world conditions. The metering conducted by utilities for billing purposes does not always provide adequate information to allow for an adequate level of building performance verification against a project's SB 2030 Energy Standard.

The current project is limited to planning and design and therefore exempt. A signed copy of the facility plan will be submitted to the B3 2030 coordinator along with a narrative describing the operation flexibility and anticipated operating conditions.

A copy of the B3 202 exemption certification checklist can be found in Appendix D-3 of this report.

6.2 CWRF Cost and Effectiveness Additional Non-Monetary Discussion

6.2.1 Sustainability and Climate Resilience

The wastewater treatment facility is located along the Mississippi River. In consideration to potential flooding or other hydrological events, treatment facilities have been located outside of the 100-year flood plain.

The facility is serviced by two backup generators. One generator which was installed as part of the solids conditioning building, provide backup power to the solids conditioning building and preliminary treatment building. The other is located in the administration building and installed in the mid-1970s. The generator provides backup power to the administration building, selector basins, oxidation ditches, and secondary clarifiers. The generator capacity does not provide sufficient power to maintain operation of the aerobic digesters during a utility outage.

Utility outages may become more frequent, or longer in duration due to climate change. It is included in the recommended alternative for a new backup generator to be utilized as part of the disinfection and pumping building to replace the generator in the administration building, and include sufficient capacity for the existing facilities, aerobic digester complex, disinfection and pumping building, and blower building.

The proposed generator would be fuel efficient and comply with modern air quality requirements as compared to the existing generator.

The recommended expansion of the secondary treatment process for biological phosphorus removal significantly reduces the volume of coagulant required for transport, storage, and addition to the wastewater stream. Additionally, biological phosphorus removal is a passive treatment process requiring and additional recirculation side stream to facilitate phosphorus removal. Comparatively, it is an energy efficient method of removal and assists in reduction of organics in the waste stream prior to aerobic treatment.

6.2.2 Consolidation and Regionalization

The Big Lake wastewater treatment facility has existing facilities to act as a regional acceptor for vactor and hauled wastewater. The facilities are currently not utilized due to capacity limitations at the facility.

Regionalization was evaluated as part of the Antidegradation Review. Adjacent communities within a reasonable distance include the Monticello, Elk River, and Becker facilities. Each facility ultimately discharged to the Mississippi River and would require significant improvements to be able to treat the additional wastewater generated by Big Lake.

It is therefore recommended that Big Lake expand its treatment capacity to continue treatment of regional, small sewage generators and treat wastewater generated by the City near its source.

6.2.3 Reliability

Process reliability is discussed in greater detail for the reviewed alternatives as part of the Alternative Evaluation.

Generally, the current condition and capacity of facilities was evaluated to determine suitability for current and anticipated flow and load demand. Those processes which were identified as near, at, or beyond capacity were considered for improvements. These capacity review consider common practice design guidelines for loading, but also includes those recommendation for redundancy and resilience. This includes use of multiple treatment trains, and sizing of those trains such that operation is consistent with one unit out of service.

Where appropriate, recommendations for additional treatment trains were included. An example is the recommendation for a second primary aerobic digester. The use of two parallel aerobic digester trains follows reliability recommendations, but also allows for energy efficient fine-bubble diffusers to be utilized rather than coarse-bubble diffusers.

6.2.4 Green Infrastructure

Where suitable, plant effluent was considered for use as wash water, sluice water, and site cleaning. Not all applications are suitable for plant effluent as the small amount of residual suspended solids may result in plugging of spray nozzles or premature wear of seals.

The alternatives considered were also intended to reduce the consumption of on-site chemical use. The reduction in chemical demand, primarily through biological phosphorus removal, has long reaching environmental benefits. The reduced chemical lowers the need for resource extraction, manufacturing, hauling, and ultimately addition and discharge to the Mississippi River. This is especially true for Big Lake as the facility pursues Antidegradation Review approval for chlorides, a major constituent of the ferric chloride currently utilized for chemical phosphorus precipitation.

Recommended improvements include replacement of several make-up air units, blowers, and pumps. Much of the existing facility equipment was installed in the mid-1970s and 1990s. Replacement equipment and motors will be more energy efficient and include appropriate instrumentation and variable frequency drives to minimize energy consumption where possible.

6.2.5 Environmental Justice

The City has two identified significant industrial users (SIU). Both have indicated a desire to increase production, expand workforce, and increase flow and load demand for wastewater generated through operation.

The City has identified approximately 500 acres of non-industrial and non-domestic property which is anticipated to be developed during the planning period. The additional flow demand corresponds to approximately 1,700 residential equivalent units (REU).

Based on historical population trends, the City anticipates an additional approximate 2,200 residents during the planning period, which corresponds to approximately 760 residential equivalent units (REU).

The identified demand cannot be met in a manner which responsibly protects the public health and environmental quality using the given facilities and design treatment capacity. Aging equipment, infrastructure, and condition limit operations and contribute to inefficient use of energy, water, and chemical addition at the facility. Operator labor and attention is spent undergoing frequent maintenance and “band-aid” repairs rather than process operation and optimization.

Big Lake anticipates an increase in wastewater flow demand as a result of residential, commercial, and industrial growth of nearly 200% during the planning period. As mentioned, the existing facility is near 90% of its design hydraulic capacity based on calendar day average flows. At the 90% threshold, it is not uncommon for further evaluation being required when applying for and receiving sewer extension permits for new construction.

Capital improvements are needed at the existing facility to address age and condition of existing equipment regardless of addressing treatment capacity. Without the additional development, the costs associated with age and condition replacement will be felt solely by the current residential, commercial, and industrial users.

The City is in a difficult position for housing based on two outstanding conditions:

- The average household income is such that affordable housing for new and moderate to lower income households is limited.
- There is no available senior housing in the community as the last facility had been converted to other uses.

The City is currently in planning for construction to add the following residential developments to the community which may become impacted by the limitation in treatment flow capacity at the wastewater treatment facility:

- 60 unit apartment complex at market rate and low income,
- 75 unit single-family detached house subdivision at market rate, and
- 139 unit townhome subdivision at market rate.

The City has seen its dedicated senior housing be converted to other land uses or away from dedicated senior housing. The last facility was converted recently leaving no dedicated senior housing. The City is currently planning for construction of:

- 74 unit dedicated senior apartment complex.

The City has been working with private companies to pursue equitable housing opportunities for various economic and demographic groups served by the community. The treatment capacity limitations at the wastewater treatment facility may affect the timeframe for construction and ability to service such housing opportunities.

The additional residential units will also expand both the tax base for the community, resulting is a greater source of revenue to operation and maintenance of facility, but also distribute the costs for repayment of capital expenses as a result of construction.

The underutilized, City owned lots for development represent 30 acres and 6 lots. When developed, the market value for the addition non-domestic users is $909,900. Sufficient capacity for wastewater treatment would allow the City to more aggressively prepare and market the lots for development.

The significant industrial users have indicated a desire to expand production. Should treatment capacity not be available, those industrial users may be motivated to either move operations to another community to develop additional facilities outside of the community. The result in either event is lost employment, revenue, and development in the community.

The largest industrial user, a food processor, is planning to increase the wastewater flow generated by 100% within the next two years. The increase would result in a significant increase in flow and load to the facility, but also a significant revenue source for the City. The additional revenue from the industrial user would offset the costs being shared by residential users. The additional production at the facility would also substantiate additional work opportunities for residents and potential residents of Big Lake.

6.2.6 Acceptability and Affordability

The recommended alternative comes with a capital cost that will require the City to pursue additional avenues of funding in the form of grants, loans, and other opportunities. The anticipated costs are significant for a community the size of Big Lake and will have a substantial impact of the water and sewer service rates currently paid by residents.

A preliminary Wastewater User Rate Impact Evaluation is discussed later in this report and provides several funding scenarios and the potential impact funding the recommended improvements may have on the community. As part of the evaluation, the USDA Rural Development and MPCA affordability criterion was also considered.

6.3 Integrated Cost and Effectiveness Analysis

Table 6 on the following page describes an assigned value for non-monetary factors discussed in the CWRF cost and effectiveness. The table also contains a column with an assigned value based on the preliminary engineer's opinion of probable costs for the alternatives. A relative score of 1 to 3 was assigned to each monetary and non-monetary factor with 1 being lowest relative benefit and 3 being highest relative benefit. The non-monetary factors were averaged to create a composite score, The averaged non-monetary value was then averaged with the monitory value.

Refer to Appendix C3 for a full discussion of the alternatives including the evaluated preliminary engineer's opinion of probable costs.

Table 6 – CWRF Monetary and Non-Monetary Evaluation for Alternatives

Alternative	Monetary	CWRF Cost and Effectiveness Non-Monetary Sections						Avg
		6.2.1	6.2.2	6.2.3	6.2.4	6.2.5	6.5.6	
Secondary Treatment Alternatives								
Oxidation Ditch Expansion	1	2	2	3	2	3	1	1.6
IFAS Conversion	2	3	3	2	3	3	3	2.4
MOB Conversion	3	3	3	2	3	3	3	2.9
Secondary Clarification Alternatives								
Rehabilitation and Expansion	1	2	3	2	2	3	1	1.6
Replacement	3	3	3	3	3	3	3	3.0
Coagulant Feed Alternatives								
Rehabilitation of Existing	3	1	3	2	1	3	1	2.4
Replacement	2	3	3	3	3	3	3	2.5
Aerobic Digestion Alternatives								
Diffused Aeration and Mixing, Single-Primary Cell	3	1	2	1	1	3	2	2.3
Diffused Aeration and Mixing, Dual-Primary Cells	2	2	3	2	2	3	3	2.3
Diffused Aeration and Compressed Mixing, Single-Primary Cell	2	2	2	2	2	3	2	2.1
Diffused Aeration and Compressed Mixing, Dual-Primary Cells	1	3	3	3	3	3	3	2.5

The facilities plan review process and alternative evaluation does not require the recommended alternative to be the lowest cost alternative; however, it is generally an important consideration. Where appropriate, non-monetary considerations are evaluated and used to determine if potential operational, reliability, environmental, or social consideration outweigh the purely economic considerations.

Table 6 will be provided during public hearings and to the City Council to facilitate discussion of input regarding the non-monitory benefits, concerns, and to solicit addition input for factors relevant to both the City staff, served community, and other stakeholders impacted by the facility's operation.

The recommended alternatives for improvements can be summarized by the following:

Secondary Treatment:

6.2.1 Sustainability and Climate Resilience: MOB conversion of the secondary treatment process allows to the use of a sustainable, plant-based suspended growth media as compared to the IFAS process. Both IFAS and MOB allow for partial media fill, which meaning the organic capacity may be increased through additional media so lang as aeration capacity is available. Both the IFAS and MOB processes require a minimum of 2 oxidation ditches to be converted, though conversion of all three is recommended for future expansion and flexibility. The result is the ability to operate with one out of service and not lose treatment capacity given the ability to add additional media and aeration to the remaining tanks. New facilities would have both utility furnished power and onsite backup power via a new onsite generator. All facilities are located outside of the flood plain.

6.2.2 Consolidation and Regionalization: Both the MOB and IFAS use suspended growth biology. The biology can absorb shock organics loads better than conventional mixed liquor due to its ability to operate at higher MLSS and rapidly grow biomass on the fixed film. Potential toxicity is also better managed by the suspended growth as the outer layer of biofilm may be affected, however the biomass can recovery faster due to the insulated, inner layer of biofilm remaining.

6.2.3 Reliability: The oxidation ditch alternative requires the least amount of equipment. Each oxidation ditch is fitted with two surface aerators and the long hydraulic retention time allows for equalization of wastewater constituents where shock loading may be a concern. Both the IFAS and MOB processes incorporate the need to manage a suspended media, and the MOB process includes the need to separate the media from the waste sludge stream. As noted, the IFAS and MOB do offer superior resiliency to potential short-term toxicity due to the depth of biofilm accumulated on the media surface.

6.2.4 Green Infrastructure: The IFAS and MOB alternatives reuse existing tankage, whereas the oxidation ditch alternative requires significant construction for three additional basins, as well as expansion for a parallel selector train. Both the IFAS and MOB can incorporate step aeration which provides better process control of the biological phosphorus process. Both the IFAS and MOB may incorporate separate methods for aeration and mixing which may be an energy saving benefit during operation. The decoupling of aeration and mixing was not examined during the facilities plan but may be included in preliminary design.

6.2.5 Environmental Justice: All alternatives adequately address the needs for additional capacity as it pertains to the housing, employment, and development of the communities underserved groups. Additionally, the alternative allows for biological phosphorus removal which reduces emissions associated with resource extraction, manufacturing, and delivery. All activities which tend to be located in disproportionately rural and underserved areas. The alternatives reduce the volume of chemical added and ultimately discharged via the outfall to the receiving waters.

6.2.6 Acceptability and Affordability: The alternative has the lowest preliminary engineer's opinion of probable costs for those alternatives evaluated. Biological treatment is

considered important to the facility operating staff and administration staff for the City. The City is pursuant of alternatives which maximum the reuse of existing facilities, and also plan accordingly for future wastewater limits and future expansion when necessary.

Secondary Clarification:

6.2.1 Sustainability and Climate Resilience: Replacement of the secondary clarifiers reduces the number of drive motors, motor control centers, and instrumentation from five to two. The two secondary clarifiers would also have a replaced splitter structure to allow for better diversion of influent flow and mixing of coagulant, as needed. Replacement also allows for purpose-built clarifiers for the appropriate two of sludge removal system for operation as a ballasted clarifier. New facilities would have both utility furnished power and onsite backup power via a new onsite generator. All facilities are located outside of the flood plain.

6.2.2 Consolidation and Regionalization: All alternatives adequately provide the additional capacity required for acceptance of small wastewater generating users which transport waste via vactor or hauling.

6.2.3 Reliability: All alternatives meet the reliability recommendations of 10 States Standards and the MPCA. Two secondary clarifiers as opposed to five simplifies operation and hydraulics of the influent splitter structure, waste pumping, and return pumping. The lower number of clarifiers also reduces the amount of chemical feed points, piping, valves, pumps, and controls associated with coagulant addition.

6.2.4 Green Infrastructure: Two secondary clarifiers as opposed to five reduces the motors, controls, and maintenance for the mechanism drives, waste pumping, and return pumping. The lower number of clarifiers also reduces the amount required for chemical feed points, piping, valves, and pumps associated with coagulant addition. Appropriately sized chemical feed pumps with sufficient turndown and the ability to control coagulant dose adequately to each discharge location improves operability and performance of the biological phosphorus removal system.

6.2.5 Environmental Justice: All alternatives adequately address the needs for additional capacity as it pertains to the housing, employment, and development of the communities underserved groups. Additionally, the alternative allows for biological phosphorus removal which reduces emissions associated with resource extraction, manufacturing, and delivery. All activities which tend to be located in disproportionately rural and underserved areas. The alternatives reduce the volume of chemical added and ultimately discharged via the outfall to the receiving waters.

6.2.6 Acceptability and Affordability: The alternative has the lowest preliminary engineer's opinion of probable costs for those alternatives evaluated. The City is pursuant of alternatives which maximum the reuse of existing facilities, and also plan accordingly for future wastewater limits and future expansion when necessary. Though the secondary clarifier are being replaced, the existing tanks are being utilized for the solids thickening and recirculation processes at the facility.

Coagulant Feed:

6.2.1 Sustainability and Climate Resilience: Both alternatives provide appropriately sized chemical feed pumps with sufficient turndown and the ability to control coagulant dose adequately to each discharge location improves operability and performance of the biological phosphorus removal system. New facilities also allow for appropriate storage, containment, level monitoring, ventilation, and safety features such as overhead sprinkling systems for hazardous chemical storage. New facilities would have both utility furnished power and onsite backup power via a new onsite generator. All facilities are located outside of the flood plain.

6.2.2 Consolidation and Regionalization: All alternatives adequately provide the additional capacity required for acceptance of small wastewater generating users which transport waste via vactor or hauling.

6.2.3 Reliability: All alternatives meet the reliability recommendations of 10 States Standards and the MPCA. Two secondary clarifiers as opposed to five simplifies operation and hydraulics of the influent splitter structure, waste pumping, and return pumping. The lower number of clarifiers also reduces the amount of chemical feed points, piping, valves, pumps, and controls associated with coagulant addition. New facilities also allow for appropriate storage, containment, level monitoring, ventilation, and safety features such as overhead sprinkling systems for hazardous chemical storage. Appropriately sized chemical feed pumps with sufficient turndown and the ability to control coagulant dose adequately to each discharge location improves operability and performance of the biological phosphorus removal system.

6.2.4 Green Infrastructure: Two secondary clarifiers as opposed to five reduces the amount required for chemical feed points, piping, valves, and pumps associated with coagulant addition. Appropriately sized chemical feed pumps with sufficient turndown and the ability to control coagulant dose adequately to each discharge location improves operability and performance of the biological phosphorus removal system.

6.2.5 Environmental Justice: All alternatives adequately address the needs for additional capacity as it pertains to the housing, employment, and development of the communities underserved groups. Additionally, the alternative allows for biological phosphorus removal which reduces emissions associated with resource extraction, manufacturing, and delivery. All activities which tend to be located in disproportionately rural and underserved areas. The alternatives reduce the volume of chemical added and ultimately discharged via the outfall to the receiving waters.

6.2.6 Acceptability and Affordability: Though the alternative is not the lowest preliminary engineer's opinion of probable cost for those alternatives evaluated, it does provide the most responsible approach to hazardous chemical safe storage, handling, and feed. The new equipment will allow for adequate turn down, the ability to control chemical being delivered to each treatment train, and modern, code-compliant storage and handling safety features. The City is pursuant of alternatives which maximum the reuse of existing facilities, and also plan accordingly for future wastewater limits and future expansion when necessary. The existing building will be repurposed as a storage and maintenance facility, which is its original intended use.

Aerobic Digestion:

6.2.1 Sustainability and Climate Resilience: Alternatives incorporating dual primary aerobic digester cells provide the option on incorporating fine-bubble aeration diffusers, which are more energy efficient than coarse-bubble diffusers. Alternatives which provide separate aeration through diffusers and compressed air mixing further reduce energy required for operation of facilities. Decoupling of aeration and mixing improvements process control, reducing the chance of souring of the digester due to over aeration. Continuing use of aerobic digestion improves operability of the biological phosphorus removal process by limiting releases associated with anaerobic conditions. New facilities would have both utility furnished power and onsite backup power via a new onsite generator. All facilities are located outside of the flood plain.

6.2.2 Consolidation and Regionalization: All alternatives adequately provide the additional capacity required for acceptance of small wastewater generating users which transport waste via vactor or hauling. All alternatives furnish facilities which can receive hauled waste directly to the aerobic digesters as appropriate.

6.2.3 Reliability: Dual primary digester cell alternatives allow for the removal of either one primary cell, or the secondary cell due to maintenance, repair, or unexpected equipment failure. Removal of a primary cell will still allow for 60 days of SRT at design load conditions in compliance with EPA 503 requirements for land application. Removal of the secondary cell will still allow for 30 days of SRT at design load condition for disposal of biosolids under current methods. For separate aeration and mixing, failure of either the compressors or blowers will not result in complete loss of process control.

6.2.4 Green Infrastructure: Alternatives incorporating dual primary aerobic digester cells provide the option on incorporating fine-bubble aeration diffusers, which are more energy efficient than coarse-bubble diffusers. Alternatives which provide separate aeration through diffusers and compressed air mixing further reduce energy required for operation of facilities. The new blower equipment would replace the current blowers, which were installed in the 1990's. The new blowers would be energy efficient. The alternative also covers the secondary aerobic digest tank, reducing rain accumulation which would be removed during dewatering. The cover also conserves heat, which reduces the time required in the digester to meet the desired volatile solids reduction.

6.2.5 Environmental Justice: All alternatives adequately address the needs for additional capacity as it pertains to the housing, employment, and development of the communities underserved groups.

6.2.6 Acceptability and Affordability: Though the alternative is not the lowest preliminary engineer's opinion of probable cost for those alternatives evaluated, it does provide the ability to operate under the reliability recommendations of 10 states standards and the MPCA. The alternative also allows for use of fine-bubble diffused aeration, which are significantly more energy efficient that the current coarse-bubble diffusers. The alternative incorporates flexibility in operation to allow staff to run trains in series or parallel as needed. The additional capacity will give the City the flexibility to either landfill or land apply biosolids as well. The City is pursuant of alternatives which maximum the reuse of existing facilities, and also plan accordingly for future wastewater limits and future expansion when necessary.

6.4 Recommended Alternative

The following improvements are recommended for implementation at the Big Lake wastewater treatment facility.

The recommended improvements from the facilities plan technical memorandum are:

- **Secondary Treatment:** Modifications of existing oxidation ditches for Mobile Organic Biofilm (MOB).
- **Secondary Clarification:** Conversion of existing and construction of new secondary clarifiers.
- **Coagulant Feed:** Relocate chemical storage and feed equipment o the proposed Disinfection and Pumping Building.
- **Waste Sludge and Scum Thickening:** Dissolved air floatation thickening.
- **Aerobic Digestion:** Second primary aerobic digester, conversion of liquid biosolids storage to secondary aerobic digester.
- **Sludge and Biosolids Aeration and Mixing:** Fine-bubble aeration and compressed aerated mixing.
- Other condition, capacity, and age-related improvements as described.

The recommended improvements provide the most cost-effective treatment alternative which are:

- Reliably capable of meeting the effluent water quality limits as indicated by the preliminary effluent request prepared by the MPCA and assumed approval of the antidegradation review currently being prepared.
- Best position the facility to meet future wastewater flow and load demand in a manner which is both environmental responsible, fiscally informed, and operable by the facility staff.
- Provide facilities and equipment which are user-friendly, align with the facility staffing level, and are responsive to the amount of staffing time required.

Recommended preliminary design activities include:

- Geotechnical investigation of the site is recommended to determine the groundwater level. This determination will be needed in development of the subsurface, horizontal flow, fixed film bioreactor and may result in intermediate pumping between the secondary cell and bioreactor.
- Pre-selection of secondary treatment equipment. Pre-selection will include:
  - Preliminary design flow and load determination for the recommended alternative as proposed by pre-selection equipment manufacturer.
  - Detailed biological modeling of facility based on the pre-selection equipment manufacturer.
  - Determination of process guarantee for effluent parameters based on biological modeling.
  - Final determination of supplemental chemical addition and tertiary treatment to meet effluent water quality limits.
- Pre-selection of sludge and biosolids aeration and mixing equipment. Pre-selection would include:
  - Pre-selection of manufacturer equipment to allow for placement and design in existing Biosolids Control Building.
  - Layout of piping, controls, valves, and equipment based on the pre-selected manufacturer equipment.
  - Determination of process guarantee for effluent parameters based on biological modeling.

Refer to Appendix C-4 for a preliminary site plan of the recommended alternative.

7 Capital Costs

Manufacturers and vendors were solicited for major equipment items. These costs reflect the opinion of probable costs at the time of preparation of this report. Probable costs are likely to change between preparation of the facility plan and bidding of improvements.

Costs for the recommended alternative have been updated for the facilities plan and are presented in Table 7 on the following page. The revised costs reflect the volatility for materials and labor as a result of inflation and supply shortages during preparation of this report as well as revised chemical costs as a result of jar and pilot testing. The revised costs are for January 2024.

Table 7 – Preliminary Engineer's Opinion of Probable Costs for Recommended Improvements

Description	Opinion of Probable Cost [1]
Main Lift Station and Forcemain	$ 4,118,000
Preliminary Treatment	$ 1,568,000
Selector Basin, Biological Alternative 3	$ 1,028,000
Biological Alternative 3	$ 6,332,000
Secondary Sedimentation Alternative 2	$ 6,887,000
Chemical Phosphorus Removal Alternative 2	$ 487,000
Disinfection and Pumping Building	$ 3,806,000
Sludge and Biosolids Mixing Alternative 2	$ 4,317,000
Waste Sludge and Scum Thickening Alternative 2	$ 2,674,000
Waste Sludge Storage Conversion	$ 307,000
Biosolids Control Building and Aerobic Digestion Alternative 2	$ 3,759,000
Biosolids Conditioning Building and Dewatering	$ 1,487,000
Administration Building	$ 682,000
Site Improvements	$ 1,566,000
Additional Cost to Owner [2]	$ 2,619,000
Engineering and Design [3]	$ 5,865,000
Total for Project	$ 47,502,000

Notes:

1 Includes 30.0% contingency, 3.0% mobilization, bonding, and insurance, 0.1% permitting as part of Construction Costs.

2 Includes permitting (Watershed, Building, Plumbing, Mechanical, Electrical, etc.), third-party testing, 5.0% contract modifications, and 1.0% legal fees.

3 Includes 15% of preliminary anticipated capital improvements costs for Engineering, Design, and Field Services.

7.1 Financial Assistance

Until 1990, virtually every municipality constructing wastewater treatment facilities received funding through the Minnesota Pollution Control Agency and the U.S. Environmental Protection Agency construction grants program. When that program expired in 1990, cities pursued funding through other sources. These often have included the Public Facilities Authority (PFA), Farmers Home Administration (now referred to as USDA Rural Development [RUS/CF]), Department of Housing and Urban Development (HUD), and the Minnesota Department of Trade and Economic Development (DTED).

The most likely source of loan funds, based on availability, is from PFA. The PFA administers the Water Pollution Control Revolving Fund, which provides below market rate financing for upgrading and constructing wastewater treatment facilities. Interest rates are determined by a set formula based on demographic characteristics of the borrower and other established rules.

The PFA loan program was established to provide a permanent source of funding that could be used to finance municipal wastewater treatment projects in perpetuity. The program was created by the U.S. Congress in 1987, through amendments to the Clean Water Act, once it had decided

to discontinue the construction grants program. Under this program, Congress mandated the Environmental Protection Agency (EPA) to establish and capitalize a Water Pollution Control Revolving Fund Program.

The capitalization grant received annually from EPA is used as a form of financial security for the sale of bonds by the Public Facilities Authority (PFA). Each year it is matched by State funds equal to 20 percent of the Federal grant. The money that PFA realizes through the sale of its bonds is used to award loans to municipalities for planning, design, and/or construction of wastewater treatment facilities. The PFA cannot sell an unlimited amount of bonds; a limit exists on PFA's bonding authority. In addition, the size of the capitalization grant, the financial capability of eligible cities, and the size of each community's project all affect the amount of bonds that PFA can sell.

Each year, the MPCA prepares an Intended Use Plan (IUP), which lists eligible cities that have requested loan assistance for that year. To be eligible for placement on the IUP, a community must have an approved facility plan and a community's name must first appear on the PPL list, which is a list of all communities needing new or upgraded wastewater treatment facilities. For placement on the PPL, interested cities must send a completed PPL application and Priority Point Ranking forms to the MPCA. To move to the IUP from the PPL, another short, written request is required.

Cities contemplating any type of wastewater treatment improvements should get their name on the PPL as early as possible in the planning process. A community's placement on the IUP does not guarantee it will receive a loan. The PFA is responsible for reviewing each city's financial capability and determining the amounts, terms, and conditions of the loans. Although a city may be placed on the IUP at any of several times during the year, it is advisable to request placement as early as possible to have the best chance of receiving a loan and having the fund available when needed. However, a city cannot be placed on the IUP for a construction loan until it has an approved Facilities Plan.

Before the PFA can award a loan, the MPCA must review and approve the city's loan application and then certify the project to the PFA. An application for a construction loan must include plans and specifications, and sewer use and rate documents. A construction project must also complete the environmental review process and have a National Pollutant Discharge Elimination System/State Disposal System (NPDES/SDS) permit before loan certification can be made. Nearly all costs associated with a wastewater treatment project are eligible, including costs incurred prior to loan award.

There are two categories of costs which are not eligible; these include:

- Storm Sewers; and
- Land that is not an integral part of the treatment process or that will not be used for the ultimate disposal of residues resulting from such treatment.

All other costs associated with facilities planning, preparation of contract documents including drawings and specifications, and construction are eligible. This includes legal, administrative, equipment, and any other costs related to the project.

Two key features of the PFA loan program are the requirements to:

- Pay Federal and State mandated wage rates during construction, and
- Use a qualified full-time inspector during major construction activity.

Other funding sources for wastewater treatment improvement projects such as this one are available. Loan funding is also available through Rural Development. These loans tend to have higher interest rates compared with PFA loans, but they can be paid back over longer periods, up to forty years, to keep the payments lower.

8 Recommendations/Implementation Schedule

A tentative schedule is proposed in Table 8 that follows the compliance schedule agreed upon between the City and the MPCA.

Table 8 – Proposed Project Schedule

Action	Tentative Date [1]
Submit Facility Plan	March 2024
Receive MPCA approval of Facility Plan	June 2024
Request placement on IUP	June 2024
Authorize preparation of design documents	November 2024
Submit Plans and specifications to MPCA	December 2025
Receive MPCA approval of plans and specifications	March 2026
Advertise project for bids	April 2026
Receive bids and award contract	May/June 2026
Begin construction	July 2026
Improvements operational	September 2028
Final Completion	November 2028

Notes:

1. Tentative dates are subject to change.

Wastewater must still be treated in accordance with the current NPDES permit during construction. In order to meet this requirement, the existing structures and facilities must remain in operation during the construction of the new facilities and temporary shutdowns during periods of low flows may be required for connection of the new facilities with the existing facilities.

8.1 Wastewater User Rate Impact Evaluation

Understanding the impact the new capital projects will have on the existing rates requires knowledge of the existing annual operations and maintenance costs and an understanding of how those annual costs will change with the capital projects in place. This evaluation provided an estimated impact to future wastewater user rates based on existing costs and projected future costs.

It is estimated that at design conditions the facility will cost approximately $189,000 more per year to operate and maintain than was budgeted in 2022.

Recognizing that:

- At design conditions there is more flow and load than the facility sees today, and
- In the future the cost would be spread among more users.

The basis of estimating the impacts to the current user rates uses the projected increase in O&M costs of $189,000.

Table 10 of the following page summarizes the loan terms for each alternative evaluated. The actual interest rate will be determined during the application process. Anticipated semiannual and annual loan payments are based on the preliminary engineer's opinion of probable costs associated with the facility estimate in 2023 dollars.

Based on assumptions that the City may be eligible for a variety of funding opportunities such as point source implementation grants (PSIG), water infrastructure fund (WIF), green project reserve, community development grants, and potentially bonding bill grants from the State of Minnesota. Table 9 summarizes the annual loan payment for the different loan terms based on the amount needed to finance and a variety of potential funding situations.

- Scenario 1: The scenario provides a preliminary estimate of rates based on the assumption that 9.1% of applicable capital costs are provided by PSIG grant, 42.5% by bonding bill grants, and 2.5% by green project reserve. The scenario assumes 2.5% interest over the term of the remaining loan and a load duration of 20 years.
- Scenario 2: The scenario provides a preliminary estimate of rates based on the assumption that 9.1% of applicable capital costs are provided by PSIG grant and 2.5% by green project reserve. The scenario assumes 2.5% interest over the term of the remaining loan and a load duration of 20 years.
- Scenario 3: The scenario provides a preliminary estimate of rates based on the assumption that 9.1% of applicable capital costs are provided by PSIG grant, 30.0% of applicable costs are provided by bonding bill grants, and 2.5% by green project reserve. The scenario assumes 2.5% interest over the term of the remaining loan and a load duration of 20 years.
- Scenario 4: The scenario provides a preliminary estimate of rates based on the assumption that 9.1% of applicable capital costs are provided by PSIG grant, 30.0% of applicable costs are provided by bonding bill grants, 2.5% of applicable capital costs are provided green project reserve, and 25% by congressional earmarks. The scenario assumes 2.5% interest over the term of the remaining loan and a load duration of 20 years.

Table 9 – Loan Terms

Parameter	Scenario 1	Scenario 2	Scenario 3	Scenario 4
Loan Term	20			
Interest Rate	2.50%			
Loan Payments, Semi Annual	40			
Amount to Finance [1]	$21,789,800	$41,950,100	$27,719,300	$15,860,300
Semi Annual Payment	$868,024	$1,671,134	$1,104,232	$631,815
Annual Payment	$1,736,047	$3,342,268	$2,208,465	$1,263,629

Notes:

1. Assumes a total project cost of $47,502,000 and an estimated 2022 revenue of $2,926,072.

The City's user rates should be set at level to cover the annual payments for the financing as well as the annual O&M costs. The resulting annual payments are identified in Table 10. The project costs do not include any improvements for the collection system (other than those noted for the main influent lift station and forcemain to the wastewater treatment facility) as those improvements will be addressed on an as needed basis rather than included in the wastewater treatment facility improvements.

Table 10 – Loan Payment

Parameter	Scenario 1	Scenario 2	Scenario 3	Scenario 4
Existing O&M	$2,964,768			
Additional O&M	$189,000			
Annual Financing Payment [1]	$1,736,047	$3,342,268	$2,208,465	$1,263,629
Total Annual Cost (including O&M)	$4,861,465	$6,467,686	$5,333,883	$4,389,047
Current Annual Revenue	$3,026,878			
Net Increase Cost	$1,834,587	$3,440,808	$2,307,005	$1,362,169
Estimated % Increase in Rate for Typical Household	61%	114%	76%	45%

Notes:

1. Assumes loan terms as identified in Table 9.

Based on the existing wastewater user rate structure a typical residential family using 3,300 gallons of water per month pays approximately $41.81 per month. Rural development and the MPCA have developed an affordability criterion for a monthly wastewater fee which corresponds to 1.4% of the median household income. For Big Lake the affordability criterion is $109.11 per month. Assuming the same typical residential user each scenario is anticipated to result in the following monthly wastewater fee based on preliminary evaluation:

- Scenario 1 would result in the user paying approximately $67.15 per month.
- Scenario 2 would result in the user paying approximately $89.34 per month.
- Scenario 3 would result in the user paying approximately $73.68 per month.
- Scenario 4 would result in the user paying approximately $60.63 per month.

The specific changes to the rates (i.e. the increases to the monthly fee versus the commodity charges) should be evaluated further with a detailed rate analysis following detailed design estimates and additional information on funding type and amount is available.

8.2 Rate Analysis

The estimated rate impact is an estimate based on the City's past expenditures and revenues for the wastewater collection and sewer fund, as well as current rates and estimated capital costs. It is also based on assumptions for the type of funding programs used and the amount of grant the City would be eligible for. It is recommended the City evaluate further the specific change in rates with a detailed rate analysis. This analysis should be performed following more detailed cost estimates during the design process and when the type of funding and potential grant dollars is better known. A detailed rate analysis will include expenditures, existing debt, capital cost, O&M and replacement costs, depreciation of structures and equipment, and other costs associated with the project. The analysis may include rates for residential, commercial, and industrial depending on the needs of the City.

8.3 Public Hearing

A public hearing to present the contents of this report was held on February 14, 2024. The public hearing documents are included in Appendix F.

ejm

Appendix A

Regulatory Requirements

A-1 – NPDES/SDS Discharge Permit
A-2 – Preliminary Effluent Request Response Letter
A-3 – Antidegration Review

A-1 – NPDES/SDS Discharge Permit

MINNESOTA POLLUTION CONTROL AGENCY

National Pollutant Discharge Elimination System/State Disposal System

MN0041076

Permittee:	City of Big Lake
Facility name:	Big Lake Wastewater Treatment Plant
Receiving water:	Mississippi River - Class 1C, 2Bd, 3B, 3C, 4A, 4B, 5, 6 water
City or Township:	Big Lake **County:** Sherburne
Issuance date:	April 11, 2018
Expiration date:	March 31, 2023
Modification date:	August 7, 2019

The state of Minnesota, on behalf of its citizens through the Minnesota Pollution Control Agency (MPCA), authorizes the Permittee to operate a disposal system at the facility named above and to discharge from this facility to the receiving water named above, in accordance with the requirements of this permit.

The goal of this permit is to reduce pollutant levels in point source discharges and protect water quality in accordance with the U.S. Clean Water Act, Minnesota statutes and rules, and federal laws and regulations.

This permit is effective on the modification date identified above. This permit expires at midnight on the expiration date identified above.

Signature: Aaron N. Luckstein

This document has been electronically signed.

for the Minnesota Pollution Control Agency

Aaron N. Luckstein
Manager
Municipal Wastewater Section
Municipal Division

Submit eDMRs
Submit via the MPCA e-Services at
https://rsp.pca.state.mn.us/TEMPO_RSP/Orchestrate.do?initiate=true

Submit WQ reports to:

Electronically: wq.submittals.mpca@state.mn.us
Include *Water quality submittals form*:
https://www.pca.state.mn.us/sites/default/files/wq-wwprm7-71.docx

Or, by mail:
Attention: WQ Submittals Center
Minnesota Pollution Control Agency
520 Lafayette Road North
St. Paul, MN 55155-4194

Whole Effluent Testing (WET) and Pretreatment Annual Reports must be mailed to the WQ Submittals Center

Questions on this permit?
For eDMR and other permit reporting issues, contact:
Jennifer Satnik (Jennifer.satnik@state.mn.us)
651 757 2692

For specific permit requirements, please refer to:
Jeremy Sanoski (jeremy.sanoski@state.mn.us) 218 316 3888

Wastewater Permit Program general questions, contact:
MPCA, 651-282-6143 or 1-800-657-3938.

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1. Permitted facility description

The Big Lake Wastewater Treatment Plant (Facility) is located in the SW ¼ of Section 31, Township 33 North, Range 27 West, Big Lake Township, Sherburne County, Minnesota. This is a Class A Facility.

The City of Big Lake has proposed that all limits associated with the existing permit be frozen at existing mass caps. Mass cap limits provide both direct control of specific pollutants, and they can also function as surrogate caps for other pollutants. Because the Facility has agreed to accept mass caps, this permit will not result in a net increase in loading; and therefore, antidegradation procedures are not required including an antidegradation assessment or preliminary determination.

Existing Facility

The application indicates that the existing treatment system consists of a lift station with parallel 8 and 12-inch force mains, two cylindrical fine screens with spray wash and compaction system, vortex grit removal system with grit separator and classifier, influent Parshall flume, a selector tank with two mixers and baffle wall, two oxidation ditches, chemical feed system for phosphorus removal, three final clarifiers, ultraviolet disinfection system, and an outfall pipe. The Facility also has 24-hour composite influent and effluent samplers and solids handling units including two gravity biosolids thickeners, an aerobic digester, a biosolids storage tank, two biosolids batch tanks to feed the centrifuges, two centrifuges, a biosolids bunker to feed the dryer system, a Komline Sanderson indirect heat drying system, a carbon adsorber odor control system, and a biosolids storage silo with dust collection and load out system. Biosolids are land applied on approved sites. Chlorine is also available for addition to the return activated biosolids for process control.

The Facility has a continuous discharge (SD001) to the Mississippi River (Class 1C, 2Bd, 3B, 3C, 4A, 4B, 5, 6 Water). The Facility is designed to treat an average dry weather design flow of 709,000 gallons per day (gpd), an average wet weather (AWW) design flow of 840,000 gpd and a peak hourly wet weather flow of 2,204,000 gpd with a five-day carbonaceous biochemical oxygen demand of 240 milligrams per liter (mg/L) based on the AWW design flow.

Proposed Facility

The application indicates that the proposed treatment system consists of a lift station with parallel 8 and 12-inch force mains, two rotary drum fine screens with spray wash and compaction system, vortex grit removal system with grit separator and classifier, influent Parshall flume, a selector tank with two mixers and baffle wall, three oxidation ditches, chemical feed system for phosphorus removal, three final clarifiers, ultraviolet disinfection system, and an outfall pipe. The Facility also has 24-hour composite effluent samplers and solids handling units, including two gravity biosolids thickeners, an aerobic digester, a biosolids storage tank, two biosolids batch tanks to feed the centrifuges, two centrifuges, a biosolids bunker to feed the dryer system, a Komline Sanderson indirect heat drying system, a carbon adsorber odor control system, and a biosolids storage silo with dust collection and load out system. Biosolids are land applied on approved sites. Chlorine is also available for addition to the return activated sludge for process control.

The Facility has a continuous discharge (SD001) to the Mississippi River (Class 1C, 2Bd, 3B, 3C, 4A, 4B, 5, 6 Water). The Facility is designed to treat an average dry weather design flow of 746,000 gallons per day (gpd), an average wet weather (AWW) design flow of 958,000 gpd and a peak hourly wet weather flow of 2,204,000 gpd with a five-day carbonaceous biochemical oxygen demand of 400 milligrams per liter (mg/L) based on the AWW design flow.

There are no designed bypass/overflow points in either the existing or the proposed systems.

The Mississippi River was designated an Outstanding Resource Value Water (ORVW) on November 5, 1984. The design AWW flow of this Facility on the date of ORVW designation was 363,000 gpd.

Changes to the Facility may result in an increase in pollutant loading to surface waters or other causes of degradation to surface waters. If a change to the Facility will result in a net increase in pollutant loading or other causes of degradation that exceed the maximum loading authorized through conditions specified in the existing permit, the changes to the Facility are subject to antidegradation requirements found in Minn. R. 7050.0250 to 7050.0335.

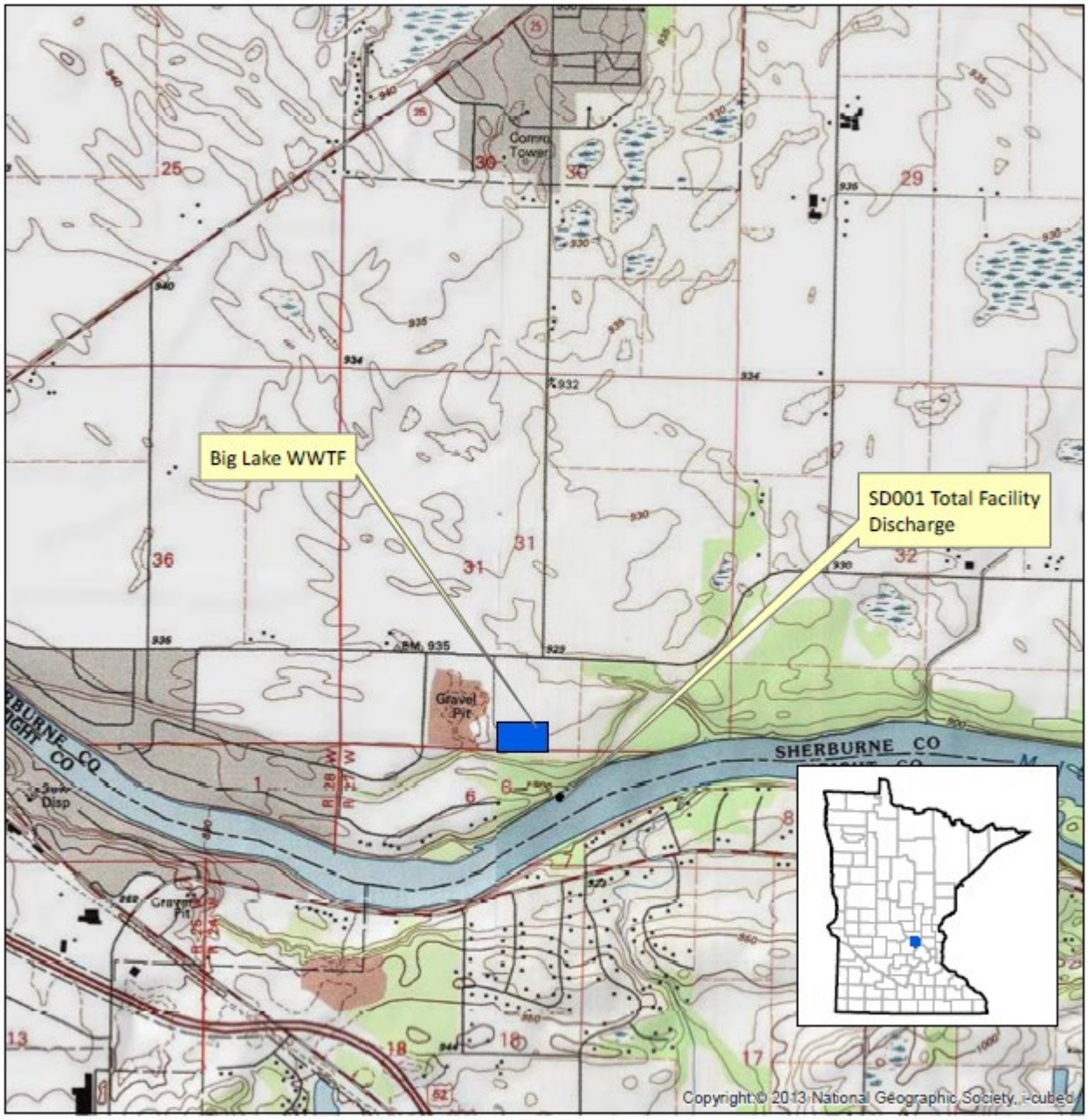
This Permit also complies with Minn. R. 7053.0275 regarding anti-backsliding.

Any point source discharger of sewage, industrial, or other wastes for which a NPDES permit has been issued by the MPCA that contains effluent limits more stringent than those that would be established by Minn. R. 7053.0215 to 7053.0265, shall continue to meet the effluent limits established by the permit, unless the permittee establishes that less stringent effluent limits are allowable pursuant to federal law, under section 402(o) of the Clean Water Act, United States Code, title 33, section 1342.

2. Location map of permitted facility

Topographic Map of Permitted Facility

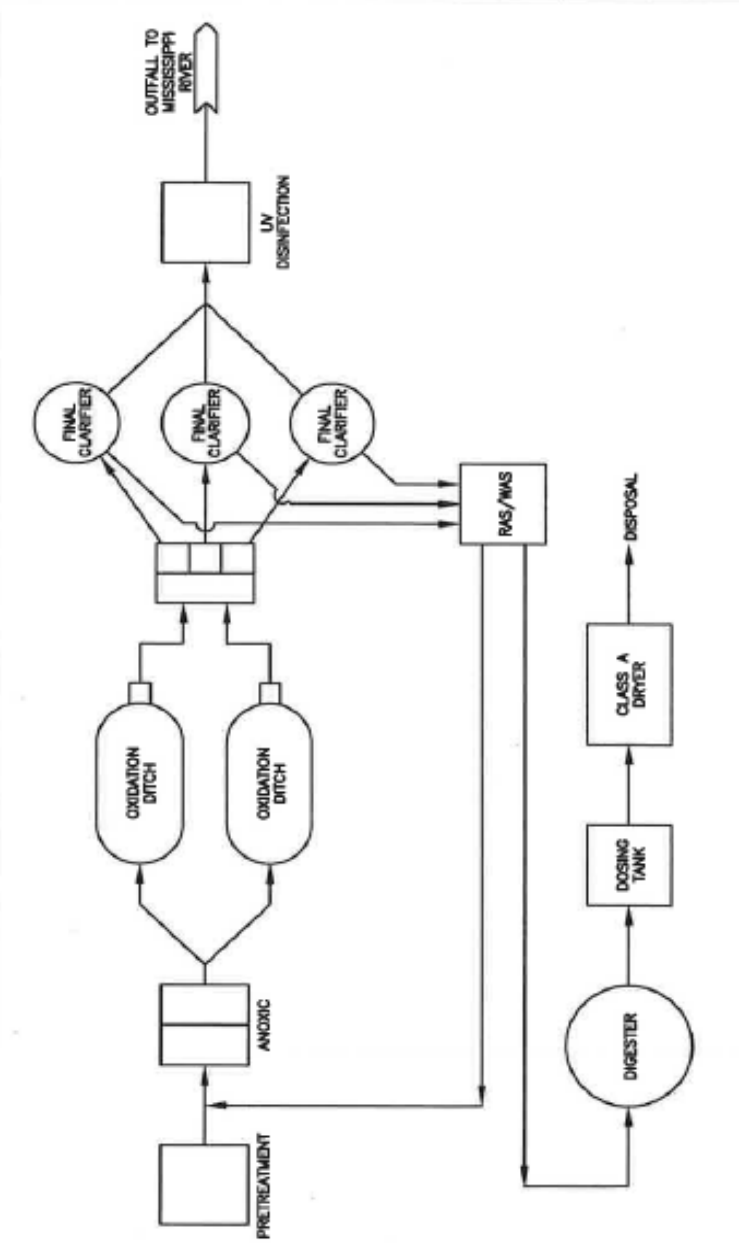
MN0041076: Big Lake Wastewater Treatment Plant
T33N, R27W, Section 31
Big Lake, Sherburne County, Minnesota



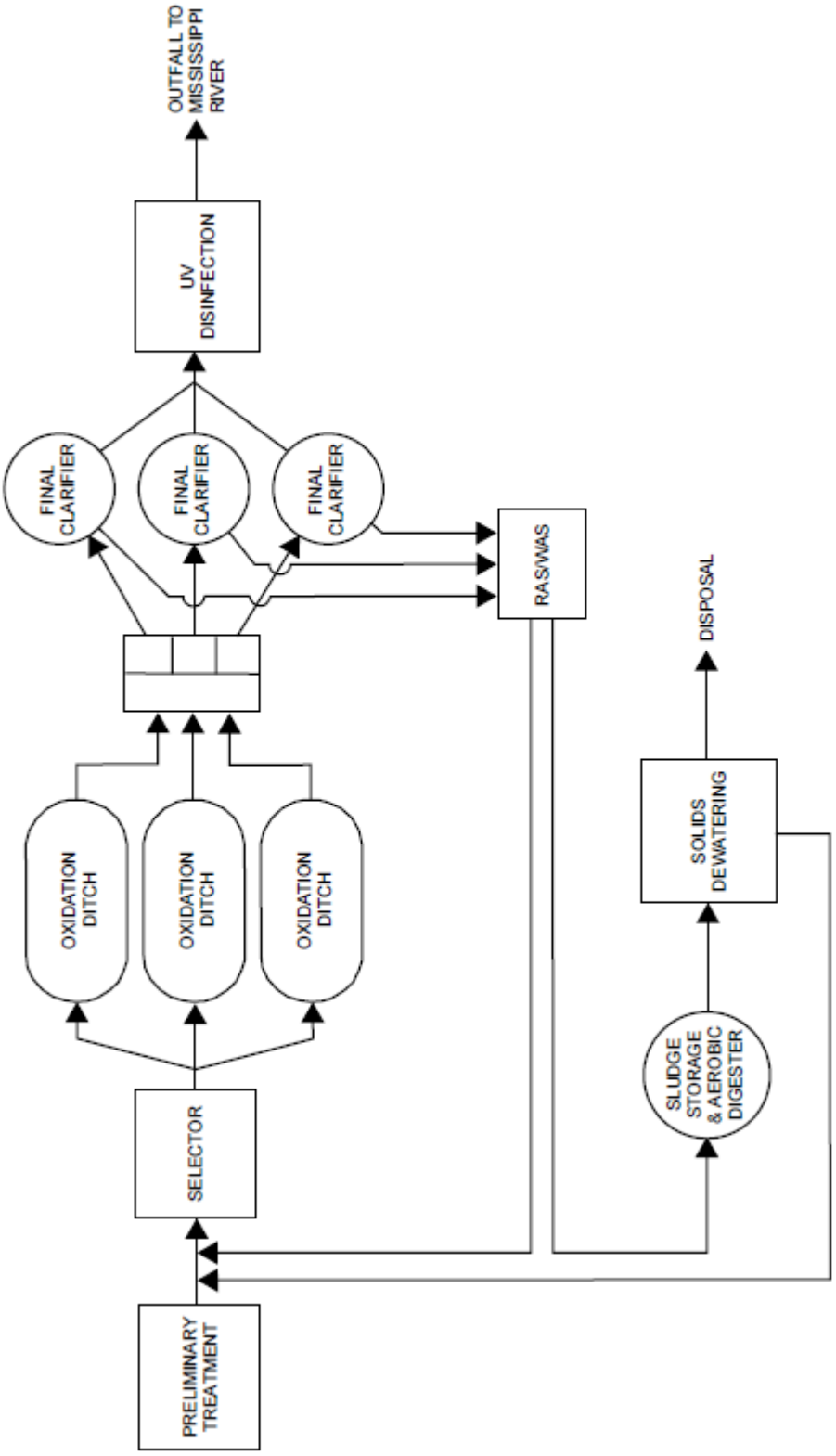
Map produced by: MPCA Staff, 5/21/2019
Scale: 1:24,000

0 0.25 0.5 1 Miles

3. Flow diagram –Existing Facility



Flow Diagram – Proposed Facility



4. Summary of stations and station locations

Station	Type of station	Local name	PLS location
SD 001	Effluent To Surface Water	001 Total Facility Discharge	T32N, R27W, S06, NW Quarter of the NE Quarter
WS 001	Influent Waste	Influent Waste Stream	T33N, R27W, S31, SW Quarter

5. Permit requirements

SD 001	Effluent To Surface Water	
		Surface Discharge: Class A Minor Facility Effluent Requirements
	5.1.1	The Permittee shall submit a monthly DMR : Due by 21 days after the end of each calendar month following permit issuance. [Minn. R. 7001.0150, Subp. 2(B)]
	5.1.2	Sampling Location. [Minn. R. 7001.0150, Subp. 2(B)]
	5.1.3	Samples for Station SD001 shall be taken at a point representative of the discharge to the receiving water. [Minn. R. 7001.0150, Subp. 2(B)]
	5.1.4	The Permittee shall submit monitoring results in accordance with the limits and monitoring requirements for this station. If conditions are such that no sample can be acquired, the Permittee shall report "No Flow" or "No Discharge" on Discharge Monitoring Report (DMR) and shall add a Comments attachment to the DMR detailing why the sample was not collected. [Minn. R. 7001.0150, Subp. 2(B)]
WS 001	Influent Waste	
		Waste Stream: Class A Minor Facility Influent Requirements
	5.2.1	The Permittee shall submit a monthly DMR : Due by 21 days after the end of each calendar month following permit issuance. [Minn. R. 7001.0150, Subp. 2(B)]
	5.2.2	Sampling Location. [Minn. R. 7001.0150, Subp. 2(B)]
	5.2.3	Samples for Station WS001 shall be taken at a point representative of total influent flow to the system. [Minn. R.0150, Subp. 2 (B)] The Permittee shall submit monitoring results in accordance with the limits and monitoring requirements for this station. If conditions are such that no sample can be acquired, the Permittee shall report "No Flow" or "No Discharge" on Discharge Monitoring Report (DMR) and shall add a Comments attachment to the DMR detailing why the sample was not collected. [Minn. R. 7001.0150, Subp. 2(B)]
MN0041076	Big Lake WWTP	
		Surface Discharge Station General Requirements
	5.3.1	Analysis Requirements. [Minn. R. 7001]
	5.3.2	Dissolved Oxygen and pH analyses shall be conducted within 15 minutes of Sample collection. [Minn. R. 7053]
	5.3.3	Representative Samples. [Minn. R. 7001]
	5.3.4	Samples and measurements required by this permit shall be representative of the monitored activity. [Minn. R. 7001]
	5.3.5	Surface Discharge Prohibitions. [Minn. R. 7001]
	5.3.6	Floating solids or visible foam shall not be discharged in other than trace amounts. Oil or other substances shall not be discharged in amounts that create a visible color film. The Permittee shall install and maintain outlet protection measures at the discharge stations to prevent erosion. [Minn. R. 7001]
	5.3.7	Winter Sampling Conditions. [Minn. R. 7001]

	5.3.8	The Permittee shall sample flows at the designated monitoring stations including when this requires removing ice to sample the water. If the station is completely frozen throughout a designated sampling month, the Permittee shall check the "No Discharge" box on the Discharge Monitoring Report (DMR) and note the ice conditions in Comments on the DMR. [Minn. R. 7001]
	5.3.9	Phosphorus Limits and Monitoring Requirements. [Minn. R. 7001]
	5.3.10	Phosphorus Calculation Definitions. [Minn. R. 7001]
	5.3.11	"12-Month Moving Total" is a rolling total. To calculate, for each month multiply the total volume of effluent flow (MG) by the monthly average concentration and by a 3.785 conversion factor to get kg/month. Then add all of the monthly values (kg/mo) during the last twelve months, starting with the monthly total for the month of the current reporting period. [Minn. R. 7001]
	5.3.12	Mercury Limits and Monitoring Requirements. [Minn. R. 7001]
	5.3.13	Permittees are required to sample for TSS (grab sample) at the same time that Total/Dissolved Mercury samples are taken. Total Mercury, Dissolved Mercury, and TSS (grab sample) samples shall be collected via grab samples. All results shall be recorded on DMRs. [Minn. R. 7001]
	5.3.14	Total and Dissolved Mercury samples shall be analyzed using the most current versions of EPA Method 1631 with clean techniques method 1669. Should another mercury analytical method that has a reportable quantitation level of <0.5 ng/L that allows for low-level sample characterization be approved by the EPA and certified by an MPCA recognized accreditation body, the method may be used in place of 1631/1669. [Minn. R. 7001]
	5.3.15	Nitrogen Limits and Monitoring Requirements. [Minn. R. 7001]
	5.3.16	"Total Nitrogen" is to be reported as the summation of the Total Kjeldahl Nitrogen and Total Nitrite plus Nitrate Nitrogen values. [Minn. R. 7001]
		Waste Stream Station General Requirements
	5.4.17	Analysis Requirements. [Minn. R. 7001]
	5.4.18	Dissolved Oxygen and pH analyses shall be conducted within 15 minutes of Sample collection. [Minn. R. 7053]
	5.4.19	Representative Samples. [Minn. R. 7001]
	5.4.20	Grab and composite samples shall be collected at a point representative of total influent flow to the system. [Minn. R. 7001]
	5.4.21	Nitrogen Limits and Monitoring Requirements. [Minn. R. 7001]
	5.4.22	"Total Nitrogen" is to be reported as the summation of the Total Kjeldahl Nitrogen and Total Nitrite plus Nitrate Nitrogen values. [Minn. R. 7001]
		Construction Schedule
	5.5.23	Definitions. [Minn. R. 7001]
	5.5.24	"Initiation of operation" means the date that MPCA determines all components of the wastewater treatment system are complete and functioning and the project begins operating for the purposes for which it was planned, designed, and built. [Minn. R. 7001]
	5.5.25	"Completion of construction" means all the construction is complete except for minor weather-related components and conforms to the approved plans and specifications and change orders. [Minn. R. 7001]

	5.5.26	Submit Notice of Intent to Initiate Operation. The Permittee shall notify the MPCA in writing at least 14 days before the planned initiation of operation date. Following MPCA staff concurrence that the facility is adequately prepared, MPCA staff will notify the Permittee that it may initiate operation of the new or upgraded facility. [Minn. R. 7001]
	5.5.27	Submit Initiation of Operation Date. The Permittee shall notify the MPCA in writing within 14 days after the actual initiation of operation date. The Permittee shall comply with all permit requirements and attain final limits within 90 days of the initiation of operation date. [Minn. R. 7001]
	5.5.28	Submit Notice to Complete Construction. The Permittee shall notify the MPCA in writing at least 14 days before the planned completion of construction date. The MPCA may complete a final inspection. [Minn. R. 7001]
	5.5.29	Submit Final Technical Documents. The Permittee shall submit the following to the MPCA within one year after the initiation of operation date: a. One copy of "as-built" plans and specifications, also known as record drawings, shall be submitted in a format approved by the MPCA. The factsheet titled: "Wastewater Treatment Facility Construction Record Documents, As-built Submittal Requirements" contains specific information regarding the required format of the submittal. The document is located on the MPCA web page at: http://www.pca.state.mn.us/index.php/view-document.html?gid=15492. [Minn. R. 7001]
		Mercury Minimization Plan
	5.6.30	The Permittee is required to complete and submit a Mercury Pollutant Minimization Plan (MMP) to the MPCA as detailed in this section. If the Permittee has previously submitted a MMP, it shall update its MMP and submit the updated MMP to the MPCA. The purpose of the MMP is to evaluate collection and treatment systems to determine possible sources of mercury as well as potential mercury reduction options. Guidelines for developing a MMP are detailed in this section. [Minn. R. 7001]
	5.6.31	The specific mercury monitoring requirements are detailed in the limits and monitoring section of this permit. Information gained through the MMP process can be used to reduce mercury concentrations. As part of its mercury control strategy, the Permittee should consider selecting activities based on the potential of those activities to reduce mercury loadings to the wastewater treatment facility. [Minn. R. 7001]
	5.6.32	The Permittee shall submit a mercury pollutant minimization plan : Due by 180 days prior to permit expiration. [Minn. R. 7001]

	5.6.33	At a minimum, the MMP shall include the following: a. A summary of mercury influent and effluent concentrations and biosolids monitoring data using the most recent five years of monitoring data, if available. b. Identification of existing and potential sources of mercury concentrations and/or loading to the facility. As appropriate for your facility, you should consider residential, institutional, municipal, and commercial sources (such as dental clinics, hospitals, medical clinics, nursing homes, schools, laundries, and industries with potential for mercury contributions). You should also consider other influent mercury sources, such as stormwater inputs, ground water (inflow & infiltration) inputs, lift station components, and waste streams or sewer tributaries to the wastewater treatment facility. c. An evaluation of past and present WWTF operations to determine those operating procedures that maximize mercury removal. d. A summary of any mercury reduction activities implemented during the last five years. e. A plan to implement mercury management and reduction measures during the next five years. [Minn. R. 7001]
		Mechanical System
	5.7.34	Bypass Structures. [Minn. R. 7001]
	5.7.35	All structures capable of bypassing the treatment system shall be manually controlled and kept locked at all times. [Minn. R. 7001.0030]
	5.7.36	Sanitary Sewer Extension Permit. [Minn. R. 7001]
	5.7.37	The Permittee may be required to obtain a Sanitary Sewer Extension Permit from the MPCA for any addition, extension or replacement to the sanitary sewer. If a sewer extension permit is required, construction may not begin until plans and specifications have been submitted and a written permit is granted except as allowed in Minn. Stat. 115.07, Subd. 3(b). [Minn. R. 7001.0020, D]
	5.7.38	Operator Certification. [Minn. R. 7001]
	5.7.39	The Permittee shall provide a Class A state certified operator who is in direct responsible charge of the operation, maintenance and testing functions required to ensure compliance with the terms and conditions of this permit. [Minn. R. 9400]
	5.7.40	The Permittee shall provide the appropriate number of operators with a Type IV certification to be responsible for the land application of biosolids or semisolids from commercial or industrial operations. [Minn. R. 7048]
	5.7.41	If the Permittee chooses to meet operator certification requirements through a contractual agreement, the Permittee shall provide a copy of the contract to the MPCA, WQ Submittals Center. The contract shall include the certified operator's name, certificate number, company name if appropriate, the period covered by the contract and provisions for renewal; the duties and responsibilities of the certified operator; the duties and responsibilities of the permittee; and provisions for notifying the MPCA 30 days in advance of termination if the contract is terminated prior to the expiration date. [Minn. R. 9400]
	5.7.42	The Permittee shall notify the MPCA within 30 days of a change in operator certification or contract status. [Minn. R. 9400]
		Pretreatment: Undelegated Requirements
	5.8.43	Pretreatment - Definitions. [Minn. R. 7049]
	5.8.44	An "Individual Control Mechanism" is a document, such as an agreement or permit, that imposes limitations or requirements on an individual industrial user of the POTW. [Minn. R. 7049]

	5.8.45	"Significant Industrial User" (SIU) means any industrial user that: a. discharges 25,000 gallons per day or more of process wastewater; b. contributes a load of five (5) % or more of the capacity of the POTW; or c. is designated as significant by the Permittee or the MPCA on the basis that the SIU has a reasonable potential to adversely impact the POTW, or the quality of its effluent or residuals. [Minn. R. 7049]
	5.8.46	Pretreatment - Permittee Responsibility to Control Users. [Minn. R. 7049]
	5.8.47	It is the Permittee's responsibility to regulate the discharge from users of its wastewater treatment facility. The Permittee shall prevent any pass through of pollutants or any inhibition or disruption of the Permittee's facility, its treatment processes, or its sludge processes or disposal that contribute to the violation of the conditions of this permit or any federal or state law or regulation limiting the release of pollutants from the POTW. [Minn. R. 7049]
	5.8.48	The Permittee shall prohibit the discharge of the following to its wastewater treatment facility: a. pollutants which create a fire or explosion hazard, including any discharge with a flash point less than 60 degrees C (140 degrees F); b. pollutants which would cause corrosive structural damage to the POTW, including any waste stream with a pH of less than 5.0; c. solid or viscous pollutants which would obstruct flow; d. heat that would inhibit biological activity, including any discharge that would cause the temperature of the waste stream at the POTW treatment plant headwork's to exceed 40 degrees C (104 degrees F); e. pollutants which produce toxic gases, vapors, or fumes that may endanger the health or safety of workers; or f. any pollutant, including oxygen demanding pollutants such as biochemical oxygen demand, released at a flow rate or pollutant concentration that will cause interference or pass through. [Minn. R. 7049]
	5.8.49	The Permittee shall prohibit new discharges of non-contact cooling waters unless there is no cost effective alternative. Existing discharges of non-contact cooling water to the Permittee's wastewater treatment facility shall be eliminated, where elimination is cost-effective, or where an infiltration/inflow analysis and sewer system evaluation survey indicates the need for such removal. [Minn. R. 7049]
	5.8.50	If the Permittee accepts trucked-in wastes, the Permittee shall evaluate the trucked in wastes prior to acceptance in the same manner as it monitors sewered wastes. The Permittee shall accept trucked-in wastes only at specifically designated points. [Minn. R. 7049]
	5.8.51	Pollutant of concern means a pollutant that is or may be discharged by an industrial user that is, or reasonably should be of concern on the basis that it may cause the permittee to violate any permit limits on the release of pollutants. The following pollutants shall be evaluated to determine if they should be pollutants of concern: pollutants limited in this permit, pollutants for which monitoring is required in this permit, pollutants that are likely to cause inhibition of the Permittee's POTW, pollutants which may interfere with sludge disposal, pollutants for which the Permittee's treatment facility has limited capacity. [Minn. R. 7049]
	5.8.52	Control of Significant Industrial Users. [Minn. R. 7049]
	5.8.53	The Permittee shall impose pretreatment requirements on SIUs which will ensure compliance with all applicable effluent limitations and other requirements set forth in this permit or any federal or state law or regulation limiting the release of pollutants from the POTW. These requirements shall be applied to SIUs by means of an individual control mechanism. [Minn. R. 7049]

	5.8.54	The Permittee shall not knowingly enter into an individual control mechanism with any user that would allow the user to contribute an amount or strength of wastewater that would cause violation of any limitation or requirement in the permit, or any applicable federal, state or local law or regulation. [Minn. R. 7049]
	5.8.55	Monitoring of Significant Industrial Users. [Minn. R. 7049]
	5.8.56	The Permittee shall obtain from SIUs specific information on the quality and quantity of the SIU's discharges to the Permittee's POTW. Except where specifically requested by the Permittee and approved by the MPCA, this information shall be obtained by means of representative monitoring conducted by the Permittee or by the SIU under requirements imposed by the Permittee in the SIU's individual control mechanism. Monitoring performed to comply with this requirement shall include all pollutants for which the SIU is significant and shall be done at a frequency commensurate with the significance of the SIU. [Minn. R. 7049]
	5.8.57	Reporting and Notification. [Minn. R. 7049]
	5.8.58	The Permittee shall submit a pretreatment annual report : Due by 31 days after the end of each calendar year following permit issuance if a SIU discharges to the POTW during a given calendar year. [Minn. R. 7049]
	5.8.59	The Pretreatment Annual Report shall be submitted on forms provided by the agency or shall provide equivalent information. The Permittee shall submit the pre-treatment report to the following address: MPCA Attn: WQ Submittals Center 520 Lafayette Road North St. Paul, Minnesota 55155-4194. [Minn. R. 7049]
	5.8.60	The Permittee shall notify the MPCA in writing of any: a. SIU of the Permittee's POTW which has not been previously disclosed to the MPCA; b. anticipated or actual changes in the volume or quality of discharge by an industrial user that could result in the industrial user becoming an SIU as defined in this chapter; or c. anticipated or actual changes in the volume or quality of discharges by a SIU that would require changes to the SIU's required local limits. This notification shall be submitted within 30 days of identifying the IU as a SIU. Where changes are proposed, they shall be submitted prior to changes being made. [Minn. R. 7049]
	5.8.61	Upon notifying the MPCA of a SIU or change in a SIU discharge as required above, the Permittee shall submit the following information on forms provided by the agency or in a comparable format: a. the identity of the SIU and a description of the SIU's operation and process; b. a characterization of the SIU's discharge; c. the required local limits that will be imposed on the SIU; d. a technical justification of the required local limits; and e. a plan for monitoring the SIU which is consistent with monitoring requirements in this chapter. [Minn. R. 7049]

	5.8.62	In addition, the Permittee shall, upon request, submit the following to the MPCA for approval: a. additional information on the SIU, its processes and discharge; b. a copy of the individual control mechanism used to control the SIU; c. the Permittee's legal authority to be used for regulating the SIU; and d. the Permittee's procedures for enforcing the requirements imposed on the SIU. [Minn. R. 7049]
	5.8.63	The permittee shall notify MPCA of any of its industrial users that may be subject to national categorical pretreatment standards. [Minn. R. 7049]
	5.8.64	This permit may be modified in accordance with Minnesota Rules, ch. 7001 to require development of a pretreatment program approvable under the Federal General Pretreatment Regulation (40 CFR 403). [Minn. R. 7049]
		Biosolids: Exceptional Quality
	5.9.65	Authorization. [Minn. R. 7041]
	5.9.66	This permit authorizes the Permittee to prepare, store and distribute or apply heat dried domestic wastewater treatment Exceptional Quality Biosolids and biosolids described in this permit to the land in accordance with the provisions in this chapter and Minnesota Rules ch. 7041. [Minn. R. 7041]
	5.9.67	Permittees who prepare bulk biosolids shall obtain approval of the sites on which bulk biosolids are applied before they are applied unless they are Exceptional Quality Biosolids. Site application procedures are set forth in Minn. R. ch. 7041.0800. [Minn. R. 7041.800]
	5.9.68	Compliance Responsibility. [Minn. R. 7041]
	5.9.69	The Permittee is responsible for ensuring that the applicable requirements in this chapter and Minn. R. ch. 7041 are met when biosolids are prepared, distributed, and/or applied to the land. [Minn. R. 7041]
	5.9.70	Exceptional Quality Biosolids produced by the Permittee may not be blended by the Permittee with other materials before distributing them to other persons. [Minn. R. 7041]
	5.9.71	Long-term storage of Exceptional Quality Biosolids shall not exceed seven months on agricultural land, forest land, or a reclamation site. [Minn. R. 7041]
	5.9.72	Protection from precipitation and blowing shall be provided when storing Exceptional Quality Biosolids in the field or out of doors. [Minn. R. 7041]
	5.9.73	The total nitrogen, phosphorus and potassium content of Exceptional Quality Biosolids shall be supplied, in writing, by the person who prepares the biosolids to the person who applies or distributes the Exceptional Quality Biosolids for that person's use in recommending application rates. [Minn. R. 7041]
	5.9.74	Notification Requirements. [Minn. R. 7041]
	5.9.75	The Permittee shall provide information needed to comply with the biosolids requirements of Minn. R. ch. 7041 to others who prepare or use the biosolids. [Minn. R. 7041]
	5.9.76	The Permittee shall inform, in writing, persons who receive the bulk Exceptional Quality Biosolids of the storage requirements in this chapter. [Minn. R. 7041]
	5.9.77	Pollutant Limits. [Minn. R. 7041]

	5.9.78	Biosolids which are applied to the land shall not exceed the ceiling concentrations in Table 1 and shall not be applied so that the cumulative amounts of pollutant in Table 2 are exceeded. Table 1 Ceiling Concentrations (dry weight basis) Parameter in units mg/kg Arsenic 75 Cadmium 85 Copper 4300 Lead 840 Mercury 57 Molybdenum 75 Nickel 420 Selenium 100 Zinc 7500 Table 2 Cumulative Loading Limits Parameter in units lbs/acre Arsenic 37 Cadmium 35 Copper 1339 Lead 268 Mercury 15 Molybdenum not established* Nickel 375 Selenium 89 Zinc 2500 *The cumulative limit for molybdenum has not been established at the time of permit issuance Table 3 Pollutant Concentrations Pollutant Concentration (mg/kg)* Arsenic 41 Cadmium 39 Copper 1500 Lead 300 Mercury 17 Nickel 420 Selenium 100 Zinc 2800 * On a dry weight basis, the arithmetic mean of all measurements taken during the month. [Minn. R. 7041]
	5.9.79	Pathogen and Vector Attraction Reduction. [Minn. R. 7041]
	5.9.80	Biosolids shall be processed, treated, or be incorporated or injected into the soil to meet one of the vector attraction reduction requirements in Minnesota Rules, pt. 7041.1400. [Minn. R. 7041.1400]

	5.9.81	Biosolids shall be processed or treated by one of the alternatives in Minnesota Rules, pt. 7041.1300 to meet the Class A or Class B standards for the reduction of pathogens. When Class B biosolids are applied to the land, the site restrictions in Minnesota Rules, pt. 7041.1300 shall also be met. [Minn. R. 7041]
	5.9.82	The minimum duration between application and harvest, grazing or public access to areas where Class B biosolids have been applied to the land is as follows: a. 14 months for food crops whose harvested parts may touch the soil/biosolids mixture (such as melons, squash, tomatoes, etc.), when biosolids are surface applied, incorporated or injected. b. 20 months or 38 months depending on the application method for food crops whose harvested parts grow in the soil (such as potatoes, carrots, onions, etc.). The 20 month time period is required when biosolids are surface applied or surface applied and incorporated after they have been on the soil surface for at least four (4) months. The 38 month time period is required when the biosolids are injected or surface applied and incorporated within four (4) months of application. c. 30 days for feed crops, other food crops (such as field corn, sweet corn, etc.), hay or fiber crops when biosolids are surface applied, incorporated or injected. d. 30 days for grazing of animals when biosolids are surface applied, incorporated or injected. e. One year where there is a high potential for public contact with the site, (such as a reclamation site located in populated areas, a construction site located in a city, turf farms, plant nurseries, etc.) and 30 days where there is low potential for public contact (such as agricultural land, forest, a reclamation site located in an unpopulated area, etc.) when biosolids are surface applied, incorporated, or injected. [Minn. R. 7041]
	5.9.83	Exceptional Quality Biosolids are required to meet the Class A process standard in Minnesota Rules 7041.1300 subp. 2, item G.2. Heat drying. Sewage sludge is dried by direct or indirect contact with hot gases to reduce the moisture content of the sewage sludge to 10 percent or lower. Either the temperature of the sewage sludge particles exceeds 80 degrees Celsius or the wet bulb temperature of the gas in contact with the sewage sludge as the sewage sludge leaves the dryer exceeds 80 degrees Celsius. [Minn. R. 7041.1300, 2 (G.2)]
	5.9.84	In addition to the Class A process defined above, either the density of fecal coliform in the biosolids shall be less than 1000 MPN/gram of total solids (dry weight basis) or the density of Salmonella sp. bacteria in the biosolids shall be less than three MPN per four grams or total solids (dry weight basis) at the time the biosolids are applied to land, are prepared for sale or giveaway in a bag or other container for application to land, or when the biosolids or material derived from the biosolids is prepared to meet the requirements of Exceptional Quality Biosolids. [Minn. R. 7041]
	5.9.85	Exceptional Quality Biosolids are required to meet vector attraction reduction by the option defined in Minnesota Rules 7041.1400 subp. 2, item H, drying to at least 90% total solids content. [Minn. R. 7041.1400, 2 (H)]
	5.9.86	Management Practices. [Minn. R. 7041]
	5.9.87	The management practices for the land application of biosolids are described in detail in Minn. R. ch. 7041.1200 and shall be followed unless specified otherwise in a site approval letter or a permit issued by the MPCA. [Minn. R. 7041.1200]

	5.9.88	Overall management requirements: a. Biosolids shall not be applied to the land if it is likely to adversely affect a threatened or endangered species listed under Section 4 of the Endangered Species Act or its designated critical habitat. b. Biosolids shall not be applied to flooded, frozen or snow covered ground so that the biosolids enter wetlands or other waters of the state. c. Biosolids shall be applied at an agronomic rate unless specified otherwise by the MPCA in a permit. d. Biosolids shall not be applied within 33 feet of a wetland or waters of the state unless specified otherwise by the MPCA in a permit. [Minn. R. 7041]
	5.9.89	Monitoring Requirements. [Minn. R. 7041]
	5.9.90	Representative samples of biosolids applied to the land shall be analyzed by methods specified in Minnesota Rule pt. 7041.3200 for the following parameters: arsenic, cadmium, copper, lead, mercury, molybdenum, nickel, selenium, zinc, Kjeldahl nitrogen, ammonia nitrogen, total solids, volatile solids, phosphorus, potassium and pH. [Minn. R. 7041]
	5.9.91	At a minimum, biosolids shall be monitored at the frequencies specified in Table 3 for the parameters listed above, and any pathogen or vector attraction reduction requirements in Minnesota Rules, pts. 7041.1300 and 7041.1400 if used to determine compliance with those parts. Table 3 Minimum Sampling Frequencies Biosolids Applied* Biosolids Applied* Frequency (metric tons/365-day period) (tons/365-day period) (times/365-day period) >0 but <290 >0 but <320 1 >=290 but <1,500 >=320 but <1,650 4 >=1,500 but <15,000 >=1,650 but <16,500 6 >=15,000 >=16,500 12 * Either the amount of bulk biosolids applied to the land or the amount of biosolids received by a person who prepares biosolids that are sold or given away in a bag or other container for application to the land (dry weight basis). [Minn. R. 7041]
	5.9.92	Increased sampling frequencies are specified for the parameters listed in Table 4. Sampling at a frequency at twice the minimum frequencies in Table 3 is required if concentrations listed in Table 4 are exceeded (based on the average of all analyses made during the previous cropping year). Table 4 Increased Frequency of Sampling Parameter (mg/kg dry weight basis) Arsenic 38 Cadmium 43 Copper 2150 Lead 420 Mercury 28 Molybdenum 38 Nickel 210 Selenium 50 Zinc 3750. [Minn. R. 7041]

	5.9.93	The Permittee shall keep records of the information necessary to show compliance with pollutant concentrations and loadings, pathogen reduction requirements, vector attraction reduction requirements and management practices as specified in Minnesota Rules, pt. 7041.1600, subp. 2 and/or 3, as applicable. [Minn. R. 7041]
	5.9.94	Reporting Requirements. [Minn. R. 7041]
	5.9.95	The Permittee shall submit a biosolids annual report : Due annually, by the 31st of December on a form provided by or approved by the MPCA. The report shall include the requirements in Minnesota Rules, part 7041.1700. [Minn. R. 7041]
	5.9.96	The permittee shall submit a Biosolids Annual Report by December 31 of each year for biosolids storage and/or transfer activities occurring during the cropping year previous to December 31. The report shall indicate whether or not biosolids were transferred and/or stored. If biosolids were transferred, the report shall describe how much was transferred, where it was transferred to, the name of the facility that accepted the transfer and the contact person at that facility. "Cropping year" means a year beginning on September 1 of the year prior to the growing season and ending August 31 the year the crop is harvested. For example, the 2012 cropping year began September 1, 2011, and ended August 31, 2012. [Minn. R. 7041]
	5.9.97	For biosolids that are stored for more than two years, the Biosolids Annual Report shall also include the analytical data from the representative sample of the biosolids generated during the cropping year. [Minn. R. 7041]
	5.9.98	The Permittee shall submit the Biosolids Annual Report to: MPCA Submittals Center Minnesota Pollution Control Agency 520 Lafayette Road North St. Paul, Minnesota 55155-4194. [Minn. R. 7041]
	5.9.99	The Permittee shall notify the MPCA in writing when 90 percent or more of any of the cumulative pollutant loading rates listed for any Land Application Sites has been reached for a site. [Minn. R. 7041]
		Total Facility Requirements (NPDES/SDS)
	5.10.100	Definitions. Refer to the 'Permit Users Manual' found on the MPCA website (www.pca.state.mn.us) for standard definitions. [Minn. R. 7001.]
	5.10.101	Incorporation by Reference. The following applicable federal and state laws are incorporated by reference in this permit, are applicable to the Permittee, and are enforceable parts of this permit: 40 CFR pts. 122.41, 122.42, 136, 403 and 503; Minn. R. pts. 7001, 7041, 7045, 7050, 7052, 7053, 7060, and 7080; and Minn. Stat. ch. 115 and 116. [Minn. R. 7001]
	5.10.102	Permittee Responsibility. The Permittee shall perform the actions or conduct the activity authorized by the permit in compliance with the conditions of the permit and, if required, in accordance with the plans and specifications approved by the Agency. [Minn. R. 7001.0150, subp. 3(E)]
	5.10.103	Toxic Discharges Prohibited. Whether or not this permit includes effluent limitations for toxic pollutants, the Permittee shall not discharge a toxic pollutant except according to Code of Federal Regulations, Title 40, sections 400 to 460 and Minnesota Rules 7050, 7052, 7053 and any other applicable MPCA rules. [Minn. R. 7001.1090, subp. 1(A)]
	5.10.104	Nuisance Conditions Prohibited. The Permittee's discharge shall not cause any nuisance conditions including, but not limited to: floating solids, scum and visible oil film, acutely toxic conditions to aquatic life, or other adverse impact on the receiving water. [Minn. R. 7050.0210, subp. 2]
	5.10.105	Property Rights. This permit does not convey a property right or an exclusive privilege. [Minn. R. 7001.0150, subp. 3(C)]

	5.10.106	Liability Exemption. In issuing this permit, the state and the MPCA assume no responsibility for damage to persons, property, or the environment caused by the activities of the Permittee in the conduct of its actions, including those activities authorized, directed, or undertaken under this permit. To the extent the state and the MPCA may be liable for the activities of its employees, that liability is explicitly limited to that provided in the Tort Claims Act. [Minn. R. 7001.0150, subp. 3(O)]
	5.10.107	The MPCA's issuance of this permit does not obligate the MPCA to enforce local laws, rules, or plans beyond what is authorized by Minnesota Statutes. [Minn. R. 7001.0150, subp. 3(D)]
	5.10.108	Liabilities. The MPCA's issuance of this permit does not release the Permittee from any liability, penalty or duty imposed by Minnesota or federal statutes or rules or local ordinances, except the obligation to obtain the permit. [Minn. R. 7001.0150, subp. 3(A)]
	5.10.109	The issuance of this permit does not prevent the future adoption by the MPCA of pollution control rules, standards, or orders more stringent than those now in existence and does not prevent the enforcement of these rules, standards, or orders against the Permittee. [Minn. R. 7001.0150, subp. 3(B)]
	5.10.110	Severability. The provisions of this permit are severable and, if any provisions of this permit or the application of any provision of this permit to any circumstance are held invalid, the application of such provision to other circumstances and the remainder of this permit shall not be affected thereby. [Minn. R. 7001]
	5.10.111	Compliance with Other Rules and Statutes. The Permittee shall comply with all applicable air quality, solid waste, and hazardous waste statutes and rules in the operation and maintenance of the facility. [Minn. R. 7001]
	5.10.112	Inspection and Entry. When authorized by Minn. Stat. ch. 115.04; 115B.17, subd. 4; and 116.091, and upon presentation of proper credentials, the agency, or an authorized employee or agent of the agency, shall be allowed by the Permittee to enter at reasonable times upon the property of the Permittee to examine and copy books, papers, records, or memoranda pertaining to the construction, modification, or operation of the facility covered by the permit or pertaining to the activity covered by the permit; and to conduct surveys and investigations, including sampling or monitoring, pertaining to the construction, modification, or operation of the facility covered by the permit or pertaining to the activity covered by the permit. [Minn. R. 7001.0150, subp. 3(I)]
	5.10.113	Control Users. The Permittee shall regulate the users of its wastewater treatment facility so as to prevent the introduction of pollutants or materials that may result in the inhibition or disruption of the conveyance system, treatment facility or processes, or disposal system that would contribute to the violation of the conditions of this permit or any federal, state or local law or regulation. [Minn. R. 7001.0150, subp. 3(F)]
	5.10.114	Sampling. [Minn. R. 7001]
	5.10.115	Representative Sampling. Samples and measurements required by this permit shall be conducted as specified in this permit and shall be representative of the discharge or monitored activity. [40 CFR 122.41(j)(1)]
	5.10.116	Additional Sampling. If the Permittee monitors more frequently than required, the results and the frequency of monitoring shall be reported on the Discharge Monitoring Report (DMR) or another MPCA-approved form for that reporting period. [Minn. R. 7001.1090, subp. 1(E)]
	5.10.117	Certified Laboratory. A laboratory certified by the Minnesota Department of Health and/or registered by the MPCA shall conduct analyses required by this permit. Analyses of dissolved oxygen, pH, temperature, specific conductance, and total residual oxidants (chlorine, bromine) do not need to be completed by a certified laboratory but shall comply with manufacturers specifications for equipment calibration and use. [Minn. R. 4740.2010, Minn. R. 4740.2050 through 2120]

	5.10.118	Sample Preservation and Procedure. Sample preservation and test procedures for the analysis of pollutants shall conform to 40 CFR Part 136 and Minn. R. 7041.3200. [40 CFR 136, Minn. R. 7041.3200]
	5.10.119	Equipment Calibration: Flow meters, pumps, flumes, lift stations or other flow monitoring equipment used for purposes of determining compliance with permit shall be checked and/or calibrated for accuracy at least twice annually. [Minn. R. 7001.0150, 2(B and C)]
	5.10.120	Maintain Records. The Permittee shall keep the records required by this permit for at least three years, including any calculations, original recordings from automatic monitoring instruments, and laboratory sheets. The Permittee shall extend these record retention periods upon request of the MPCA. The Permittee shall maintain records for each sample and measurement. The records shall include the following information: a. the exact place, date, and time of the sample or measurement; b. the date of analysis; c. the name of the person who performed the sample collection, measurement, analysis, or calculation; d. the analytical techniques, procedures and methods used; and e. the results of the analysis. [Minn. R. 7001.0150, 2(C)]
	5.10.121	Completing Reports. The Permittee shall submit the results of the required sampling and monitoring activities on the forms provided, specified, or approved by the MPCA. The information shall be recorded in the specified areas on those forms and in the units specified. Required forms may include DMR Supplemental/Sample Value Form Individual values for each sample and measurement shall be recorded on the DMR Supplemental/Sample Value Form which, if required, will be provided by the MPCA. DMR Supplemental/Sample Value Forms shall be submitted with the appropriate DMRs. You may design and use your own supplemental form; however it shall be approved by the MPCA. Note: Required summary information shall also be recorded on the DMR. Summary information that is submitted ONLY on the DMR Supplemental/Sample Value Form does not comply with the reporting requirements. [Minn. R. 7001.1090, 1(D), Minn. R. 7001.150, 2(B)]
	5.10.122	Submitting Reports. DMRs, DMR supplemental forms and related attachments must be electronically submitted via MPCA e-Services after authorization is approved. DMRs and DMR Supplemental Forms shall be electronically submitted by the 21st day of the month following the sampling period or otherwise as specified in this permit. Electronic DMR submittal shall be complete on or before 11:59 PM of the 21st day of the month following the sampling period or as otherwise specified in this permit. A DMR shall be submitted for each required station even if no discharge occurred during the reporting period. Other reports required by this permit shall be postmarked by the date specified in the permit to: MPCA, Attn: WQ Submittals Center, 520 Lafayette Road North, St Paul Minnesota 551554194. [Minn. R. 7001.0150, 2(B), Minn. R. 7001.0150, 3(H)]

	5.10.123	Incomplete or Incorrect Reports. The Permittee shall immediately submit an electronically amended report or DMR to the MPCA upon discovery by the Permittee or notification by the MPCA that it has submitted an incomplete or incorrect report or DMR. The amended report or DMR shall contain the missing or corrected data along with a cover letter explaining the circumstances of the incomplete or incorrect report. If it is impossible to electronically amend the report or DMR, the Permittee shall immediately notify the MPCA and the MPCA will provide direction for the amendment submittals. [Minn. R. 7001.0150, 3(G)]
	5.10.124	Required Signatures. All DMRs, forms, reports, and other documents submitted to the MPCA shall be signed by the Permittee or the duly authorized representative of the Permittee. Minn. R. 7001.0150, subp. 2, item D. The person or persons that sign the DMRs, forms, reports or other documents shall certify that he or she understands and complies with the certification requirements of Minn. R. 7001.0070 and 7001.0540, including the penalties for submitting false information. Technical documents, such as design drawings and specifications and engineering studies required to be submitted as part of a permit application or by permit conditions, shall be certified by a registered professional engineer. [Minn. R. 7001.0540]
	5.10.125	Detection Level. The Permittee shall report monitoring results below the reporting limit (RL) of a particular instrument as "<" the value of the RL. For example, if an instrument has a RL of 0.1 mg/L and a parameter is not detected at a value of 0.1 mg/L or greater, the concentration shall be reported as "<0.1 mg/L." "Non-detected," "undetected," "below detection limit," and "zero" are unacceptable reporting results, and are permit reporting violations. Where sample values are less than the level of detection and the permit requires reporting of an average, the Permittee shall calculate the average as follows: a. If one or more values are greater than the level of detection, substitute zero for all nondetectable values to use in the average calculation. b. If all values are below the level of detection, report the averages as "<" the corresponding level of detection. c. Where one or more sample values are less than the level of detection, and the permit requires reporting of a mass, usually expressed as kg/day, the Permittee shall substitute zero for all nondetectable values. [Minn. R. 7001.0150, 2(B)]
	5.10.126	Records. The Permittee shall, when requested by the Agency, submit within a reasonable time the information and reports that are relevant to the control of pollution regarding the construction, modification, or operation of the facility covered by the permit or regarding the conduct of the activity covered by the permit. [Minn. R. 7001.0150, 3(H)]
	5.10.127	Confidential Information. Except for data determined to be confidential according to Minn. Stat. ch. 116.075, subd. 2, all reports required by this permit shall be available for public inspection. Effluent data shall not be considered confidential. To request the Agency maintain data as confidential, the Permittee shall follow Minn. R. 7000.1300. [Minn. R. 7000.1300]
	5.10.128	Noncompliance and Enforcement. [Minn. R. 7001]
	5.10.129	Subject to Enforcement Action and Penalties. Noncompliance with a term or condition of this permit subjects the Permittee to penalties provided by federal and state law set forth in section 309 of the Clean Water Act; United States Code, title 33, section 1319, as amended; and in Minn. Stat. ch. 115.071 and 116.072, including monetary penalties, imprisonment, or both. [Minn. R. 7001.1090, 1(B)]

	5.10.130	Criminal Activity. The Permittee may not knowingly make a false statement, representation, or certification in a record or other document submitted to the Agency. A person who falsifies a report or document submitted to the Agency, or tampers with, or knowingly renders inaccurate a monitoring device or method required to be maintained under this permit is subject to criminal and civil penalties provided by federal and state law. [Minn. R. 7001.0150, 3(G), Minn. R. 7001.1090, 1(G and H), Minn. Stat. ch. 609.671, 1]
	5.10.131	Noncompliance Defense. It shall not be a defense for the Permittee in an enforcement action that it would have been necessary to halt or reduce the permitted activity in order to maintain compliance with the conditions of this permit. [40 CFR 122.41(c)]
	5.10.132	Effluent Violations. If sampling by the Permittee indicates a violation of any discharge limitation specified in this permit, the Permittee shall immediately make every effort to verify the violation by collecting additional samples, if appropriate, investigate the cause of the violation, and take action to prevent future violations. If the permittee discovers that noncompliance with a condition of the permit has occurred which could endanger human health, public drinking water supplies, or the environment, the Permittee shall within 24 hours of the discovery of the noncompliance, orally notify the commissioner and submit a written description of the noncompliance within 5 days of the discovery. The written description shall include items a. through e., as listed below. If the Permittee discovers other non-compliance that does not explicitly endanger human health, public drinking water supplies, or the environment, the non-compliance shall be reported during the next reporting period to the MPCA with its Discharge Monitoring Report (DMR). If no DMR is required within 30 days, the Permittee shall submit a written report within 30 days of the discovery of the noncompliance. This description shall include the following information: a. a description of the event including volume, duration, monitoring results and receiving waters; b. the cause of the event; c. the steps taken to reduce, eliminate and prevent reoccurrence of the event; d. the exact dates and times of the event; and e. steps taken to reduce any adverse impact resulting from the event. [Minn. R. 7001.150, 3(K)]
	5.10.133	Upset Defense. In the event of temporary noncompliance by the Permittee with an applicable effluent limitation resulting from an upset at the Permittee's facility due to factors beyond the control of the Permittee, the Permittee has an affirmative defense to an enforcement action brought by the Agency as a result of the noncompliance if the Permittee demonstrates by a preponderance of competent evidence: a. the specific cause of the upset; b. that the upset was unintentional; c. that the upset resulted from factors beyond the reasonable control of the Permittee and did not result from operational error, improperly designed treatment facilities, inadequate treatment facilities, lack of preventative maintenance, or increases in production which are beyond the design capability of the treatment facilities; d. that at the time of the upset the facility was being properly operated; e. that the Permittee properly notified the Commissioner of the upset in accordance with Minn. R. 7001.1090, subp. 1, item I; and f. that the Permittee implemented the remedial measures required by Minn. R. 7001.0150, subp. 3, item J. [Minn. R. 7001.1090]
	5.10.134	Release. [Minn. R. 7001]

	5.10.135	Unauthorized Releases of Wastewater Prohibited. Except for discharges from outfalls specifically authorized by this permit, overflows, discharges, spills, or other releases of wastewater or materials to the environment, whether intentional or not, are prohibited. However, the MPCA will consider the Permittee's compliance with permit requirements, frequency of release, quantity, type, location, and other relevant factors when determining appropriate action. [40 CFR 122.41, Minn. Stat. ch. 115.061]
	5.10.136	Discovery of a release. Upon discovery of a release, the Permittee shall: a. Take all reasonable steps to immediately end the release. b. Notify the Minnesota Department of Public Safety Duty Officer at 1(800)422-0798 or (651)649-5451 (metro area) immediately upon discovery of the release. You may contact the MPCA during business hours at 1(800)657-3864 or (651)296-6300 (metro area). c. Recover as rapidly and as thoroughly as possible all substances and materials released or immediately take other action as may be reasonably possible to minimize or abate pollution to waters of the state or potential impacts to human health caused thereby. If the released materials or substances cannot be immediately or completely recovered, the Permittee shall contact the MPCA. If directed by the MPCA, the Permittee shall consult with other local, state or federal agencies (such as the Minnesota Department of Natural Resources and/or the Wetland Conservation Act authority) for implementation of additional clean-up or remediation activities in wetland or other sensitive areas. [Minn. R. 7001.1090]
	5.10.137	Sampling of a release. Upon discovery of a release, the Permittee shall: a. Collect representative samples of the release. The Permittee shall sample the release for parameters of concern immediately following discovery of the release. The Permittee may contact the MPCA during business hours to discuss the sampling parameters and protocol. In addition, Fecal Coliform Bacteria samples shall be collected where it is determined by the Permittee that the release contains or may contain sewage. If the release cannot be immediately stopped, the Permittee shall consult with MPCA regarding additional sampling requirements. Samples shall be collected at least, but not limited to, two times per week for as long as the release continues. b. Submit the sampling results on the Release Sampling Form (http://www.pca.state.mn.us/index.php/view-document.html?gid=18867). The Release Sampling Form shall be submitted to the MPCA with the next DMR or within 30 days whichever is sooner. [Minn. R. 7001.1090]
	5.10.138	Bypass. [Minn. R. 7001]
	5.10.139	Anticipated bypass. The permittee may allow any bypass to occur which does not cause effluent limitations to be exceeded, but only if the bypass is for essential maintenance to assure efficient operation of the facility. The permittee shall submit prior notice, if possible at least ten days before the date of the bypass to the MPCA. The notice of the need for an anticipated bypass shall include the following information: a. the proposed date and estimated duration of the bypass; b. the alternatives to bypassing; and c. a proposal for effluent sampling during the bypass. Any bypass wastewater shall enter waters of the state from outfalls specifically authorized by this permit. Therefore, samples shall be collected at the frequency and location identified in this permit or two times per week for as long as the bypass continues, whichever is more frequent. [40 CFR 122.41(m)(2 and 3), Minn. R. 7001.1090, 1(J)]

	5.10.140	All other bypasses are prohibited. The MPCA may take enforcement action against the Permittee for a bypass, unless the specific conditions described in Minn. R. Ch. 7001.1090 subp. 1, K and 122.41(m)(4)(i) are met. In the event of an unanticipated bypass, the permittee shall: a. Take all reasonable steps to immediately end the bypass. b. Notify the Minnesota Department of Public Safety Duty Officer at 1(800)422-0798 or (651)649-5451 (metro area) immediately upon commencement of the bypass. You may contact the MPCA during business hours at 1(800)657-3864 or (651)296-6300 (metro area). c. Immediately take action as may be reasonably possible to minimize or abate pollution to waters of the state or potential impacts to human health caused thereby. If directed by the MPCA, the Permittee shall consult with other local, state or federal agencies for implementation of abatement, clean-up, or remediation activities. d. Only allow bypass wastewater as specified in this section to enter waters of the state from outfalls specifically authorized by this permit. Samples shall be collected at the frequency and location identified in this permit or two times per week for as long as the bypass continues, whichever is more frequent. The permittee shall also follow the reporting requirements for effluent violations as specified in this permit. [40 CFR 122.41(m)(4)(i), Minn. R. 7001.1090, 1(K), Minn. Stat. ch. 115.061]
	5.10.141	Operation and Maintenance. [Minn. R. 7001]
	5.10.142	The Permittee shall at all times properly operate and maintain the facilities and systems of treatment and control, and the appurtenances related to them which are installed or used by the Permittee to achieve compliance with the conditions of the permit. Proper operation and maintenance includes effective performance, adequate funding, adequate operator staffing and training, and adequate laboratory and process controls, including appropriate quality assurance procedures. The Permittee shall install and maintain appropriate backup or auxiliary facilities if they are necessary to achieve compliance with the conditions of the permit and, for all permits other than hazardous waste facility permits, if these backup or auxiliary facilities are technically and economically feasible Minn. R. 7001.0150. subp. 3, item F. [Minn. R. 7001.0150, 3(F)]
	5.10.143	In the event of a reduction or loss of effective treatment of wastewater at the facility, the Permittee shall control production or curtail its discharges to the extent necessary to maintain compliance with the terms and conditions of this permit. The Permittee shall continue this control or curtailment until the wastewater treatment facility has been restored or until an alternative method of treatment is provided. [Minn. R. 7001.1090, 1(C)]
	5.10.144	Solids Management. The Permittee shall properly store, transport, and dispose of biosolids, septage, sediments, residual solids, filter backwash, screenings, oil, grease, and other substances so that pollutants do not enter surface waters or ground waters of the state. Solids should be disposed of in accordance with local, state and federal requirements. [40 CFR 503, Minn. R. 7041]
	5.10.145	Scheduled Maintenance. The Permittee shall schedule maintenance of the treatment works during non-critical water quality periods to prevent degradation of water quality, except where emergency maintenance is required to prevent a condition that would be detrimental to water quality or human health. [Minn. R. 7001.0150, 3(F), Minn. R. 7001.150, 2(B)]
	5.10.146	Control Tests. In-plant control tests shall be conducted at a frequency adequate to ensure compliance with the conditions of this permit. [Minn. R. 7001.0150, 3(F), Minn. R. 7001.150, 2(B)]
	5.10.147	Changes to the Facility or Permit. [Minn. R. 7001]

	5.10.148	Permit Modifications. Except as provided under Minnesota Statutes, section 115.07, subdivisions 1 and 3, no person required by statute or rule to obtain a permit may construct, install, modify, or operate the facility to be permitted, nor shall a person commence an activity for which a permit is required by statute or rule until the agency has issued a written permit for the facility or activity. Permittees that propose to make a change to the facility or discharge that requires a permit modification shall follow Minn. R. 7001.0190. If the Permittee cannot determine whether a permit modification is needed, the Permittee shall contact the MPCA prior to any action. It is recommended that the application for permit modification be submitted to the MPCA at least 180 days prior to the planned change. [Minn. R. 7001.0030]
	5.10.149	Plans, specifications and MPCA approval are not necessary when maintenance dictates the need for installation of new equipment, provided the equipment is the same design size and has the same design intent. For instance, a broken pipe, lift station pump, aerator, or blower can be replaced with the same design-sized equipment without MPCA approval. If the proposed construction is not expressly authorized by this permit, it may require a permit modification. If the construction project requires an Environmental Assessment Worksheet under Minn. R. 4410, no construction shall begin until a negative declaration is issued and all approvals are received or implemented. [Minn. R. 7001.0030]
	5.10.150	Report Changes. The Permittee shall give advance notice as soon as possible to the MPCA of any substantial changes in operational procedures, activities that may alter the nature or frequency of the discharge, and/or material factors that may affect compliance with the conditions of this permit. [Minn. R. 7001.0150, 3(M)]

	5.10.151	Chemical Additives. The Permittee shall receive prior written approval from the MPCA before increasing the use of a chemical additive authorized by this permit, or using a chemical additive not authorized by this permit, in quantities or concentrations that have the potential to change the characteristics, nature and/or quality of the discharge. The Permittee shall request approval for an increased or new use of a chemical additive at least 60 days, or as soon as possible, before the proposed increased or new use. This written request shall include at least the following information for the proposed additive: a. The process for which the additive will be used; b. Safety Data Sheet (SDS) which shall include aquatic toxicity, human health, and environmental fate information for the proposed additive. The aquatic toxicity information shall include at minimum the results of: a) a 48-hour LC50 or EC50 acute study for a North American freshwater planktonic crustacean (either Ceriodaphnia or Daphnia sp.) and b) a 96-hour LC50 acute study for rainbow trout, bluegill or fathead minnow or another North American freshwater aquatic species other than a planktonic crustacean; c. a complete product use and instruction label; d. the commercial and chemical names and Chemical Abstract Survey (CAS) number for all ingredients in the additive (If the MSDS does not include information on chemical composition, including percentages for each ingredient totaling to 100%, the Permittee shall contact the supplier to have this information provided); and e. The proposed method of application, application frequency, concentration, and daily average and maximum rates of use. Upon review of the information submitted regarding the proposed chemical additive, the MPCA may require additional information be submitted for consideration. This permit may be modified to restrict the use or discharge of a chemical additive and include additional influent and effluent monitoring requirements. Approval for the use of an additive shall not justify the exceedance of any effluent limitation nor shall it be used as a defense against pollutant levels in the discharge causing or contributing to the violation of a water quality standard. [Minn. R. 7001.0170]
	5.10.152	MPCA Initiated Permit Modification, Suspension, or Revocation. The MPCA may modify or revoke and reissue this permit pursuant to Minn. R. 7001.0170. The MPCA may revoke without reissuance this permit pursuant to Minn. R. 7001.0180. [Minn. R. 7001.0170, Minn. R. 7001.0180]
	5.10.153	TMDL Impacts. Facilities that discharge to an impaired surface water, watershed or drainage basin may be required to comply with additional permits or permit requirements, including additional restriction or relaxation of limits and monitoring as authorized by the CWA 303(d)(4)(A) and 40 CFR 122.44.l.2.i., necessary to ensure consistency with the assumptions and requirements of any applicable US EPA approved wasteload allocations resulting from Total Maximum Daily Load (TMDL) studies. [40 CFR 122.44(l)(2)(i)]
	5.10.154	Permit Transfer. The permit is not transferable to any person without the express written approval of the Agency after compliance with the requirements of Minn. R. 7001.0190. A person to whom the permit has been transferred shall comply with the conditions of the permit. [Minn. R. 7001.0150, 3(N)]

	5.10.155	Facility Closure. The Permittee is responsible for closure and post-closure care of the facility. The Permittee shall notify the MPCA of a significant reduction or cessation of the activities described in this permit at least 180 days before the reduction or cessation. The MPCA may require the Permittee to provide to the MPCA a facility Closure Plan for approval. Facility closure that could result in a potential long-term water quality concern, such as the ongoing discharge of wastewater to surface or ground water, may require a permit modification or reissuance. The MPCA may require the Permittee to establish and maintain financial assurance to ensure performance of certain obligations under this permit, including closure, post-closure care and remedial action at the facility. If financial assurance is required, the amount and type of financial assurance, and proposed modifications to previously MPCA-approved financial assurance, shall be approved by the MPCA. [Minn. Stat. ch. 116.07, 4]
	5.10.156	Permit Reissuance. If the Permittee desires to continue permit coverage beyond the date of permit expiration, the Permittee shall submit an application for permit reissuance : Due by 180 days prior to permit expiration. If the Permittee does not intend to continue the activities authorized by this permit after the expiration date of this permit, the Permittee shall notify the MPCA in writing at least 180 days before permit expiration. If the Permittee has submitted a timely application for permit reissuance, the Permittee may continue to conduct the activities authorized by this permit, in compliance with the requirements of this permit, until the MPCA takes final action on the application, unless the MPCA determines any of the following (Minn. R. 7001.0040 and 7001.0160): a. The Permittee is not in substantial compliance with the requirements of this permit, or with a stipulation agreement or compliance schedule designed to bring the Permittee into compliance with this permit; b. The MPCA, as a result of an action or failure to act by the Permittee, has been unable to take final action on the application on or before the expiration date of the permit; c. The Permittee has submitted an application with major deficiencies or has failed to properly supplement the application in a timely manner after being informed of deficiencies. [Minn. R. 7001.0160]

6. Submittal action summary

SD 001	**Effluent To Surface Water**	
		Surface Discharge: Class A Minor Facility Effluent Requirements
	6.1.1	The Permittee shall submit a monthly DMR : Due by 21 days after the end of each calendar month following permit issuance. [Minn. R. 7001.0150, Subp. 2(B)]
WS 001	**Influent Waste**	
		Waste Stream: Class A Minor Facility Influent Requirements
	6.2.1	The Permittee shall submit a monthly DMR : Due by 21 days after the end of each calendar month following permit issuance. [Minn. R. 7001.0150, Subp. 2(B)]
MN0041076	**Big Lake WWTP**	
		Mercury Minimization Plan
	6.3.1	The Permittee shall submit a mercury pollutant minimization plan : Due by 180 days prior to permit expiration. [Minn. R. 7001]
		Pretreatment: Undelegated Requirements
	6.4.2	The Permittee shall submit a pretreatment annual report : Due by 31 days after the end of each calendar year following permit issuance if a SIU discharges to the POTW during a given calendar year. [Minn. R. 7049]
		Biosolids: Exceptional Quality
	6.5.3	The Permittee shall submit a biosolids annual report : Due annually, by the 31st of December on a form provided by or approved by the MPCA. The report shall include the requirements in Minnesota Rules, part 7041.1700. [Minn. R. 7041]
		Total Facility Requirements (NPDES/SDS)
	6.6.4	Permit Reissuance. If the Permittee desires to continue permit coverage beyond the date of permit expiration, the Permittee shall submit an application for permit reissuance : Due by 180 days prior to permit expiration. If the Permittee does not intend to continue the activities authorized by this permit after the expiration date of this permit, the Permittee shall notify the MPCA in writing at least 180 days before permit expiration. If the Permittee has submitted a timely application for permit reissuance, the Permittee may continue to conduct the activities authorized by this permit, in compliance with the requirements of this permit, until the MPCA takes final action on the application, unless the MPCA determines any of the following (Minn. R. 7001.0040 and 7001.0160): a. The Permittee is not in substantial compliance with the requirements of this permit, or with a stipulation agreement or compliance schedule designed to bring the Permittee into compliance with this permit; b. The MPCA, as a result of an action or failure to act by the Permittee, has been unable to take final action on the application on or before the expiration date of the permit; c. The Permittee has submitted an application with major deficiencies or has failed

		to properly supplement the application in a timely manner after being informed of deficiencies. [Minn. R. 7001.0160]

7. Limits and monitoring

		Discharge limitations							Monitoring requirements			
Subject item	**Parameter**	**Quantity /Loading avg.**	**Quantity /Loading max.**	**Quantity /Loading units**	**Quality /Conc. min.**	**Quality /Conc. avg.**	**Quality /Conc. max.**	**Quality/ Conc. units**	**Frequency**	**Sample type**	**Effective period**	**Notes**
SD 001 Total Facility Discharge	BOD, Carbonaceous 05 Day (20 Deg C)	34.3 calendar month average	54.9 maximum calendar week average	kilograms per day		25.0 calendar month average	40.0 maximum calendar week average	milligrams per liter	twice per week	24-Hour Flow Composite	Jan-Dec	
SD 001 Total Facility Discharge	BOD, Carbonaceous 05 Day (20 Deg C) Percent Removal				85 minimum calendar month average			percent	once per month	Calculation	Jan-Dec	
SD 001 Total Facility Discharge	Fecal Coliform, MPN or Membrane Filter 44.5C					200 calendar month geometric mean		organisms per 100 milliliter	twice per week	Grab	Apr-Oct	
SD 001 Total Facility Discharge	Flow		Monitor only. calendar month total	million gallons		Monitor only. calendar month average	Monitor only. calendar month maximum	million gallons per day	once per day	Measurement, Continuous	Jan-Dec	
SD 001 Total Facility Discharge	Mercury, Dissolved (as Hg)						Monitor only. calendar month maximum	nanograms per liter	once per month	Grab	Jul	
SD 001 Total Facility Discharge	Mercury, Total (as Hg)						Monitor only. calendar month maximum	nanograms per liter	once per month	Grab	Jul	
SD 001 Total Facility Discharge	Nitrite Plus Nitrate, Total (as N)					Monitor only. calendar quarter average		milligrams per liter	once per quarter	24-Hour Flow Composite	Mar, Jun, Sep, Dec	
SD 001 Total Facility Discharge	Nitrogen, Ammonia, Total (as N)					Monitor only. calendar month average		milligrams per liter	once per month	24-Hour Flow Composite	Mar, Sep	

		Discharge limitations							Monitoring requirements			
Subject item	**Parameter**	**Quantity /Loading avg.**	**Quantity /Loading max.**	**Quantity /Loading units**	**Quality /Conc. min.**	**Quality /Conc. avg.**	**Quality /Conc. max.**	**Quality/ Conc. units**	**Frequency**	**Sample type**	**Effective period**	**Notes**
SD 001 Total Facility Discharge	Nitrogen, Kjeldahl, Total					Monitor only. calendar quarter average		milligrams per liter	once per quarter	24-Hour Flow Composite	Mar, Jun, Sep, Dec	
SD 001 Total Facility Discharge	Nitrogen, Total (as N)					Monitor only. calendar quarter average		milligrams per liter	once per quarter	24-Hour Flow Composite	Mar, Jun, Sep, Dec	
SD 001 Total Facility Discharge	Oxygen, Dissolved				Monitor only. calendar month minimum			milligrams per liter	once per day	Grab	Jan-Dec	
SD 001 Total Facility Discharge	pH				6.0 calendar month minimum		9.0 calendar month maximum	standard units	once per day	Grab	Jan-Dec	
SD 001 Total Facility Discharge	Phosphorus, Total (as P)		1160 12-month moving total	kilograms per year					once per month	Calculation	Jan-Dec	
SD 001 Total Facility Discharge	Phosphorus, Total (as P)	Monitor only. calendar month average		kilograms per day		Monitor only. calendar month average		milligrams per liter	once per week	24-Hour Flow Composite	Jan-Dec	
SD 001 Total Facility Discharge	Solids, Total Dissolved (TDS)					Monitor only. calendar month average		milligrams per liter	once per month	24-Hour Flow Composite	Mar, Sep	
SD 001 Total Facility Discharge	Solids, Total Suspended (TSS)	41.2 calendar month average	61.7 maximum calendar week average	kilograms per day		30 calendar month average	45 maximum calendar week average	milligrams per liter	twice per week	24-Hour Flow Composite	Jan-Dec	
SD 001 Total Facility Discharge	Solids, Total Suspended (TSS) Percent Removal				85 minimum calendar month average			percent	once per month	Calculation	Jan-Dec	

		Discharge limitations							Monitoring requirements			
Subject item	**Parameter**	**Quantity /Loading avg.**	**Quantity /Loading max.**	**Quantity /Loading units**	**Quality /Conc. min.**	**Quality /Conc. avg.**	**Quality /Conc. max.**	**Quality/ Conc. units**	**Frequency**	**Sample type**	**Effective period**	**Notes**
SD 001 Total Facility Discharge	Solids, Total Suspended (TSS), grab (Mercury)						Monitor only. calendar month maximum	milligrams per liter	once per month	Grab	Jul	
WS 001 Influent Waste Stream	BOD, Carbonaceous 05 Day (20 Deg C)					Monitor only. calendar month average	Monitor only. calendar month maximum	milligrams per liter	twice per week	24-Hour Flow Composite	Jan-Dec	
WS 001 Influent Waste Stream	Flow		Monitor only. calendar month total	million gallons		Monitor only. calendar month average	Monitor only. calendar month maximum	million gallons per day	once per day	Measurement, Continuous	Jan-Dec	
WS 001 Influent Waste Stream	Nitrite Plus Nitrate, Total (as N)					Monitor only. calendar quarter average		milligrams per liter	once per quarter	24-Hour Flow Composite	Mar, Jun, Sep, Dec	
WS 001 Influent Waste Stream	Nitrogen, Kjeldahl, Total					Monitor only. calendar quarter average		milligrams per liter	once per quarter	24-Hour Flow Composite	Mar, Jun, Sep, Dec	
WS 001 Influent Waste Stream	Nitrogen, Total (as N)					Monitor only. calendar quarter average		milligrams per liter	once per quarter	24-Hour Flow Composite	Mar, Jun, Sep, Dec	
WS 001 Influent Waste Stream	pH				Monitor only. calendar month minimum		Monitor only. calendar month maximum	standard units	once per day	Grab	Jan-Dec	
WS 001 Influent Waste Stream	Phosphorus, Total (as P)					Monitor only. calendar month average		milligrams per liter	once per week	24-Hour Flow Composite	Jan-Dec	

		Discharge limitations							Monitoring requirements			
Subject item	**Parameter**	**Quantity /Loading avg.**	**Quantity /Loading max.**	**Quantity /Loading units**	**Quality /Conc. min.**	**Quality /Conc. avg.**	**Quality /Conc. max.**	**Quality/ Conc. units**	**Frequency**	**Sample type**	**Effective period**	**Notes**
WS 001 Influent Waste Stream	Precipitation		Monitor only. calendar month total	inches					once per day	Measurement	Jan-Dec	
WS 001 Influent Waste Stream	Solids, Total Suspended (TSS)					Monitor only. calendar month average	Monitor only. calendar month maximum	milligrams per liter	twice per week	24-Hour Flow Composite	Jan-Dec	

A-2 – Preliminary Effluent Request Response Letter

RE: Preliminary Effluent Limits for the Proposed Big Lake Discharge
NPDES/SDS Permit MN0041076-SD001

Mr. Wolohan:

This electronic-letter is in response to your request for preliminary effluent limits for an expansion of the City of Big Lake wastewater treatment plant (WWTP). It summarizes the preliminary effluent limits for the WWTP proposed expansion. The preliminary limits are draft values. Effluent limits only become final after the National Pollutant Discharge Elimination System (NPDES) permit has undergone a complete review, been public noticed, the public's comments considered and either our Commissioner or a delegated representative signs the permit.

Please be aware that receiving the preliminary effluent limits in the table below does not mean that your proposed expansion/new facility has been approved. As part of the permitting process, your project must comply with antidegradation requirements (see the Antidegradation Requirement section below for important details). You must demonstrate that there is no way to avoid water quality degradation and that the chosen project alternative is the least degrading prudent and feasible alternative. In many cases, the least degrading prudent and feasible alternative may not be your preferred option or the option(s) discussed in this letter. (7050.0280, subp. 2).

Scenario descriptions

The City of Big Lake requested preliminary effluent limits for one scenario at their Big Lake WWTF discharge:

	Average Wet Weather Design (MGD)	Average Dry Weather Design (MGD)	Discharge Type
Existing Facility	0.958	0.746	Continuous
Scenario #1	2.206	1.413	Continuous

The receiving water will remain the Mississippi River. This section of the Mississippi River is classified as a 1C, 2Bdg, 3,4,5,6 river and is also designated as a restricted outstanding resource value water.

The 7Q10 flow rate of this reach of the Mississippi River is 1074 cfs and this 7Q10 flow rate represents a dilution ratio of 1746:1 at the expanded flow rate.

Table 1: Limits Table

	Existing Discharge		Scenario 1	
AWWDF (MGD)	0.958		2.206	
ADWDF (MGD)	0.746		1.413	
River flow- 7q10	1074		1074	
Dilution Ratio	2685		1746	
Antideg review needed?	No		Yes	
Environmental review needed?	No		No	
Frozen Mass Limits Possible?			Yes	
$cBOD_5$-Ammonia Linkage Eligible?	NA		No	
POLLUTANT / PARAMETER	Conc.	Mass	Conc.	Mass
$cBOD_5$, mg/L (kg/day)	25	34.3	25	34.3[1]
TSS, mg/L (kg/day)	30	41.2	30	41.2[1]
Fecal Coliform Organisms, orgs/100 mL	200 (Apr-Oct)	---	200 (Jan-Dec)	---
Ammonia-N (June 1 - September 30)	---	---	---	---
Ammonia-N (October 1 - November 30)	---	---	---	---
Ammonia-N (December 1 - March 31)	---	---	---	---
Ammonia-N (April 1 - May 31)	---	---	---	---
Dissolved Oxygen, mg/L	---	---	---	---
pH (Standard Unit)	6.0 - 9.0	---	6.0 - 9.0	---
Mercury[3]	---	---	---	---
Phosphorus, mg/L	---		1.0	
Phosphorus, kg/yr (12 month rolling avg)	---	1,160	---	1,160
Chloride, mg/L as Mo. Avg. (kg/day)	---	---	---	---

1. Mass limits associated with previous permit 0.84 MGD AWWDF frozen mass limits.
2. The disinfection limits would be required all year to ensure protection of the ORVW and ensure protection of water at the metro drinking water intakes.
3. Mercury limits and antidegradation analysis of mercury loading would not be required if frozen TSS mass limits are accepted.

Impaired Waters

There are numerous waters impaired for a variety of pollutants ranging from PFAS to mercury and nutrients. Not all of these impairments are relevant for any of the proposed scenarios. The impaired waters of primary importance for effluent limit setting are nutrients, TSS and fecal coliform and all three of these parameters have wasteload allocations in approved TMDLS. It would be very difficult and time intensive to officially modify these TMDLs for Big Lake to receive a larger wasteload allocation.

Phosphorus Details

The current facility has a 1,160 kg/yr 12-month moving total mass limit. The proposed facility has an average wet weather design flow (AWWDF) of 2.206 mgd (Table 2). The new facility will have an annual 1.0 mg/L concentration limit regardless of design flow (Minnesota Rule 7053.0255 subpart 3) because the AWWDF is greater than 1.0 MGD. The Mississippi River and Lake Pepin TMDL established an annual wasteload allocation of 1,160 kg/yr for the Big Lake WWTF (MPCA and Limnotech 2021). The annual mass limit for the proposed expansion is 1,160 kg/yr. As flows at the Big Lake WWTF increase, the facility will have to achieve well below 1.0 mg/L to comply with the 1,160 kg/yr annual mass limit.

Table 2. Total phosphorus (TP) effluent concentrations to achieve Lake Pepin based mass allocation of 1,160 kg/yr at proposed average wet weather design flows (AWWDF) and average dry weather design flows (ADWDF).

Design	flow (mgd)	TP mg/L	TP kg/d	kg/yr
Current AWWDF	0.958	0.8765	3.18	1,160
Current ADWDF	0.746	1.00	2.82	1,031
Proposed AWWDF 1	2.206	0.3805	3.18	1,160
Proposed ADWDF 1	1.413	0.594	3.18	1,160

The proposed expansion will continue to be to the Mississippi River. Kaufenberg (2017) found that the Lake Pepin based limits were sufficient to protect the Mississippi River reaches within the Mississippi River – St. Cloud Watershed. An antidegradation review for phosphorus is not needed since no additional mass of phosphorus is authorized from the proposed expansion.

Class 3 and 4 Water Quality Standards

In 2020 the MPCA submitted a rulemaking proposal to make changes to the existing class 3 and 4 water quality standards. On July 13th, 2021 these rules became effective in state law. The new draft class 3 and 4 standards now have translators effective (Class 3 & Class 4A) in rule that the MPCA must use to determine whether a discharger requires an effluent limit to protect the class 3 and 4 beneficial uses. These translators turn the protective narrative goals of the class 3 and 4A designated uses into enforceable numeric effluent limits. The MPCA does not expect that Big Lake will need a new limit because of these translators, but the MPCA must document that the translators were used upon issuing the permit.

Monitoring requirements

All municipal NPDES permit holders need to monitor for pH, TSS, CBOD5, and DO, fecal coliform. In addition, this permittee will have to monitor the following parameters at the frequencies specified in the table below. The WET testing and priority pollutant scans are required because the facility would become a Major facility (AWWDF > 1MGD).

Table 3 Additional required monitoring beyond standard monitoring

Analyte	Units	Options 1-3 Mechanical Frequency & Influent/Effluent
Mercury, Total	ng/L	4X per year I/E
Mercury, Dissolved	ng/L	4X per year I/E
TSS (grab w/Mercury)	mg/L	4X per year I/E
Ammonia nitrogen, Total	mg/L	4X per year E
Kjeldahl nitrogen, Total	mg/L	4X per year I/E
Nitrate/nitrite nitrogen	mg/L	4X per year I/E
TDS	mg/L	2X per year E
Sulfate	mg/L	2X per year E
Chloride	mg/L	---
Sodium, Calcium & Magnesium	mg/L, umhos/cm	---
Acute Wet Testing	NA	1X per Year
Priority Pollutant Scan	NA	3X per 5 yr cycle

Regulatory Certainty

In response to listening session comments, a voluntary option — part of the Governor's Community Water Infrastructure bonding investment package — would provide up to 20 years of regulatory certainty for wastewater treatment facilities that are willing to accept phosphorus and nitrogen effluent limits and design, construct, and fully operate a biological nutrient removal (BNR) treatment system[1],[2]. BNR systems remove both phosphorous and nitrogen, and are considered the best available technology for wastewater treatment. Indeed, BNR is the only known cost-effective wastewater removal technology for nitrate.

Once the BNR system is in place, the facility would not be required to comply with any new phosphorous or nitrogen limits, beyond those in their discharge permit, for the estimated useful life of the new BNR system. The proposal is linked to a bonding request for water infrastructure grants, and is intended to incentivize facility upgrades to BNR systems.

Communities that volunteer to participate by installing and operating BNR systems would no longer have to speculate what future nitrogen water quality standards might mean for them. Rather than needing to upgrade to meet phosphorus limits now and potentially upgrade again to meet nitrogen limits in five or ten years, communities that install a BNR system would comprehensively address all nutrients for up to 20 years and obtain regulatory certainty. Over time, communities could also save money by reducing both energy usage and the purchase of chemicals for phosphorus removal. Water quality in Minnesota lakes and rivers would also benefit from more treatment plants converting to the best available technology. Notably, we could get a jump on reducing nitrogen in state waters, years ahead of when we can institute a new nitrogen standard. And because Minnesota is home to the headwaters of the Mississippi River, the Great Lakes, and the Red River of the North, the impact of reducing phosphorus and nitrogen in the state will be felt in all our downstream waters, including the Hudson Bay, the Gulf of Mexico, and all the Great Lakes.

[1] Minnesota Statute 115.426

[2] Fact sheet on regulatory certainty

Antidegradation Assessments and Capped Mass Limits

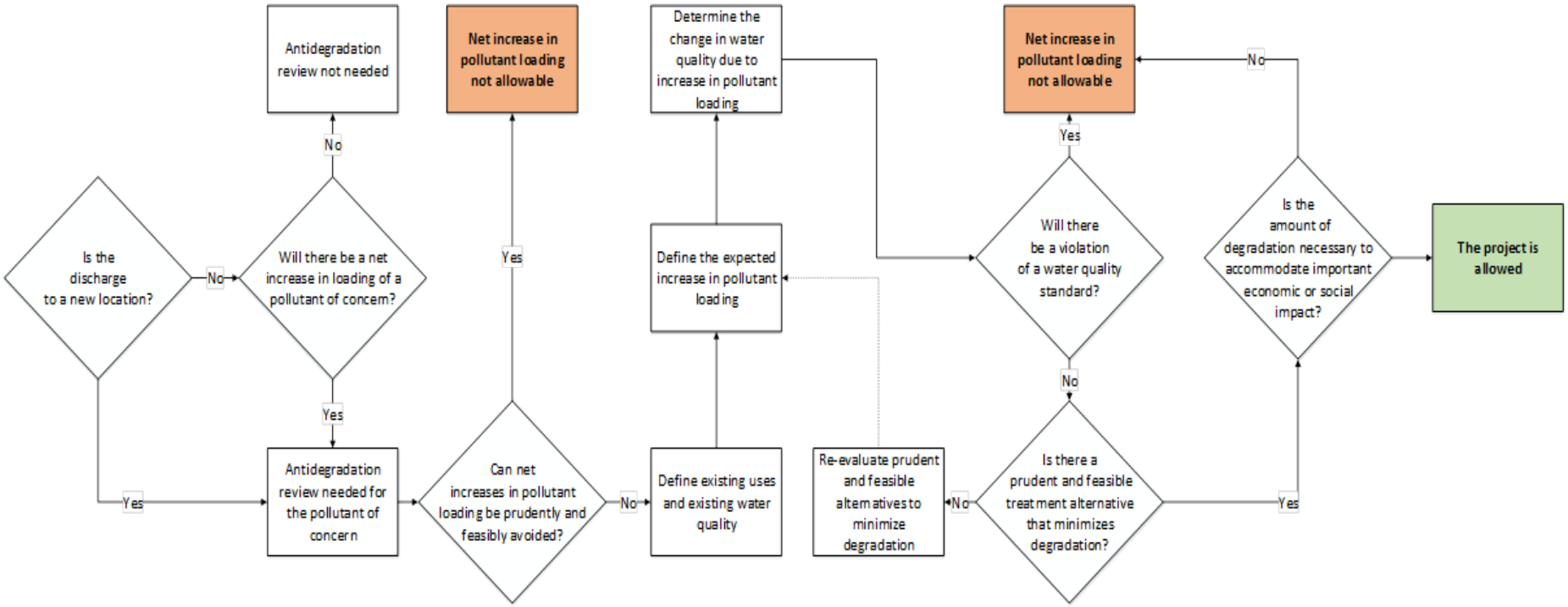
Antidegradation is one of the fundamental protections in the Clean Water Act, and all newly issued or re-issued wastewater permits must comply with both state and federal antidegradation Rules. The goal of antidegradation is to preserve waters of high quality and to ensure that they are not degraded unless balanced by important economic or social development. See Minn. R. 7050.0250 to 7050.0335. The antidegradation assessment process may result in more restrictive effluent limits.

For wastewater permitting, antidegradation concerns are triggered when a new discharge is proposed or when an existing discharger is proposing to increase the loading of any parameter of concern in its discharge. An antidegradation assessment is a substantial evaluation that must consider all beneficial uses of the receiving water, potential economic impacts, all possible treatment options and the potential environmental degradation for every pollutant that triggers the need for an antidegradation assessment. The applicant (permittee) must demonstrate that the chosen project alternative cannot be avoided and is the least degrading prudent and feasible alternative. The permittee must also examine the socioeconomic impacts of the project as compared to the environmental changes in water quality. The environmental degradation must be offset by the socioeconomic benefit. A flowchart summary of the antidegradation assessment process required by state rules (Minn. R. 7050.0280) can be seen below.

New and expanded NPDES permits that result in net increases in pollutant loading to surface waters are required to undergo an antidegradation review (Minn. R. 7050.0280). When applied to a proposed activity that is not regulated by an existing control document (i.e. permit), any loading or other causes of degradation resulting from the proposed activity constitute a net increase (7050.0255 Subp. 26). In this situation, the proposed new treatment system constitutes a net increase in loading; and therefore, an antidegradation review must be completed and approved in order for the effluent limitations to be final for the selected option.

The permittee must submit the antidegradation assessment to the Minnesota Pollution Control Agency (MPCA). MPCA staff will review the assessment to determine if it satisfies state and federal rules. The MPCA has recently developed a guidance document for developing antidegradation assessments that you may find helpful.

Antidegradation assessments frequently require permittees to perform additional water quality monitoring to ensure that appropriate water quality evaluations are performed. The water quality monitoring required for an antidegradation assessment is permit-specific and is intended to fill gaps in existing water quality knowledge. Filling these water quality gaps could require additional monitoring of the discharge, receiving waters upstream and downstream of the discharger or significant industrial users permitted by the discharger.



Summary of the antidegradation assessment process required by Minn. R. 7050.0280

Completing an antidegradation assessment can require a significant amount of time, data and writing effort. It is reasonable to expect at least six to twelve months of effort to complete an antidegradation assessment. The permittee is expected to complete the antidegradation assessment, but the MPCA must approve it as a part of permit documents. The MPCA is responsible for defending the assessment during public comment and in any future legal proceedings. Antidegradation assessments are frequently legally contested, and as such, the MPCA will only approve an assessment of high quality that complies with state and federal antidegradation rules. MPCA staff may provide assistance to the permittee with the antidegradation process.

Because of the workload associated with completing an antidegradation assessment, most permittees looking to expand their permitted flow rates choose to accept "frozen mass limits". "Frozen mass limits" represent the full authorized load in the previous permit for the pollutants of interest. If the permittee is willing to accept "frozen mass limits" while also expanding their flow rates, then the receiving water would receive no net increase in authorized loading because of the expansion, and an antidegradation assessment would not be needed for that parameter. In this scenario, permitted concentration limits would stay the same as in the last permit issuance, however "effective" concentration limits would be lower in order to comply with voluntary mass limits. If the permittee voluntarily accepts frozen mass limits for the pollutants of concern, they will have satisfied antidegradation rules for that parameter, and they will not need to submit an antidegradation assessment for that parameter.

It must be noted that the receiving water for Big Lake is a restricted outstanding resource value water and the requirements in Minn. R. 7050.0265 subp. 6 are applicable (see statute below).

> **Subp. 6.** Protecting restricted outstanding resource value waters.
>
> The commissioner shall restrict a proposed activity in order to preserve the existing water quality as necessary to maintain and protect the exceptional characteristics for which the restricted outstanding resource value waters identified under part 7050.0335, subparts 1 and 2, were designated.

This statute requires the MPCA to restrict loading to ORVW waters to a higher degree than for non-ORVW waters. The functional result of this statute to Big Lake is that it would be difficult to justify expanding the frozen mass limits for any parameter and Big Lake would be wise to consider accepting frozen mass limits as they are found in the current permit.

Chloride is the only pollutant of concern that must be addressed in an antidegradation review that doesn't currently have a limit in the permit. Big Lake will not receive a chloride limit in the current or future permit, but because of the expansion there will be a net increase in chloride loading. An antidegradation review must address this net increase in loading of chloride and demonstrate that the exceptional characteristics of the Mississippi River will be maintained. It would be prudent to collect at least five chloride samples in Big Lake's effluent to characterize Big Lake's current chloride loading and fulfill the requirements in Minn. R. 7050.0265 with regards to calculating changes in receiving water quality because of the expansion. The MPCA can provide surface water quality data that would help with this calculation and has attached the Otsego West antidegradation assessment that contains a similar calculation for reference.

Environmental Review

An Environmental Assessment Worksheet (EAW) is likely to be required for the expanded facility. This is because for the expansion the flow rate would increase by both 200,000 GPD and by >50% (Minn. R. 4410.4300 subp. 18b). Please contact current MPCA Environmental Review (ER) Wastewater Liaison (Kim Grosenheider) with questions on MPCA ER interpretation. More information can be found in Minn. R. 4410.4300 or at https://www.eqb.state.mn.us/content/mandatory-environmental-review-categories-legislative-assessment-report. A full environmental review is not likely to be needed.

According to the *Preliminary Effluent Limit Review Request* document, the building of a new continuous WWTP will not impact wetlands. If building of the WWTP were to result in the physical alteration of a wetland, then wetland mitigation sequencing in compliance with Minn. R. 7050. 0186 would be required.

References

Kaufenberg, L. 2017. Total phosphorus effluent limit review: Upper Subwatershed of the Mississippi River – St. Cloud Watershed. MPCA St. Paul 17 pp.

If you have any questions, comments or concerns, please contact me at 651-757-2665 or email me at *Scott.Kyser@state.mn.us*

Sincerely,

Scott Kyser, PE
Minnesota Pollution Control Agency
Environmental Analysis and Outcomes Division

A-3 – Antidegradation Review

Antidegradation Review

Big Lake Wastewater Treatment Facility

Big Lake, Minnesota

BIGLK 167307 | February 2, 2024

SEH

Building a Better World for All of Us®

Engineers | Architects | Planners | Scientists

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February 2, 2024

RE: Big Lake Wastewater Treatment Facility
Antidegradation Review
Big Lake, Minnesota
SEH No. BIGLK 167307 4.00

Mr. Dan Childs
City of Big Lake
18999 County Road 14 NW
Big Lake, Minnesota 55309

Dear Mr. Childs:

This report provides justification for an antidegradation review request to be presented to the MPCA and used in determination of the effluent limits implemented in the Big Lake Wastewater Treatment Facility NPDES/SDS permit. The limits are a result of the increased wastewater flow demand for expanding the design flow of the Wastewater Treatment Facility. The outcome of the antidegradation review will be used to complete the current wastewater facilities plan being prepared for the City.

We would like to thank you for the opportunity to work in cooperation with your city staff to provide this review and consideration for future improvements at the wastewater treatment facilities.

Sincerely,

Jessica Hedin, PE
Project Manager (Lic. MN)

ejm
x:\ae\b\biglk\167307\4-prelim-dsgn-rpts\antidegradation\20230714 antidegradation review_draft.docx

Antidegradation Review

Big Lake Wastewater Treatment Facility
Big Lake, Minnesota

SEH No. BIGLK 167307

February 2, 2024

I hereby certify that this report was prepared by me or under my direct supervision, and that I am a duly Licensed Professional Engineer under the laws of the State of Minnesota.

Jessica Hedin, PE

Date: August 18, 2023 License No.: 41639

Reviewed By: _____ Date: _____

Short Elliott Hendrickson Inc.
2351 Connecticut Avenue, Suite 300
Sartell, MN 56377-2485
320.229.4300

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Antidegradation Review

Big Lake Wastewater Treatment Facility

Prepared for City of Big Lake

1 Introduction

The purpose of this report is to substantiate the basis for an antidegradation review in accordance with rules for the National Pollution Discharge Elimination System (NPDES) wastewater permit and Minnesota Rules parts 7050.0250 to 7050.0335. The report consists of three critical elements:

- Ambient Water Quality,
- Alternatives Analysis, and
- Economic Analysis.

2 Ambient Water Quality

A Preliminary Effluent Limit Request (PELR) was submitted by the City of Big Lake to the MPCA dated July 28, 2022. The response to the PELR:

- Identify Pollutants of Concern (POC) as developed by the MPCA.
- Provide preliminary concentration and/or mass limits for continuous discharge.

2.1 Definitions

The PELR identifies pollutants of concern. Pollutants of Concern mass limits are referred to using the following nomenclature:

- Load Caps - POC which are identified in the PELR and are not part of the Antidegradation Review. Load Caps correspond to the frozen mass limit at current permitted flow and load.
- Load Limits - POC which are identified in the PELR and are part of the Antidegradation Review. Load limits apply to POC which have an approved Antidegradation Review.

Load caps may be accepted by the permittee in lieu of load limits without the need to prepare and submit and antidegradation review.

Treated wastewater from the City of Big Lake's Wastewater Treatment Facility (WWTF) is continually discharged into the Mississippi River, which is classified as Class 1C, 2Bd, 3, 4A, 4B, 5, and 6 waters. The Mississippi River does not have a listed designation under Minnesota Rule 7050.0430. Such unlisted waters are given a 2B aquatic life and recreation classification.

The definitions of these classifications follow:

- **Class 1C:** The quality of class 1C waters of the state shall be such that with treatment consisting of coagulation, sedimentation, filtration, storage, and chlorination, or other equivalent treatment processes, the treated water will meet both the primary (maximum contaminant levels) and secondary drinking water standards issued by the United States Environmental Protection Agency.
- **Class 2Bd:** The quality of class 2Bb surface waters shall be such as to permit the propagation and maintenance of a healthy community of cool or warm water aquatic biota, and their habitats. These waters shall be suitable for aquatic recreation of all kinds, including bathing, for which the waters may be usable. This class of surface water is also protected as a source of drinking water.
- **Class 3:** The quality of class 3 waters of the state must be such as to permit their use for industrial purposes to avoid severe fouling, corrosion, or scaling. If the standard in this part is exceeded in waters of the state that have the class 3 designation, it is considered indicative of a polluted condition that is actually or potentially deleterious, harmful, detrimental, or injurious with respect to the designated use. No sewage, industrial waste, or other wastes from point or nonpoint sources, treated or untreated, shall be discharged into or permitted by any person to gain access to any waters of the state classified for industrial purposes so as to cause any material impairment of their use as a source of industrial water supply.
- **Class 4A:** The quality of Class 4A waters of the state shall be such as to permit their use for irrigation without significant damage or adverse effects upon any crops or vegetation usually grown in the waters or area, including truck garden crops.
- **Class 4B:** The quality of Class 4B waters of the state shall be such as to permit their use by livestock and wildlife without inhibition or injurious effects.
- **Class 5:** The quality of Class 5 waters of the state shall be such as to be suitable for aesthetic enjoyment of scenery, to avoid any interference with navigation or damaging effects on property.
- **Class 6:** The quality of Class 6 waters may be under other jurisdictions and in other areas to which the waters of the state are tributary and may include any or all of the uses listed in Minnesota Rules parts 7050.0221 to 7050.0225, plus any other possible beneficial uses.

2.2 Pollutants of Concern (POC)

The following parameters were identified by the MPCA as POC as part of the PELR.

Table 1 – Identified Pollutants of Concern and Current Regulatory Requirements

POC with Establish Concentration or Load Cap	POC Without Establish Concentration or Load Cap but is Monitored	POC Without Establish Concentration or Load Cap and is not Monitored
• 5-Day Carbonaceous Biochemical Oxygen Demand ($cBOD_5$) • Total Suspended Solids (TSS) • Total Phosphorus (TP)	• Total Mercury	• Sulfate • Chlorides

Should an Antidegradation Review be prepared for TSS, a Load Cap would be established for Total Mercury. Although not prescribed a limit as part of the PELR Chloride are identified as a POC. Sulfate is included as a POC during additional discussion with the MPCA but not addressed in the PELR.

The City of Big Lake has reviewed the applicable parameters and considered the current and future impacts regarding development of the community, current and proposed treatment technologies, potential future pollutants of concern, and the economic impacts for levels of treatment required to meet load caps and load limits for the parameters identified. The City of Big Lake has chosen to proceed with an Antidegradation Review of load limits for the following parameters:

Table 2 – Pollutants of Concern applicable to Antidegradation Review

Request Antidegradation Review for the Following LOAD LIMITS	Accept LOAD CAPS Associated with the Following Parameters
• $cBOD_5$ • TSS • Total Mercury • Sulfate • Chlorides	• Total Phosphorus

Big Lake, in lieu of an antidegradation review and with understanding of the specific impairments present in the receiving water bodies, accepts load caps as noted above.

2.3 Discharge Water Quality Scenarios

The following effluent limitations were provided by the MPCA as a response to the PERL. They were developed by the MPCA in response to existing ambient water quality and consider the effects of impairment resulting in additional flows and loads as part of a facility expansion as discussed in the limit request.

The Table 1 on the following page summarizes the PELR for the discharge scenario provided to the MPCA. The anticipated flow demand has been modified from the original requested 2.206 MGD average wet weather (AWW) flow to 1.682 MGD AWW flow. The adjustment to flow capacity is to better serve the community through responsible phased planning in response to anticipated growth and development within the community.

Table 1 also indicates the requested Load Limit for POC which are addressed as part of the Antidegradation Review. The Load Limits are based on the anticipated design flow and allow for acceptance of the total phosphorus load cap as part of the PELR. The anticipated concentration required to meet the load cap for total phosphorus at the anticipated AWW flow of 1.682 MGD is 0.50 mg/L. That concentration is the generally accepted minimum concentration which can be reliably achieved without the addition of tertiary treatment. The facility does not currently operate tertiary treatment processes. The addition of such processes would necessitate intermediate pumping and construction of treatment facilities, both of which are expensive capital improvements, result in an energy dependent treatment process which can serve as appoint of failure, increase cost for operation and maintenance, and add significant operator labor.

Table 3 – Preliminary Calendar Day Average Effluent Limits for Continuous Discharge

Parameter	Requested Antidegradation Load Limits				Accepted PELR Load Caps			
	Concentration [1]		Mass		Concentration [1]		Mass	
	Value	Units	Value	Units	Value	Units	Value	Units
AWW Design Flow	1.682	mgd			1.682	mgd		
$cBOD_5$	10.82 [2]	mg/L	68.85	kg/d	34.4	kg/d	5.4	mg/L
TSS	13.00 [2]	mg/L	82.69	kg/d	41.2	kg/d	6.5	mg/L
TP	1.00 [3]	mg/L					1.0 [3]	mg/L
TP, 12 month rolling total	0.50	mg/L	1160	kg/yr	1160	kg/yr	0.5	mg/L
Total Mercury [4]	Monitor only				Monitor only			
Sulfate [5]	41.20	mg/L	262	kg/d	41.2	mg/L	130	kg/d
Chloride [6]	585	mg/L	3,722	kg/d	585	mg/L	1,854	kg/d
Fecal Coliform [7, 8]	200	orgs/ 100ml					200	orgs/ 100ml
pH, minimum [8]	6.0	su					6.0	su
pH. Maximum [8]	9.0	su					9.0	su

Notes

1. Calculated equivalent day average concentration required to meet mass limit, unless noted otherwise.
2. Requested equivalent day average concentration based on the current calculated equivalent day average concentration to meet current mass load limits.
3. Prescribed effluent concentration limit.
4. Mercury limits and antidegradation analysis of mercury loading would not be required if frozen TSS mass limits are accepted.
5. Load Caps and effluent limits have not been identified are part of the PELR. An anticipated effluent concentration limit of 10 mg/L is assumed based on the sulfate standard to protect the beneficial use of downstream waters. Calculated load caps based on the maximum of (2) samples taken in one month multiplied by the current average wet weather flow. Calculated load limit based on the maximum of (2) samples taken in one month multiplied by the design average wet weather flow.
6. Load Caps and effluent limits have not been identified are part of the PELR. An anticipated effluent concentration limit of 230 mg/L is assumed based on the protection of fish and other aquatic life. Calculated load caps based on the maximum of (3) samples taken in one month multiplied by the current average wet weather flow. Calculated load limit based on the maximum of (3) samples taken in one month multiplied by the design average wet weather flow.
7. The discharge is beyond the 25-mile upstream boundary for drinking water intake to the Minneapolis/St. Paul intake. The City currently operates with a current seasonal disinfection requirement. The PELR has indicated the potential for a year-round disinfection requirement
8. Identified as a limit in the PELR, but not included in the antidegradation review.

Load caps are calculated depending on whether the POC has an existing discharge permit or not. Where discharge mass load limits currently exist, the limited mass load is used. Where discharge mass load limits do not exist, the mass load limit is given by the following equation:

Existing Authorized Mass Load=Q*C

Q = permitted hydraulic design capacity

C = recorded effluent concentration

Current discharge mass limits existing for $cBOD_5$, TSS, and TP. Current discharge mass limits do not exist for mercury, sulfate, and chloride.

Table 4 below and 5 on the following page summarize the anticipated changes in concentration and mass in the discharge of the wastewater treatment facility given the requested load limits and accepted load caps.

Table 4 – Effluent Concentrations as a Result of Requested Load Limits and Accepted Load Caps

Parameter	Discharge Limit Type	Current Permitted Load		Requested Permitted Load at Anticipated Design AWW Flow	
		Current AWW Flow (mg/L) [1]	Permitted AWW Flow (mg/L) [2]	Load Cap (mg/L) [3]	Load Limit (mg/L) [3, 8]
$cBOD_5$ [4]	Calendar Month Average	10.82	9.46	---	10.82
TSS [4]	Calendar Month Average	13.00	11.37	---	13.00
TP [4]	12 Month Moving Total	1.00	0.88	0.50	---
Total Mercury [5]	Calendar Day Average	13.90 [9]	13.90 [9]	---	13.90 [9]
Sulfate [6]	Calendar Day Average	41.20	41.20	---	41.20 [8]
Chloride [7]	Calendar Day Average	585.00	585.00	---	585.00 [8]

Notes

1. Determined using the reported effluent flow data from 1/1/2017 through 2/28/2022.
2. Determined using the current AWW design flow of 0.958 mgd.
3. Determined using the design AWW flow of 1.683 mgd.
4. Determined using the permitted mass discharge.
5. Determined using the maximum effluent concentration measured from 1/1/2017 through 2/28/2022 and the current AWW design flow. Maximum of 13.9 ng/L on 7/6/2021.
6. Determined using the maximum of two samples collected 6/27/2023 and 6/29/2023 and the current AWW design flow. Effluent sulfate reported as 41.2 mg/L on both dates.
7. Determined using the maximum of three samples collected 5/11/2023, 5/18/2023, and 5/25/2023 and the current AWW design flow. Maximum of 585 mg/L on 5/25/2023.
8. Determined using the difference between the current AWW design flow and projected AWW design flow at the maximum sampled effluent concentration.
9. Nanograms per liter.

Table 5 – Effluent Mass Load as a Result of Requested Load Limits and Accepted Load Caps

Parameter	Discharge Limit Type	Current Permitted Load		Requested Permitted Load at Anticipated Design AWW Flow		
		No Load Limit (kg/d)	Load Limit (kg/d)	Load Cap (kg/d)	Load Limit (kg/L)	Change in Load (kg/d) [6]
$cBOD_5$	Calendar Month Average	N/A	34.30	---	68.85 [1]	+34.55
TSS	Calendar Month Average	N/A	41.20	---	82.69 [1]	+41.49
TP	12 Month Moving Total	N/A	3.18 [2]	3.18	---	0.00
Total Mercury [3]	Calendar Day Average	44.06 [7]	MONITOR	---	88.44 [7]	+44.38 [7]
Sulfate [4]	Calendar Day Average	149.31	NO LIMIT	---	262.15	+112.84
Chloride [5]	Calendar Day Average	2,120	NO LIMIT	---	3,722	+1,602

Notes

1. Determined using the discharge concentration based on the current AWW flow.
2. 12 Month Moving Total Permitted Discharge is 1,160 kg. Day Average Equivalent is 3.16 kg/d.
3. Determined using the maximum effluent concentration measured from 1/1/2017 through 2/28/2022 and the current AWW design flow. Maximum of 13.9 ng/L on 7/6/2021.
4. Determined using the maximum of two samples collected 6/27/2023 and 6/29/2023 and the current AWW design flow. Effluent sulfate reported as 41.2 mg/L on both dates.
5. Determined using the maximum of three samples collected 5/11/2023, 5/18/2023, and 5/25/2023 and the current AWW design flow. Maximum of 585 mg/L on 5/25/2023.
6. Determined using the difference between the current AWW design flow and projected AWW design flow at the maximum sampled effluent concentration.
7. Milligrams per day.

2.3.1 5-Day Carbonaceous Biochemical Oxygen Demand ($cBOD_5$)

$cBOD_5$ has a limit in the current NPDES/SDS discharge permit.

- **Current permitted calendar day average discharge mass limit:** 34.30 kg/d, which corresponds to 10.82 mg/L at the reported AWW flow and used as the basis for calculating the requested mass load for the antidegradation review.
- **Requested calendar day average discharge mass limit:** 68.85 kg/d, which corresponds to 10.82 mg/L at the projected design AWW flow.
- **Anticipated change in mass loading as a result of expansion:** increase of 34.55 kg/d.

Effluent sampling for $cBOD_5$ was conducted between 1/1/2017 and 2/28/2022 and consists of 531 samples. The average of those samples corresponds to an effluent calendar day average concentration of 3.40 mg/L, maximum of 23.00 mg/L, and standard deviation of 2.91 mg/L.

2.3.2 Total Suspended Solids (TSS)

TSS has a limit in the current NPDES/SDS discharge permit.

- **Current calendar day average discharge mass limit:** 41.20 kg/d, which corresponds to 13.00 mg/L at the current reported AWW flow and used as the basis for calculating the requested mass load as part of the antidegradation review.
- **Requested calendar day average discharge mass limit:** 82.69 kg/d, which corresponds to 13.0 mg/L at the projected design AWW flow.
- **Anticipated change in mass loading as a result of expansion:** increase of 41.49 kg/d.

Effluent sampling for TSS was conducted between 1/1/2017 and 2/28/2022 and consists of 532 samples. The average of those samples corresponds to an effluent calendar day average concentration of 6.98 mg/L, maximum of 29.00 mg/L, and standard deviation of 4.18 mg/L.

2.3.3 Total Phosphorus (TP)

The frozen mass limit is being accepted as a Load Cap. No additional load is anticipated with the increase, and the POC will not be discussed further.

2.3.4 Total Mercury

Total mercury does not have a limit in the current NPDES/SDS discharge permit but is a monitored parameter. Due to the requested increase in TSS mass load discharged, mercury is a POC in the PELR and is included in the Antidegradation Review.

The General Guidelines for the Computation of the Maximum Authorized Load for Expansions of Municipal Wastewater Treatment Plants to Satisfy Antidegradation, Table 4. Maximum authorized load from a continuous discharge to an expanded continuous discharge was used for determining the frozen pollutant load for evaluation as part of the antidegradation review. The maximum reported total mercury effluent concentration was 13.90 ng/L and was used as the basis for determining the frozen mass limit.

- **Current calendar day average discharge mass limit:** 44.06 milligrams per day, which corresponds to 13.9 ng/L at the current reported AWW flow and used as the basis for calculating the requested mas load as part of the antidegradation review.
- **Requested calendar day average discharge mass limit:** 88.44 milligrams per day, which corresponds to 13.9 ng/L at the projected AWW flow.
- **Anticipated change in mass loading as a result of expansion:** 44.38 milligrams per day.

Effluent sampling for total mercury was conducted between 1/1/2017 and 2/28/2022 and consists of 7 samples. The average of those samples corresponds to an effluent calendar day average concentration of 2.82 ng/L, maximum of 13.90 ng/L, and standard deviation of 9.99 ng/L.

2.3.5 Sulfate

Sulfate does not have a limit in the current NPDES/SDS discharge permit and is not required to be monitored. The General Guidelines for the Computation of the Maximum Authorized Load for Expansions of Municipal Wastewater Treatment Plants to Satisfy Antidegradation, Table 4. Maximum authorized load from a continuous discharge to an expanded continuous discharge was used for determining the frozen pollutant load for evaluation as part of the antidegradation

review. The maximum sampled sulfate effluent concentration was 41.2 mg/L and was used as the basis for determining the frozen mass limit.

- **Current calendar day average discharge mass limit:** 149.31 kg/d, which corresponds to 41.20 mg/L at the current reported AWW flow and used as the basis for calculating the requested mass load as part of the antidegradation review.
- **Requested calendar day average discharge mass limit:** 262.15 kg/d, which corresponds to 41.20 mg/L at the projected design AWW flow.
- **Anticipated change in mass loading as a result of expansion:** increase of 112.84 kg/d.

Special effluent sampling was conducted between 6/27/2023 and 6/29/2023 and consists of two samples. The average of those samples corresponds to an effluent calendar day average concentration of 41.20 mg/L, maximum of 41.20 mg/L, and standard deviation of 0.00 mg/L.

2.3.6 Chloride

Chloride does not have a limit in the current NPDES/SDS discharge permit and is not required to be monitored. Regardless of the increase in capacity, chloride was identified as a POC in the PELR and is included in the Antidegradation Review. The General Guidelines for the Computation of the Maximum Authorized Load for Expansions of Municipal Wastewater Treatment Plants to Satisfy Antidegradation, Table 4. Maximum authorized load from a continuous discharge to an expanded continuous discharge was used for determining the frozen pollutant load for evaluation as part of the antidegradation review. The maximum sampled chloride effluent concentration was 585 mg/L and was used as the basis for determining the frozen mass limit.

- **Current calendar day average discharge mass limit:** 2,120 kg/d, which corresponds to 585 mg/L at the current reported AWW flow and used as the basis for calculating the requested mass load as part of the antidegradation review.
- **Requested calendar day average discharge mass limit:** 3,722 kg/d, which corresponds to 585 mg/L at the projected design AWW flow.
- **Anticipated change in mass loading as a result of expansion:** increase of 1,602 kg/d.

Special effluent sampling was conducted between 5/11/2023 and 5/28/2023 and consists of three samples. The average of those samples corresponds to an effluent calendar day average concentration of 552 mg/L, maximum of 585 mg/L, and standard deviation of 28.57 mg/L.

2.4 Existing Water Quality

2.4.1 Mississippi River

The Mississippi River is classified in the current NPDES/SDS discharge limit as a Class 1C, 2Bd, 3, 4A, 4B, 5, 6 water.

Class 1C waters must meet the following criteria:

- Must be able to be treated to meet primary and secondary drinking water standards when used as a drinking water source.
- Any discharges to this water cannot increase issues with “taste, hardness, temperature, chronic toxicity, corrosiveness, or nutrient content, or in any other manner to impair the natural quality or value of the waters for use as a source of drinking water”.

Class 2Bd waters must meet the following criteria:

Total Suspended Solids (TSS)

- Central Nutrient Region 6 = 30 mg/L, not to be exceed more than 10% of the time from April 1 – September 30

Total Mercury

- Chronic standard = 6.9 ng/L
- Maximum standard = 2,400 ng/L
- Final Acute Value = 4,900 ng/L

Sulfate

- Chronic standard = 10 mg/L

Chloride

- Chronic standard = 230 mg/L
- Maximum standard = 860 mg/L
- Final Acute Value = 1,720 mg/L

TSS, Total Mercury, Sulfate, and Chloride have been identified at POCs and included in the Antidegradation Review. The quality and constituency of wastewater received and discharged from the Big Lake treatment facility is not anticipated to change during the facility planning period, therefore it can be assumed that the effluent water concentrations for POC will remain relatively consistent between now and the future planning period. The total increase in flow will result in an increase in mass discharge for the requested POC parameters of the Antidegradation Review, though the concentration remains relatively consistent.

3 Alternative Analysis

3.1 Planning Period

A technical memorandum was prepared for the City of Big Lake dated March 20, 2023. The memorandum provides discussion and presents the determination for current and future flows and loads based on the DMR review period and definitions for flow, load, and planning. The technical memorandum can be found in Appendix A-1 of this report and was prepared using the MPCA Flow and Load Determination Guidance.

The determinations of the technical memorandum can generally be summarized by the following:

- A design year of 2045 was used for preparation of the facilities plan.
- An anticipated service population of 14,447 residence was used for preparation of the facilities plan.
- Treatment capacity was added for the anticipated flow and load demand due to:
  - Expansion of identified significant industrial users.
  - Anticipated non-domestic development as identified by the City's Comprehensive Growth Plan.

3.2 Wastewater Treatment Facilities

3.2.1 Existing Facilities

The City of Big Lake operates an extended aeration, oxidation ditch-type, activated sludge system at the municipal wastewater treatment facility for treatment of wastewater generated within the City. There are facilities for biological removal of phosphorus, however current load conditions do not allow of effective operation and phosphorus removal is achieved through chemical precipitation.

A technical memorandum was prepared for the City of Big Lake dated March 30, 2023. The memorandum provides discussion and presents the determination for capacity and considerations for condition of current wastewater treatment facilities and equipment. The technical memorandum can be found in Appendix A-2 of this report.

3.2.2 Current Flow and Load Demand

Tables 6 below and 7 on the following page summarize the current flow and load demands for the wastewater treatment facility.

Table 6 – Current Combined Wastewater Flow Demand

Flow Condition	Value
Average Dry Weather (ADW), mgd	0.699
Calendar Average Day Flow (ADF), mgd	0.721
Average Wet Weather (AWW), mgd [1]	0.838
Maximum Calendar Day, mgd	1.208
Peak Hour Wet Weather (PHWW), mgd [2, 3]	2.204
Peak Instantaneous Wet Weather (PIWW), mgd [3]	2.204

Notes

1. Day average flow for 30 consecutive highest flow days reported.
2. Instantaneous flow data unavailable. Peak determined using existing lift station pump capacity base on sewer flow rates.
3. Corresponds to a calendar day average to peak hourly wet weather peaking factor of 2.6, which is equal to the 10 States Standards for Wastewater Facilities (2014 Edition) recommendation of 2.6 based on service population.

Table 7 – Current Combined Wastewater Load Demand

Load Parameter	Calendar Day Average	Maximum Month as Day	Calendar Day Maximum
5-Day Carbonaceous Biochemical Oxygen Demand ($cBOD_5$), ppd [1]	2,141	3,679	7,386
Total Suspended Solids (TSS), ppd [2]	2,963	6,702	11,202
Total Phosphorus (TP), ppd [3]	47	75	107
Total Kjeldahl Nitrogen (TKN), ppd [4]	358	496	496

Notes

1. Non-Industrial portion of load parameter corresponds to a per capita loading rate of 0.10 ppcd.
2. Non-Industrial portion of load parameter corresponds to a per capita loading rate of 0.22 ppcd.
3. Non-Industrial portion of load parameter corresponds to a per capita loading rate of 0.003 ppcd.
4. Non-Industrial portion of load parameter corresponds to a per capita loading rate of 0.027 ppcd.

Refer to Appendix A-2 for additional information pertaining to the determination for existing flow and load demand at the facility.

3.2.3 Anticipated Flow and Load Demand

The anticipated flow and load demand at the design year are summarized in Tables 8 below and 9 on the following page which include consideration for:

- Projected domestic population demand,
- Anticipated significant industrial user demand, and
- Anticipated non-industrial and non-domestic user demand.

Table 8 – Design Year Combined Wastewater Flow and Load Demand

Flow Condition	Value
Average Dry Weather (ADW), mgd	1.366
Calendar Average Day Flow (ADF), mgd	1.446
Average Wet Weather (AWW), mgd [1]	1.682
Peak Hour Wet Weather (PHWW), mgd [2, 3]	4.379
Peak Instantaneous Wet Weather (PIWW), mgd [2]	4.379

Notes:

1. Corresponds to a flow rate of 62 gpcd for non-industrial users and 100 gpcd for domestic users.
2. Instantaneous flow data unavailable. PIWW determined using existing lift station pump capacity.
3. Corresponds to a calendar day average to peak hourly wet weather peaking factor of 2.6, which is equal to the 10 States Standards for Wastewater Facilities (2014 Edition) recommendation of 2.6 based on service population.

Table 9 – Design Year Combined Wastewater Flow and Load Demand

Load Parameter	Calendar Day Average	Maximum Month as Day	Calendar Day Maximum
5-Day Carbonaceous Biochemical Oxygen Demand ($cBOD_5$), ppd [1]	4,621	7,773	14,988
Total Suspended Solids (TSS), ppd [2]	5,465	12,227	19,984
Total Phosphorus (TP), ppd [3]	87	138	195
Total Kjeldahl Nitrogen (TKN), ppd	562	894	894

Notes:

1. Corresponds to MPCA recommended minimum design value for parameter.
2. Corresponds to observed loading based on reported DMR sampling values.
3. Corresponds to Metcalf and Eddy recommended minimum design value for loading.

Refer to Appendix A-2 for additional information pertaining to the determination for anticipated flow and load demand at the facility.

3.2.4 Anticipated Impact to Receiving Waters

Effluent limitation requirements are based on the annual minimum 7-day discharge at the discharge location of the facility. The hydrological parameter which represents this flow is referred to as the 7Q10 flow. The facility discharges continuously to the Mississippi River. The PELR indicates the 7Q10 for the discharge water at 1,074 cfs of flow.

The requested POC effluent concentrations for $cBOD_5$ and TSS presented in Table 3 maintain the same effluent concentrations as those currently being discharge. Total Mercury and Sulfate are not anticipated to vary significantly due to known changes to the influent wastewater to the facility other than quantity. Chloride is anticipated to be reduced as the recommended improvements include conversion to biological phosphorus removal rather than chemical precipitation with ferric chloride and no known change to the influent wastewater to the facility other than quantity. The current discharge concentrations are such that future discharge is below chronic water quality limitation for the intended water uses for those POCs which are not already exceeded in the receiving water. The impairment of the Mississippi for Sulfate is such that the change in anticipated mass load due to an increase in treatment capacity has little to no effect on the overall water quality of the receiving water.

The Mississippi River has a large assimilative capacity. The expected effluent concentrations and anticipated increase in effluent load for the identified POCs was calculated. The anticipated changes in river concentrations due to the increased mass loading of $cBOD_5$, TSS, Total Mercury, Sulfate, and Chlorides were small and do not violate any water quality standards.

Tables 10 and 11 on the following page summarize the anticipated changes in concentration and mass in the Mississippi River the requested load limits and accepted load caps at the 7Q10 flow.

Table 10 – Change in Mississippi River Concentration as a Result of Requested Load Limits and Accepted Load Caps at 7Q10 Flow.

Parameter	Discharge Limit Type	POC Concentrations for Receiving Water			
		Current (mg/L)	Proposed Load Limit (mg/L)	Change in Conc. (ng/L)	Chronic Limit (mg/L)
$cBOD_5$	Calendar Month Average	1.83 [1]	1.84	+13.16	32.00
TSS	Calendar Month Average	10.75 [1]	10.77	+15.80	N/A
Total P	12 Month Moving Total	0.06 [1]	Accept Frozen Mass Load Cap		
Total Mercury	Calendar Day Average	1.39 [2,3]	1.41 [3]	+0.017 [3]	6.90 [3]
Sulfate	Calendar Day Average	6.91 [1]	6.95	+42.98	10.00
Chloride	Calendar Day Average	9.48 [1]	10.09	+610.20	230.00

Notes

1. Determined using surface water sampling from station S007-335 downstream of the Big Lake Wastewater Treatment Facility.
2. Determined using surface water sampling from station S000-221 upstream of the Big Lake Wastewater Treatment Facility at Monticello, MN.
3. Nanograms per liter.

Table 11 – Change in Mississippi River Mass Load as a Result of Requested Load Limits and Accepted Load Caps at 7Q10 Flow.

Parameter	Discharge Limit Type	POC Mass Load for Receiving Water		
		Current (kd/d)	Proposed Load Limit (kg/d)	Change in Load (kg/d)
$cBOD_5$	Calendar Month Average	4,805 [1]	4,840	+34.55
TSS	Calendar Month Average	28,227 [1]	28,268	+41.49
TP	12 Month Moving Total	157.54 [1]	Accept Frozen Mass Load Cap	
Total Mercury	Calendar Day Average	3,650 [2,3]	3,694 [3]	+44.38 [3]
Sulfate	Calendar Day Average	18,144	18,257	+112.84
Chloride	Calendar Day Average	24,892	26,494	+1,602

Notes

1. Determined using surface water sampling from station S007-335 downstream of the Big Lake Wastewater Treatment Facility.
2. Determined using surface water sampling from station S000-221 upstream of the Big Lake Wastewater Treatment Facility at Monticello, MN.
3. Milligrams per day.

3.2.4.1 5-Day Carbonaceous Biochemical Oxygen Demand ($cBOD_5$)

The anticipated impacts to receiving water quality are summarized by the follow:

- Current Receiving Water $cBOD_5$ Concentration: 1.83 mg/L.
- Current Receiving Water $cBOD_5$ Mass Load at 7Q10 Flow: 4,805 kg/d.
- Increase in $cBOD_5$ Mass Load Due to Expansion: 34.55 kg/d.
- Receiving Water $cBOD_5$ Concentration Due to Expansion: 1.84 mg/L.

Improvements to the secondary treatment process include secondary sedimentation and are anticipated to result in similar, if not improved discharge water quality for suspended solids. The reduced suspended solids will result in a commensurate reduction in $cBOD_5$.

The change in $cBOD_5$ concentration of the Mississippi River during a 7Q10 flow event at calendar day average flow and load is 13.16 ng/L, or 0.72%. The anticipated $cBOD_5$ concentration at 7Q10 flow with the approved load limit is 1.84 mg/L at monitoring station S007-335.

As a result, the increase in $cBOD_5$ mass discharged will not contribute to downstream water quality impairment.

3.2.4.2 Total Suspended Solids (TSS)

The anticipated impacts to receiving water quality are summarized by the follow:

- Current Receiving Water TSS Concentration: 10.75 mg/L.
- Current Receiving Water TSS Mass Load at 7Q10 Flow: 28,227 kg/d.
- Increase in TSS Mass Load Due to Expansion: 41.49 kg/d.
- Receiving Water TSS Concentration Due to Expansion: 10.77 mg/L.

Improvements to the secondary treatment process include secondary sedimentation and are anticipated to result in similar, if not improved discharge water quality for suspended solids.

The change in TSS concentration of the Mississippi River during a 7Q10 flow event at calendar day average flow and load is 15.80 ng/L, or 0.15%. The anticipated TSS concentration at 7Q10 flow with the approved load limit is 10.77 mg/L at monitoring station S007-335.

As a result, the increase is TSS mass discharged will not contribute to downstream water quality impairment.

3.2.4.3 Total Mercury

The anticipated impacts to receiving water quality are summarized by the follow:

- Current Receiving Water Total Mercury Concentration: 1.39 ng/L.
- Current Receiving Water Total Mercury Mass Load at 7Q10 Flow: 3,650 mg/d.
- Increase in Total Mercury Mass Load Due to Expansion: 44.38 mg/d.
- Receiving Water Total Mercury Concentration Due to Expansion: 1.41 ng/L.

Improvements to the secondary treatment process include secondary sedimentation and are anticipated to result in similar, if not improved discharge water quality for suspended solids. The reduced suspended solids will result in a commensurate reduction in total mercury.

The increase in Total Mercury concentration of the Mississippi River during a 7Q10 flow event at calendar day average flow and load is 0.017 ng/L, or 1.22%. The anticipated Total Mercury concentration at 7Q10 flow with the approved load limit is 1.41 ng/L at monitoring station S007-335.

The MPCA has prepared a guidance document for total mercury titled Minnesota Statewide Mercury Total Maximum Daily Load published March 27, 2007. The report identifies:

- The state-wide total mercury chronic standard of 6.9 ng/L, which is intended to prevent impairment of waters based on a targeted fish tissue mercury concentration of 0.2 mg/kg.
- The average geometric mean bioaccumulation factor based on 14 representative lakes in Minnesota is 388,424 L/kg.

To achieve the targeted NP_{55} concentration 0.2 mg/kg at average geometric mean for the representative lakes' bioaccumulation factor provided in the TMDL, the maximum water concentration for total mercury will need to be less than 1.94 ng/L. The anticipated receiving water concentration at design of 1.41 ng/L, which is below the calculated maximum of 1.94 ng/L. The anticipated concentration in the receiving water due to expansion is well below the 6.9 ng/L chronic standard for 2Bd waters.

As a result, the increase is mercury mass discharged will not contribute to downstream water quality impairment.

3.2.4.4 Sulfate

The anticipated impacts to receiving water quality are summarized by the follow:

- Current Receiving Water Sulfate Concentration: 6.91 mg/L.
- Current Receiving Water Sulfate Mass Load at 7Q10 Flow: 18,144 kg/d.
- Increase in Sulfate Mass Load Due to Expansion: 112.84 kg/d.
- Receiving Water Sulfate Concentration Due to Expansion: 6.95 mg/L.

The increase in sulfate concentration of the Mississippi River during a 7Q10 flow event at calendar day average flow and load is 42.98 ng/L, or 0.68%. The anticipated sulfate concentration at 7Q10 flow with the approved load limit is 6.95 mg/L at monitoring station S007-335. The chronic limit for sulfate is 10.0 mg/L, which is not anticipated to be exceeded at the reference monitoring station, though other referenced stations already exceed the 10 mg/L chronic limit for sulfate.

As a result, the increase in sulfate mass discharged will have little real impact to the degree of current downstream water quality impairment.

3.2.4.5 Chloride

The anticipated impacts to receiving water quality are summarized by the follow:

- Current Receiving Water Chloride Concentration: 9.84 mg/L.
- Current Receiving Water Chloride Mass Load at 7Q10 Flow: 24,892 kg/d.
- Increase in Chloride Mass Load Due to Expansion: 1,602 kg/d.
- Receiving Water Chloride Concentration Due to Expansion: 10.09 mg/L.

The increase in chloride concentration of the Mississippi River during a 7Q10 flow event at calendar day average flow and load is 610.20 ng/L, or 6.44%. The anticipated chloride

concentration at 7Q10 flow with the approved load limit is 10.09 mg/L at monitoring station S007-335. The chronic limit for chloride is 230.0 mg/L, which is not anticipated to be exceeded at the reference monitoring station.

As a result, the increase in chloride mass discharged will have little real impact to the degree of current downstream water quality impairment.

Alternatives will be presented and evaluated which preserve the existing water quality as necessary to maintain and protect the exceptional characteristics for which the restricted outstanding resource value waters.

3.3 Project Need

3.3.1 Preserving the Outstanding Water Quality Resources

The City is currently at the design capacity of their secondary treatment and sludge stabilization processes. Though the City continues to meet effluent limit requirements, there is no longer sufficient capacity to operate the facility as intended. Additional flow and load demand as a result of development and the ability of existing facilities to maintain capacity due to aging infrastructure may begin to impact the facility's ability to preserve the existing water quality as necessary to maintain and protect the exceptional characteristics of the restricted outstanding resource value waters. The discharge is beyond the 25-mile upstream boundary for drinking water intake to the Minneapolis/St. Paul intake, however the City operates with this in mind with current seasonal disinfection. The PELR has indicated the potential for a year-round disinfection requirement.

The operation limitations due to current influent flow and load demand include:

- **Process Limitation:** Inability to operate the biological phosphorus removal process.

  Impact: The facility is forced to operate as a chemical precipitation facility resulting in:
  - Additional solids loading to already loaded secondary clarifiers.
  - Additional solids loading to already loaded aerobic digesters and solids handling facilities.
  - Additional chemical coagulant (ferric chloride) consumption increasing delivery requirements and mass of chloride discharged (note chloride has been identified as a POC).

- **Process Limitation:** Inability to operate solids stabilization and dewatering equipment due to additional solids.

  Impact: The facility is not able to operate all treatment processes and is unable to dispose of biosolids generated through land application.
  - Inability to digest to meet Part 503 requirements for solids retention time and the resulting need to dispose of solids via landfilling.
  - Additional solids require energy consumption for pumping, aeration, mixing, dewatering, and drying.
  - Additional polymer consumption due to excessive chemical solids generated from coagulant addition.
  - Inability to operate cake driers due to lack of capacity for process water returning to the head of the facility.
  - Need for additional trucking of solids to landfill due to inability to operate drier.

Although not included in the PELR, facilities will be designed to adapt and incorporate potential future nitrate/nitrite or total nitrogen limits with minimal need for construction of new facilities.

3.3.2 Limitations of Treatment

The City of Big Lake does not operate a central softening system at the water treatment plant. As a result, it can be assumed there are a significant number of private residences and business which operate individual softening systems. This can also be inferred by the average chloride wastewater effluent concentration of 552 mg/L as noted in the special sampling performed for preparation of this report.

Although planning for a central softening system may be incorporated into the long-term planning for growth of the community, the reality of the current wastewater treatment capacity limitation is that improvements at the wastewater treatment facility need to occur prior to any significant projects at the water treatment facility.

3.3.3 Economic and Development

The City has two identified significant industrial users (SIU). Both have indicated a desire to increase production, expand workforce, and increase flow and load demand for wastewater generated through operation.

The City has identified approximately 500 acres of non-industrial and non-domestic property which is anticipated to be developed during the planning period. The additional flow demand corresponds to approximately 1,700 residential equivalent units (REU).

Based on historical population trends, the City anticipates an additional approximate 2,200 residents during the planning period, which corresponds to approximately 760 residential equivalent units (REU).

The identified demand cannot be met in a manner which responsibly protect the public health and environmental quality using the given facilities and design treatment capacity. Aging equipment, infrastructure, and condition limit operations and contribute to inefficient use of energy, water, and chemical addition at the facility. Operator labor and attention is spent undergoing frequent maintenance and “band-aid” repairs rather than process operation and optimization.

3.4 Proposed Alternatives

The MPCA recommends the following possible alternatives for preventing degradation in water bodies:

- Alternative discharge methods:
  - Holding tanks transported to a permitted WWTF.
  - Pipeline conveyance to a permitted WWTF.
  - Discharge to alternate locations.
  - Recycle/reuse of pollutants and/or water.
  - Land application and/or infiltration, such as spray irrigation, rapid infiltration, and mound systems.

- Source reduction strategies:
  - Reduction in the scale of the activity, such as downsizing the project and/or implementing water conservation practices so that a land disposal method might be used.
  - Pollution prevention/minimization and/or pretreatment techniques.
- Regulatory and administrative practices:
  - Loading offsets/pollutant trading, such as point-to-point trading and point-to-nonpoint trading.
- Facility improvements:
  - Improved operation and maintenance of existing pollution prevention and WWTFs.
  - Modified, additional, or enhanced treatment technology alternatives and treatment levels.

Alternatives should be eliminated at this stage if they:

- Do not feasibly minimize degradation.
- Harm economy.
- Harm social development.
- Do not follow sound engineering practices.
- Do not follow sound environmental practices.
- Are not legal.
- Do not have supportive governance.

3.4.1 Alternative Discharge Methods

Holding Tanks Transported to a Permitted WWTF

The anticipated wastewater flow demand of 1.682 MGD for the design year makes this alternative impractical.

The alternative has been eliminated from consideration due to feasibility and sound engineering practices.

Pipeline Conveyance to a Permitted WWTF

Nearby communities to Big Lake include Elk River, Monticello, and Becker. Each facility does not have sufficient capacity to receive flow from Big Lake without improvements. The facilities all ultimately discharge to or directly to the Mississippi River as well. If determined both technically and politically feasible, the receiving facility would need to undergo an antidegradation review for the expanded treatment capacity. Big Lake includes facilities for vactor and hauled waste receiving to provide regional wastewater treatment for small generators which may otherwise not be properly treated. The current capacity limitation of the wastewater facility limits the City's ability to accept these waste streams.

This alternative has been eliminated from consideration due to feasibility, sound engineering practices, and does not feasibly reduce degradation.

Discharge to Alternate Locations

The wastewater treatment facility currently discharges to the Mississippi River. Alternative discharge locations would either discharge to lakes or to tributaries which ultimately discharge to the Mississippi River. As noted previously, the 7Q10 for the Mississippi River at the facility discharge is 1,074 cfs which provides a large assimilation capacity for wastewater discharge. Impairment for POCs are largely in downstream sections of the river, therefore there are limited, practical locations for an alternate discharge which is near enough to the WWTF for feasible construction and operation.

This alternative has been eliminated from consideration due to feasibility, sound engineering practices, and does not feasibly reduce degradation.

Recycle/Reuse of Pollutants and/or Water

A portion of the plant effluent may be utilized for reuse at the wastewater treatment facility in the form of wash water, sluice water, process cleaning, or other on site uses. The anticipated wastewater flow demand of 1.682 MGD generates a volume of water which is not practical to be fully utilized on site in a significant manner to reduce the volume of effluent discharged.

This alternative has been incorporated where reasonable and technically sound, however as a total solution has been eliminated from consideration due to feasibility and sound engineering practices.

Land Application and/or Infiltration

The WWTF is located within the boundaries of the City of Big Lake but is not contiguous to the City. The surrounding land is largely agricultural food crops; however, the properties are privately owned. The predominate soil type are excessively drained sands and gravels with relatively deep groundwater in excess of 80-inches based on NRCS web soil survey mapping. There are adjacent residential developments in and around the field which are served by private well systems. The developments are not within the municipal boundaries of Big Lake or adjacent municipalities. Land application of infiltration is technically feasible, however long-term planning would be required with to determine and identify suitable agricultural sites which can be utilized and protect potential drinking water sources for nearby residences.

The proximity of the facility to the Mississippi River and distance required for pumping and piping to potential land application site does not follow sound engineering practices and the potential for impacts to groundwater sources does not follow sound environmental practices.

3.4.2 Source Reduction Strategies

Reduction in the Scale of the Activity

The City of Big Lake has been designed and planned based on the observed and projected demographic growth of the City. The City comprehensive growth plan and wastewater treatment facilities plan details the analysis and studies performed in determining the future treatment capacity of the WWTF.

An initial PELR had been prepared for approximately 2.2 MGD of flow. Further discussion with the City and stakeholders indicated a revised design capacity of 1.682 MGD to better balance the development demand of the City, likely rate of development during the design period, and resulting impact to the environment for preservation of the existing ambient water quality.

Refer to Appendix A-1 for additional information regarding the determination for reducing the scale of proposed activities.

Pollution Prevention/Minimization and/or Pretreatment Techniques

Wastewater generated by the City of Big Lake is largely domestic from residential, commercial, and institutional sources. Two significant industrial users have been identified, one food processor and one brewery. The City has entered into a formal SIU agreement with the food processor and is currently developing an SIU with the brewery.

Per capita flow demand was 59 gpcd. The per capita flow demand is below the recommended minimum design value identified by the MPCA and recommended by 10 States Standards and Metcalf and Eddy Wastewater Engineering. Source reduction is therefore unlikely to impact the design capacity for the anticipated future flow demand.

Per capita load demand for $cBOD_5$, TSS, and TP were 0.10 ppcd, 0.22 ppcd, and 0.003 ppcd respectively. The per capita load demand for the POCs identified are at or below the recommended design minimum values identified by the MPCA and recommended by 10 States Standards and Metcalf and Eddy Wastewater Engineering. Source reduction is therefore unlikely to impact the design capacity for the anticipated future load demand.

Sulfate naturally occurs in groundwater through oxidation of elemental sulfur resulting from geological deposition, fertilization, decomposition, and other natural mechanisms. Sulfates may be reduced through centralized treatment using ion exchange, reverse osmosis, and distillation, however each generates a concentrated waste stream requiring additional treatment for disposal, such as crystallization. Sulfates introduced to the waste stream and treated at the wastewater treatment facility would likewise require reverse osmosis and crystallization of the concentrated waste stream for disposal. These pollution prevention methods will be further considered as alternatives for sulfate degradation.

Chloride is commonly addressed through source control rather than treatment at the WWTF. Potable water supply for the City utilizes groundwater wells, which are dosed with chlorine, fluoride, and polyphosphate prior to distribution. The addition of centralized water softening would lower chloride brine discharges from individual water softeners to the WWTF by eliminating the need for individual softeners, thereby providing source control for chloride. Central softening may be achieved by ion exchange, lime softening, and RO filtration at the centralized water treatment plant. With implementation of centralized softening, a City ordinance limiting water softener use may be used to further limit chloride discharge through enforcement. These pollution prevention methods will be further considered as alternatives for chloride degradation.

3.4.3 Regulatory and Administrative Practices

Loading Offsets/Pollutant Trading

The WWTF discharges to the Mississippi River. Trading for pollutant credits or offsets was considered, however there are not readily identifiable parties available for trade. POCs such as TP, which has very little TMDL capacity relative to the demand, and sulfate, which the receiving water is currently impaired for, are not feasible for trading. Pursuing offsets and trading for $cBOD_5$, TSS, Mercury, and chlorides may be feasible, however the uncertainty associated with the long-term commitment for both the seller and buyer have limited the local governmental support for such alternatives. The potential for costs associated with implementing improvements to lose the trade partner outweigh the potential benefit for pursuit of this approach.

The alternative has been eliminated from consideration due to feasibility.

3.4.4 Facility Improvements

3.4.4.1 Capacity and Condition Related Improvements

Capacity and condition related improvements were identified which impact the facility's ability to operate under current and anticipated flow and load conditions. These improvements convey, condition, and support wastewater treatment and solids stabilization regardless of the alternatives identified for each POC, unless noted otherwise. The costs associated with construction, operation, and maintenance for these improvements are included in each alternative determination where appropriate.

The capacity and condition related improvements recommended at the facility can generally be summarized by the following:

- Old Main Lift Station
  - Demolition of abandoned facilities.
- Main Lift Station:
  - Building, HVAC, Electrical, and Architectural Improvements.
  - Influent Pump Replacement.
  - Influent Forcemain Improvements.
- Preliminary Treatment Building:
  - Building, HVAC, Electrical, and Architectural Improvements.
  - Fine Screen Replacement.
  - Grit Pumping and Classifying Modification and Replacement.
  - Influent Sampling and Monitoring Replacement.
- Biosolids Control Building:
  - Waste Sludge Storage Improvements.
  - Building, HVAC, Electrical, and Architectural Improvements.
  - Aerated Digester Expansion.
  - Aeration and Mixing Blower and Pump Replacement.
  - Liquid Biosolids Storage Improvements.

- Biosolids Conditioning Building:
  - Building, HVAC, and Electrical Improvements.
  - Polymer Feed Operation and Safety Improvements.
  - Dewatered Cake Biosolids Loadout Improvements.
  - Dewatered Cake Biosolids Storage.
- Administrative Building:
  - Building, HVAC, and Electrical Improvements.
  - Disinfection and Effluent Flow measurement Improvements.

The costs associated with capital, operation, and maintenance are included in each alternative considered. Refer to Appendix A-3 for further discussion of capacity and condition related improvements.

3.4.4.2 Treatment Technologies

5-Day Carbonaceous Biochemical Oxygen Demand ($cBOD_5$)

The facility currently operates with a $cBOD_5$ limit based on frozen mass limitations established by the November 5, 1984 Mississippi River designation as an Outstanding Resource Value Water. The designation and resulting effluent water quality limitations for $cBOD_5$ requires the facility to achieve a calendar day average $cBOD_5$ effluent limit of 34.4 kg/d (10.8 mg/L). Though that low of an effluent concentration is not required by permit, it is required to meet the mass limit identified by permit. The requested antidegradation review limitation would increase the calendar day average $cBOD_5$ mass discharged to 68.9 kg/d.

The facility currently meets the water quality effluent limit without the need for filtration. It is anticipated that reduction in effluent $cBOD_5$ concentration below 10.0 mg/L will require tertiary treatment in the form of filtration to reliably meet low concentrations. Acceptance of frozen mass limits in the form of Load Caps would require a calendar day average $cBOD_5$ effluent concentration of 5.4 mg/L.

Two alternatives were considered:

- Alternative 1 - Conventional Secondary Treatment Improvements
- Alternative 2 - Conventional Secondary and Tertiary Treatment Improvements

Total Suspended Solids (TSS) and Mercury

The facility currently operates with a TSS limit based on frozen mass limitations established by the November 5, 1984 Mississippi River designation as an Outstanding Resource Value Water. The designation and resulting effluent water quality limitations for TSS requires the facility to achieve a calendar day average TSS effluent limit of 41.2 kg/d (13.0 mg/L). Though that low of an effluent concentration is not required by permit, it is required to meet the mass limit identified by permit. The requested antidegradation review limitation would increase the calendar day average TSS mass discharged to 82.8 kg/d.

The facility currently meets the water quality effluent limit without the need for filtration. It is anticipated that reduction in effluent TSS concentration below 10.0 mg/L will require tertiary treatment in the form of filtration to reliably meet low concentrations. Furthermore, acceptance of frozen mass limits in the form of Load Caps would require a calendar day average TSS effluent concentration of 6.5 mg/L.

Inclusion of TSS in the Antidegradation Review request includes the need to address Mercury. The increase in mass for suspended solids is anticipated to increase the mass of mercury discharged by the facility. Tertiary treatment to address suspended solids would therefore also include provisions for the removal of mercury suspended solids.

Three alternatives were considered:

- Alternative 1 - Conventional Secondary Treatment Improvements
- Alternative 2 - Conventional Secondary and Tertiary Treatment Improvements
- Alternative 3 - Membrane Secondary Treatment

Sulfate

Depending on the source of sulfate:

- If sulfate is above 10 mg/L in the source water: treatment may either occur at the drinking water source or the wastewater treatment facility;
- If the sulfate is below 10 mg/L in the source water: Sulfate contribution is from the discharges and would be treated at the wastewater treatment facility, for those locations where sulfate is discharge from to the collection system.

The current drinking water distribution system at the City of Big Lake is designed for multiple, small treatment processes at each wellhead. Attempts to move to a single large treatment facility would result in high costs and the need to reconfigure the distribution system. This limits the softening options to those that would perform well under these conditions. Reverse osmosis treatment systems can have high capital and operational costs, making treatment using these methods cost prohibitive for small water treatment operations. The resulting treatment would produce a concentrated waste brine which would either need to be impounded in a waste storage pond or removed by crystallizer.

Similarly, treatment at the wastewater treatment facility would consist of membrane pre-treatment, likely through ultra filtration, and reverse osmosis. Also similarly, the resulting treatment would produce a concentrated waste brine which would either need to be impounded in a waste storage pond or removed by crystallizer.

The costs would be in addition to those needed at the wastewater treatment facility for treatment of other parameters. The increased capital cost as a cost per household would further impact the social and economic development of the City and drive unaffordability of the project. For this reason, the alternative is not considered feasible.

Chloride

The current drinking water distribution system at the City of Big Lake is designed for multiple, small treatment processes at each wellhead. Attempts to move to a single large treatment facility would result in high costs and the need to reconfigure the distribution system. This limits the softening options to those that would perform well under these conditions. Lime softening and reverse osmosis treatment systems can have high capital and operational costs, making treatment using these methods cost prohibitive for small water treatment operations.

It was for these reasons centralized softening is not recommended in Big Lake, however; centralized water softening does have the greatest likely effect on reducing chloride loadings to the receiving water.

The City could reduce chloride loadings in the wastewater via City ordinances regulating water softener use. There are currently no regulations on individual water softener use for the City. By establishing City ordinances, users would have a set limit on individual water softeners to follow.

Costs associated with centralized lime softening would include the piping, pumping, softening facilities, chemical storage, handling, and addition, and waste beds required for treatment. The costs would be in addition to those needed at the wastewater treatment facility for treatment of other parameters.

The increased capital cost as a cost per household would further impact the social and economic development of the City and drive unaffordability of the project. For this reason, the alternative is not considered feasible.

3.4.5 Feasible Technology Alternatives

Three alternatives were developed to meet the effluent water quality requirements based on the approval, partial approval, or acceptance of load limits as provide in the PELR. Those alternatives are:

- **Technology Alternative 1 -** Conventional Secondary Treatment Improvements – Load Limit for $cBOD_5$, TSS, Mercury, Sulfate and Chloride with Load Cap for TP.
- **Technology Alternative 2 -** Conventional Secondary and Tertiary Treatment Improvements – Load Limit for Sulfate and Chloride with Load Cap for $cBOD_5$, TSS, TP, and Mercury.
- **Technology Alternative 3 -** Membrane Secondary Treatment – Load Limit for Sulfate and Chloride with Load Cap for $cBOD_5$, TSS, Mercury, and TP.

The applicability for Alternative 1 requires approval of the antidegradation review for $cBOD_5$, TSS, Mercury, Sulfate and Chloride as the alternative does not have the facilities to address the POCs. The applicability of Alternative 2 requires approval of the antidegradation review for Sulfate and Chloride as the alternative does not have the facilities to address the POC. The applicability of Alternative 3 requires approval of the antidegradation review for Sulfate and Chloride as the alternative does not have the facilities to address the POC. Alternative 3 would be a suitable pre-conditioning step to a reverse osmosis process, which would be required to meet a load cap for sulfate or chloride.

In addition to the POC driven improvements, capacity and condition related improvements are also recommended.

3.4.5.1 Technology Alternative 1 – Conventional Secondary Treatment Improvements

This alternative considers the following treatment processes for biological phosphorus removal with chemical precipitation finishing to meet effluent water quality requirements:

- Expansion of the existing selector basin.
- Expansion of the existing extended aeration conventional activated sludge to suspended fixed film media.
- Expansion of the existing secondary clarifier treatment capacity.

Reuse of Existing Facilities:

- The existing selector basin would be rehabilitated and expanded for biological phosphorus removal.
- This alternative would reuse the existing extended aeration activated sludge basins.
- The existing secondary clarifier tanks would be repurposed for waste sludge thickening.

New Facilities:

- Secondary clarifier tanks would be constructed for improved process control and performance for biological phosphorus removal.
- Disinfection and Pumping Building would be constructed on site to address capacity and condition related improvements at the facility.
- Blower Building would be added for aeration of the converted oxidation ditches.

3.4.5.2 Technology Alternative 2 – Conventional Secondary and Tertiary Improvements

This alternative considers the following treatment processes for biological phosphorus removal with chemical precipitation finishing to meet effluent water quality requirements:

- Expansion of the existing selector basin.
- Expansion of the existing extended aeration conventional activated sludge to suspended fixed film media.
- Expansion of the existing secondary clarifier treatment capacity.
- Addition of secondary filtration to meet accepted frozen mass load cap for Mercury.
  - Modification to secondary clarifier effluent diversion structure.
  - Addition of intermediate pumping to filtration building.
  - Rapid Mix, coagulation, and flocculation with coagulant and flocculant polymer aid addition.
  - Continuous backwash disc filtration.
  - Backwash water holding tank and pumping.

Reuse of Existing Facilities:

- The existing selector basin would be rehabilitated and expanded for biological phosphorus removal.
- This alternative would reuse the existing extended aeration activated sludge basins.
- The existing secondary clarifier tanks would be repurposed as waste sludge thickening storage.
- Modification to secondary clarifier effluent bypass structure for intermediate pumping.

New Facilities:

- Secondary clarifier tanks would be constructed for improved process control and performance for biological phosphorus removal.
- Intermediate pumping station to filtration.

- Filtration building would be constructed for:
  - Rapid mix, flocculation, and coagulation.
  - Chemical feed and storage.
  - Disc filtration.
  - Backwash storage and pumping station.
- Disinfection and Pumping Building would be constructed on site to address capacity and condition related improvements at the facility. As part of that structure, a blower room would be added for aeration of the converted oxidation ditches.

3.4.5.3 Technology Alternative 3 – Membrane Secondary Treatment

This alternative considers the following treatment processes for biological phosphorus removal with chemical precipitation finishing to meet effluent water quality requirements:

- Addition of a Secondary Screening Building for conditioning of influent wastewater.
- Addition of Membrane Bioreactor Complex for equipment and process tankage to meet accepted frozen mass load caps for $cBOD_5$, TSS, and Chloride.

Reuse of Existing Facilities:

- Alternative would require replacement of all secondary treatment facilities.

New Facilities:

- Secondary screening building would be constructed for the following facilities:
  - 1mm automatic screening equipment.
  - Screening bypass.
- Membrane bioreactor complex would be constructed for the following facilities:
  - Replacement of the existing extended aeration conventional activated sludge and secondary clarifiers with membrane bioreactor (MBR) activated sludge.
  - Integrate selector basin cells to new MBR aeration basin. New basin increases side water depth for improved oxygen transfer.
  - Membrane thickening equipment for waste sludge and scum.
  - Chemical storage and feed equipment for operation and maintenance of the MBR and thickening systems.
  - Blowers for aeration and cleaning of the MBR and thickening systems.
  - Permeate pumps for operation of the MBR and thickening systems.

4 Economic Analysis

The economic analysis includes a determination of Engineer's opinion of probably cost for each alternative, and an evaluation utilizing United States Environmental Protection Agency (USEPA) and Minnesota Pollution Control Agency (MPCA) guidance for affordability of alternatives by the community. Depending on the outcome of the evaluation, a justification for the alternative which can feasibly meet effluent water quality standards at the lowest economic burden to the community will be presented.

4.1 Opinion of Cost for Alternatives

The costs for alternatives are presented in Table 12 include:

- Capital Cost – construction costs, contingency, engineering.
- Operation and Maintenance (O&M) Cost – costs related to utilities, labor, chemical usage, repair, maintenance, and user fees as applicable. The costs include the total sewer and water operating costs for the community including the additional operating costs associated with improvements to the wastewater treatment facility.
- 20-year Present Worth (PW) Cost – the present value of the cost and how much the costs are worth today (allows you to compare the alternatives on an apples-to-apples basis).

Table 12 – Preliminary Engineer's Opinion of Probable Costs for Alternatives

Alternative	Estimated Project Cost [1]	Estimated Year O&M [2, 3, 4, 5, 6]	Estimated 20-year PW
Alternative 1 – Conventional Secondary Treatment Improvements	$39,961,000	$3,104,000	$86,138,000
Alternative 2 – Conventional Secondary and Tertiary Treatment Improvements	$45,486,000	$3,217,000	$93,344,000
Alternative 3 - Membrane Secondary Treatment Improvements	$46,429,000	$3,569,000	$99,524,000

General Notes:

- Preliminary Engineer's Opinion of Probable Costs estimate is based on an "as built" estimated costs as if the project was constructed and operating in 2023.

Notes:

1. Includes 30% construction contingency and engineering design, construction administration, and construction field services.
2. Estimated labor hours per year based on *The Northeast Guide for Estimating Staffing at Publicly and Privately Owned Wastewater Treatment Plants*.
3. Assumes operator total compensation labor rate of $35.00 per hour. Represents year one O&M rate.
4. 20 year period at 3.0% annual rate.
5. Includes anticipated replacement costs for major equipment including filter media, membranes, disinfection lamps, and chemicals as applicable.
6. The estimated non-wastewater facility operation and maintenance cost per year is $2,338,000.

Referring to the information presented in Table 4 and the discussion of alternatives, there are conclusions for each alternative can be determined.

Alternative 1. Alternative 1 considers capacity improvements to secondary treatment and biosolids stabilization. The alternative is the lowest cost alternative and is capable of meeting the effluent water quality limits of the approved antidegradation review. Additional water quality testing should be performed to ensure appropriate media is proposed for the influent wastewater characteristics of the facility.

Alternative 2. Alternative 2 includes all of the recommended improvements included in Alternative 1, and adds intermediate pumping, coagulation, flocculation, and cloth media disc filtration. The alternative is intended to meet the water quality effluent limits as a result of not receiving approval for the requested antidegradation parameters of $cBOD_5$, TSS, or Mercury. Additional water quality testing should be performed to ensure appropriate filter media is proposed for the influent wastewater characteristics of the facility.

Alternative 3. Alternative 3 provides the ability to meet all anticipated frozen mass limits as identified in the PELR and through discussion with the MPCA. If a frozen mass limit is applied to chloride, additional preliminary design and water quality sampling will be required to determine if additional filtration is required. Without consideration for the additional filtration, Alternative 3 has the largest capital and operation and maintenance cost for the City.

Given the estimated capital costs, operation and maintenance, and other considerations as noted, the Alternative 1 provides the most economically feasible treatment that reliably provides effluent water quality within permit limitations for the most critical water quality parameters for the receiving stream. The alternative best protects public health and environmental quality while being technically feasible and constructible.

The Alternative:

- Introduces process intensification to address process currently at capacity.
- Maintains and/or improves the current effluent day average concentrations for POCs identified in the antidegradation review.
- Incorporates biological phosphorus removal and increased settling performance for secondary clarification to improvement solids capture performance of the process.
- Reduces the mass or chloride introduced to the plant effluent by meeting total phosphorus effluent limits by biological process rather than chemical precipitation.
- Reduces the sludge volume developed by biological phosphorus removal rather than chemical precipitation and increased settling performance settling improvements sludge settling and dewaterability. Both contribute to lower energy and chemical requirements due to sludge stabilization.
- Expands sludge stabilization capacity allowing for land application of biosolids rather than landfilling, reducing the industrial fertilizer demand for the fields treated.

With the Engineer's opinion of probable costs determined, the USEPA and MPCA guidance for the economic impact of alternatives can be calculated using the Municipal Preliminary Screening (MPS) and Secondary Indicator (SI).

Whether or not minimizing high water quality degradation is likely to interfere with development due to additional public-sector costs is determined by jointly considering the results of two evaluations. The first is a "screener" referred to as the Municipal Preliminary Screener (MPS) to establish whether the community can clearly pay for the project and must be completed prior to continuing to the second step, the Secondary Indicator.

4.1.1 Municipal Preliminary Screener

To assess the financial burden that total pollution control costs are expected to have on households, an average annualized pollution control cost per household is calculated for all households in the community that would bear project costs.

The USEPA provides a worksheet for the calculation of costs associated with the MPS. A copy of the worksheet completed with relevant values for the identified alternatives and community can be found in Appendix B-1 of this report.

The MPS estimates the total per household annual pollution control costs to be borne by households (existing costs plus those attributable to the proposed project) as a percentage of median household income. The screener is written as follows:

$$MPS\ Value = \frac{Annual\ pollution\ control\ cost\ per\ household}{\text{Median household income}} \times 100$$

The MPS range is determined using the following comparison in Table 13.

Table 13 – Municipal Preliminary Screener Matrix

Less than 1.0%	1.0% - 2.0%	Greater than 2.0%
Little Impact	Mid-Range Impact	Large Impact
Indicates no substantial economic impacts.	Proceed to Secondary Indicator Evaluation	

Values which are greater than 2.0% are considered to be a large impact. Values between 1.0% and 2.0% are considered moderate impact. Values below 1.0% indicate no substantial economic impact. Given the result of the MPS calculation, a secondary indicator review is completed.

Big Lake has a 2021 service population of 12,165 residents and 4,071 households. All 4,071 households will share in the burden costs resulting from the proposed improvements alternative identified above. The municipality currently bills a flat user fee to residential and commercial users of $11.55 per month. An additional usage fee of $9.17 per 1,000 gallons of water consumed is also charged to both residential and commercial users.

The City bears existing operating costs for the wastewater collection and treatment system. The City has provided the most current household costs which were used in the determination provided by the MPS.

The median household income for Big Lake was retrieved from the United States Census Bureau 2021 ACS 5-year estimates S2503 data profiles was $93,524. The median household income can be corrected using the Consumer Price Index for Urban Consumers (CPI-U) published by the US Bureau of Labor Statistics. The CPI-U for Minneapolis-St. Paul in January 2021 was 256.379 and the March 2023 CPI-U was 289.968. The median household income corrected by CPI-U for Minneapolis-St. Paul is $105,777. Comparably the State Median income from Minnesota was $87,902 once adjusted by the CPI-U for Minneapolis-St. Paul, meaning the median household

income for Big Lake is approximately 6.4% above the median household for the State when comparing unadjusted values.

Each alternative was evaluated to determine an MPS value based on the preliminary Engineer's opinion for the project's estimated total annual pollution control costs per household. Table 14 summarizes the MPS values.

Table 14 – Municipal Preliminary Screener for Alternatives

Alternative	Annualized Cost per Household	MPS Result	MPS Value
Alternative 1 – Conventional Secondary Treatment Improvements	$1,497	Mid-Range 1.0%-2.0%	2.0
Alternative 2 – Conventional Secondary and Tertiary Treatment Improvements	$1,580	Mid-Range 1.0%-2.0%	2.0
Alternative 3 - Membrane Secondary Treatment Improvements	$1,685	Mid-Range 1.0%-2.0%	2.0

Notes:

1. If the MPS is less than 1.0 percent of median household income, USEPA does not expect the pollution control project to impose a substantial economic impact on the community; do not continue to the secondary affordability test.
2. If the MPS is between 1.0 and 2.0 percent of median household income, the community may incur a mid-range economic impact; continuing to the secondary affordability test is optional.
3. If the MPS is greater than 2.0 percent of median household income, then the pollution control project may interfere with development; continue to the secondary affordability test.

All alternatives result in an MPS value which indicates that the total annual household cost as a percent of median household income is between 1.0% and 2.0%. The MPS result is considered to indicate the cost burden of alternatives may have a large impact on the residents of the City. All alternatives have a potential of creating a negative impact on the economic development of the community. The total annual household cost burden is therefore the best indicator of the alternative which can meet effluent water quality requirements at the lowest economic impact to the residents.

4.1.2 Secondary Indicator

The secondary indicator utilizes the USEPA's "Interim Economic Guidance for Water Quality Standards" for public sector projects. The secondary indicators are designed to build upon the characterization of community identified in the Municipal Preliminary Screener. This evaluation indicates the community's ability to obtain financing and describes the socioeconomic health of the community. Indicators describe debt, socioeconomic, and financial management conditions in the community. Using these indicators and the scoring system, the impact of the pollution control costs is estimated. A completed Secondary Indicator worksheet can be found in Appendix B-2 of this report for each alternative.

Indicators used for the secondary evaluation include:

- Debt indicators such as bond rating and overall net debt.
- Socioeconomic indicators such as unemployment rate and median household income.
- Financial management indicators such as property tax revenue and property tax collection rate.

Table 15 summarizes the current City socioeconomic health indicators.

Table 15 – Socioeconomic Health Indicators

Indicator	Value
Direct Net Debt	$22,212,000
Indirect Debt	$39,254,679
Market Value of Taxable Property	$1,269,862,192
Annual Property Tax Revenue	$5,300,234
Property Tax Collection Rate	99%
City Bond Rating – Standard and Poor's	AA

The socioeconomic health indicators result in a calculated overall net debt as a percent of full market value of taxable property of 3.10% and a property tax revenue as a percent of full market value of taxable property of 0.04%.

The current unemployment rate for the City was retrieved from the United States Census Bureau 2021 ACS 5-year estimates S2301 data profiles as 2.4% compared to the national average of 5.5%. As noted previously, the median household income not corrected by CPI-U for Minneapolis-St. Paul is $93,524 compared to the State Median income from Minnesota of $87,902 for the same period.

The secondary indicators above are referenced against the information presented in Table 16 on the following page to determine a value of 1 to 3, where 1 indicates a weak value, 2 indicates a moderate value, and 3 indicates a strong value. A value of 1 to 3 is provided for the MPS evaluation.

Table 16 – Secondary Indicator Matrix

Secondary Indicators	Weak	Mid-Range	Strong
Bond Rating (S&P) (Moody)	Below BBB Below BAA	BBB BAA	Above BBB Above BAA
Overall Net Debt as Percent of Full Market Value of Taxable Property	Above 5%	2% - 5%	Below 2%
Unemployment	>1.0% above National Average	National Average	>1% below National Average
Median Household Income	>10.0% below State Median	State Median	>10% above State Median
Property Tax Revenues as a Percent of Full Market Value of Taxable Property	Above 4%	2%-4%	Below 2%
Property Tax Collection Rate	<94%	94% - 98%	>98%

Table 17 provides a summary of the secondary indicator criteria for the city with the corresponding secondary indicator value. The MPS is not included as the score is unique to each alternative evaluated.

Table 17 – Secondary Indicator for Big Lake

Secondary Indicator Criteria	Value	Indicator Range	SI Value
Bond Rating – Standard and Poor's	AA	Strong	3.0
Overall Net Debt as Percent of Full Market Value of Taxable Property (MPS)	3.10%	Mid-Range	2.0
Unemployment	2.4%	Strong	3.0
Median Household Income	6.4%	Mid-Range	2.0
Property Tax Revenues as a Percent of Full Market Value of Taxable Property	0.04%	Strong	3.0
Property Tax Collection Rate	99%	Strong	3.0

The calculated secondary indicator value for Big Lake is 2.7. The secondary indicator, without the MPS, is consistent for all alternatives. Of the six non-MPS criteria, two of the criteria rank mid-range and the remaining four rank strong.

4.1.3 Substantial Impacts Matrix

The secondary indicator values are added together including the MPS and divided by the number of indicators. The result is an average which ranges from 1 to 3 and is used to determine the substantial impact matrix. As the final step of the determination, substantial impacts matrix is compared to the secondary indicator value and the MPS for a determination of likelihood of substantial economic impacts.

All three alternatives were determined to have a mid-range indication for substantial economic impacts. Therefore, the substantial impacts matrix will be the same for all three alternatives. Table 18 provides an overview for the substantial matrix determination.

Appendix B-3 contains the substantial impacts matrix calculated for each alternative.

Table 18 – Substantial Impacts Matrix

Secondary Indicators	Municipal Preliminary Screener (MPS) Calculation		
	Less than 1.0%	1.0% to 2.0%	Greater than 2.0%
Less than 1.5	?	x	x
Between 1.5 and 2.5	o	?	x
Greater than 2.5	o	o	?

Notes:

x: Indicates that the impact is likely to interfere with economic development. The closer the community is to the upper right-hand corner of the matrix, the greater the likelihood.

?: Indicates that the impact is unclear and justification is needed why the alternative is not prudent or feasible.

o: Indicates that the impact is not likely to interfere with development. The closer to the lower left-hand corner of the matrix, the smaller the likelihood.

Table 19 on the following page presents each alternative with the corresponding preliminary Engineer's opinion for the 20-year net present value, preliminary Engineer's opinion of annual operation and maintenance cost, the calculated MPS value, and the substantial impacts matrix result. The data presented is used for the determination of affordability and the degree of impact resulting from proposed capital improvements as a result of the effluent water quality requirements. The substantial impacts matrix will be used to rank alternatives in determining the alternative which would achieve the least amount of water degradation at the lowest economic impact for the community.

Table 19 – Substantial Impacts for Alternatives

Alternative	Estimated 20 yr NPV	Estimated Annual OM	MPS Result	Substantial Matrix
Alternative 1 – Conventional Secondary Treatment Improvements	$86,138,000	$3,104,000	2.0	2.7
Alternative 2 – Conventional Secondary and Tertiary Treatment Improvements	$93,344,000	$3,217,000	2.0	2.7
Alternative 3 - Membrane Secondary Treatment Improvements	$99,524,000	$3,569,000	2.0	2.7

Table 20 on the following page summarizes each alternative for the calculated MPS value, ability to meet effluent water quality requirements, and adaptability to future water quality standards, comments, and feasibility.

Table 20 – Evaluation of Alternatives

Alternative	Calculated MPS Value [1]	Effluent Limits	Adapt to Future	Comments	Feasible
Alternative 1 – Conventional Secondary Treatment Improvements	1.4%	Load Limits: $cBOD_5$ TSS Mercury Chlorides Load Caps: TP	Yes [2]	Alternative reuses the most existing facilities in order to minimize capital expenses. Design conditions maintain the current effluent concentrations for $cBOD_5$ and TSS by requesting an approved antidegradation review for increased load.	Yes
Alternative 2 – Conventional Secondary and Tertiary Treatment Improvements	1.5%	Load Limits: $cBOD_5$ TSS Chlorides Load Caps: TP Mercury	Yes [2]	Alternative uses the same proposed preliminary, secondary, and disinfection processes as alternative 1 while utilizing and existing effluent bypass structure to pump to tertiary treatment. The current facility is flow-through. The alternative would add in intermediate pumping step which could contribute to bypass pumping due to equipment failure and increase overall plant energy use for treatment. The alternative will also require the addition of polymer and coagulant prior to filtration.	Yes [4]
Alternative 3 - Membrane Secondary Treatment Improvements	1.6%	Load Limits: None Load Caps: $cBOD_5$ TSS TP Mercury Chlorides	Yes [3]	The alternative replaces the entire secondary treatment process. Membrane treatment provides the highest level of effluent water quality as a significantly higher energy cost and capital expense. Membrane treatment also involves the use of hazardous, caustic cleaners which are introduced into the waste stream.	Yes [5]

Notes:

1. Determined based on the total annual pollution control cost per household divided by the adjusted media household income.
2. Secondary treatment would be designed for sufficient capacity to add additional suspended growth media for expanded organic capacity.
3. Secondary treatment may be designed for sufficient capacity to add additional membrane modules.
4. Preliminary testing will need to be conducted to determine suitability of disc filtration for removal of mercury to meet the anticipated effluent water quality requirements.
5. The alternative assumes MBR treatment is capable of removing chloride to meet the anticipated effluent limit concentration. The alternative may require a grater degree of secondary membrane treatment based on the actual influent water quality and effluent water quality requirements.

The MPS and Secondary Indicator allow for alternatives to be ranked from least anticipated economic impacts for an alternative capable of meeting effluent water quality standards to highest. As each alternative have the same secondary indicator, the MPS is used for ranking of alternatives.

The costs associated with Conventional Secondary and Tertiary Treatment Improvements assumes disc filtration using a coagulant and flocculation step followed by non-woven disc media. Preliminary testing should be conducted to determine the suitability of the proposed system for meeting the anticipated Mercury effluent water quality requirements.

The costs associated with Membrane Secondary Treatment assume a membrane bioreactor using ultrafiltration membranes would be sufficient for the removal of chlorides to meets the effluent water quality requirements. Such limits were not included in the preliminary effluent limit request and the current effluent chloride concentration of the facility is not known. If additional membrane treatment using a smaller membrane pore opening is required, the anticipated capital, operation and maintenance, and 20 year net present value of the alternative will increase significantly.

Appendix B-3 contains the substantial impacts matrix results for each alternative.

4.2 Recommended Alternative

The recommended alternative is Alternative 1 – Conventional Secondary Treatment Improvements. The alternative reuses most of the existing facility tankage while requiring the least amount of chemical addition to meet effluent limit requirements. The process intensification proposed as part of secondary treatment will greatly reduce the amount of coagulant being used as the facility will operate for biological phosphorus removal rather than chemical phosphorus precipitation.

The alternative provides flexibility as reusing the existing oxidations ditches leaves the ability to add additional suspended media if needed. This provides additional organic capacity without the need for additional tankage. The existing facilities also provide sufficient capacity and operability to meet nitrogen or ammonia effluent limits if introduced into effluent permit requirements during the operational life of the facility.

The recommended secondary treatment alternative incorporates biological phosphorus removal and increased settling performance in the secondary clarifiers. In addition to improvements sludge characteristics, it is anticipated that the secondary clarifiers will have increased solids removal which will assist in biological phosphorus treatment, further reducing the likelihood coagulant will be required as a polishing step for treatment.

Table 21 on the following page provides a substantial impacts evaluation for the recommended alternative.

Table 21 – Substantial Impacts for Recommend Alternative

Secondary Indicators		Municipal Preliminary Screener (MPS) Calculation		
		Less than 1.0%	1.0% to 2.0%	Greater than 2.0%
		1.5%		
Less than 1.5		?	x	x
Between 1.5 and 2.5		o	?	x
Greater than 2.5	2.7	o	o	?

Notes:

Orange highlight indicates the determined likelihood for substantial impacts for alternative.

x: Indicates that the impact is likely to interfere with economic development. The closer the community is to the upper right-hand corner of the matrix, the greater the likelihood.

?: Indicates that the impact is unclear and justification is needed why the alternative is not prudent or feasible.

o: Indicates that the impact is not likely to interfere with development. The closer to the lower left-hand corner of the matrix, the smaller the likelihood.

Table 22 summarizes evaluation of the reasonable alternatives on a pollutant-by-pollutant basis.

Table 22 – Recommend Alternative Degradation Comparison

Pollutant of Concern	Potential Degradation	Comments
$cBOD_5$	Yes	Removal efficiencies for the alternative are anticipated to increase significantly compared to the current treatment facility. The requested increase for total mass discharged maintains the same effluent concentration as the current mass limit when calculated as an average concentration. Total mass loading would increase due to additional flow.
TSS	Yes	Removal efficiencies for the alternative are anticipated to increase significantly compared to the current treatment facility. The requested increase for total mass discharged maintains the same effluent concentration as the current mass limit when calculated as an average concentration. Total mass loading would increase due to additional flow.
Mercury	No	The facility does not currently operate with an effluent limitation for the POC. Total mass loading would increase due to additional flow.
Chlorides	No	The facility does not currently operate with an effluent limitation for the POC. A limit was not provided with the preliminary effluent limit request. The 7Q10 flow rate for the receiving water body is 1,074 cfs. Though total mass loading would increase due to additional flow, net chloride is likely to be reduced due to the anticipated reduction in coagulant consumption.

Past capital improvement projects addressing drinking water, sanitary sewer collection systems, roads, and other vital infrastructure have resulted in the current Direct Net Debt carried by the City of $$22,212,000 with an indirect debt of an additional $39,254,679. Alternatives such as Membrane Secondary Treatment would incur not only direct debt as a result of capital improvements, but also carry a significantly larger operation and maintenance costs associated with electrical consumption, chemical addition, process monitoring, and control.

The total estimated construction cost for the recommended alternative is $39,961,000. The construction project represents approximately 24 to 36 months of construction. During construction, it is anticipated that a number of full-time workers will be employed by the Contractor and Sub Contractors for the 14 to 36 months of construction. All of these jobs will be subject to state and federal wage rates as Big Lake will pursue development grants and loans. Local suppliers will be used for some building materials and fabrications such as concrete, lumber, metal fabrications, and other durable and non-durable goods. The effects of construction will have broader impact on the surrounding communities as a result. The expanded wastewater treatment facility will likely not require additional operators for the proposed treatment processes if the antidegradation review is approved.

The City currently carriers both direct and indirect debt as a result of past improvements. Given the additional costs proposed by construction, moderate economic impacts are anticipated for the community. This is indicated by the preliminary screen and secondary indicator values as calculated in this report. The City is utilizing approximately 90% of the hydraulic capacity of the wastewater facility as a month average. The current flow demand will contribute to difficulty receiving sewer extension permits which will begin to impact development of the community. The objective of the improvements is to protect the environment, provide equity of services and housing for the residents of Big lake, and assure environmental justice for those impacted by the improvements.

4.3 Justification for Degradation

The recommended treatment alternative will result in attainment of all water quality-based effluent limitations as identified in the PELR when adjusted to the anticipated design flow capacity and requested as part of the Antidegradation Review. The total effluent mass of pollutants to the receiving waters may increase for the requested parameters at design capacity due to higher discharge flow. The recommended alternative meets practicable criteria at the lowest economic and affordability criteria while protecting public health and environmental quality and is therefore the only reasonable alternative.

The recommended alternative will:

- Provide additional flow capacity to meet increasing wastewater demand, therefore protecting operability of the facility and providing adequate equipment to meet effluent limitations.
- Allow for the addition of cost-effective multi-unit housing for affordability of all residents and construction of dedicated senior housing which is not otherwise available in the community.
- Allow for development of City owned lots which otherwise are underutilized. The expanded development will contribute to urban infilling and expand the tax base to further distribute the anticipated yearly household cost across additional business and residences.

- Allow for biological phosphorus removal in lieu of chemical precipitation. The capital cost savings for chemical combined with the reduction in manufacturing, shipping, and introduction of chlorides to the environment greatly reduce the ecological impact of treatment.
- Replacement of existing facilities and equipment with new, energy efficient systems contribute to a reduction in operation and maintenance for lighting, heat, ventilation, and equipment at the facility – further reducing the ecological impact of treatment.

The facility discharges continuously to the Mississippi River. The PELR indicates the 7Q10 for the discharge water at 1,074 cfs of flow. The recommended alternative continues continuous discharge to the receiving water.

Degradation for some pollutants of concern will result from the projected growth of the community and implementation of the recommended treatment alternative. Minnesota's Antidegradation Review considers net mass pollutant increases irrespective of effluent or receiving stream pollutant concentrations. Therefore, the Social and Economic Importance (SEI) of the project must be demonstrated.

4.4 Social and Economic Impact

Big Lake anticipates an increase in wastewater flow demand as a result of residential, commercial, and industrial growth of nearly 200% during the planning period. As mentioned, the existing facility is near 90% of its design hydraulic capacity based on calendar day average flows. At the 90% threshold, it is not uncommon for further evaluation being required when applying for and receiving sewer extension permits for new construction.

Capital improvements are needed at the existing facility for address age and condition of existing equipment regardless of addressing treatment capacity. Without the additional development, the costs associated with age and condition replacement will be felt solely by the current residential, commercial, and industrial users.

The City is in a difficult position for housing based on two outstanding conditions:

1. The average household income is such that affordable housing for new and moderate to lower income households is limited.
2. There is no available senior housing in the community as the last facility had been converted to other uses.

The City is currently in planning for construction to add the following residential developments to the community which may become impacted by the limitation in treatment flow capacity at the wastewater treatment facility:

- 60 unit apartment complex at market rate and low income,
- 75 unit single-family detached house subdivision at market rate, and
- 139 unit townhome subdivision at market rate.

The City has seen its dedicated senior housing be converted to other land uses or away from dedicated senior housing. The last facility was converted recently leaving no dedicated senior housing. The City is currently planning for construction of:

- 74 unit dedicated senior apartment complex.

The City has been working with private companies to pursue equitable housing opportunities for various economic and demographic groups served by the community. The treatment capacity limitations at the wastewater treatment facility may affect the timeframe for construction and ability to service such housing opportunities.

The additional residential units will also expand both the tax base for the community, resulting is a greater source of revenue to operation and maintenance of facility, but also distribute the costs for repayment of capital expenses as a result of construction.

The underutilized, City owned lots for development represent 30 acres and 6 lots. When developed, the market value for the addition non-domestic users is $909,900. Sufficient capacity for wastewater treatment would allow the City to more aggressively prepare and market the lots for development.

The significant industrial users have indicated a desire to expand production. Should treatment capacity not be available, those industrial users may be motivated to either move operations to another community to develop additional facilities outside of the community. The result in either event is lost employment, revenue, and development in the community.

The largest industrial user, a food processor, is planning to increase the wastewater flow generated by 100% within the next two years. The increase would result in a significant increase in flow and load to the facility, but also a significant revenue source for the City. The additional revenue from the industrial user would offset the costs being shared by residential users. The additional production at the facility would also substantiate additional work opportunities for residents and potential residents of Big Lake.

As noted previously, the City operates the wastewater treatment facility as a chemical phosphorus removal facility. For 2022 the City consumed 124,410 pounds of ferric chloride solution. The economics of chemical phosphorus precipitation can be summarized by the following:

- The total City anticipated 2023 expenditure for water and sewer services is $3,490,560.
- $2,068,336 of the 2023 expenditure is residential revenue.
- The cost for chemical to the City was $73,576.
- The chemical costs correspond to just over 3.5% of the residential share of operating costs.

The environmental impact of chemical phosphorus precipitation can be summarized by the following:

- The ferric chloride consumption corresponds to 11,600 gallons of 40% solution.
- The mass of ferric chloride solution corresponds to adding approximately 32,600 pounds of chloride the wastewater being treated at the facility each year.
- Assuming deliveries of 2,000 gallons per trip, this corresponds to six semi loads per year.
- Production of ferric chloride involves reacting iron, ferrous chloride oxides, and chlorine gas utilizing industrial processes.
- Chemical precipitation of phosphorus can increase solids production rates by as much as 15% percent. The additional solids reduce the available capacity for digestion and solids handling, increase energy consumption, and increase costs and environmental impacts associated with disposal of biosolids.

Although biological phosphorus removal may not eliminate the need for coagulant addition, it will significantly reduce the chemical dose requirements.

The ability to received approval of this antidegradation review will allow for implementation of the recommended alternative with the least economic hardship placed on the community. Implementation of the recommended alternative will have both economic and environmental benefits for the community.

Significant near-term economic benefits to the community as a result of construction activities are anticipated to be significant and will still contribute to the community through sales-tax and property tax. The short-term benefits include development of residential parcels as noted and revisions to significant industrial user agreements to allow for additional flow and load.

Construction related short-term benefits are limited but include sale tax and relatively induced employment during construction.

Long term economic benefits include having an accountable non-domestic reserve capacity at the wastewater treatment facility which will enable the City to pursue commercial, institutional, and industrial development with the knowledge that sufficient capacity existing for providing wastewater utilities.

Implementation of the recommended alternative will have environmental benefits, which all community members are rewarded by. The environmental benefits can be summarized by the following:

- The recommended alternative will provide sufficient treatment capacity to meet current flow and load demand while operating the facility as intended.
- The facility will be able to operate as intended, proving biological phosphorus removal rather than chemical precipitation. The modifications to operation will both reduce the amount of chemical produced, transported, and utilized on site and the energy requirements processing, storing, transporting, and disposing additional solids generated by chemical precipitation.
- The reduced coagulant use will reduce the effluent load of chloride being discharged, a noted pollutant of concern.
- The additional solids stabilization capacity will allow for land application of biosolids generated at the facility rather than landfilling.
- The recommended alternative will provide expanded treatment capacity to meet the future growth flow and load demand while providing considerations for future pollutants of concern.
- The recommended alternative will provide a more consistent and reliable treatment of the wastewater as compared to the existing facility.

The approved antidegradation review will allow for:

- Implementing the recommended alternative with the least economic hardship placed on the community.
- Allow for continued affordable residential development supported by high-quality job opportunities through business development.
- Allow for continued development of residences not only for market rate users, but also a variety of economic and demographic users.
- Increase the wastewater users to allow for a greater source of revenues and distribute anticipated household costs across a greater number of users.
- Establish facilities to protect public health and environmental quality reliably in accordance with NPDES/SDS discharge permit requirements.

When partnered with the environmental benefits, the community will be in its best position for positive development and growth.

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Appendix A

Technical Memoranda

A-1 – Facilities Plan Anticipated Flow and Load Review Memorandum
A-2 – Facilities Plan Capacity and Condition Evaluation Memorandum
A-3 – Facilities Plan Treatment Alternatives Memorandum
A-4 – Preliminary Site Plan of the Recommended Alternative

A-1 – Facilities Plan Anticipated Flow and Load Review Memorandum

Building a Better World for All of Us®

MEMORANDUM

TO: Dan Childs

FROM: Jessica Hedin, PE (Lic. MN 41639)

DATE: March 20, 2023

RE: Big Lake Wastewater Treatment Facilities Plan, Anticipated Flow and Load Review
SEH No. BIGLK 167307 14.00

The purpose of this memorandum is to summarize the current wastewater facilities flow and load, basis of population and wastewater demand projections, and basis of projected wastewater facilities flow and load for the design year of 2045. The projected flows and loadings for the facility are summarized in Table 1.

Table 1: Design Year Combined Wastewater Anticipated Flow and Load Demand

Flow Condition		**Value**	
Average Dry Weather (ADW), mgd		1.366	
Calendar Average Day Flow (ADF), mgd		1.446	
Average Wet Weather (AWW), mgd [A]		1.682	
Peak Hour Wet Weather (PHWW), mgd [B, C]		4.379	
Peak Instantaneous Wet Weather (PIWW), mgd [B]		4.379	
Load Parameter	**Calendar Day Average**	**Maximum Month as Day**	**Calendar Day Maximum**
5-Day Carbonaceous Biochemical Oxygen Demand ($cBOD_5$), ppd [D]	4,621	7,773	14,988
Total Suspended Solids (TSS), ppd [E]	5,465	12,227	19,984
Total Phosphorus (TP), ppd [F]	87	138	195
Total Kjeldahl Nitrogen (TKN), ppd [F]	562	894	894

Notes:
A. Corresponds to a flow rate of 62 gpcd for non-industrial users and 100 gpcd for domestic users.
B. Instantaneous flow data unavailable. PIWW determined using existing lift station pump capacity.
C. Corresponds to a calendar day average to peak hourly wet weather peaking factor of 2.6, which is equal to the 10 States Standards for Wastewater Facilities (2014 Edition) recommendation of 2.6 based on service population.
D. Corresponds to MPCA recommended minimum design value for parameter.
E. Corresponds to observed loading based on reported DMR sampling values.
F. Corresponds to Metcalf and Eddy recommended minimum design value for loading.

Refer to the remainder of the memorandum for the justification and methodology used to develop the projected flows and loads above.

Note that the City receives industrial flow from two identified industrial users, referred to as industrial user 1 and industrial user 2 for the purpose of this report. Unless noted otherwise, current and design flows and loads reference the combined flow and load from both industrial and non-industrial users.

FLOW AND LOAD DEMAND

The City provided SEH with historical influent and effluent data from discharge monitoring reports (DMRs) for the Big Lake Wastewater Treatment Facility (WWTF) for January 1, 2017 through February 28, 2022. The following sections summarize the existing flows and loads to the WWTF.

The purpose of this memorandum is to evaluate the capacity of the current wastewater facilities to meet the anticipated design year flow and load demand. Each treatment process at the wastewater treatment facility (WWTF) was reviewed for suitability.

Flow Definitions

The MPCA defines several flow conditions that are used to design process units. The existing system design and the capacities of existing process units reference the following flow conditions:

- **Average dry weather (ADW)** flow: ADW flow is defined as the flow that occurs during dry periods when the groundwater level is low or normal. This flow would include the normal sanitary sewer flows from homes, commercial establishments, public institutions, and any industrial facilities. This flow level normally becomes apparent in winter months (December, January, and February), when there is little to no inflow.
- **Average wet weather (AWW) flow:** AWW or peak month flow is the daily average flow for the 30 consecutive days with the highest precipitation for continuous dischargers. AWW of peak month flow is the daily average for the approximately 180 consecutive days between November 15 and May 15 and May 15 to November 15 for controlled dischargers.
- **Peak hourly wet weather (PHWW) flow:** PHWW is the peak flow during the peak hour of the day at a time when the groundwater is high and a five-year, one-hour storm event is occurring. For the City of Big Lake, a five-year, one-hour storm event corresponds to a precipitation event of 1.7 inches in one hour (MPCA, 2019).
- **Peak Instantaneous Wet Weather (PIWW) flow:** PIWW is the peak instantaneous flow during the day at a time when the groundwater is high and a 25-year, one-hour storm even is occurring. For the City of Big Lake, a 25-year, one-hour storm event corresponds to a precipitation event of 2.4 inches in one hour (MPCA, 2019).

Load Definitions

The MPCA refers to the Ten States Standards for design load determination. The Ten States Standards defines several load conditions that are used to design process units. The existing system design and the capacities of existing process units reference the following flow conditions:

- Design Average Load: The design average load is generally the average of the load to be received for a continuous 12-month period for the design year, expressed as weight per day.
- Design Maximum Month as Day Load: The design maximum month as day load is the largest amount of load to be received for a continuous 30-day period for the design year, expressed as weight per day.
- Design Maximum Day Load: The design maximum day load is the largest amount of load to be received during a continuous 24-hour period, expressed as weight per day.

The design load for facilities having critical seasonal high loading periods (e.g., recreational areas, campuses, industrial facilities) shall be based on the average organic load to be received during the seasonal period.

The determination for projected design loads is calculated as follows:

$$\text{Design Load} = \text{Calculated Peaking Factor} \times \left[\left(\text{Design Per Capita Load} \times \text{Domestic Service Population} \right) + \left(\text{Actual Per Capita Load} \times \text{Commercial and Light Industrial REU} \right) \right] + \text{Industrial Load}$$

where,

- Calculated peaking factor is based on the reported DMR sampling data.
- Design per capita load is based on the larger of the calculated per capita loading based on the reported DMR sampling data minus industrial contribution, MPCA design minimums, or other reference values.
- Domestic service population is the projected service population for the design year.
- Actual per capita load is based on the reported DMR sampling data minus industrial contribution.
- Commercial and light industrial residential equivalent units (REU) is based upon the anticipated non-significant industrial user (SIU) / categorical industrial user (CIU) industrial growth and non-domestic growth converted to a population equivalent.
- Industrial load is based on the anticipated growth and planned additional capacity for SIUs and CIUs.

Planning Definitions

Review of the current flows and loads and the determination for future flow and load capacities can generally be divided into four planning categories. The categories can generally be described as follows:

- **Domestic Capacity:** The domestic capacity reflects the residential contribution of wastewater flows and loads for current and future capacities. The basis of current flows is associated with the Minnesota Demographic Center population projections for determination of current per capita flows and loads, and the population projection determined in this report for future flow and load capacity. At a minimum, the MPCA requires minimum flow and load per capita loadings for design of future capacities as discussed later in this report.
- **Commercial and Light Industrial Capacity:** The commercial and light industrial capacity reflects the non-domestic and non-SIU/CIU industrial contribution of wastewater flows and loads for current and future capacities. The current flows and loads are included in the per capita flow and load contribution determination. The future flow and load contribution is based on the approved comprehensive growth plan acreage identified for commercial and light industrial development. An assumed flow per acre based on land use is utilized and associated to a residential equivalent unit. The actual per capita load is then used based on the equivalent residential unit to determine a future load condition.
- **Industrial Capacity:** The industrial capacity reflects the identified significant industrial and categorical industrial users identified by the City. The basis of current flows and loads reflect the industrial suer agreements prepared by the City, and the future flow and load conditions reflect discussions between the industrial users and the City based on projected future wastewater generation.
- **In-Plant Recirculation Capacity:** The in-plant recirculation capacity reflects the flows and loads generated by recirculation waste streams generated by wastewater treatment. The recirculation capacity may include washdown water, decant, process drains, filtrate, and other treatment side streams. These side streams may reflect existing processes and be impacted by proposed alternatives. For the facility, the side stream flows and loads are introduced after influent flow measurements and sampling. Although treatment capacity for individual units will reflect in-plant recirculation capacity, the permitted facility design capacity review does not.

Refer to Figure 1 for the components of the design capacity planning definitions.

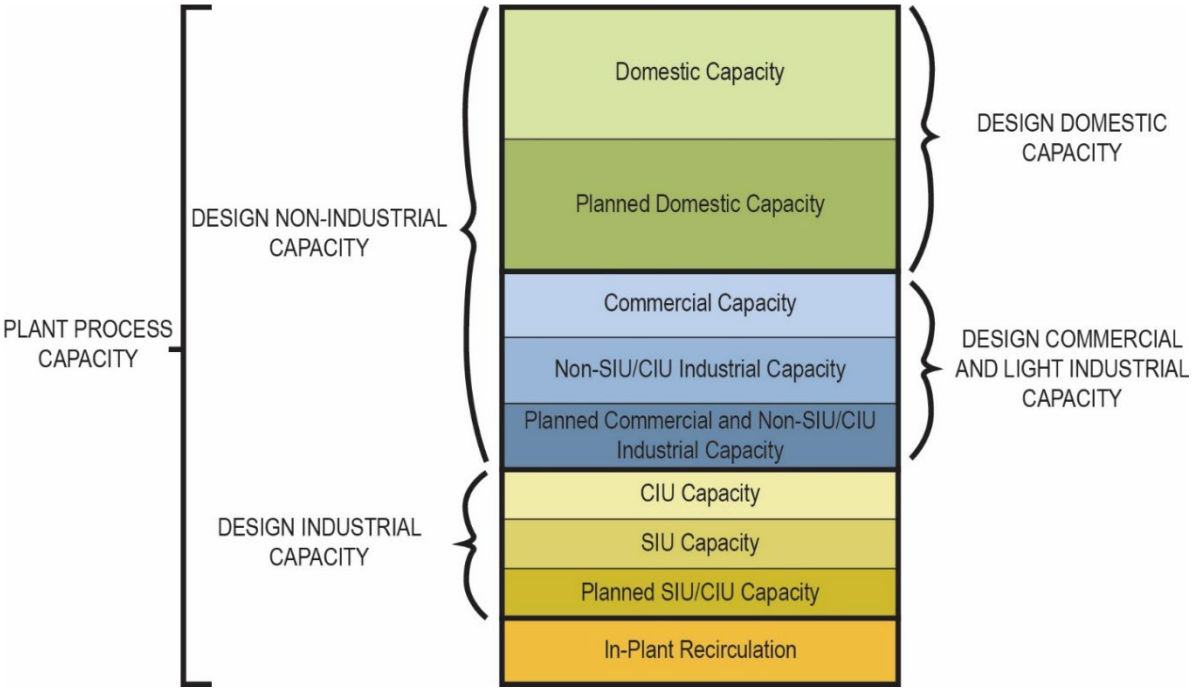

Figure 1: Design Capacity Planning Definitions

Infiltration and Inflow

Infiltration and inflow (I/I) are essentially clean water that enters the collection system as a result of rainfall or elevated groundwater levels. The MPCA has established guidelines to assist in evaluating the extent of both infiltration and inflow by comparing average flows during periods of high groundwater levels with and without precipitation events to established threshold values. If either inflow or infiltration is found to be excessive, the MPCA recommends an analysis to determine the feasibility of removing I/I.

The collection system in Big Lake is well maintained and relatively new, resulting in lower-than-average per capita flow rates observed at the wastewater treatment facility. The typical age of the collection system for the community is as follows:

- Total of 60 miles of gravity sanitary sewer piping and 8 miles of forcemain.
- 10% of sewer are >50 years old.
- 20% of sewer are 30-50 years old.
- 70% of sewer are <30 years old.

The community does not have major I/I reduction projects under construction, planning, or incorporated into a capital improvements plan. There are no project lists for the community for state funding on either the Intended Use Plan (IUP) or Project Priority List (PPL) list.

The community has identified two manholes for replacements and a number of vented sanitary sewer castings in the system which are to be replaced. Continuing efforts to ensure sump pumps and other sources of inflow have been disconnected are ongoing.

Infiltration

Infiltration is groundwater that enters the collection system through defective pipes, pipe joints, and manholes. Infiltration occurs when groundwater is high, and runoff is not occurring (i.e. no rain event). To determine the magnitude of the infiltration, the influent flow for a base condition must be compared with the influent flow during an infiltration condition. The base condition occurs when the groundwater is low, and runoff is not occurring.

Groundwater would be expected to be high in the spring season. The average infiltration condition for each year was determined by averaging the influent flows on days without precipitation during the wet period of March through June. To eliminate the effect of time of concentration following precipitation events and differences in the recording of precipitation and flow, days that were one day prior to or following a precipitation event were excluded from the average.

2022 was excluded as the review period only includes January and February, both of which are considered winter months.

The averages for each year are presented in Table 2. The average base condition is the minimum month as calendar day flow for the corresponding year's review period.

Table 2: Infiltration Conditions

Year	Infiltration Condition [A]	Base Condition [B]	Infiltration (MGD)	Per Capita Flow During Infiltration Conditions [C] (gpcd)
	Average Influent Flow on for Dry Days (MGD)	Minimum Month as Day Flow (MGD)		
2017	0.678	0.629	0.049	60.7
2018	0.697	0.676	0.021	60.8
2019	0.716	0.670	0.046	62.0
2020	0.694	0.694	0.001	57.6
2021	0.655	0.617	0.038	53.8
Average	**0.688**	**0.657**	**0.031**	**59.0**

Notes:
A. Influent condition represents averaging the influent flows on days without precipitation during the wet period of March through June.
B. Base condition occurs when the groundwater is low, and runoff is not occurring.
C. Based on a service population for each corresponding year as provided by the Minnesota Demographic Center population estimate.

Comparing the infiltration condition with the base condition flow for municipal flows, contribution from infiltration appears to average approximately 31,000 gpd during infiltration conditions. Infiltration is considered excessive if the average flow during periods with seasonal high groundwater exceeds 120 gallons per capita per day (gpcd) for domestic base flow and infiltration. The service population was used for each corresponding year based on the Minnesota Demographic Center population estimate. The average per capita wastewater flow during a period of high groundwater was determined using the combined industrial and non-industrial flow, which was approximately 59.0 gpcd, which on average does not exceed the threshold criterion.

Inflow

Inflow is rainfall contribution from sources such as flooded manhole covers, roof drains, foundation drains, storm water collection system cross connections, and other drain areas. Inflow occurs when groundwater is average or low and runoff is occurring (i.e., during a rain event). The high day reported influent flow for

the three days following the rain event is compared to the 30-day average flow proceeding the rain event to determine the amount of inflow.

The five days with the highest total rainfall during the spring, summer, or fall for the review period. The review period extends from March through November for each year of reporting data. Winter was excluded due to freezing precipitation. The wastewater flows during high precipitation events are compared with the average wastewater flows during the precipitation event month.

Table 3 summarizes the five days with the highest total rainfall during the review period.

Table 3: Inflow Conditions

Date of Precipitation	Amount of Precipitation (inches)	Inflow Event [A] Influent WW Flow (MGD)	Average Month Prior Influent WW Flow (MGD)	Inflow (MGD)	Per Capita Contribution During Inflow Conditions [B] (gpcd)
10/2/2017	4.70	0.815	0.784	0.031	72.9
6/28/2020	3.40	0.744	0.714	0.030	64.9
7/15/2019	2.50	0.827	0.782	0.045	71.6
7/1/2018	2.20	0.782	0.720	0.062	64.9
9/20/2021	2.10	0.820	0.746	0.074	67.4
Average	**2.98**	**0.798**	**0.749**	**0.048**	**68.4**

Notes:
A. Largest reported influent flow within three days preceding the rain event.
B. Based on a service population for each corresponding year as provided by the Minnesota Demographic Center population estimate.

The maximum inflow was 0.961 MGD, which occurred on 10/3/2017 during a 4.70 inch rainfall event that occurred the day before. Inflow is considered excessive if the flow during periods of significant rainfall exceeds 275 gpcd for domestic and industrial base flow plus infiltration and inflow. The service population was used for each corresponding year based on the Minnesota Demographic Center population estimate. The average per capita wastewater flow during a period of increased precipitation was determined using the combined industrial and non-industrial flow and was approximately 68.4 gpcd, which does not exceed the threshold criterion.

Current Wastewater Flow and Load Demand

Discharge monitoring reports (DMRs) for the review period are included in Appendix A-2. The reported flows are measured with a Parshall flume located in the preliminary treatment building at the wastewater treatment facility and represents the combined flow to the facility, including any I/I and industrial contributions.

The facility receives industrial flow from 2 significant industrial users and zero categorical industrial users.

Over the review period, the combined average dry weather influent flow was 699,000 gallons per day. The highest 30 consecutive days of flow were evaluated for a maximum month as day average (also referred to as the average wet weather) flow of 838,000 gallons per day. With two significant industrial users contributing approximately 52,000 gallons per calendar day of average flow and 78,000 gallons per maximum month as calendar day of flow, the adjusted average dry weather and maximum month as day flows for non-industrial users are then 647,000 gallons per day and 786,000 gallons, respectively. Based on an estimated 2022 service population of 12,278 residents from the Minnesota Demographic Center, the non-industrial user portion of the average wet weather flow correspond to a per capita flow contribution of approximately 55 gallons per capita day.

Peak hourly wet weather (PHWW) and peak instantaneous wet weather (PIWW) flows are also important for unit process capacity determination. Flow and precipitation data is required for determining the PHWW and PIWW flows. Instantaneous flow data is not available at the facility. Although the facility has a Parshall flume flow meter, it does not have a historian with sufficient enough data for a determination of measured data. Instantaneous precipitation data is not available for the facility, however daily rainfall totals from DMR data were used. The peak hourly flow was determined using the existing pump capacity for the facility's main influent lift station. The corresponding peaking factor is 3.1, which was calculated based on the projected average day flow to peak hour wet weather flow. The utilized peaking factor is greater than the 10 States Standard recommended peaking factor for the corresponding population, which would be 2.6.

Table 4 summarizes the current flows to the treatment facility.

Table 4: Current Combined Wastewater Flow Demand

Flow Condition	Value
Average Dry Weather (ADW), mgd	0.699
Calendar Average Day Flow (ADF), mgd	0.721
Average Wet Weather (AWW), mgd [A]	0.838
Maximum Calendar Day, mgd	1.208
Peak Hour Wet Weather (PHWW), mgd [B, C]	2.204
Peak Instantaneous Wet Weather (PIWW), mgd [B]	2.204

Notes:
A. Day average flow for 30 consecutive highest flow days reported.
B. Instantaneous flow data unavailable. Peak determined using existing lift station pump capacity base on sewer flow rates.
C. Corresponds to a calendar day average to peak hourly wet weather peaking factor of 2.6, which is equal to the 10 States Standards for Wastewater Facilities (2014 Edition) recommendation of 2.6 based on service population.

Table 5 summarizes the assumed industrial flow based on the monitoring data available and the user agreements between the industries and the City. The table also provides the revised non-industrial flow to the facility which corresponds to the residential, commercial, and light industrial user discharge.

Table 5: Current Industrial and Non-Industrial Wastewater Flow Demand

User	Calendar Day Average	Maximum Month as Day	Calendar Day Maximum
Significant Industrial User 1 Wastewater Flow, mgd [A]	0.004	0.005	0.005
Significant Industrial User 2 Wastewater Flow, mgd	0.048	0.073	0.073
Total Industrial Wastewater Flow, mgd	0.052	0.078	0.078
Flow Condition	**Value**		
Non-Industrial Average Dry Weather, mgd	0.647		
Non-Industrial Calendar Average Day Flow, mgd	0.670		
Non-Industrial Average Wet Weather, mgd [B, C]	0.760		
Non-Industrial Maximum Calendar Day, mgd	1.130		
Non-Industrial Peak Hour Wet Weather, mgd [D, E]	2.126		
Non-Industrial Peak Instantaneous Wet Weather, mgd [D]	2.126		

Notes:
A. Assumed wastewater flow rate based on metered water usage.
B. Corresponds to a flow rate of 59 gpcd.
C. Day average flow for 30 consecutive highest flow days reported.
D. Instantaneous flow data unavailable. Peak determined using existing lift station pump capacity base on sewer flow rates.
E. Corresponds to a calendar day average to peak hourly wet weather peaking factor of 2.6, which is equal to the 10 States Standards for Wastewater Facilities (2014 Edition) recommendation of 2.6 based on service population.

In addition to flow data, the following loadings were determined for the review period:

- 5-day carbonaceous biochemical oxygen demand ($cBOD_5$),
- Total suspended solids (TSS),
- Total phosphorus (TP),
- Total nitrogen (TN), and
- Total Kjeldahl nitrogen (TKN).

Table 6 summarizes the current loading to the treatment facility.

Table 6: Current Combined Wastewater Load Demand

Load Parameter	Calendar Day Average	Maximum Month as Day	Calendar Day Maximum
5-Day Carbonaceous Biochemical Oxygen Demand ($cBOD_5$), ppd [A]	2,141	3,679	7,386
Total Suspended Solids (TSS), ppd [B]	2,963	6,702	11,202
Total Phosphorus (TP), ppd [C]	47	75	107
Total Kjeldahl Nitrogen (TKN), ppd [D]	358	496	496

Notes

A. Non-Industrial portion of load parameter corresponds to a per capita loading rate of 0.10 ppcd.
B. Non-Industrial portion of load parameter corresponds to a per capita loading rate of 0.22 ppcd.
C. Non-Industrial portion of load parameter corresponds to a per capita loading rate of 0.003 ppcd.
D. Non-Industrial portion of load parameter corresponds to a per capita loading rate of 0.027 ppcd.

Monthly organics loading, analyzed as 5-day carbonaceous biochemical oxygen demand, averaged approximately 2,141 pounds per day (ppd) over the period, with a maximum month as day average load of 3,679 pounds per day. The most recent 2018 facilities plan indicated a calendar day average load of 2,481 ppd, indicated a general reduction in loading since the last facility plan update. The daily maximum during the review period occurred December 19, 2017 with a reported 7,386 ppd. The following peak events were excluded from the data analysis as operational outliers:

- August 30, 2017 the influent 5-day carbonaceous biochemical oxygen demand was 9,165 ppd, corresponding to a concentration of 1,350 mg/L as a result of atypical flow from industrial discharge to the facility.

Monthly solids loading, analyzed as total suspended solids, averaged approximately 2,963 pounds per day (ppd) over the period, with a maximum month as day average load of 6,702 pounds per day. The most recent 2018 facilities plan indicated a calendar day average load of 4,240 ppd, indicated a general reduction in loading since the last facility plan update. The daily maximum during the review period occurred December 19, 2017 with a reported 11,202 ppd. The following peak events were excluded from the data analysis as operational outliers:

- August 30, 2017 the influent total suspended solids concentration was 20,909 ppd, corresponding to a concentration of 3,080 mg/L as a result of atypical flow from industrial discharge to the facility.

Monthly total phosphorus loading, analyzed as phosphorus, averaged approximately 47 pounds per day (ppd) over the period, with a maximum month as day average load of 75 pounds per day. The most recent 2018 facilities plan indicated a calendar day average load of 113 ppd, indicated a general reduction in loading since the last facility plan update. The daily maximum during the review period occurred October 25, 2017 with a reported 107 ppd. The following peak events were excluded from the data analysis as operational outliers:

- August 6, 2019 influent total phosphorus concentration was 218 ppd, corresponding to a concentration of 32.0 mg/L as a result of atypical flow from industrial discharge to the facility.

Monthly total Kjeldahl nitrogen loading, analyzed as nitrogen, averaged approximately 358 pounds per day (ppd) over the period, with a maximum month as day average load of 496 pounds per day. The most recent 2018 facilities plan did not include analysis of TKN. The daily maximum during the review period occurred June 5, 2018 with a reported 496 ppd. No peak events were excluded from the data analysis as a result of operations.

Table 7 summarizes the assumed industrial loading based on the monitoring data available and the user agreements between the industries and the City. The table also provides the revised non-industrial loading to the facility.

Table 7: Current Industrial and Non-Industrial Wastewater Load Demand

Load Parameter	Calendar Day Average	Maximum Month as Day	Calendar Day Maximum
Significant Industrial User 1 $cBOD_5$, ppd	322	490	618
Significant Industrial User 2 $cBOD_5$, ppd	548	928	2,505
Total Industrial $cBOD_5$, ppd	870	1,418	3,122
Non-Industrial $cBOD_5$, ppd [A]	**1,271**	**2,261**	**4,263**
Significant Industrial User 1 TSS, ppd	70	184	232
Significant Industrial User 2 TSS, ppd	204	430	1,094
Total Industrial TSS, ppd	275	614	1,325
Non-Industrial TSS, ppd	**2,689**	**6,088**	**9,877**
Significant Industrial User 1 TP, ppd	2.1	3.7	4.6
Significant Industrial User 2 TP, ppd	2.1	3.5	12.4
Total Industrial TP, ppd	4.3	7.2	17.0
Non-Industrial TP, ppd [B]	**42.5**	**67.6**	**89.9**
Significant Industrial User 1 TKN, ppd [C]	3.5	4.3	4.3
Significant Industrial User 2 TKN, ppd [D]	22.9	36.7	36.7
Total Industrial TKN, ppd	26.4	40.9	40.9
Non-Industrial TKN, ppd [B]	**331.4**	**455.0**	**455.0**

Notes:
A. Reported Current calendar average load corresponds to a per capita loading which is less than the MPCA and 10 States Standards recommended minimum design value for the parameter.
B. Reported Current calendar average load corresponds to a per capita loading which is less than the Metcalf and Eddy recommended minimum design value for the parameter.
C. Sample information not provided. Values used based on references in SIU agreement. It is possible there may be TKN component to both industrial user's flow to WWTF that is not accounted for.
D. Special sampling completed consisting of 2 samples collected 7/14/2022 and 7/19/2022.

Nutrient loading to the facility is based upon present calculated per capita loading compared to reference design standards. The more conservative per capita design loading was used for facility design for the community population under design conditions. The per capita loading is referenced against accepted design standards from the Recommended Standards for Wastewater Facilities (2014), often referred to as "Ten States Standards," the Fourth Edition of the Wastewater Engineering Treatment and Reuse text by Metcalf and Eddy (2003), Water Environment Federation Manual of Practice No. 8, and the MPCA guidance for minimum design standards.

The calculated non-industrial per capita $cBOD_5$ load is 0.10 pounds per capita per day (ppcd). According to the Recommended Standards for Wastewater Facilities (Ten States Standards) and the MPCA Flow and Load Guidance, the design of domestic waste treatment shall be based upon at least 0.17 ppcd $cBOD_5$, or 0.22 ppcd where garbage comminutors are commonly used. The recommended reference per

capita load of 0.17 ppcd $cBOD_5$ was used for the domestic and the calculated per capita load of 0.10 was used for the commercial and light industrial portions of the design capacity, respectively.

The calculated non-industrial per capita TSS load is 0.22 ppcd. According to the Recommended Standards for Wastewater Facilities (Ten States Standards) and the MPCA Flow and Load Guidance, the design of domestic waste treatment shall be based upon at least 0.20 ppcd TSS, or 0.25 ppcd where garbage disposals are commonly used. The calculated per capita load of 0.22 ppcd TSS was used for the domestic, commercial, and light industrial portions of the design capacity.

The calculated non-industrial per capita TP load is 0.003 ppcd. Metcalf and Eddy (2003) Wastewater Engineering suggest a typical design range for total phosphorus of 0.004-0.010 ppcd, with a typical per capita loading of 0.006 ppcd. The recommended reference per capita load of 0.004 ppcd TP was used for the domestic and the calculated per capita load of 0.003 was used for the commercial and light industrial portions of the design capacity, respectively.

The calculated non-industrial per capita TKN load is 0.027 ppcd. Metcalf and Eddy (2003) Wastewater Engineering suggest a typical design range for ammonia as nitrogen of 0.011-0.026 ppcd, with an average of 0.019 ppcd. Ammonia, as nitrogen, in domestic wastewater can be expected to comprise 60% of the total Kjeldahl nitrogen. Therefore, the expected NH_3-N / TKN would be expected to be 0.60. The recommended range for total Kjeldahl nitrogen would then be 0.018-0.043 ppcd TKN. The reported value of 0.028 ppcd TKN was used.

Anticipated Flow and Load Demand

For facility plans, the MPCA prescribes specific design parameters. Specifically, the four flow conditions, defined in Section 3.1, must be established for the planning period. These flow conditions are used to quantify the range of flows observed and provide a basis for future planning. Population projections are also important to assess the requirements of new or existing treatment processes. The flow conditions, described below, account for future population growth and industrial expansion estimates. No new significant industrial users are anticipated; however, the City has included future capacity to either attract or expand existing industrial users.

Planning Period

The typical planning period for collection system infrastructure is 50 to 70 years and 20 years for wastewater treatment facilities. Determination of the planning period includes the additional time required for facility design, bidding, and construction.

The future capacity of the WWTF will be based upon the higher value of either:

- Projections of flows and loading to a design year of 2045, or
- The existing permitted capacity of the WWTF.

Anticipated Flow and Load Demand from Domestic Users

Two anticipated population demand scenarios were evaluated for the determination of the domestic wastewater flow and load demand associated with the design year:

- Constant growth based on historical City growth maximum.
- Growth similar to County based on Minnesota Demographic Center estimates.

The community has observed a maximum growth rate of 3.0% year-to-year during the planning period. This growth scenario assumes the 2.0% growth rate remains the average during the planning period of the report. This alternative will serve as a “high” growth scenario.

The State Demographic Center prepares population growth estimates for counties within Minnesota. Historically, this has been well reflected in the growth rate of the community as well and would serve as the basis for population projections during the planning period. This alternative will serve as a “typical” growth scenario.

Figure 2 illustrates the predicted service populations for the design year based on the growth scenarios identified.

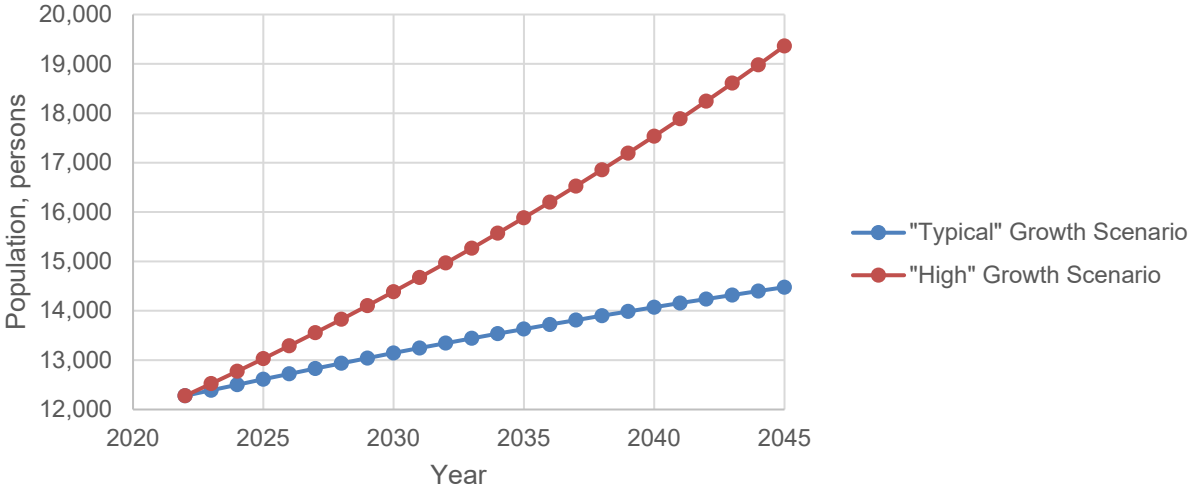

Figure 2: Anticipated Population Demand Scenarios

The 2021 estimated service population is 12,165 residents based on the Minnesota Demographic Center estimate. The “high” growth scenario would result in a service population of 19,361 residents for the design year, while the “typical” growth scenario would result in a service population of 14,447 residents for the design year.

The “typical” growth rate was determined to be the likely rate of development for the community and will be used as the basis for the non-industrial flow and load determination. The future design condition will also account for addition flows and loads from the following growth components:

- Additional wastewater generated from new and existing Industrial users (SIU and CIU users).
- Additional wastewater generated from new and existing Non-Industrial and Non-Domestic users (commercial and light industrial users).

Anticipated Flow and Load Demand from Non-Industrial and Non-Domestic Users

The community had developed and adopted a comprehensive growth plan in 2018. As part of the comprehensive plan, zoning maps were developed to indicate the areas in and around the City which are targeted for particular types of development. As part of these maps, the following land use areas were identified for non-industrial and non-residential development:

- 180 acres of General Business (B-3)
- 160 acres of Industrial Park (I-1)
- 150 acres of General Industrial (I-2)
- 50 acres of Isolated Industrial (I-3)

The comprehensive plan identifies the anticipated land uses for each area. Each area is assumed to generate residential strength wastewater and not contain SIU or CIU users, which would be identified as Industrial users for the purposed of flow and load design capacities.

- **General Business (B-3):** Retail, service, office, civic, cultural and entertainment uses, R-C mixed-use, conference centers, convenience stores, brew pubs, day care, motels, long-term care, auto repair, theatres. It is assumed this land use will generate 1,200 gallons of wastewater per day per acre at The City’s current wastewater loading rate.

- **Industrial Park (I-1):** Animal hospitals, distribution centers, hospitals, offices, PUD, accessory retail. It is assumed this land use will generate 900 gallons of wastewater per day per acre at The City's current wastewater loading rate.
- **General Industrial (I-2):** Animal hospitals, distribution centers, hospitals, offices, PUD, accessory retail, radio antennas, shooting range, incineration. It is assumed this land use will generate 900 gallons of wastewater per day per acre at The City's current wastewater loading rate.
- **Isolated Industrial (I-3):** Animal hospitals, distribution centers, hospitals, offices, PUD, accessory retail, radio antennas, shooting range, incineration, satellite dishes, oil storage, outdoor storage, freight terminals, trash disposal. It is assumed this land use will generate 900 gallons of wastewater per day per acre at The City's current wastewater loading rate.

Additional commercial and light industrial flow can be characterized by the residential equivalent unit. This unit is a helpful tool in understanding the available capacity for non-domestic wastewater generation in terms of household equivalents. For the City, the typical wastewater generation is approximately 55 gallons per capita per day. According to the Minnesota Demographic Center, the typical household size is 2.99 persons per household. This corresponds to an average household wastewater generation rate of 165 gallons per day per household. Since the additional planned flows and loads are required to be at or below residential strength, and does not include SIU or CIU dischargers, a similar approach can be assumed for anticipated loads as a result of additional development.

Table 8 summarizes the anticipated additional flows and loads as a result of Non-Industrial and Non-Domestic users.

Table 8: Anticipated Non-Industrial and Non-Domestic Users

Land Use	Land Use Description	Commercial			Light Industrial		
		gal/d/ acre [A]	acre [B]	gal/d	gal/d/ acre [A]	acre [B]	gal/d
B-3	Area 1. General Business	1,200	80	96,000			
B-3	Area 2. General Business	1,200	100	120,000			
I-1	Area 3. Industrial Park				900	100	90,000
I-1	Area 4. Industrial Park				900	60	54,000
I-2	Area 5. General Industrial				900	50	45,000
I-2	Area 6. General Industrial				900	60	54,000
I-3	Area 7. Isolated Industrial				900	90	81,000
		Total	180	216,000	Total	360	324,000
Flow Condition or Load Parameter		**Unit**		**Value**	**Unit**		**Value**
Wastewater Flow, gallon per capita day [B]		gpd		100	gpd		100
Population equivalents, persons		persons		2,160	persons		3,240
Persons per household, persons [C]		pph		2.99	pph		2.99
Residential equivalents, residences		REU		723	REU		1,084

Notes:
A. Based on assumed wastewater flow generation rates for associated land uses.
B. Acreage from areas identified in 2018 comprehensive growth plan.
C. Based on the Non-Industrial Calendar Average Day Flow.
D. Based on Minnesota Demographic Center Estimates.

The additional Non-Industrial and Non-Domestic wastewater anticipated to be generated from the areas identified in the 2018 comprehensive growth plan correspond to a population equivalent of 5,400 population equivalents (residents), or 1,804 residential equivalent units (households).

Table 9 summarizes the addition planned flow and load capacity for anticipated commercial and light industrial users identified in the 2018 comprehensive growth plan.

Table 9: Anticipated Flow and Load Demand from Non-Industrial and Non-Domestic Users

Flow Condition or Load Parameter	Calendar Day Average	Maximum Month as Day	Calendar Day Maximum
Wastewater Flow Condition, mgd [A]	0.476	0.540	0.803
5-Day Carbonaceous Biochemical Oxygen Demand ($cBOD_5$), ppd [B]	559	994	1,875
Total Suspended Solids (TSS), ppd [C]	1,182	2,678	4,344
Total Phosphorus (TP), ppd [D]	19	30	40
Total Kjeldahl Nitrogen (TKN), ppd [E]	146	200	200

Notes:
A. Non-Industrial portion of flow condition corresponds to a per capita flow rate of 100 gpcd.
B. Non-Industrial portion of load parameter corresponds to a reported per capita loading rate of 0.10 ppcd.
C. Non-Industrial portion of load parameter corresponds to a reported per capita loading rate of 0.22 ppcd.
D. Non-Industrial portion of load parameter corresponds to a reported per capita loading rate of 0.003 ppcd.
E. Non-Industrial portion of load parameter corresponds to a reported per capita loading rate of 0.027 ppcd.

Anticipated Flow and Load Demand from Industrial Users

The City is currently in the process of finalizing a significant industrial user agreement with significant industrial user 1. As part of the agreement, a flow charge has been determined based upon metered facility water use rates. Assumptions for corresponding wastewater generation and characterization have been applied to compare the industrial wastewater flows and loads to the equivalent residential strength wastewater. A strength charge for loading was determined using reference values for typical wastewater characteristics for that industry.

For the purpose of planning, significant industrial user 1 will increase wastewater generation to three times the current flow. Wastewater characteristics for the operation are not anticipated to change significantly during the planning period, therefore load concentration will remain constant and the current peaking factors for maximum month as day average load and maximum calendar day loads will be used for the future projection.

Table 10 on the following page summarized the anticipated current and future day average flow and loading rates for significant industrial user 1.

Table 10: Significant Industrial User 1 Flow and Load Demand

Flow Condition or Load Parameter	Current			Additional Capacity		
	Calendar Day Average	Maximum Month as Day	Calendar Day Maximum	Calendar Day Average	Maximum Month as Day	Calendar Day Maximum
Flow, mgd [A]	0.004	0.005	0.005	0.007	0.009	0.009
5-Day Carbonaceous Biochemical Oxygen Demand ($cBOD_5$), ppd [B]	322	490	618	643	980	1,235
Total Suspended Solids (TSS), ppd [B]	70	184	232	141	368	463
Total Phosphorus (TP), ppd [C]	2.1	3.7	4.6	4.3	7.4	9.3
Total Kjeldahl Nitrogen (TKN), ppd [D]	3.5	4.3	4.3	7.0	8.5	8.5

Notes:
A. Based on metered water use rates, assumed 70% wastewater production.
B. Based on typical wastewater characterization as presented in Brewer's Association. Wastewater Management Guidance Manual. 2017.
C. Based on typical wastewater characterization as presented in Enitan, A. M. et al. Characterization of Brewery Wastewater Composition. World Academy of Science, Engineering and Technology International Journal of Environmental and Ecological Engineering Vol:9, No:9. 2015.
D. Based on additional sampling performed 7/26/2022.

The City has prepared and issued a significant industrial user agreement with significant industrial user 2. As part of the agreement, flow charge has been determined based upon metered facility flow rates and sampled facility wastewater. Measured wastewater generation and characterization compare the industrial wastewater flows and loads to the equivalent residential strength wastewater. Strength charge for loading is determined based upon composite sampling completed on the wastewater generated by that industry.

It is estimated that significant industrial user will increase their wastewater generation by 20,000 gallons per day in 2023 with another increase in flow of 20,000 gallons in 2024. For the purpose of planning, significant user 2 will double the wastewater generation to three times the current flow. Wastewater characteristics for the operation are not anticipated to change significantly during the planning period, therefore load concentration will remain constant and the current peaking factors for maximum month as day and maximum day loads will be used for the future projection.

Table 11 on the following page summarized the anticipated current and future day average flow and loading rates for significant industrial user 2.

Table 11: Significant Industrial User 2 Flow and Load Demand

Flow Condition or Load Parameter	Current			Additional Capacity		
	Calendar Day Average	Maximum Month as Day	Calendar Day Maximum	Calendar Day Average	Maximum Month as Day	Calendar Day Maximum
Wastewater Flow, mgd [A]	0.048	0.73	0.128	0.048	0.073	0.128
5-Day Carbonaceous Biochemical Oxygen Demand ($cBOD_5$), ppd [B]	548	928	2,505	548	928	2,505
Total Suspended Solids (TSS), ppd [B]	204	430	1,094	204	430	1,094
Total Phosphorus (TP), ppd [B]	2.2	3.5	12.4	2.2	3.5	12.4
Total Kjeldahl Nitrogen (TKN), ppd [C]	22.9	36.7 [D]	36.7	22.9	36.7	36.7

Notes:
A. Metered value as part of SIU agreement November 2019 through April 2022.
B. Sampled value as part of SIU agreement November 2019 through April 2022.
C. Special sampling completed consisting of 2 samples collected 7/14/2022 and 7/19/2022.
D. Corresponding peaking factor assumed as 1.6 based on similar peaking factor for $cBOD_5$ and TP.

The City intends to require new industries sited in the community and discharging to the sanitary sewer system to pretreat industrial wastewater to residential strength as needed. The City is planning to reserve facility flow and load capacity for new or expansion to existing significant industrial users. The reserved capacity provides flexibility to be utilized as either new users, or additional expansion for current users.

NPDES/SDS Effluent Permit Limitations

The Big Lake WWTF is regulated by the National Pollutant Discharge Elimination System (NPDES) permit number MN0041076. Table 12 on the following page summarizes the effluent limits at the current AWW design flow of 0.958 MGD and anticipated future effluent limits as indicated by frozen mass limits provided by a preliminary effluent limit request response letter furnished by the MPCA.

The preliminary effluent limit request response letter is dated November 2, 2022 and is included in Attachment 1. The preliminary effluent request response letter is for an initial, higher-growth planning scenario. The frozen mass limits were used for projecting the anticipated effluent water quality requirements at the revised growth scenario addressed in this facilities plan report.

Table 12: Current and Anticipated NPDES/SDS Effluent Permit Limitations

Parameter	Current Effluent Limit		Anticipated Effluent Limit [6]	
	Month [1]	Week [2]	Month [1]	Week [2]
$cBOD_5$ load, kg/d	34.3	54.9	34.3	54.9
$cBOD_5$ concentration, maximum, mg/L	25.0	40.0	25.0	40.0
$cBOD_5$ concentration, at AWW flow, mg/L[5]	10.8	17.3	5.4	8.6
$cBOD_5$ percent removal	85% min		85% min	
TSS load, kg/d	41.2	61.7	41.2	61.7
TSS concentration, maximum, mg/L	30	45	30	45
TSS concentration, at AWW flow, mg/L[5]	10.8	17.3	6.5	9.7
TSS percent removal	85% min		85% min	
TP, kg/year	1160 [3]		1160 [3]	
TP load, kg/d [5]	3.2		3.2	
TP concentration. at AWW flow, mg/L[5]	0.5		0.5	
pH, SU	6.0 – 9.0 [4]		6.0 – 9.0 [4]	
Fecal Coliform, MPN (geometric mean)	200		200	

Notes:
1. Denotes Calendar Month Average effluent permit limitation.
2. Denotes Calendar Week Average effluent permit limitation.
3. 12-Month Moving Total effluent permit limitation.
4. Each Sample effluent permit limitation.
5. Parameter is not included in effluent permit limitation but is the calculated equivalent to meet required effluent limitations.
6. Corresponds to a concentration as the design flow of 1.682 MGD AWW flow based on the frozen mass limits indicated in the preliminary effluent request response letter furnished by the MPCA.

Anticipated Flow and Load Demand Scenario

The anticipated flow and load demand scenario was developed with consideration for the frozen mass limits provided with the preliminary effluent limit request response letter from the MPCA.

The anticipated flow and load scenario pursued by the City of Big Lake was developed to include:
- Anticipated Domestic Flow and Load Demand associated with the “Typical” growth scenario,
- Anticipated Significant Industrial User 1 Flow and Load Demand,
- Anticipated Significant Industrial User 2 Flow and Load Demand, and
- Anticipated Non-Industrial and Non-Domestic Flow and Load Demand.

The flow and load demand correspond to flow associated with the attainable level of effluent quality without need for tertiary treatment. This determination is based on the frozen mass limits provided by the preliminary effluent limit request response letter from the MPCA. The limiting constituent is total phosphorus. A total design flow capacity of 1.680 MGD is therefore targeted for a corresponding average effluent total phosphorus limit of 0.5 mg/L, which is required to meet the 12-month moving total mass limit of 1,1160 kg.

The historical flow data from the review period was used to help determine the design year projected flows and loads. The MPCA flow determination worksheet for the design period is included in Attachment 2. The projected average wet weather flow for the design year is 1.680 MGD.

The projected flow conditions are reported in Table 13 on the following page and account for the projected changes in the domestic service population, anticipated non-industrial and non-domestic users, and industrial users.

Projected flows were determined using the more conservative per capita flow based on:

- Reported flow from discharge monitoring reports,
- MPCA minimum design standards, and
- Reference recommended minimum design standards.

Table 13: Anticipated Wastewater Flow Demand

Flow Condition	Flow
Average Dry Weather (ADW), mgd	1.366
Calendar Average Day Flow (ADF), mgd	1.446
Average Wet Weather (AWW), mgd [A]	1.682
Peak Hour Wet Weather (PHWW), mgd [B, C]	4.467
Peak Instantaneous Wet Weather, mgd (PIWW) [B]	4.467

Notes:
A. Corresponds to a flow rate of 100 gpcd for non-industrial users and 100 gpcd for domestic users.
B. Instantaneous flow data unavailable. Peak determined using existing lift station pump capacity base on sewer flow rates.
C. Corresponds to a peaking factor of 2.6 times the average calendar day flow, which is equivalent to the 10 States Standards Recommendation of 2.6 based on service population.

Peaking factors for projected loading were calculated from the review period discharge monitoring reports. Peaking factors were determined by calculating the per capita flow or load condition based on the current service population, and projecting the future peak loading based on the increase in service population.

Peak Instantaneous Wet Weather and Peak Hourly Wet Weather flow are assumed to be the same for the facility and based upon the existing main lift station rated pump capacity of 1,500 gpm. The City has not experienced backups at the main lift station during the review period.

Table 14 summarizes the projected loading conditions for the facility.

Table 14: Anticipated Wastewater Load Demand

Load Parameter	Calendar Day Average	Maximum Month as Day	Calendar Day Maximum
5-Day Carbonaceous Biochemical Oxygen Demand, ppd [A, C]	4,621	7,773	14,988
Total Suspended Solids (TSS), ppd	5,465	12,227	19,984
Total Phosphorus (TP), ppd [B, D]	87	138	195
Total Kjeldahl Nitrogen (TKN), ppd [B, E]	562	894	894

Notes:
A. Reported Current calendar average load corresponds to a per capita loading which is less than the MPCA and 10 States Standards recommended minimum design value for the parameter.
B. Reported Current calendar average load corresponds to a per capita loading which is less than the Metcalf and Eddy recommended minimum design value for the parameter.
C. Minimum per capita load design value of 0.17 ppcd $cBOD_5$ used.
D. Minimum per capita load design value of 0.004 ppcd TP used.
E. Minimum per capita load design value of 0.027 ppcd TKN used.

The anticipated wastewater flow and load demands include sufficient capacity for:

- Additional anticipated domestic growth of 2,199 persons,
- Additional partial anticipated non-industrial and non-commercial growth, and
- Additional anticipated industrial growth for significant industrial users 1 and 2.

Equalization

The MPCA recommends investigation of equalization for projected flows and loads where the projected design peak instantaneous wet weather flow is greater than three times the projected design average wet weather flow. The projected flow values for the community correspond to PIWW flow 2.66 times larger than the AWW flow.

Design Year Conditions

The anticipated flow and loading demand is based upon the "typical" growth scenario for domestic service population. The anticipated flow and load demand also includes planned capacity for any additional commercial, light industrial users, and institutional users as well as known expansion of the current industrial users.

The MPCA flow determination worksheet was also reviewed for determination of ADW, AWW, PHWW, and PIWW flow. PHWW and PIWW flows were determined using the current main lift station pumping capacity and if greater than the peaking factor using service population as recommended by 10 States Standards for Wastewater Facilities (2014 Edition) based on the service population, sections A and B for design flow determination of table 2 will not be used. A peaking factor of 2.6 was used based on the current influent lift station design capacity. The peaking factor is equivalent to the 2.6 recommended as part of the 10 States Standards based on service population. Inflow and infiltration have also been considered and factored into the anticipate flow determination as discussed previously. A copy of the MPCA Design Flow and Loading Guidelines for Wastewater Treatment Plants is located in Attachment 3, however sections A and B for design flow determination of table 2 were not used. Rather the determination of this memorandum sufficiently discusses the flow and loads outlined by the guidance.

Table 15 summarizes the design year flows and loadings for the facility.

Table 15: Design Year Combined Wastewater Anticipated Flow and Load Demand

Flow Condition		**Value**	
Average Dry Weather (ADW), mgd		1.366	
Calendar Average Day Flow (ADF), mgd		1.446	
Average Wet Weather (AWW), mgd [A]		1.682	
Peak Hour Wet Weather (PHWW), mgd [B, C]		4.467	
Peak Instantaneous Wet Weather (PIWW), mgd [B]		4.467	
Load Parameter	**Calendar Day Average**	**Max Month as Day**	**Calendar Day Maximum**
5-Day Carbonaceous Biochemical Oxygen Demand ($cBOD_5$), ppd [D]	4,621	7,773	14,988
Total Suspended Solids (TSS), ppd [E]	5,465	12,227	19,984
Total Phosphorus (TP), ppd [F]	87	138	195
Total Kjeldahl Nitrogen (TKN), ppd [F]	562	894	894

Notes:

A. Corresponds to a flow rate of 62 gpcd for non-industrial users and 100 gpcd for domestic users.
B. Instantaneous flow data unavailable. PIWW determined using existing lift station pump capacity.
C. Corresponds to a calendar day average to peak hourly wet weather peaking factor of 2.6, which is equal to the 10 States Standards for Wastewater Facilities (2014 Edition) recommendation of 2.6 based on service population.
D. Corresponds to MPCA recommended minimum design value for parameter.
E. Corresponds to observed loading based on reported DMR sampling values.
F. Corresponds to Metcalf and Eddy recommended minimum design value for loading.

ejm
Attachments:
Attachment 1: Preliminary Effluent Limit Request Electronic Response Letter Dated Nov. 2, 2022.
Attachment 2: Summary of Monthly Flow and Load Demand
Attachment 3: MPCA Design Flow and Loading Determination Guidelines for Wastewater Treatment Plants

c: Eric Miller, SEH Inc.
Colin Marcusen, SEH Inc.

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Attachment 1

Preliminary Effluent Limit Request Response Letter

RE: Preliminary Effluent Limits for the Proposed Big Lake Discharge
NPDES/SDS Permit MN0041076-SD001

Mr. Wolohan:

This electronic-letter is in response to your request for preliminary effluent limits for an expansion of the City of Big Lake wastewater treatment plant (WWTP). It summarizes the preliminary effluent limits for the WWTP proposed expansion. The preliminary limits are draft values. Effluent limits only become final after the National Pollutant Discharge Elimination System (NPDES) permit has undergone a complete review, been public noticed, the public's comments considered and either our Commissioner or a delegated representative signs the permit.

Please be aware that receiving the preliminary effluent limits in the table below does not mean that your proposed expansion/new facility has been approved. As part of the permitting process, your project must comply with antidegradation requirements (see the Antidegradation Requirement section below for important details). You must demonstrate that there is no way to avoid water quality degradation and that the chosen project alternative is the least degrading prudent and feasible alternative. In many cases, the least degrading prudent and feasible alternative may not be your preferred option or the option(s) discussed in this letter. (7050.0280, subp. 2).

Scenario descriptions

The City of Big Lake requested preliminary effluent limits for one scenario at their Big Lake WWTF discharge:

	Average Wet Weather Design (MGD)	Average Dry Weather Design (MGD)	Discharge Type
Existing Facility	0.958	0.746	Continuous
Scenario #1	2.206	1.413	Continuous

The receiving water will remain the Mississippi River. This section of the Mississippi River is classified as a 1C, 2Bdg, 3,4,5,6 river and is also designated as a restricted outstanding resource value water.

The 7Q10 flow rate of this reach of the Mississippi River is 1074 cfs and this 7Q10 flow rate represents a dilution ratio of 1746:1 at the expanded flow rate.

Table 1: Limits Table

	Existing Discharge		Scenario 1	
AWWDF (MGD)	0.958		2.206	
ADWDF (MGD)	0.746		1.413	
River flow- 7q10	1074		1074	
Dilution Ratio	2685		1746	
Antideg review needed?	No		Yes	
Environmental review needed?	No		No	
Frozen Mass Limits Possible?			Yes	
$cBOD_5$-Ammonia Linkage Eligible?	NA		No	
POLLUTANT / PARAMETER	Conc.	Mass	Conc.	Mass
$cBOD_5$, mg/L (kg/day)	25	34.3	25	34.3[1]
TSS, mg/L (kg/day)	30	41.2	30	41.2[1]
Fecal Coliform Organisms, orgs/100 mL	200 (Apr-Oct)	---	200 (Jan-Dec)	---
Ammonia-N (June 1 - September 30)	---	---	---	---
Ammonia-N (October 1 - November 30)	---	---	---	---
Ammonia-N (December 1 - March 31)	---	---	---	---
Ammonia-N (April 1 - May 31)	---	---	---	---
Dissolved Oxygen, mg/L	---	---	---	---
pH (Standard Unit)	6.0 - 9.0	---	6.0 - 9.0	---
Mercury[3]	---	---	---	---
Phosphorus, mg/L	---		1.0	
Phosphorus, kg/yr (12 month rolling avg)	---	1,160	---	1,160
Chloride, mg/L as Mo. Avg. (kg/day)	---	---	---	---

1. Mass limits associated with previous permit 0.84 MGD AWWDF frozen mass limits.
2. The disinfection limits would be required all year to ensure protection of the ORVW and ensure protection of water at the metro drinking water intakes.
3. Mercury limits and antidegradation analysis of mercury loading would not be required if frozen TSS mass limits are accepted.

Impaired Waters

There are numerous waters impaired for a variety of pollutants ranging from PFAS to mercury and nutrients. Not all of these impairments are relevant for any of the proposed scenarios. The impaired waters of primary importance for effluent limit setting are nutrients, TSS and fecal coliform and all three of these parameters have wasteload allocations in approved TMDLS. It would be very difficult and time intensive to officially modify these TMDLs for Big Lake to receive a larger wasteload allocation.

Phosphorus Details

The current facility has a 1,160 kg/yr 12-month moving total mass limit. The proposed facility has an average wet weather design flow (AWWDF) of 2.206 mgd (Table 2). The new facility will have an annual 1.0 mg/L concentration limit regardless of design flow (Minnesota Rule 7053.0255 subpart 3) because the AWWDF is greater than 1.0 MGD. The Mississippi River and Lake Pepin TMDL established an annual wasteload allocation of 1,160 kg/yr for the Big Lake WWTF (MPCA and Limnotech 2021). The annual mass limit for the proposed expansion is 1,160 kg/yr. As flows at the Big Lake WWTF increase, the facility will have to achieve well below 1.0 mg/L to comply with the 1,160 kg/yr annual mass limit.

Table 2. Total phosphorus (TP) effluent concentrations to achieve Lake Pepin based mass allocation of 1,160 kg/yr at proposed average wet weather design flows (AWWDF) and average dry weather design flows (ADWDF).

Design	flow (mgd)	TP mg/L	TP kg/d	kg/yr
Current AWWDF	0.958	0.8765	3.18	1,160
Current ADWDF	0.746	1.00	2.82	1,031
Proposed AWWDF 1	2.206	0.3805	3.18	1,160
Proposed ADWDF 1	1.413	0.594	3.18	1,160

The proposed expansion will continue to be to the Mississippi River. Kaufenberg (2017) found that the Lake Pepin based limits were sufficient to protect the Mississippi River reaches within the Mississippi River – St. Cloud Watershed. An antidegradation review for phosphorus is not needed since no additional mass of phosphorus is authorized from the proposed expansion.

Class 3 and 4 Water Quality Standards

In 2020 the MPCA submitted a rulemaking proposal to make changes to the existing class 3 and 4 water quality standards. On July 13th, 2021 these rules became effective in state law. The new draft class 3 and 4 standards now have translators effective (Class 3 & Class 4A) in rule that the MPCA must use to determine whether a discharger requires an effluent limit to protect the class 3 and 4 beneficial uses. These translators turn the protective narrative goals of the class 3 and 4A designated uses into enforceable numeric effluent limits. The MPCA does not expect that Big Lake will need a new limit because of these translators, but the MPCA must document that the translators were used upon issuing the permit.

Monitoring requirements

All municipal NPDES permit holders need to monitor for pH, TSS, CBOD5, and DO, fecal coliform. In addition, this permittee will have to monitor the following parameters at the frequencies specified in the table below. The WET testing and priority pollutant scans are required because the facility would become a Major facility (AWWDF > 1MGD).

Table 3 Additional required monitoring beyond standard monitoring

Analyte	Units	Options 1-3 Mechanical Frequency & Influent/Effluent
Mercury, Total	ng/L	4X per year I/E
Mercury, Dissolved	ng/L	4X per year I/E
TSS (grab w/Mercury)	mg/L	4X per year I/E
Ammonia nitrogen, Total	mg/L	4X per year E
Kjeldahl nitrogen, Total	mg/L	4X per year I/E
Nitrate/nitrite nitrogen	mg/L	4X per year I/E
TDS	mg/L	2X per year E
Sulfate	mg/L	2X per year E
Chloride	mg/L	---
Sodium, Calcium & Magnesium	mg/L, umhos/cm	---
Acute Wet Testing	NA	1X per Year
Priority Pollutant Scan	NA	3X per 5 yr cycle

Regulatory Certainty

In response to listening session comments, a voluntary option — part of the Governor's Community Water Infrastructure bonding investment package — would provide up to 20 years of regulatory certainty for wastewater treatment facilities that are willing to accept phosphorus and nitrogen effluent limits and design, construct, and fully operate a biological nutrient removal (BNR) treatment system[1],[2]. BNR systems remove both phosphorous and nitrogen, and are considered the best available technology for wastewater treatment. Indeed, BNR is the only known cost-effective wastewater removal technology for nitrate.

Once the BNR system is in place, the facility would not be required to comply with any new phosphorous or nitrogen limits, beyond those in their discharge permit, for the estimated useful life of the new BNR system. The proposal is linked to a bonding request for water infrastructure grants, and is intended to incentivize facility upgrades to BNR systems.

Communities that volunteer to participate by installing and operating BNR systems would no longer have to speculate what future nitrogen water quality standards might mean for them. Rather than needing to upgrade to meet phosphorus limits now and potentially upgrade again to meet nitrogen limits in five or ten years, communities that install a BNR system would comprehensively address all nutrients for up to 20 years and obtain regulatory certainty. Over time, communities could also save money by reducing both energy usage and the purchase of chemicals for phosphorus removal. Water quality in Minnesota lakes and rivers would also benefit from more treatment plants converting to the best available technology. Notably, we could get a jump on reducing nitrogen in state waters, years ahead of when we can institute a new nitrogen standard. And because Minnesota is home to the headwaters of the Mississippi River, the Great Lakes, and the Red River of the North, the impact of reducing phosphorus and nitrogen in the state will be felt in all our downstream waters, including the Hudson Bay, the Gulf of Mexico, and all the Great Lakes.

[1] Minnesota Statute 115.426

[2] Fact sheet on regulatory certainty

Antidegradation Assessments and Capped Mass Limits

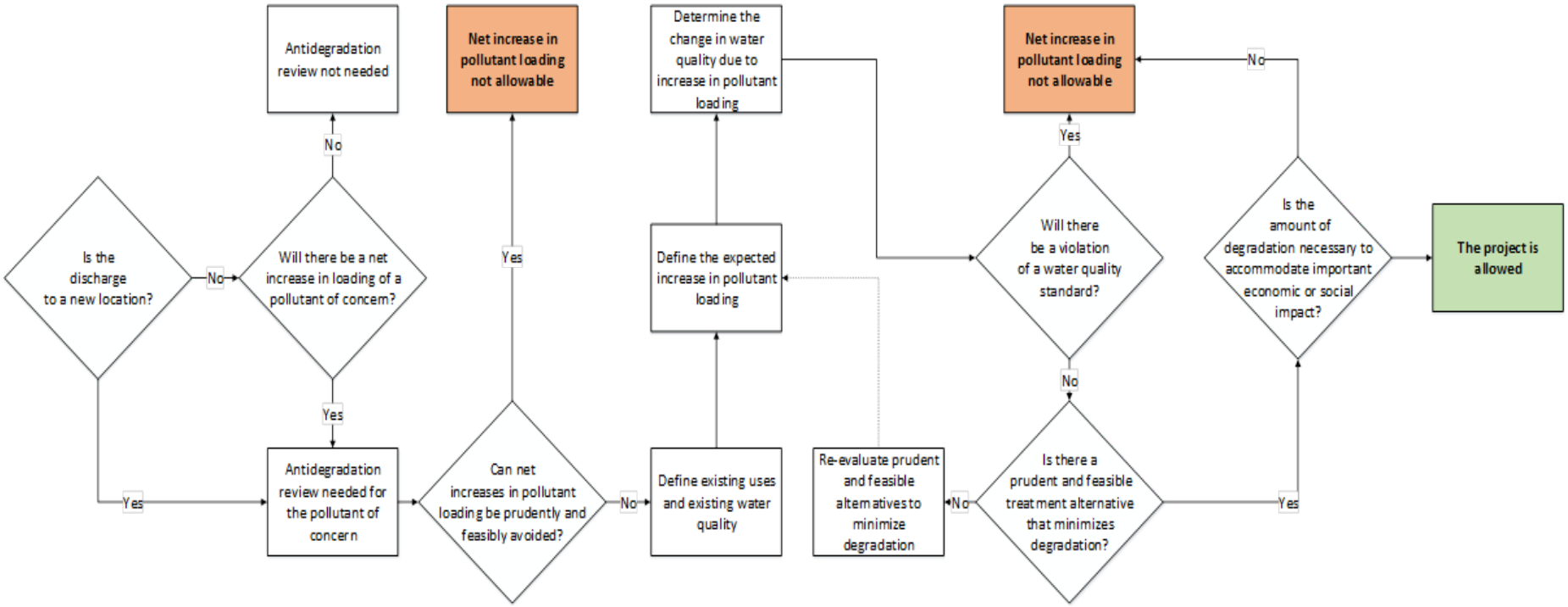
Antidegradation is one of the fundamental protections in the Clean Water Act, and all newly issued or re-issued wastewater permits must comply with both state and federal antidegradation Rules. The goal of antidegradation is to preserve waters of high quality and to ensure that they are not degraded unless balanced by important economic or social development. See Minn. R. 7050.0250 to 7050.0335. The antidegradation assessment process may result in more restrictive effluent limits.

For wastewater permitting, antidegradation concerns are triggered when a new discharge is proposed or when an existing discharger is proposing to increase the loading of any parameter of concern in its discharge. An antidegradation assessment is a substantial evaluation that must consider all beneficial uses of the receiving water, potential economic impacts, all possible treatment options and the potential environmental degradation for every pollutant that triggers the need for an antidegradation assessment. The applicant (permittee) must demonstrate that the chosen project alternative cannot be avoided and is the least degrading prudent and feasible alternative. The permittee must also examine the socioeconomic impacts of the project as compared to the environmental changes in water quality. The environmental degradation must be offset by the socioeconomic benefit. A flowchart summary of the antidegradation assessment process required by state rules (Minn. R. 7050.0280) can be seen below.

New and expanded NPDES permits that result in net increases in pollutant loading to surface waters are required to undergo an antidegradation review (Minn. R. 7050.0280). When applied to a proposed activity that is not regulated by an existing control document (i.e. permit), any loading or other causes of degradation resulting from the proposed activity constitute a net increase (7050.0255 Subp. 26). In this situation, the proposed new treatment system constitutes a net increase in loading; and therefore, an antidegradation review must be completed and approved in order for the effluent limitations to be final for the selected option.

The permittee must submit the antidegradation assessment to the Minnesota Pollution Control Agency (MPCA). MPCA staff will review the assessment to determine if it satisfies state and federal rules. The MPCA has recently developed a guidance document for developing antidegradation assessments that you may find helpful.

Antidegradation assessments frequently require permittees to perform additional water quality monitoring to ensure that appropriate water quality evaluations are performed. The water quality monitoring required for an antidegradation assessment is permit-specific and is intended to fill gaps in existing water quality knowledge. Filling these water quality gaps could require additional monitoring of the discharge, receiving waters upstream and downstream of the discharger or significant industrial users permitted by the discharger.



Summary of the antidegradation assessment process required by Minn. R. 7050.0280

Completing an antidegradation assessment can require a significant amount of time, data and writing effort. It is reasonable to expect at least six to twelve months of effort to complete an antidegradation assessment. The permittee is expected to complete the antidegradation assessment, but the MPCA must approve it as a part of permit documents. The MPCA is responsible for defending the assessment during public comment and in any future legal proceedings. Antidegradation assessments are frequently legally contested, and as such, the MPCA will only approve an assessment of high quality that complies with state and federal antidegradation rules. MPCA staff may provide assistance to the permittee with the antidegradation process.

Because of the workload associated with completing an antidegradation assessment, most permittees looking to expand their permitted flow rates choose to accept "frozen mass limits". "Frozen mass limits" represent the full authorized load in the previous permit for the pollutants of interest. If the permittee is willing to accept "frozen mass limits" while also expanding their flow rates, then the receiving water would receive no net increase in authorized loading because of the expansion, and an antidegradation assessment would not be needed for that parameter. In this scenario, permitted concentration limits would stay the same as in the last permit issuance, however "effective" concentration limits would be lower in order to comply with voluntary mass limits. If the permittee voluntarily accepts frozen mass limits for the pollutants of concern, they will have satisfied antidegradation rules for that parameter, and they will not need to submit an antidegradation assessment for that parameter.

It must be noted that the receiving water for Big Lake is a restricted outstanding resource value water and the requirements in Minn. R. 7050.0265 subp. 6 are applicable (see statute below).

> **Subp. 6.** Protecting restricted outstanding resource value waters.
>
> The commissioner shall restrict a proposed activity in order to preserve the existing water quality as necessary to maintain and protect the exceptional characteristics for which the restricted outstanding resource value waters identified under part 7050.0335, subparts 1 and 2, were designated.

This statute requires the MPCA to restrict loading to ORVW waters to a higher degree than for non-ORVW waters. The functional result of this statute to Big Lake is that it would be difficult to justify expanding the frozen mass limits for any parameter and Big Lake would be wise to consider accepting frozen mass limits as they are found in the current permit.

Chloride is the only pollutant of concern that must be addressed in an antidegradation review that doesn't currently have a limit in the permit. Big Lake will not receive a chloride limit in the current or future permit, but because of the expansion there will be a net increase in chloride loading. An antidegradation review must address this net increase in loading of chloride and demonstrate that the exceptional characteristics of the Mississippi River will be maintained. It would be prudent to collect at least five chloride samples in Big Lake's effluent to characterize Big Lake's current chloride loading and fulfill the requirements in Minn. R. 7050.0265 with regards to calculating changes in receiving water quality because of the expansion. The MPCA can provide surface water quality data that would help with this calculation and has attached the Otsego West antidegradation assessment that contains a similar calculation for reference.

Environmental Review

An Environmental Assessment Worksheet (EAW) is likely to be required for the expanded facility. This is because for the expansion the flow rate would increase by both 200,000 GPD and by >50% (Minn. R. 4410.4300 subp. 18b). Please contact current MPCA Environmental Review (ER) Wastewater Liaison (Kim Grosenheider) with questions on MPCA ER interpretation. More information can be found in Minn. R. 4410.4300 or at https://www.eqb.state.mn.us/content/mandatory-environmental-review-categories-legislative-assessment-report. A full environmental review is not likely to be needed.

According to the *Preliminary Effluent Limit Review Request* document, the building of a new continuous WWTP will not impact wetlands. If building of the WWTP were to result in the physical alteration of a wetland, then wetland mitigation sequencing in compliance with Minn. R. 7050. 0186 would be required.

References

Kaufenberg, L. 2017. Total phosphorus effluent limit review: Upper Subwatershed of the Mississippi River – St. Cloud Watershed. MPCA St. Paul 17 pp.

If you have any questions, comments or concerns, please contact me at 651-757-2665 or email me at *Scott.Kyser@state.mn.us*

Sincerely,

Scott Kyser, PE
Minnesota Pollution Control Agency
Environmental Analysis and Outcomes Division

Attachment 2

Summary of Monthly Flow and Load Demand

Building a Better World for All of Us®

MEMORANDUM

TO: Dan Childs

FROM: Jessica Hedin, PE (Lic. MN 41639)

DATE: March 25, 2023

RE: Big Lake Wastewater Treatment Facilities Plan, Summary of Monthly Flow and Load Demand
SEH No. BIGLK 167307 14.00

The following memorandum is a summary of the reported influent and effluent water quality samples summarized as monthly flow and load demand. Sampling information was provided by the City of Big Lake and serves as the basis of flow and load determination as described in the memorandum "Big Lake Wastewater Treatment Facilities Plan, Anticipated Flow and Load Demand" memorandum.

Refer to the tables on the following sheets for a monthly summary of the sampling information provided.

Table 1 – Summary of Monthly Average Flow and Load Demand as Reported by Big Lake, 2017

Month	Influent Monitoring Parameters							Effluent Monitoring Parameters					
	Total Flow	$cBOD_5$	TSS	Total P as P	$NO^-_2 + NO^-_3$ as N	TKN	TN as N	$cBOD_5$	TSS	Total P as P	$NO^-_2 + NO^-_3$ as N	TKN	TN as N
	(MGD)	(mg/L)	(mg/L)	(mg/L)	(mg/L)	(mg/L)	(mg/L)	(mg/L)	(mg/L)	(mg/L)	(mg/L)	(mg/L)	(mg/L)
January	0.681	283	42	6.5	ND	ND	ND	6.8	8.6	0.5	ND	ND	ND
February	0.662	315	25	5.6	ND	ND	ND	3.5	9.0	0.4	ND	ND	ND
March	0.640	348	17	6.0	ND	ND	ND	2.8	7.2	0.4	ND	ND	ND
April	0.656	319	36	6.3	ND	ND	ND	5.0	9.6	0.6	14.0	28.0	24.3
May	0.731	299	17	7.3	ND	ND	ND	2.6	6.5	0.5	ND	ND	ND
June	0.772	385	33	8.5	ND	ND	ND	4.4	9.8	0.8	ND	ND	ND
July	0.755	418	16	8.1	ND	ND	ND	2.5	7.0	0.7	ND	ND	ND
August	0.767	345	22	8.9	ND	ND	ND	3.0	7.1	0.8	ND	ND	ND
September	0.779	469	19	10.7	ND	ND	ND	2.8	5.9	0.7	23.8	3.5	1.3
October	0.806	455	19	9.8	ND	ND	ND	2.5	10.9	0.9	ND	ND	ND
November	0.760	327	21	7.8	ND	ND	ND	2.9	7.3	0.7	18.9	ND	ND
December	0.728	469	21	8.6	ND	ND	ND	3.0	6.6	0.8	ND	ND	ND
Average	0.728	369	24	7.8	ND	ND	ND	3.5	8.0	0.7	18.9	15.7	**12.8**
Minimum	0.640	283	16	5.6	ND	ND	ND	2.5	5.9	0.4	14.0	3.5	**1.3**
Maximum	0.806	469	42	10.7	ND	ND	ND	6.8	10.9	0.9	23.8	28.0	**24.3**

Notes:
$cBOD_5$: 5-day carbonaceous biochemical oxygen demand.
TSS: Total suspended solids.
TP: Total Phosphorus.
TKN: Total Kjeldahl Nitrogen.
1. ND: No data collected for parameter during reporting period.

Table 2 – Summary of Monthly Average Flow and Load Demand as Reported by Big Lake, 2018

Month	Influent Monitoring Parameters							Effluent Monitoring Parameters					
	Total Flow	$cBOD_5$	TSS	Total P as P	$NO^-_2 + NO^-_3$ as N	TKN	TN as N	$cBOD_5$	TSS	Total P as P	$NO^-_2 + NO^-_3$ as N	TKN	TN as N
	(MGD)	(mg/L)	(mg/L)	(mg/L)	(mg/L)	(mg/L)	(mg/L)	(mg/L)	(mg/L)	(mg/L)	(mg/L)	(mg/L)	(mg/L)
January	0.702	420	33	7.7	ND	ND	ND	5.5	9.8	0.8	ND	ND	ND
February	0.750	454	38	7.5	ND	ND	ND	5.9	12.5	0.7	ND	ND	ND
March	0.703	313	37	7.3	ND	ND	ND	5.3	7.0	0.7	ND	ND	ND
April	0.669	321	30	7.1	ND	ND	ND	5.3	10.0	0.7	0.6	32.8	31.2
May	0.727	327	40	9.2	ND	ND	ND	5.6	10.9	0.7	ND	ND	ND
June	0.718	472	16	9.0	0.05	87	25	2.4	6.8	0.7	21.9	2.7	ND
July	0.733	423	16	8.5	ND	ND	ND	2.4	5.2	0.8	ND	ND	ND
August	0.723	302	13	8.2	ND	ND	ND	2.0	6.0	0.8	ND	ND	ND
September	0.736	299	14	8.6	0.05	53	25	1.9	4.3	0.8	22.6	1.9	0.3
October	0.715	595	17	8.7	ND	ND	ND	2.4	5.1	0.8	ND	ND	ND
November	0.702	527	41	8.6	ND	ND	ND	6.7	9.0	0.7	ND	ND	ND
December	0.601	529	18	9.1	0.05	73	36	3.3	9.5	0.6	22.2	13.7	9.6
Average	**0.706**	**415**	**26**	**8.3**	**0.05**	**71**	**28**	**4.1**	**8.0**	**0.7**	**16.8**	**12.8**	**13.7**
Minimum	**0.601**	**299**	**13**	**7.1**	**0.05**	**53**	**25**	**1.9**	**4.3**	**0.6**	**0.6**	**1.9**	**0.3**
Maximum	**0.750**	**595**	**41**	**9.2**	**0.05**	**87**	**36**	**6.7**	**12.5**	**0.8**	**22.6**	**32.8**	**31.2**

Notes:
$cBOD_5$: 5-day carbonaceous biochemical oxygen demand.
TSS: Total suspended solids.
TP: Total Phosphorus.
TKN: Total Kjeldahl Nitrogen.
1. ND: No data collected for parameter during reporting period.

Table 3 – Summary of Monthly Average Flow and Load Demand as Reported by Big Lake, 2019

Month	Influent Monitoring Parameters							Effluent Monitoring Parameters					
	Total Flow	$cBOD_5$	TSS	Total P as P	$NO^-_2 + NO^-_3$ as N	TKN	TN as N	$cBOD_5$	TSS	Total P as P	$NO^-_2 + NO^-_3$ as N	TKN	TN as N
	(MGD)	(mg/L)	(mg/L)	(mg/L)	(mg/L)	(mg/L)	(mg/L)	(mg/L)	(mg/L)	(mg/L)	(mg/L)	(mg/L)	(mg/L)
January	0.652	475	26	8.8	ND	ND	ND	4.3	9.5	0.5	ND	ND	ND
February	0.672	452	25	7.9	ND	ND	ND	3.7	8.1	0.4	ND	ND	ND
March	0.717	436	30	7.3	ND	ND	ND	4.4	8.0	0.4	18.8	9.7	7.1
April	0.670	494	24	7.2	ND	ND	ND	3.9	8.3	0.6	ND	ND	ND
May	0.738	466	20	7.5	ND	ND	ND	3.0	6.9	0.5	ND	ND	ND
June	0.787	359	27	7.5	0.09	54	21	4.1	7.3	0.6	18.8	2.3	ND
July	0.795	272	13	5.7	ND	ND	ND	2.0	3.6	0.5	ND	ND	ND
August	0.771	246	11	7.2	ND	ND	ND	1.7	5.1	0.7	ND	ND	ND
September	0.777	299	11	7.2	0.05	56	26	1.7	5.0	0.5	24.0	2.2	0.2
October	0.831	312	15	7.3	ND	ND	ND	2.0	4.7	0.5	ND	ND	ND
November	0.783	261	15	5.6	ND	ND	ND	2.5	6.9	0.4	ND	ND	ND
December	0.764	295	35	6.5	0.05	48	30	3.2	9.4	0.4	27.6	2.8	ND
Average	**0.746**	**364**	**21**	**7.2**	**0.06**	**53**	**26**	**3.1**	**6.9**	**0.5**	**22.3**	**4.2**	**3.7**
Minimum	**0.652**	**246**	**11**	**5.6**	**0.05**	**48**	**21**	**1.7**	**3.6**	**0.4**	**18.8**	**2.2**	**0.2**
Maximum	**0.831**	**494**	**35**	**8.8**	**0.09**	**56**	**30**	**4.4**	**9.5**	**0.7**	**27.6**	**9.7**	**7.1**

Notes:
$cBOD_5$: 5-day carbonaceous biochemical oxygen demand.
TSS: Total suspended solids.
TP: Total Phosphorus.
TKN: Total Kjeldahl Nitrogen.
1. ND: No data collected for parameter during reporting period.

Table 4 – Summary of Monthly Average Flow and Load Demand as Reported by Big Lake, 2020

Month	Influent Monitoring Parameters							Effluent Monitoring Parameters					
	Total Flow	$cBOD_5$	TSS	Total P as P	$NO^-_2 + NO^-_3$ as N	TKN	TN as N	$cBOD_5$	TSS	Total P as P	$NO^-_2 + NO^-_3$ as N	TKN	TN as N
	(MGD)	(mg/L)	(mg/L)	(mg/L)	(mg/L)	(mg/L)	(mg/L)	(mg/L)	(mg/L)	(mg/L)	(mg/L)	(mg/L)	(mg/L)
January	0.775	259	92	5.8	ND	ND	ND	15.0	19.1	1.1	ND	ND	ND
February	0.749	290	65	6.6	ND	ND	ND	10.2	19.4	0.8	ND	ND	ND
March	0.726	263	41	7.3	ND	ND	ND	6.6	9.7	0.5	0.3	36.6	32.1
April	0.700	229	39	7.5	ND	ND	ND	6.4	9.9	0.4	ND	ND	ND
May	0.694	265	12	7.0	ND	ND	ND	2.0	4.3	0.3	ND	ND	ND
June	0.718	255	12	8.1	0.05	57	32	2.0	3.8	0.4	27.4	4.3	ND
July	0.746	330	13	8.6	ND	ND	ND	2.1	4.6	0.4	ND	ND	ND
August	0.752	317	13	8.3	ND	ND	ND	1.9	5.0	0.4	ND	ND	ND
September	0.724	301	20	7.9	0.13	42	23	3.0	9.2	0.4	22.0	1.4	0.2
October	0.698	283	13	7.9	ND	ND	ND	2.2	6.4	0.3	ND	ND	ND
November	0.727	266	9	8.0	ND	ND	ND	1.7	3.9	0.1	ND	ND	ND
December	0.659	270	11	8.0	0.28	60	34	2.0	5.6	0.2	31.9	1.8	ND
Average	**0.722**	**277**	**28**	**7.6**	**0.15**	**53**	**30**	**4.6**	**8.4**	**0.4**	**20.4**	**11.0**	**16.2**
Minimum	**0.659**	**229**	**9**	**5.8**	**0.05**	**42**	**23**	**1.7**	**3.8**	**0.1**	**0.3**	**1.4**	**0.2**
Maximum	**0.775**	**330**	**92**	**8.6**	**0.28**	**60**	**34**	**15.0**	**19.4**	**1.1**	**31.9**	**36.6**	**32.1**

Notes:
$cBOD_5$: 5-day carbonaceous biochemical oxygen demand.
TSS: Total suspended solids.
TP: Total Phosphorus.
TKN: Total Kjeldahl Nitrogen.
1. ND: No data collected for parameter during reporting period.

Table 4 – Summary of Monthly Average Flow and Load Demand as Reported by Big Lake, 2021

Month	Influent Monitoring Parameters							Effluent Monitoring Parameters					
	Total Flow	$cBOD_5$	TSS	Total P as P	$NO^-_2 + NO^-_3$ as N	TKN	TN as N	$cBOD_5$	TSS	Total P as P	$NO^-_2 + NO^-_3$ as N	TKN	TN as N
	(MGD)	(mg/L)	(mg/L)	(mg/L)	(mg/L)	(mg/L)	(mg/L)	(mg/L)	(mg/L)	(mg/L)	(mg/L)	(mg/L)	(mg/L)
January	0.661	360	17	8.2	ND	ND	ND	2.8	4.1	0.2	ND	ND	ND
February	0.732	327	25	7.3	ND	ND	ND	3.7	9.1	0.2	ND	ND	ND
March	0.645	413	16	7.0	ND	ND	ND	2.5	5.8	0.2	24.1	1.7	0.1
April	0.621	387	9	7.4	ND	ND	ND	1.6	3.6	0.4	ND	ND	ND
May	0.645	365	13	7.0	ND	ND	ND	2.2	4.5	0.5	ND	ND	ND
June	0.718	364	8	7.1	0.05	61	33	1.3	4.0	0.5	30.8	1.7	ND
July	0.738	324	7	7.6	ND	ND	ND	1.1	2.2	0.6	ND	ND	ND
August	0.733	310	6	8.1	ND	ND	ND	1.1	3.6	0.6	ND	ND	ND
September	0.728	335	9	6.4	0.05	67	41	1.5	4.4	0.5	39.4	2.0	0.3
October	0.683	289	7	7.1	ND	ND	ND	1.2	4.6	0.4	ND	ND	ND
November	0.719	283	11	7.5	ND	ND	ND	2.0	3.3	0.2	ND	ND	ND
December	0.761	283	7	7.1	0.18	53	23	1.2	2.3	0.1	22.2	0.7	ND
Average	**0.699**	**337**	**11**	**7.3**	**0.09**	**60**	**32**	**1.9**	**4.3**	**0.4**	**29.1**	**1.5**	**0.2**
Minimum	**0.621**	**283**	**6**	**6.4**	**0.05**	**53**	**23**	**1.1**	**2.2**	**0.1**	**22.2**	**0.7**	**0.1**
Maximum	**0.761**	**413**	**25**	**8.2**	**0.18**	**67**	**41**	**3.7**	**9.1**	**0.6**	**39.4**	**2.0**	**0.3**

Notes:
$cBOD_5$: 5-day carbonaceous biochemical oxygen demand.
TSS: Total suspended solids.
TP: Total Phosphorus.
TKN: Total Kjeldahl Nitrogen.
1. ND: No data collected for parameter during reporting period.

Table 5 – Summary of Monthly Average Flow and Load Demand as Reported by Big Lake, 2022

Month	Influent Monitoring Parameters							Effluent Monitoring Parameters					
	Total Flow	$cBOD_5$	TSS	Total P as P	$NO^-_2 + NO^-_3$ as N	TKN	TN as N	$cBOD_5$	TSS	Total P as P	$NO^-_2 + NO^-_3$ as N	TKN	TN as N
	(MGD)	(mg/L)	(mg/L)	(mg/L)	(mg/L)	(mg/L)	(mg/L)	(mg/L)	(mg/L)	(mg/L)	(mg/L)	(mg/L)	(mg/L)
January	0.858	268	13	7.0	ND	ND	ND	2.1	3.1	0.1	ND	ND	ND
February	0.813	348	20	7.0	ND	ND	ND	6.0	5.0	0.1	ND	ND	ND
March													
April													
May													
June													
July													
August													
September													
October													
November													
December													
Average	**0.836**	**308**	**17**	**7.0**	**ND**	**ND**	**ND**	**4.1**	**4.1**	**0.1**	**ND**	**ND**	**ND**
Minimum	**0.813**	**268**	**13**	**7.0**	**ND**	**ND**	**ND**	**2.1**	**3.1**	**0.1**	**ND**	**ND**	**ND**
Maximum	**0.858**	**348**	**20**	**7.0**	**ND**	**ND**	**ND**	**6.0**	**5.0**	**0.1**	**ND**	**ND**	**ND**

Notes:
$cBOD_5$: 5-day carbonaceous biochemical oxygen demand.
TSS: Total suspended solids.
TP: Total Phosphorus.
TKN: Total Kjeldahl Nitrogen.
1. ND: No data collected for parameter during reporting period.

ejm

c: Eric Miller, SEH Inc.
Colin Marcusen, SEH Inc.

x:\ae\b\biglk\167307\4-prelim-dsgn-rpts\tech memos\facilities plan anticipated flow and load review\20230325 attachment 2 big lake wastewater treatment facilities plan, summary of monthly flow and load demand.docx

Attachment 3

MPCA Flow and Load Determination Guidance

Design flow and loading determination guidelines for wastewater treatment plants

Introduction

Determination of design flow and loadings is one of the most important items when planning a new or expanded wastewater treatment facility. Sound engineering judgement along with these minimum guidelines will determine the hydraulic and pollutant load capacity required by the proposed facility to meet all permitted limits.

All influent sources must be accounted for when completing design flow and loading determination including residential, seasonal, institutional, commercial, industrial, inflow, infiltration, any recycle streams, and any other unique aspect of flow and pollutant contributions. During the treatment facility design process, possible impacts of design flows and loadings on each upstream and downstream unit process should be considered.

Definitions

Existing flow data for critical low and peak wet weather events are used to estimate the following flow conditions critical to the design of wastewater treatment plants.

Term	Definition
ADW	**Average dry weather** flow is the daily average flow when the groundwater is at or near normal and a runoff condition is not occurring.
AWW	**Average wet weather** or peak month flow is the daily average flow for the wettest 30 consecutive days for mechanical plants or for the wettest 180 consecutive days for controlled discharge pond systems. The 180 consecutive days for pond systems should be based on either the storage period from approximately November 15 through May 15 or the storage period from approximately May 15 through November 15.
PHWW	**Peak hourly wet weather** **Existing collection system:** flow is the peak flow during the peak hour of the day at a time when the groundwater is high and a five-year one-hour storm event is occurring. To determine this five-year one-hour storm event for a specific location, please refer to Map Number 1. **New collection system:** 2.5 or higher multiplier or AWW for residential, commercial + peak hourly industrial. (Ten States Standards Figure 1, Chapter 10)
PIWW	**Peak instantaneous wet weather** **Existing collection system:** flow is the peak instantaneous flow during the day at a time when the ground water is high and a twenty-five year one-hour storm event is occurring. To determine the twenty-five year one-hour storm event for a specific location, please refer to Map Number 2. **New collection system:** 2.5 or higher multiplier or AWW for residential, commercial + peak hourly industrial. (Ten States Standards Figure 1, Chapter 10)

Minimum design requirements

Table 1 contains a summary of the minimum recommended flow and loading conditions for only a select group of processes. Specific design parameter details for individual treatment process units shall be in accordance with **Ten States Standards.**

Where the Minnesota Pollution Control Agency (MPCA) determines that the above design flow considerations will not provide adequate protection to the receiving waters, facility capacity in excess of peak instantaneous wet weather and/or organic loading calculation may be required.

Table 1: Design conditions summary.

Item	Design
Collection system	Must be capable of transporting all flow to the treatment facility without bypassing.
Lift station	Must be capable of transporting all flow to the treatment facility without bypassing.
Flow equalization basin	If PHWW/ADW > 3, or if PHWW/AWW > 3, flow equalization must be considered. If equalization is not provided, a discussion of how the facility will handle the transition in flow must be included. See flow equalization section of this document.
Facility piping and pumping	PIWW
Preliminary treatment unit (screens, grit removal, influent filters, etc.)	PIWW
Clarifiers (surface settling rate and weir loading rate)	PHWW + recirculation flow see "Ten States Standards"
Disinfection (detention time)	PHWW see (Ten States Standards)
Organic loading	Minimum BOD of 0.17 #pcd plus commercial, industrial, and other non-residential flow Minimum TSS of 0.20 #pcd plus commercial, industrial, and other non-residential flow

Design flows

Actual flow data should be used to determine design flow when possible. At a minimum, 100 gallons per capita per day should be used. Include the following information with design flow calculations.

- Data used and data excluded. At least 5-years of facility flow records should be evaluated. Extreme wet or dry weather events may be excluded where appropriate. Map 1 and 2 can be used to analyze wet weather events to determine if an event exceeds the rainfall event for design purposes.
- Water use information, particularly during dry weather flow periods.
- Total and per capita pollutant loadings during a range of flow events.
- Reliability of flow monitoring equipment, pump station performance and methods used to estimate flow reductions or contributions from inflow and infiltration.

Discussion of a method to use when existing flow data is and is not available is included below.

New treatment system and new collection system (no existing flow data)

Use Table 2 for flow calculations. Table 3 should be used to determine the design loadings for a new or upgraded wastewater treatment plant. Table 2 and 3 can also be found electronically in Excel format here: https://www.pca.state.mn.us/sites/default/files/wq-wwtp5-20a.xlsx

For mechanical plants, if the industrial flow varies during the day or week, the design flow should be based on the average flow on the peak day during the period when the industry or industries are operating. This condition is called "rated flow." For example, if the industry discharges 10,000 gallons over eight of the twenty-four hours, the rated flow is 30,000 gallons per day. For controlled discharge pond systems, if the industrial flow varies during the day or week, the average design flow may be based on a weekly average.

The MPCA may approve of an alternative flow design with appropriate justification. For determining the design of the collection system (including design flow), refer to Chapter 30 of Ten State Standards).

Some form of permit "control language" may be included for wastewater treatment facilities if the per capita design flow is less than what is recommended in this document. For this situation, it may become a permit violation when the permitted design flow is reached. Violation of the permitted flow could result in "no more connections" being allowed to the system, or the requirement for submittal of a report that examines the flow in comparison to the number of connections and the number of people using the system. The permittee could also be required to plan, design, and build additional treatment units upon reaching the design capacity.

Existing treatment systems and collection system (existing flow data)

For a mechanical plant, the attached Table 2 should also be used to determine the peak hourly wet weather flow, the peak instantaneous wet weather flow, the average dry weather flow, and the average wet weather flow.

Part A of Table 2 and Figure 1 are used to determine the peak hourly wet weather flow. The measured flow should be plotted for a twenty-four hour period when **groundwater is at or near normal and a runoff condition is not occurring** (Curve X on Figure 1). This should include flows data from overflows, bypasses, and emergency pumping events. The ground water elevation in relation to the sewer elevation should be noted. The present peak hourly dry weather flow is indicated by point (1) on Figure 1, and row 1 in Table 2.

The measured flow should be plotted for a twenty-four hour period when **groundwater is high and a runoff condition is not occurring** (Curve Y). This should include overflow, bypasses, and emergency pumping. The ground water elevation in relation to the sewer elevation should be noted. Point (2) on Figure 1 and row 2 in Table 2 is the peak hourly flow during a high groundwater period when a runoff condition is not occurring. The peak flow at point (2) minus the present peak hourly dry weather flow at point (1) is the peak hourly infiltration.

The measured flow should be plotted for a twenty-four hour period when the **groundwater is high and a runoff condition is occurring** (Curve Z). This should include flow data from overflows, bypasses, and emergency pumping events. The amount of rainfall and its duration should be plotted on the same graph. The peak inflow is represented by the greatest distance between Curve Y and Curve Z. The present hourly flow at the point of greatest distance between Curve Y and Z [point (5) on Figure 1 and row 5 in Table 2] minus the present hourly flow during high ground water at the same time of day on Curve Y [point (6) on Figure 1 and row 6 in Table 2] is the peak hourly inflow.

It may be necessary to adjust the measured flow based on a relationship between the data attained during a major storm event and the five-year one-hour designed storm event. Items (10) and (13) in Table 2 are determined through a cost effectiveness evaluation. The gallons per capita per day (gpcd) contribution for population increase in item (15), (25), (33), and (41) should all be 100 gpcd.

Part B of Table 2 determines the peak instantaneous wet weather flow. The present peak hourly inflow adjusted for a five-year one-hour rainfall event [see part A row (8)] is subtracted from the peak hourly wet weather flow [see part A row (19)]. To this number, add the present peak hourly inflow adjusted for a twenty-five year one-hour storm event. The resulting number is the peak instantaneous wet weather flow.

Part C of Table 2 determines the average dry weather flow. The present average dry weather flow (24) is the average flow received over a twenty-four hour period when the ground water is at or near normal and a runoff condition is not occurring. If the industrial flow varies during the day or week, the present average dry weather flow should be based on the average flow of the peak day during the period when the industry or industries are operating (rated flow). This also applies to the average flow from industrial increases.

Part D of Table 2 determines the thirty-day average wet weather design flow. The average infiltration and inflow after rehabilitation (where rehabilitation is cost effective) is the wettest thirty-day average. The amount of infiltration after rehabilitation averaged over the thirty wettest days should be the same or nearly the same as the peak infiltration after rehabilitation. This is due to the fact that the ground water could stay high for a fairly extended period of time. The amount of inflow after rehabilitation averaged over the thirty wettest days depends on the type of sources, their location, the amount of rainfall that affects the source, etc.

Part E of Table 2 correlates all related information that can impact the degree of accuracy of the determination of design flows. It is recommended that a minimum of six months of accurate data be recorded. Data associated with the critical peak wet weather flow events for a sustained wet weather period are essential for accurate estimation of design flows. Critical peak wet weather flow events typically occur in the spring (March-June) and must include the condition of high ground water with inflow.

Controlled discharge pond systems with existing sanitary sewer systems

The peak hourly wet weather and the peak instantaneous wet weather design flows to a pond system with an existing sanitary sewer system are arrived at in the same manner as in Parts A and B of the previous section. If the present industrial flow varies during the day or week, the present average dry weather flow (24) and (30) may be based on a weekly average. When computing the average wet weather flow, the average infiltration after rehabilitation (31), and the average inflow after rehabilitation (32) are averages over the wettest 180 consecutive days.

Flow equalization

This section applies to all treatment facilities except pond systems.

If the ratios described below are three or more, flow equalization should be considered. If flow equalization is not employed, an explanation must be provided describing how the facility will handle the transition from these average design flows to peak hourly wet weather design flow.

A. During a period of high ground water for that area and system, calculate the ratio of peak hourly wet weather design flow to average wet weather design flow [which is (19) divided by (37)]

B. During a normal ground water period, calculate the ratio of the peak hourly design flow during the five-year one-hour storm event [(1)+(14)+(15)+(17)+(18)] to the average dry weather design flow (29).

Infiltration and inflow

Infiltration and inflow (I/I) is a part of every collection system and must be taken into account in the determination of an appropriate design flow.

Inflow means water other than wastewater that enters a sewer system directly from sources such as roof leaders, foundation drains, yard drains, manhole covers, cross connections between storm sewers and sanitary sewers, catch basins, storm water runoff and other drainage structures.

Infiltration means water other than wastewater that enters the sewer system from the ground through defective pipe, pipe joints, and manholes.

Excessive infiltration means the quantity of flow that is more than 120 gpcd (domestic base flow and infiltration).

Excessive inflow means the quantity of flow during storm events that results in chronic operational problems related to hydraulic overloading of the treatment system or that results in a total flow of more than 275 gpcd (domestic and industrial base flow plus infiltration and inflow). Chronic operational problems may include surcharging, backups, bypasses, and overflows.

Bypasses/overflows and releases

Determining the design flow is one of the most challenging parts of the design process. It is not cost effective to design a system that can capture and treat flows from every extreme event, however, bypasses, overflows and releases of any kind are prohibited by permit and rules.

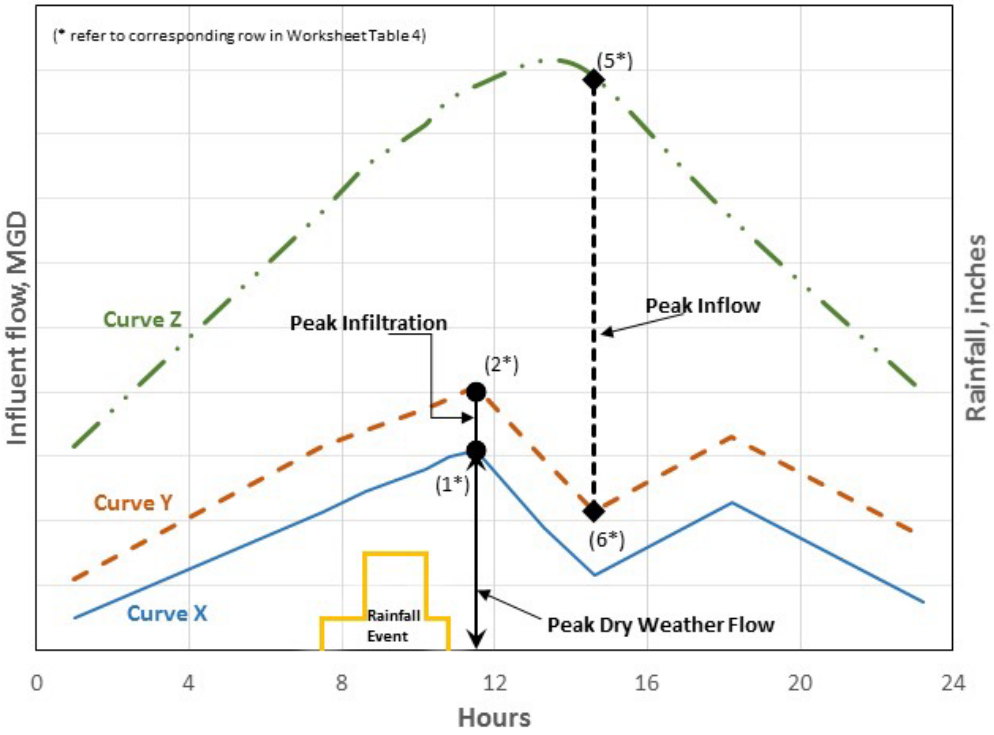
For more information

Please contact the engineer assigned to the project or district. If the engineer is unknown, contact the Customer Assistance Center.

MPCA 651-296-6300

Toll-free 800-657-3864

Figure 1: Determination of peak hourly flows before adjustment for storm event.



- Curve X: 24 hour flow with NORMAL groundwater conditions and no runoff
- Curve Y: 24 hour flow with HIGH groundwater conditions and no runoff
- Curve Z: 24 hour flow with HIGH groundwater conditions and runoff

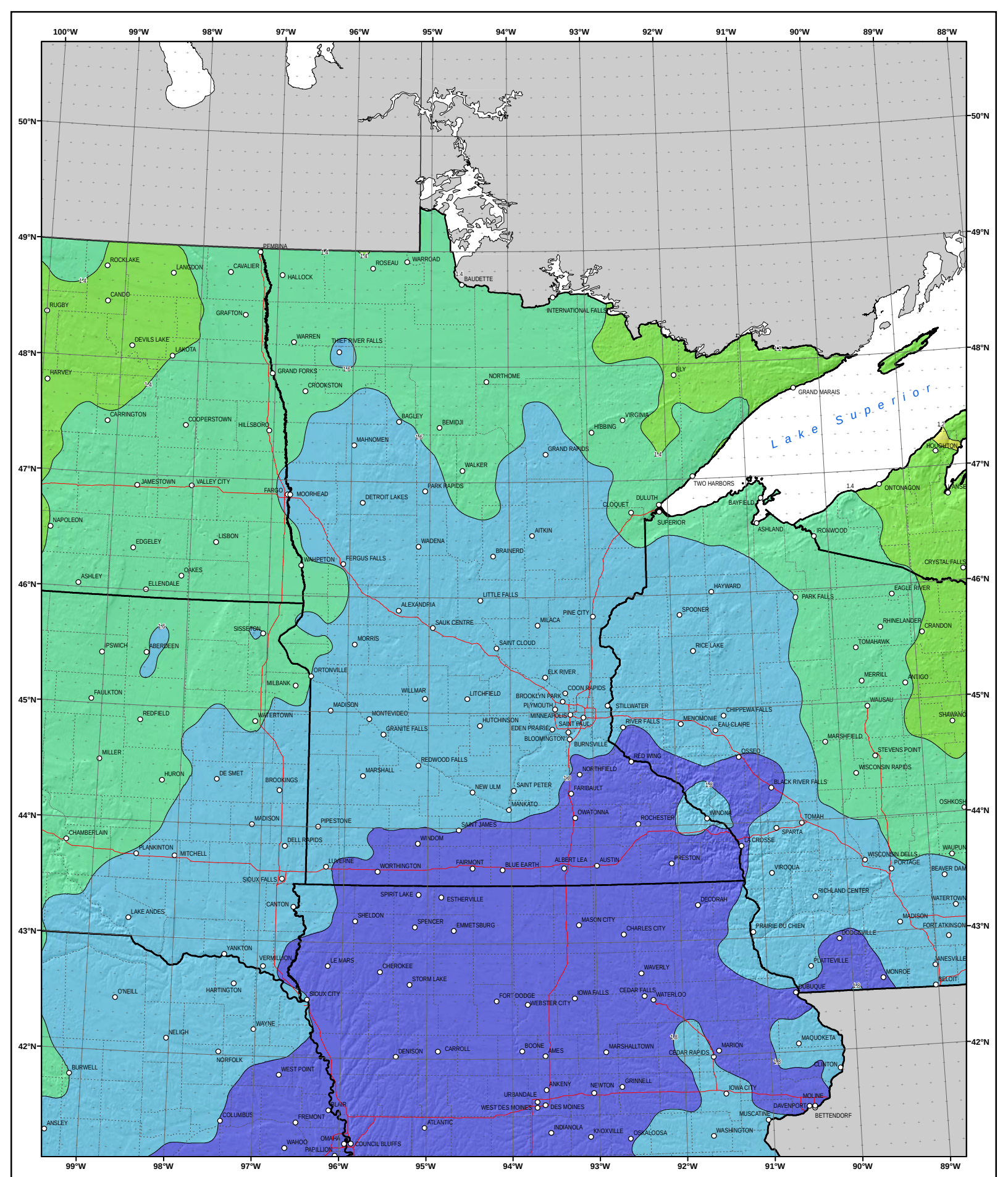
All of these flows should include any bypassing, overflows or bypass pumping.

For more detail see discussion in previous pages.

Note: All flow measurements taken at treatment plant with adjustments for bypasses, overflows and emergency pumping. Groundwater elevation in relation to sewers should be stated for several points in the sewer system. Dates of flow measurements should be stated.

Design Flow and Loading Determination Guidelines for Wastewater Treatment Plants (Table 2 and 3): https://www.pca.state.mn.us/sites/default/files/wq-wwtp5-20a.xlsx

Map 1 and Map 2 are taken from the NOAA website. An interactive site specific map can also be used. Found here: https://hdsc.nws.noaa.gov/hdsc/pfds/pfds_map_cont.html?bkmrk=mn



NOAA Atlas 14, Volume 8, Version 2
Midwestern States

MINNESOTA

Isopluvials of 5-year 60-minute precipitation in inches

SCALE 1:2,250,000

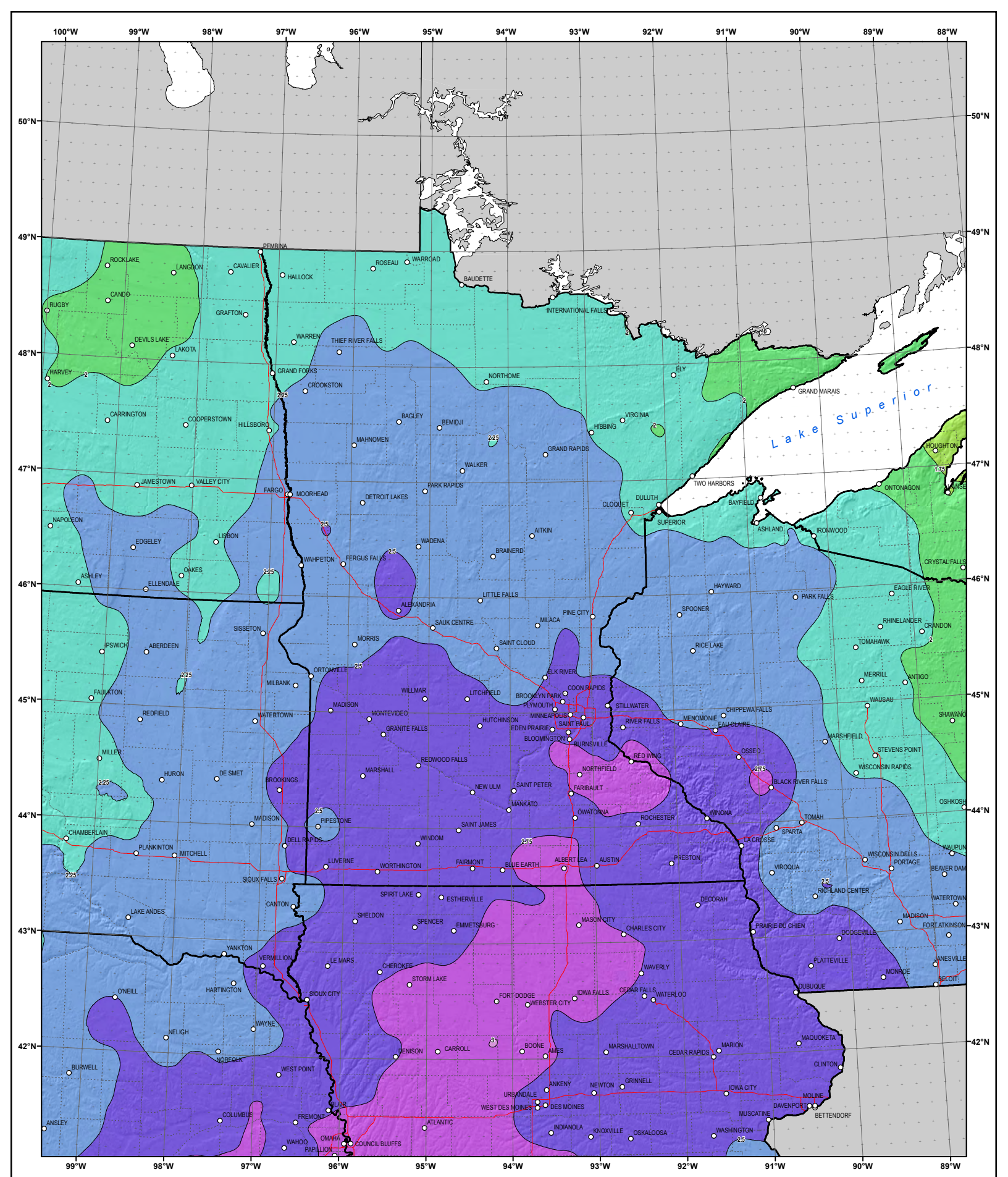
Prepared by U.S. DEPARTMENT OF COMMERCE
NATIONAL OCEANIC AND ATMOSPHERIC ADMINISTRATION
NATIONAL WEATHER SERVICE
OFFICE OF HYDROLOGIC DEVELOPMENT
HYDROMETEOROLOGICAL DESIGN STUDIES CENTER
April 2013

0 5 10 20 30 Miles
0 10 20 40 60 Kilometers

Projection: Lambert Conformal Conic; Datum NAD83; Standard Parallels: 44°N and 48°N; Central Meridian 94.5°W.

0.47 - 0.60 | 0.61 - 0.80 | 0.81 - 1.00 | 1.01 - 1.20 | 1.21 - 1.40 | 1.41 - 1.60 | 1.61 - 1.80 | 1.81 - 2.00 | 2.01 - 2.20 | 2.21 - 2.40 | 2.41 - 2.45

Legend based on entire Volume 8 project area.



NOAA Atlas 14, Volume 8, Version 2
Midwestern States

MINNESOTA

Isopluvials of 25-year 60-minute precipitation in inches

SCALE 1:2,250,000

0.74 - 0.75 | 1.26 - 1.50 | 2.01 - 2.25 | 2.76 - 3.00
0.76 - 1.00 | 1.51 - 1.75 | 2.26 - 2.50 | 3.01 - 3.25
1.01 - 1.25 | 1.76 - 2.00 | 2.51 - 2.75 | 3.26 - 3.33

Legend based on entire Volume 8 project area.

0 5 10 20 30 Miles
0 10 20 40 60 Kilometers

Projection: Lambert Conformal Conic; Datum NAD83; Standard Parallels: 44°N and 48°N; Central Meridian 94.5°W.

Prepared by U.S. DEPARTMENT OF COMMERCE
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HYDROMETEOROLOGICAL DESIGN STUDIES CENTER
April 2013

A-2 – Facilities Plan Capacity and Condition Evaluation Memorandum

Building a Better World for All of Us®

MEMORANDUM

TO: Dan Childs

FROM: Jessica Hedin, PE (Lic. MN 41639)

DATE: March 20, 2023

RE: Big Lake Wastewater Treatment Facilities Plan, Capacity and Condition Evaluation
SEH No. BIGLK 167307 14.00

The purpose of this memorandum is to evaluate the capacity of the current wastewater facilities to meet the anticipated design year flow and load demand. Each treatment process at the wastewater treatment facility (WWTF) was reviewed for suitability.

BASIS OF DESIGN

A basis of design was developed for treatment processes and utilized to determine if the process has sufficient capacity to meet the anticipated flow and/or load demand anticipated at the design year. Each treatment process may have a distinct set of flow and load requirements based on the process requirements, location of the treatment process in the overall facility, return and side streams, and accepted design practices.

Attachments 1 and 2 include the liquid and solids current and anticipate flow and load demand which serves as a basis of capacity evaluation and for solicitation of equipment as part of the alternatives analysis.

Attachment 3 includes the condition assessment survey for facilities which was completed during visits to the facilities and serves as a reference for the condition of existing facilities, and criticality of those facilities in meeting effluent water quality limitations.

Wastewater Influent Characteristics

The liquids treatment unit process capacity analyses were performed based on the current influent wastewater characteristics observed for the time period including January 2017 to February 2022. To determine if additional capacity is available, the treatment potential for each process was compared to the future flows and loadings. Refer to the Technical Memorandum *Big Lake Wastewater Treatment Facilities Plan, Flow and Load Determination* for more detail regarding the development of these flows and loads.

The influent wastewater characteristics includes flows and loads from all external sources to the wastewater facility, which includes:

- Domestic wastewater contributors,
- Commercial Wastewater contributors,
- Institution wastewater contributors,
- Industrial wastewater contributors, and
- Septage receiving.

LIQUID AND SOLID TREATMENT PROCESS CAPACITY AND CONDITION EVALUATION ELEMENTS:

- Liquid Treatment Processes
  - Main Lift Station
  - Preliminary Treatment
    - Screening
    - Grit Removal
    - Influent Flow Measurement
  - Secondary Treatment
    - Selector Basins
    - Oxidation Ditches
    - Secondary Sedimentation
    - Chemical Phosphorus Removal
  - Finishing and Discharge
    - Disinfection
    - Effluent Flow measurement
    - Outfall
- Solid Treatment Processes
  - Biosolids Stabilization
    - Waste Sludge Storage
    - Aerobic Digestion
    - Liquid Biosolids Storage
  - Biosolids Dewatering
    - Biosolids Thickening
    - Biosolids Drying
  - Other Considerations
    - Administration
    - Vactor Receiving
    - Utilities

Minor contributing flow and load sources such as seal water, small quantity wash water, and lab fixtures are not considered as part of the capacity evaluation. Detailed flow and load calculations are included as part of process design during the preparation of Plans and Specifications. A facilities plan accomplishes a high-level review of suitability of existing processes for anticipated design flow and load demand.

NPDES/SDS Effluent Permit Limitations

The Big Lake WWTF is regulated by the National Pollutant Discharge Elimination System (NPDES) permit number MN0041076. Table 1 on the following page summarizes the effluent limits at the current AWW design flow of 0.958 MGD and anticipated future effluent limits as indicated by frozen mass limits provided by a preliminary effluent limit request response letter furnished by the MPCA. The preliminary effluent limit request response letter from the Minnesota Pollution Control Agency (MPCA) is dated November 2, 2022 and is included in attachment 4 of this memorandum. The initial preliminary effluent response requested limits for a design flow of approximately 2.2 MGD. The design flow has been revised to 1.682 MGD, which corresponds to the limitations in this memorandum.

Table 1: Current and Anticipated NPDES/SDS Effluent Permit Limitations

Parameter	Current Effluent Limit		Anticipated Effluent Limit [6]	
	Month [1]	Week [2]	Month [1]	Week [2]
$cBOD_5$ load, kg/d	34.3	54.9	34.3	54.9
$cBOD_5$ concentration, maximum, mg/L	25.0	40.0	25.0	40.0
$cBOD_5$ concentration, at AWW flow, mg/L[5]	10.8	17.3	5.4	8.6
$cBOD_5$ percent removal	85% min		85% min	
TSS load, kg/d	41.2	61.7	41.2	61.7
TSS concentration, maximum, mg/L	30	45	30	45
TSS concentration, at AWW flow, mg/L[5]	10.8	17.3	6.5	9.7
TSS percent removal	85% min		85% min	
TP, kg/year	1160 [3]		1160 [3]	
TP load, kg/d [5]	3.2		3.2	
TP concentration. at AWW flow, mg/L[5]	0.5		0.5	
pH, SU	6.0 – 9.0 [4]		6.0 – 9.0 [4]	
Fecal Coliform, MPN (geometric mean)	200		200	

Notes:
1. Denotes Calendar Month Average effluent permit limitation.
2. Denotes Calendar Week Average effluent permit limitation.
3. 12-Month Moving Total effluent permit limitation.
4. Each Sample effluent permit limitation.
5. Parameter is not included in effluent permit limitation, but is the calculated equivalent to meet required effluent limitations.
6. Corresponds to a concentration as the design flow of 1.682 MGD AWW flow based on the frozen mass limits indicated in the preliminary effluent request response letter furnished by the MPCA.

LIQUID TREATMENT CAPACITY REVIEW

Liquid treatment at the facility is considered the “main line” treatment for influent wastewater. Liquid treatment includes influent entering the head of the treatment facility through the discharge outfall into the receiving water. For Big Lake, this can generally be outlined as:

- Conveyance
- Preliminary Treatment
- Secondary Treatment
- Finishing and Discharge

The following sections will review each liquid treatment process in greater detail for suitability to meet the anticipated future flow and load capacity.

Conveyance

The conveyance at Big Lake consists of the following treatment processes:

- Old Main Lift Station
- Main Lift Station
- Influent Forcemain

Wastewater generated in the community is collected through a gravity collection system. The gravity system conveys wastewater to a main lift station. Wastewater is then pumped through one of two forcemains to the preliminary treatment building at the wastewater treatment facility.

Condition-Related Issues

The main lift station was constructed in 2001 and has a number of condition related issues including:

- Interior process piping, equipment, and architectural coatings.
- Frequent ragging and grease accumulation.

- Automatic controls including programmable logic controllers (PLCs) with human machine interface (HMI) displays for remote control and monitoring.
- Automatic transfer switch for backup generator.

Old Main Lift Station

The old main lift station which was replaced by the current main lift station is abandoned-in-place. The existing old main lift station is recommended for demolition. Its removal would eliminate the existing facilities, which are degrading and pose a concern for safety.

Main Lift Station

The main lift station is located approximately 1 mile from the WWTF. The lift station was constructed in 2009, at which time the existing main lift station was decommissioned. The existing main lift station remains in place and is recommended for removal due to condition and compliance with modern building code requirements.

The main lift station consists of the wetwell with four submersible pumps, a piping and instrumentation room, and a generator room. Two 20 horsepower (HP) pumps discharge to an 8-inch forcemain, and the two 43 HP pumps discharge to a 12-inch force main. The 20 HP pumps have a design maximum flow rate of 470 gallons per minute (gpm) per pump and provide a combined flow of 600 gpm with both units operating. The 43 HP pumps have a design maximum flow rate of 1,530 gpm per pump. The MPCA requires the lift station to be able to handle peak hourly wet weather design flow with the largest unit out of service, therefore the consideration for operating both high flow pumps simultaneously is not considered when evaluating design capacity.

Accommodations to provide a future 16-inch force main are provided. Flow through each force main is measured separately by magnetic flowmeters. The main lift station is configured to achieve the current permitted peak hourly flow of 2.204 MGD (1,530 gpm) with one high flow pump in service.

The main lift station has a 100 kW/125 kVA emergency backup generator.

Influent Forcemain

The main lift station discharges to an 8-inch forcemain and a 12-inch high flow forcemain. Both forcemains were reused as part of the 2009 main lift station construction project. There are three air relief structures on each of the 8-inch and 12-inch forcemains. The relief valves are no longer serviceable and should be replaced.

Force main capacity is a function of velocity and head loss. Ten States Standards for Wastewater Facilities (2014 Edition) recommends a liquid velocity through forcemains of 4 feet per second (fps) to 8 fps and not less than 4-inches in diameter.

At the existing design flows, the 8-inch forcemain has a liquid velocity of 2.8 fps with one 20 HP pump operating and 3.5 fps with both operating. The 8-inch forcemain reaches a fluid velocity of 8.0 fps at a design flow of 1,350 gpm. 1,350 gpm corresponds to a daily flow rate of approximately 1.94 MGD. The forcemain may be utilized effectively up to this flow condition.

At the existing design flows, the 12-inch forcemain has a liquid velocity of 4.0 fps with one 43 HP pump operating. At the anticipated flow demand of 3,040 gpm, the anticipated liquid velocity would be 8.1 fps. The forcemain has sufficient capacity for the future flow condition, though the liquid velocity is on high-end of suitability and replacement of the forcemain may be considered.

Summary

The following summarizes the review for conveyance at the future anticipated flow and load demands:

- 20 HP submersible pumps are insufficient for the design year flow demand..
- 43 HP high flow submersible pumps insufficient for the design year flow demand.
- Coarse bubble aerator and regenerative blower to reduce ragging and grease accumulation.
- Replace isolation valve, relief valve, piping, and accessories for existing forcemains.
- Forcemain:
  - 8-inch forcemain will likely be undersized based on high flow pump operation.
  - 12-inch high flow forcemain may be reused for regular flow.
  - A new forcemain will likely need to be furnished to economically meet wastewater flow demand. A phasing approach is recommended to meet minimum flow velocity at startup of new equipment.
- Condition related improvements as noted.

Preliminary Treatment

The preliminary treatment at Big Lake consists of the following treatment processes:

- Screening
- Grit Removal
- Influent Flow Measurement

Preliminary Treatment at the Big Lake facility is done at the Preliminary Treatment Building. Influent is split between one of two rotary drum screens. The screens remove, wash, and compact solids. Wash waster is returned to the screen channel and screenings are collected in a bin for disposal. Screened wastewater then flows to a vortex grit basin. Grit is collected at the bottom of the basin and pumped to a classifier, separated, and washed. Overflow is returned to the screen channel and grit is collected in a bin for disposal. Wastewater then flows through a Parshall flume with ultrasonic level measurement which is used as the basis of influent flow reporting. Influent is sampled via automatic sampler from this location. Wastewater flows by gravity after measurement to secondary treatment.

Condition-Related Issues

The Preliminary Treatment Building was constructed in 2009 and has a number of condition related issues including:

- Electric unit heaters.
- Makeup air unit.
- Plumbing piping, fittings, hangers, and accessories.
- Interior process piping, equipment, and architectural coatings.
- Automatic controls including programmable logic controllers (PLCs) with human machine interface (HMI) displays for remote control and monitoring.
- Automatic sampler.
- Influent flow measurement instrumentation.
- Exterior personnel and overhead doors.

Screening

The preliminary treatment building as originally constructed in 2009. Since then, the original screens have been replaced as part of a 2011 improvements project with drum type screens. The screens have 1/4-inch perforated plate screens with wash water and a compacting system. The screens have an odor control surround installed.

Operators have reported issues with rags and other debris bypassing the screening system and accumulating in downstream treatment process, such as the biosolids processing facility. The wash water also no longer works for the screens due to condition. Secondary treatment alternatives which have been identified by the City include process intensification such as Integrated Fixed-Film Activated Sludge

(IFAS) systems. Depending on the alternative reviewed, the 1/4-inch would be sufficient for removal of debris to protect the media included with these alternatives, however other alternatives such as Membrane Bioreactors (MBRs) would require an additional 1 or 2 mm screening step.

The screens are installed in 4'-0" wide channels with 4'-2" channel depth. Upstream floats are used to trigger screen wash in additional to automatic controls. Each screening channel has an upstream and downstream isolation stop plate.

The design capacity of the preliminary treatment building is 7.0 MGD, however the capacity of individual process equipment may be larger. This nominal capacity is sufficient for the anticipated wastewater flow demand.

Grit Removal

The grit removal basin was constructed as part of the preliminary treatment building in 2001. The grit basin has a 10'-0" diameter upper chamber and 5'-0" diameter lower chamber. The upper chamber is 5'-0" to finished floor, and lower chamber is 5'-6" lower than the upper chamber. The vortex drive unit was installed in 2011. A single grit pump conveys grit from the lower chamber to the cyclone of a grit classify and washer. The grit pump has been replaced since the 2011 project. The grit washer and classifier were also replaced in 2011.

The vortex grit drive and mechanism appear to be in good working condition. Operators have mentioned wanting a redundant grit pump as when the current pump was replaced, they were unable to operate the grit removal system as the equipment had a long lead time. The grit washer appears to be in good condition, however the classifier is recommended to be replaced due to age and condition.

Influent Flow Measurement

Influent flow measurement is read at a Parshall flume in the preliminary treatment building. The Parshall flume is an 18-inch flume and was installed as part of the 2001 improvements project. The flume is in good working order; however, the level instrumentation is near the end of its anticipated service life.

An 18-inch Parshall flume is suitable up to approximately 11,000 gpm of flow measurement. The anticipated PIWW flow demand is 3,100 gpm, which is well below the capacity of the flume for measurement.

The flow measurement is used for flow-paced sampling by the influent sampler. The existing length of suction tube results in frequent issues with the automatic sampler.

The facility receives influent flow for two industrial users. An online influent pH meter after preliminary treatment may be useful in determining if non-compliant wastewater has been discharged to the facility and allow for staff to adjust operation accordingly.

Summary

The following summarizes the review for preliminary treatment at the future anticipated flow and load demands:

- Replace influent screens, washers, and compactors with system suitable for recommended secondary treatment alternative.
- Add redundant grit pump.
- Replace grit classify and washer cyclone.
- Add recirculation submersible pump after flow measurement to a sample chamber on wall in screen room opposite automatic sampler.
- Add online pH meter after flow measurement.
- Condition related improvements as noted.

Secondary Treatment

The secondary treatment at Big Lake consists of the following treatment processes:

- Selector Basin
- Oxidation Ditch
- Secondary Sedimentation
- Chemical Phosphorus Removal

The selector basin is continuously mixed, combining influent flow, return activated sludge, and other internal plant recirculation streams. The facility has the ability to create anaerobic and anoxic zones by using one of three influent pipes for introducing influent flow to return activated sludge, either at the head, mid-point after a baffle wall, or end of the selector basin. The selector tank is also the splitter structure to the existing oxidation ditches.

Flow from the selector tank flows to one of three oxidation ditches. Each oxidation ditch has mechanical surface aerators. The ditches can be run in series or parallel. Effluent is controlled by an adjustable weir at each ditch. Coagulant for chemical phosphorus removal is introduced at the effluent box after the adjustable effluent weir.

Effluent from the oxidation ditches combines in a secondary clarifier splitter structure. The structure splits flow between the secondary clarifiers. The secondary clarifiers are center-feed with the influent pipe entering the sidewall of the tank, an influent well, and peripheral v-notch effluent weirs. Scum flows by gravity to the waste sludge holding tank. Return activated sludge (RAS) and waste activated sludge (WAS) flow by gravity to a common RAS/WAS pumping structure. The sludge withdrawal rate is controlled by telescopic valve located at the RAS/WAS pumping structure. Combined RAS/WAS is pumped through the Administration building where a modulated valve and WAS flow meter are used to direct a portion of sludge to the waste sludge holding tank. The remaining sludge is recirculated to the selector basin.

Effluent from secondary clarifiers 1 and 2 combine in an effluent box, and effluent from secondary clarifier 3 flows to a common effluent box designed for a future secondary clarifier 4. Effluent from the boxes is combined via buried piping and flows to an effluent diversion structure. The diversion structure is not currently utilized but provides piping to divert secondary clarifier effluent for future tertiary treatment. Effluent from the diversion structure flows to the administration building for disinfection.

Coagulant used for chemical phosphorus removal is stored in a chemical storage building. Coagulant is fed through chemical feed pumps to a common header and discharged to chemical feed locations at each oxidation ditch effluent box.

Condition-Related Issues

The Selector Basin was constructed in 2001 and has a number of condition related issues including:

- Minor concrete repair on concrete cover.
- Process piping and flow control gates were installed in 2001 and near the end of useful life.
- Electrical, controls, and instrumentation were installed in 2001 and near the end of useful life.
- Limited process control. Addition of instrumentation to monitor oxidation reduction potential (ORP).
- Mixers operate continuously. Remote controls and communication to SCADA would allow for process monitoring and the potential for a more efficient operating scheme.
- Current mixers were installed in 2001 and experience ragging issues. Mixers are near end of useful life. Replace mixers with non-ragging type mixers.

Oxidation Ditch 1 was constructed in 1976. Oxidation Ditch 2 was constructed in 2001. Oxidation Ditch 3 was constructed in 2019. There are a number of condition related issues for each oxidation ditch, including:

- Oxidation Ditch 1
  - Control building roof is original to 1976 and should be replaced.
  - Surface aerator is original to 1976 and is at the end of its useful life.
  - Piping and valves are original to 1976 and are at the end of their useful life.
  - Existing surface aerators are brush rotor type and have exceeded their useful life. During summer months, aerator is unable to maintain a DO in the basins.
  - Surface aerator runs at constant speed. Replacing constant speed starters with variable speed will allow for dissolved oxygen control in the basins.
  - Electrical, controls, and instrumentation were installed in 2001 and near the end of useful life. Include automatic controls to allow for adjustment of aerator speed based on DO measurement in basin.
  - Control building is original to 1976. Exterior brick requires repair. HVAC equipment and controls are at the end of their useful life.
- Oxidation Ditch 2
  - Surface aerator runs at constant speed. Replacing constant speed starters with variable speed will allow for dissolved oxygen control in the basins.
  - Existing surface aerators are brush rotor type and have exceeded their useful life. During summer months, aerator is unable to maintain a DO in the basins.
  - Electrical, controls, and instrumentation were installed in 2001 and near the end of useful life. Include automatic controls to allow for adjustment of aerator speed based on DO measurement in basin.

The Secondary Clarifiers and associated structures were constructed in 2001 and have a number of condition related issues including:

- Fiberglass Reinforced Plastic (FRP) covers are original to 2001 and leak. Doors freeze shut during winter months. Exhaust fans have exceeded useful life. Covers, doors, dormers, lighting, and HVAC equipment should be replaced.
- Existing clarifier mechanism and access bridges are original to 2001 and have reached the end of their useful life. Replace clarifier mechanisms and access bridges in each clarifier.
- Slide gates at influent splitter structure are original to 2001 and have reached the end of their useful life. Replace slide gates at influent splitter structure.
- Telescopic control valves for sludge draw-off are difficult to control. Alternative method for sludge removal which can be operated per tank should be considered.
- Electrical, controls, and instrumentation were installed in 2001 and near the end of useful life. Include level indicators to monitor sludge blanket in each basin.
- Blast and recoat existing clarifier launderers and top of sidewalls.

The Chemical Feed Building was constructed in 1976 and relocated in 1995 and has a number of condition related issues including:

- Existing structure is a wood timber walled structure covered in gypsum board.
- Current chemical feed pumps are oversized for coagulant demand and unable to turn down for cost effective phosphorus control.
- Current chemical feed pumps discharge into a common chemical feed header. Piping does not allow for even flow of coagulant to oxidation ditches.
- Existing chemical feed is limited to oxidation ditch effluent boxes. Consider addition of alternative coagulant feed locations at oxidation ditches influent structures and secondary clarifier influent splitter structures.

- Electrical, controls, and instrumentation were installed in 2001 and near the end of useful life. Include level indicator for chemical fill in bulk chemical storage tanks.

Selector Basin

The facility operates a two-stage selector basin. Return activated sludge is introduced to the head of the basin. Influent may be introduced at either the head of the first cell, the head of the second cell, or at the end of the basin. Cells 1 and 2 are separated by a timber baffle wall. Each cell has a cover-mounted, dual-impeller mixing system. The selector basin was constructed in 2001. The effluent box of the selector basin also serves as a splitter structure, diving flow between the oxidation ditch treatment trains.

The selector basin has a side water depth of approximately 12'-0" and a total volume of 106,000 gallons (53,000 gallons per cell). The baffle wall is constructed from 1-3/4" thick redwood baffle board and is original to the 2001 construction.

Selector basin sizing depends on the type of treatment being performed. A two-stage anaerobic/aerobic system (AO) facilitates basin biological phosphorus removal. Assuming a typical hydraulic retention time (HRT) between 0.5 and 1.0 hours for the anaerobic cell of the selector tank (Metcalf and Eddy, fourth edition). The determination includes consideration for a return activated sludge recirculation rate of 150% of average influent flow capacity at all flow conditions.

The following summarizes total HRT for both stages at different design flows at current flow demand:
- Calendar Day, Average: 1.8 hours per cell.
- Average Wet Weather: 1.5 hours per cell.
- Peak Hourly Wet Weather: 0.6 hours per cell.

The following summarizes total HRT for both stages at different design flows at current flow demand:
- Calendar Day, Average: 0.9 hours per cell.
- Average Wet Weather: 0.8 hours per cell.
- Peak Hourly Wet Weather: 0.3 hours per cell.

Selector basin size should be reconsidered with each secondary treatment alternative technology evaluated. Suitability for AO operation in conjunction with activated sludge oxidation ditches indicates there may be sufficient capacity available, though the selector tanks are very near operational capacity at the anticipated flow demand.

Suitability of the influent wastewater characteristics can also be considered for use of the selector basin as part of an AO process. A first approximation of the suitability for a waste stream to be used for biological phosphorus removal is the $cBOD_5$:TP ratio, with a minimum $cBOD_5$:TP ratio of 20:1 (WEF Manual of Practice No. 8) necessary to produce an effluent TP of 1 mg/L. This consideration would still assume the use of coagulant for finished effluent.

The following summarizes $cBOD_5$:TP ratio for different design loads at current load demand:
- Calendar Day, Average: 46
- Maximum Month as Day Average: 49
- Calendar Day, Maximum: 69

The following summarizes $cBOD_5$:TP ratio for different design loads at anticipated load demand:
- Calendar Day, Average: 53
- Maximum Month as Day Average: 56
- Calendar Day, Maximum: 77

The $cBOD_5$:TP ratio under current and anticipated load conditions indicates the selector basins may perform well when used as part of an AO treatment process.

Oxidation Ditch

The facility operates three oxidation ditches, ditch 1 constructed in 1976, ditch 2 constructed in 2001, and ditch 3 constructed in 2019. Each oxidation ditch is approximately 350,000 gallons with a side water depth between 9.60’ and 10.80’ depending on the elevation of the adjustable effluent weir. 10 States Standards for Wastewater Facilities (2014 Edition) provide design recommendation for oxidation ditch biological treatment processes.

The activated sludge treatment process, which consists of the selector basins, oxidation ditches, secondary clarifiers, and chemical phosphorus removal was intended to treat for total phosphorus biologically with coagulant for polishing. At the current organic loading rates, biological phosphorus treatment is not achievable due to the current flow and load demand to the facility.

Oxidation ditches follow design recommendations for extended aeration systems. 10 States Standards recommends aeration tank organic loading for $cBOD_5$ at 15 lbs of $cBOD_5$ / 1,000 cuft / day. The organic loading capacity for each oxidation ditch is then approximately 700 lbs of $cBOD_5$ per day.

The three oxidation ditches are sufficient to meet current calendar day average $cBOD_5$ load demands, however the basins do not provide sufficient recommended volume at current maximum month as day average and calendar day maximum load demands.

Oxidation ditches operate as extended aeration processes with HRTs typically between 10 and 30 hours. 24 hours is a commonly used design condition as indicated by WEF Manual of Practice 8 (fourth edition). The oxidation ditches are sufficiently sized for anticipated HRT given a typical return activated sludge recirculation rate of 150% design average flow at both current and anticipated future flow demands.

MPCA reliability for wastewater treatment facilities operating activated sludge processes recommends that there here must be a sufficient number of units of a size such that, with the largest unit out of service, the remaining units will have a design load capacity of at least 50% of the total design loading to that unit operation. For current load demand, the oxidation system meets the reliability requirements. The oxidation system does not meet reliability requirements at anticipated future load demand.

Secondary Sedimentation

The facility has three 34-foot diameter center-feed secondary clarifiers. Each clarifier is fed from an influent splitters structure. The splitter structure has an influent box which combines effluent from the oxidation ditches, and a separate rectangular weir to split flow between the secondary clarifiers. Waste scum is removed by gravity to the waste sludge holding tank.

The RAS/WAS pumping station controls sludge withdrawal using three telescopic valves, one for each secondary clarifier. Operation staff have reported significant issues with use of telescopic valves to induce sludge draw-off from the secondary clarifier tanks. The valve control does not allow for the ability to vary withdrawal rates from the tanks or easily adjust and monitor withdrawal rates. Sludge is pumped using three submersible pumps and sent to the administration building. A modulating valve and flow meter separate a portion of the sludge to waste to the waste sludge holding tank. The remainder returns to the selector basin.

The clarifiers are covered with fiberglass enclosures and aluminum access bridges. The splitter structure is covered by open aluminum grating. The RAS/WAS pumping station has a concrete cover with aluminum equipment hatches.

Each secondary clarifier is:

- 34”-0” diameter
- 12’-0” side water depth
- 81,500 gallons
- 900 square foot surface area
- 94’-0” weir length

The splitter, clarifiers, and RAS/WAS pumping structures were constructed in 2001.

10 States Standard for Wastewater Facilities (2014 Edition) recommendations are followed by the MPCA for when evaluating secondary clarifiers for treatment capacity. The following are critical design characteristics:

- Dimensions
- Surface Overflow Rates
- Peak Solids Loading Rates
- Weir Loading Rates

The recommended minimum side water depth for secondary clarification is 12’-0”, which is the side water depth of the existing tanks.

MPCA reliability for wastewater treatment facilities operating secondary clarifier processes recommends that there here must be a sufficient number of units of a size such that, with the largest unit out of service, the remaining units will have a design load capacity of at least 50% of the total design loading to that unit operation.

The surface overflow rate for secondary clarification tanks with chemical addition to mixed liquor for phosphorus removal is 900 gpd per square foot. Surface overflow rate is designed at the peak hourly wet weather flow, based only on influent flow. At current flow demand, the surface overflow rate is approximately 800 gpd per square foot will all units operating and 600 gpd per square foot with one unit out of service and 50% of influent and recirculation flow. At the anticipated flow demand, the surface overflow rate is approximately 1,600 gpd per square foot will all units operating and 1,200 gpd per square foot with one unit out of service and 50% of influent and recirculation flow. The secondary clarifiers are at surface overflow design capacity under current flow and load demands but are insufficient at anticipated flow and load demand.

The peak solids loading rate for secondary clarification tanks with chemical addition to mixed liquor for phosphorus removal is 35 lbs per day per square foot. Peak solids loading rate is designed at calendar day maximum flow plus maximum recirculation and the design mixed liquor suspended solids (MLSS). Typical MLSS for extended aeration oxidation ditches is between 3,000 mg/L and 5,000 mg/L. Capacity is evaluated at the maximum MLSS concentration of 5,000 mg/L. At current flow and load demand, the peak solids loading rate is approximately 35 lbs per day per square foot will all units operating and 26 lbs per day per square foot with one unit out of service and 50% of influent and recirculation flow and load. At anticipated flow and load demand, the peak solids loading rate is approximately 68 lbs per day per square foot will all units operating and 51 lbs per day per square foot with one unit out of service and 50% of influent and recirculation flow and load. The secondary clarifiers are at peak solids loading capacity under current flow and load demands and are insufficient at anticipated flow and load demand.

The weir loading rate for secondary clarification tanks with a plant capacity greater than 1.0 MGD is 30,000 gpd per linear foot. Weir loading rate is designed at peak hourly wet weather flow, based only on influent flow. At current demand, the weir loading rate is approximately 6,900 gpd per linear foot will all units operating and 5,200 gpd per linear foot with one unit out of service and 50% of influent flow demand. At anticipated demand, the weir loading rate is approximately 14,000 gpd per linear foot will all units operating and 10,500 gpd per linear foot with one unit out of service and 50% of influent flow

demand. The secondary clarifiers have remaining weir loading capacity under current flow and load demands and are sufficient at anticipated flow and load demand.

Chemical Phosphorus Removal

Bulk chemical storage and feed equipment are located in the chemical building. The chemical building contains three double-walled bulk chemical storage tanks and four chemical feed pumps, The chemical feed pumps are oversized and unable to provide sufficient turndown for efficient total phosphorus control. As noted, the chemical feed pumps discharge to a common distribution header which makes control of coagulant feed to a given dose location difficult. The City current utilizes ferric chloride for chemical phosphorus precipitation.

It is recommended that jar testing be conducted to determine an appropriate daily amount of coagulant consumption required for phosphorus removal. Typical iron requirements for municipal wastewater are 15 to 30 mg/L as iron (45 to 90 mg/L as ferric chloride) to reduce phosphorus by 85 to 90% (WEF Manual of Practice 8 (Fourth edition). Depending on operation of the facility, chemical phosphorus precipitation may be the primary mode of phosphorus removal (current operation), supplementing biological phosphorus removal, or as backup to biological phosphorus removal.

At current calendar day average flow and total phosphorus load, it is estimated that 540 pounds of ferric is consumed daily, which corresponds to 56 gallons of solution based on the referenced guidance and assuming 40% ferric chloride solution at 90% removal. Two to four weeks of chemical storage is commonly provided, depending on the availability of bulk delivery. Between 800 and 1,600 gallons of storage would be anticipated at current flow demands.

Summary

The following summarizes the review for secondary treatment at the future anticipated flow and load demands:

- Selector basin is likely undersized for future flow demands.
- Oxidation ditches are undersized for current and anticipated load demand.
- Secondary sedimentation is undersized for anticipated flow and load demand.
- Existing chemical feed pumps and piping would be replaced for process control.
- Additional chemical feed alternate dose locations to secondary clarifier splitter structure.
- Condition related improvements as noted.

Finishing and Discharge

The finishing and discharge at Big Lake consists of the following treatment processes:

- Ultraviolet Disinfection
- Effluent Flow Measurement
- Outfall

Effluent from the secondary clarifiers flows to the administration building. A disinfection bypass is provided via piping and control valve. When disinfecting, flow enters an influent splitter box and is split between two channels for Ultraviolet (UV) disinfection. Disinfected effluent combines in an effluent box. The effluent box has an effluent control weir with ultrasonic level indicator which is used to report plant effluent flow.

Effluent flow from the disinfection effluent box flows through a series of three manhole structures prior to discharge to the Mississippi River via outfall pipe.

Condition-Related Issues

The modified portion of the Administration Building used for disinfection was constructed in 1976 and modified in 2001. It has a number of condition related issues including:

- The roof is original to 1976 and requires replacement.
- Interior and exterior architectural coatings are original to 1976 and should be replaced.
- Repair of exterior CMU walls is required to provide water-tight seal for joint cracks.
- Existing hydronic piping and equipment is failing and requires replacement.
- Raw sludge piping running through the administrative building requires clean air exchanges to avoid hazardous classification of the building space. Separate or re-route raw sludge piping from remainder of administrative building.
- Automatic controls including programmable logic controllers (PLCs) with human machine interface (HMI) displays for remote control and monitoring. Current controls cannot modulate lamp intensity.
- Interior and exterior architectural coatings are original to 1976 and should be replaced.
- Egress occupancy requirements are likely exceeded from lower level.

Disinfection

The current disinfection system consists of four banks of ultraviolet (UV) disinfection banks, arranged in two parallel trains. The system was installed in 2001. The disinfection influent piping has a manual bypass which allows for isolation of channels for maintenance and bypassing of the system while disinfection is not required. The current system is installed in a converted rectangular clarifier and located in the lower level of the administration building.

Each disinfection channel is 1’-9” wide and designed for the existing PHWW capacity of 2.204 MGD. The rated capacity is not sufficient for the anticipated future flow demand requirements. The operating staff have indicated UV disinfection is the preferred disinfection method. MPCA guidance for UV disinfection requires:

- Minimum of two treatment trains.
- Trains shall be redundant at AWW flow demand.
- Both trains operating shall meet PHWW flow demand.

Operation staff have noted that maintenance and operation of the existing system in the converted rectangular clarifier is difficult due to the location and clearance of equipment. The system also introduces humidity and filter flies into the remaining portions of the administration building.

Effluent Flow Measurement

Effluent flow measurement is accomplished via ultrasonic level indicator placed above a sharp crested weir. Top elevation of the weir is 912.00’ and is set by an adjustable 1/2-inch aluminum weir plate. The weir length is 2’-0”. At existing PIWW flow, the anticipated water level above the weir would be 8-inches. At the anticipated PIWW flow demand, the anticipated water level above the weir would be 12.75-inches.

Plant operating staff have noted that the existing system:

- Is unable to measure current peak flow events.
- Is difficult to maintain as the measurement devise is located in a converted underground structure.

Outfall

Finished plant effluent is conveyed to a gravity outfall pipe via three manhole structures. The outfall pipe is 16-inch pipe. The flow capacity of the pipe is approximately 5,550 gpm (8.0 MGD), which is sufficient for the anticipated flow demand.

Summary

The following summarizes the review for finishing and discharge at the future anticipated flow and load demands:

- Replace ultraviolet disinfection system with an appropriately sized disinfection system.
- Relocate disinfection to a stand alone building to better control work environment and conditions. Relocation to reduce the required amount of conditioning equipment and allow for proper maintenance and operation of equipment.
- Replace effluent measurement with reliable, and accessible system.
- Condition related improvements as noted.

SOLID TREATMENT CAPACITY REVIEW

Solids treatment includes waste activated sludge and waste scum from the secondary clarifiers. The facility is capable of producing either liquid biosolids, dewatered biosolids, or dried biosolids. Typically, dewatered biosolids are produced and landfilled for disposal. The following sections will review each liquid treatment process in greater detail for suitability to meet the anticipated future flow and load capacity.

Biosolids Stabilization

The biosolids stabilization at Big Lake consists of the following treatment processes:

- Waste Sludge Storage
- Aerobic Digestion
- Liquid Biosolids Storage

Waste activated sludge is stored in one of two waste sludge holding tanks. Stored solids flow to an effluent structure where it is combined with waste scum from secondary clarification and pumped to the Sludge Control Building. The waste sludge storage is mixed by diffused aeration. The waste sludge storage tank contains a supernatant wetwell which can be used to collect supernatant from the waste sludge holding tank, as well as supernatant which flows by gravity from liquid biosolid storage.

The Sludge Control Building contains treatment equipment for aerobic digestion and liquid biosolids storage. Waste sludge from waste sludge storage is pumped to the aerobic digester. The aerobic digester is mixed and aerated through diffused aeration. The aerobic digester also has the ability to be heated, though the system is not operated.

Stabilized biosolids overflow by gravity from the aerobic digester to liquid biosolids storage. The liquid biosolids storage has a decant tree to remove supernatant to the supernatant wetwell at waste sludge storage. The liquid biosolids storage is also mixed by diffused aeration system with blowers in the Sludge Control Building and off-gas from the off gas compressor as part of the drying equipment in the Biosolids Processing Building. Liquid biosolids loadout is possible via a quick companion flange at the Sludge Control Building.

For normal operation, liquid biosolids are pumped via transfer pump from the liquid biosolids storage tank to the Biosolids Processing Building.

Condition-Related Issues

The waste sludge storage was constructed in 1976 and modified in 1995 to include a duplex submersible type wetwell for transfer of waste sludge to the aerobic digesters. The waste sludge storage has a number of condition related issues including:

- Roof of blower room is original to 1976 and should be replaced.
- Interior and exterior architectural coatings are original to 1976 and should be replaced.
- Repair of exterior CMU walls is required to provide water-tight seal for joint cracks.

- Existing fiberglass covers are at end of serviceable life.
- Mixing blowers are located in Administration Building and area at the end of serviceable life.
- Coarse bubble differs are at the end of serviceable life.
- Electrical, controls, and instrumentation were installed in 1995 and near the end of useful life. Include level indictors for each storage cell.
- Existing floating decanter is not serviceable preventing thickening in holding tank. Rectangular tanks are not ideal for gravity thickening.
- Submersible sludge transfer pumps are at the end of serviceable life.
- Submersible supernatant transfer pumps are at the end of serviceable life.
- There is local demand to receiving of sludge from other communities. Operating staff would like the ability to receive solids directly to holding tank for feed to aerobic digesters.

The Sludge Control Building was constructed in 1995 and has a number of condition related issues including:

- Roof of control building is original to 1995 and should be replaced.
- Roof of aerobic digester is original to 1995 and should be replaced.
- Interior and exterior architectural coatings are original to 1995 and should be replaced.
- Minor concrete repair is likely required on interior walls of aerobic digester.
- HVAC equipment is original to 1995 and should be replaced.
- Cut-in sump for new drain/transfer sludge pump to aerobic digester.
- Cut-in sump for new drain/transfer sludge pump to liquid sludge storage.
- Electrical, controls, and instrumentation were installed in 1995 and near the end of useful life. Include level indictors for each treatment tank. Include ORP and DO instrumentation for aerobic digester.
- Blowers are original to 1995 and should be replaced.
- Coarse bubble diffused aeration equipment is aerobic digester and biosolids storage tank are original to 1995 and should be replaced.
- Boiler and recirculation pumps for heating aerobic digester are not used and at serviceable life. Equipment should be removed.
- Current biosolids storage is not covered to maintain water temperature during winter months.
- Exterior personnel doors need replacement.

Waste Sludge Storage

The waste sludge storage tank has a design capacity of 76,000 gallons. The holding tank was originally constructed as part of the 1976 improvements project and has been modified over the years. The holding tank consists of two holding cells which are mixed via diffused air, an effluent box which acts as a submersible type wetwell and drywell valve structure, and a supernatant submersible type wetwell which receives supernatant from both the waste sludge holding tank and the biosolids storage tank.

The sludge holding tank can be decanted from to reduce the required volume in the aerobic digester, however the piping and valves no longer function.

Generally, 10 States Standard for Wastewater Treatment Facilities (2014 edition) provides the following recommendations for thickening of undigested sludge:

> The use of gravity thickening tanks for unstabilized sludges is not recommended because of problems due to septicity unless provisions are made for adequate control of process operational problems and odors at the gravity thickener and any following unit processes. Particular attention should be given to the pumping and piping of the concentrated sludge and possible onset of anaerobic conditions.

Diffused aerated mixing is provided for the storage tank, however mixing or recirculation should be considered for the transfer wetwells for the aerobic digester and supernatant.

As the waste sludge storage tank does not currently operate as a thickener, thickening of waste sludge is not considered when evaluating current treatment capacity of the solid stabilization equipment. Unthickened and at current flow and load demand, the waste sludge storage tank provides the following storage times:

- 36 hours at calendar day average flows and loads,
- 12 hors at maximum month as day flows and loads,

Unthickened and at anticipated flow and load demand, the waste sludge storage tank provides the following storage times:

- 18 hours at calendar day average flows and loads
- 5 hours at maximum month as day flows and loads.

Overflow rate is a measurement of the volume of sludge being sent to a gravity thickener and the surface area of the thickener. It is assumed that a single cell will be wasted to at a time. The waste sludge storage tank overflow rate is:

- 20 cubic feet per square foot day at calendar day average flows and loads, and
- 31 cubic feet per square foot day at maximum month as day flows and loads.

At the anticipated flow and load demand, the overflow rate is:

- 41 cubic feet per square foot day at calendar day average flows and loads, and
- 65 cubic feet per square foot day at maximum month as day flows and loads.

Typical guidance is for 33 cubic feet per square foot day.

The waste sludge storage tank is likely not suitable for rehabilitation as a gravity thickener, but may be effective at a small process holding, break, or receiving tank.

Aerobic Digestion

The aerobic digester consists of a single aerated tank which is 54’-8” by 35’-6” and a side water depth of 16’-0” at overflow elevation. The total storage capacity is 233,000 gallons. The aerobic digester was constructed in 1995. A later improvements project in 2012 modified the aeration system to include off-gas from the Biosolids Processing Building.

Stabilized biosolids overflow by gravity from the aerobic digester to the liquid biosolid storage tank. The liquid biosolid storage tank is not operated as a secondary aerobic digester. The aerobic digester has the ability to be heated via boiler and heat exchanger, though the system is not operated. Operations staff would prefer to remove the current heating equipment. There is currently no way to completely drain the aerobic digester. Operations staff would like to improve the tank by having a method to drain the tank for maintenance that does not require the manual installation of a trash pump for the remaining few feet of biosolids. The aerobic digester has a flat tank bottom.

The aerobic digester is mixed using two blowers which supply air to a common head header with the liquid biosolids storage tank. The header divides into two 8-inch laterals in the aerobic digester. Each lateral consists of 22 diffuser assemblies.

Reliability recommendation by 10 States Standard for Wastewater Treatment Facilities (2014 edition) suggests that multiple digestion units capable of independent operation are desirable and shall be provided in all plants where the design average flow exceeds 100,000 gallons per day. All plants not having multiple units shall provide alternate sludge handling and disposal methods.

Current liquid sludge loadout is limited to the liquid biosolids storage tank. Alternate sludge loadout may be included as a method of draining the aerobic digester or as part of the receiving connection for outside haulers at the waste sludge holding tank.

10 States Standard for Wastewater Facilities (2014 Edition) recommendations are followed by the MPCA for when evaluating aerobic digesters for treatment capacity. The following are critical design characteristics:

- Treatment volume requirements
- Mixing and air requirements
- Supernatant, scum, and grease removal

Additional design guidance for aerobic digestion is provided by Water Environment Federation (WEF) Manual of Practice Number 8 (MOP8) and Wastewater Engineering by Metcalf and Eddy.

A minimum 60 days of solids retention time (SRT) at 59 degrees Fahrenheit (15 degrees Celsius) for aerobic stabilization of biosolids is required by the United States Environmental Protection Agency (USEPA) 40 Code of Federal Regulations (CFR) Part 503 Biosolids Rule if solids are to be liquid land applied. 10 States Standards for Wastewater Treatment (2014 Edition) requires 27 days SRT at 59 degrees Fahrenheit for stabilization and disposal. The City's current method of disposal is landfilling of cake dewatered solids. At current calendar day average flow and load demand, the 233,000-gallon aerobic digester provides approximately 36 days of SRT. At anticipated flow and load demand, there is approximately 17.5 days SRT provided by the digester. The aerobic digester is at capacity at current flow and load demand, and exceed capacity for anticipated flow and load demand if solids are to be disposed of via landfill. Digester capacity is exceeded at both current and anticipated flow and load conditions if biosolids are to be land applied.

Air demand for aerobic digesters should be sufficient to maintain between 1 mg/L and 2 mg/L residual dissolved oxygen. A minimum amount of aeration is required for mixing in order to maintain suspension of solids during treatment. 10 States Standards for Wastewater Treatment Facilities (2014 Edition) recommends a minimum mixing air supply of 30 cfm per 1,000 square feet of tank. For Big Lake this corresponds to 6,900 scfm of mixing air.

Supernatant, scum, and grease are removed in a separate biosolids storage tank. Scum and grease from the aerobic digester tank, where excessive, would be removed via overflow pipe.

Liquid Biosolids Storage

The liquid biosolids storage tank is an open-topped, 76'-0" diameter, roughly circular storage tank with a design capacity of 482,000 gallons. The maximum side water depth is 13'-8" with a 2'-0" center cone. The storage tank includes a supernatant decant tree to remove decant and thickened stabilized biosolids. The biosolids storage was constructed in 1995. A later improvements project in 2012 constructed the sludge transfer pumps to convey sludge from biosolids storage to the biosolids processing building.

The liquid biosolids storage is mixed using two blowers which supply air to a common head header within the aerobic digester. The 10-inch header feed 12 lateral legs in the biosolids storage tank. The laterals are 3-inch PVC pipes feeding diffuser assemblies.

There is currently no way to completely drain the liquid biosolids storage tank. Operations staff would like to improve the tank by having a method to drain the tank for maintenance that does not require the manual installation of a trash pump for the remaining few feet of biosolids. The liquid biosolids storage tank has a cone-shaped tank bottom.

10 States Standard for Wastewater Facilities (2014 Edition) recommendations are followed by the MPCA for when evaluating aerobic digesters for treatment capacity. The following are critical design characteristics:

- Storage volume requirements
- Mixing and air requirements
- Supernatant, scum, and grease removal

All facilities are required to provide a minimum of 120 days of anticipated sludge storage for the location of the Big Lake Wastewater Treatment Facility. Additional storage requirements based on population equivalent do not apply as on-site dewatering facilities are available for use.

Both current and future flow and load demand exceed the minimum 120 days of storage is recommended, however solids are typically dewatered to either cake or dried cake for disposal. Additionally, biosolids are disposed of by landfilling, which does not have weather, seasonal, or crop limitations associated with land application.

An additional 150,000 gallons of liquid sludge storage capacity is available in the batch and alternative batch tanks at the biosolids processing building.

Supernatant is removed through a manual decant tree with five decant elevation, each 2'-0" apart. Scum and grease, where excessive, would either be removed via decant pipe or overflow pipes.

Summary

The following summarizes the review for biosolids stabilization at the future anticipated flow and load demands:

- Aerobic digester capacity is likely exceeded at anticipated flow and load demand.
- Liquid biosolids storage capacity requires weekly dewatering at future flow and load demand.
- Condition related improvements as noted.

Biosolids Dewatering

Biosolids dewatering at the Big Lake facility occurs in the Biosolids Processing Building. The Biosolids Processing Building was constructed in 2012 and provide shift-operated dewatering of biosolids from stabilized liquid biosolids to Class A biosolids.

The biosolids dewatering at Big Lake consists of the following treatment processes:

- Biosolids Thickening
- Thickened Cake Biosolids Loadout
- Biosolids Drying
- Dried Cake Biosolids Loadout

Liquid sludge is pumped via transfer pump from Biosolids Storage to the Biosolids Processing Building. Transferred liquid biosolids is stored in one of two biosolids batch tanks at the Biosolids Processing Building. The primary batch tank has a 100,000 gallons of storage capacity and is the batch tank used for normal operation. An alternative batch tank provides an addition 50,000 gallons of storage capacity. The Biosolids batch tanks are mixed via coarse bubble diffused aeration. Each biosolids batch tank mat be pumped into using alternate connection points for hauled liquid biosolids.

Centrifuge feed pumps feed liquid biosolids to centrifuges for thickening. Centrate from the centrifuges in introduced to preliminary treated effluent ahead of the Selector Basin. Each centrifuge is sized to dewater 167 gpm of liquid biosolids. The calculated current liquid biosolids generation rate is 22 gallons per day at current calendar day average flow and load demand and 42 gallons per day at anticipated flow and load demand.

Thickened cake is transferred to a storage bunker in the Biosolids Processing Building. The dewatering centrifuges typically produce between 20% and 25% total solids with the addition of a liquid polymer thickening aid.

Dry feed pumps pump thickened biosolids to the dryer. The dryer conveys dried biosolids to either the biosolids storage silo adjacent to the Biosolids Processing Building, or an alternate loadout directly to a

receiving truck. Thickened biosolids may also be sent to an alternate loadout, bypassing drying. The biosolids dryer is sized to process up to 7,846 wet lbs per hour of dewatered cake from the centrifuges.

Typical operation is to loadout and landfill cake biosolids rather than dry due to operation and maintenance cost of the drying equipment and capacity issues for liquid treatment related to the large volume of return water from the drying process.

The current storage facilities are indented for dried biosolids, so there is effectively no cake biosolids storage provided other than a relatively small transfer bunker intended to feed the drying equipment. It is recommended that 180 days of cake biosolids storage be provided. Functionally, cake biosolids will air and freeze dry to approximately 40 to 50% total solids while being stored. For the purpose of design, it is assumed storage will be for 20% totals solids, which is the conservative minimum observed during centrifuge operation. At design conditions and 20% solids the storage requirement is approximate 3,600 cubic yards. A cake biosolids storage facility is required with a design depth of 8 feet, width of 60 feet, and overall length of 200 feet.

It is anticipated that there is sufficient capacity with shift operation to meet anticipated load demand for dewatering and drying of biosolids.

Condition-Related Issues

The Biosolids Processing Building was constructed in 2012 and has a number of condition related issues including:

- The air conditioning unit for the electrical room has exceeded its useful service life and requires replacement.
- Radiant heat boiler controls are not reliable and should be replaced.
- Plant PLC panel is no longer serviceable and should be replaced.
- Centrifuge liquid sludge feed pumps are approaching the end of serviceable life.
- Centrifuges are near major overhaul. It is anticipated that the PLC panels for the centrifuges will be recommended for replacement at this time. The VFD drive for centrifuge #1 should be replaced.
- Central odor control system requires media replacement. Location of media tank obstructs service of process equipment and should be relocated.
- There is no chemical eyewash and shower for the polymer chemical feed equipment.
- There is no shower for staff in the lavatory.
- There is no storage for dewatered cake.
- Alternate cake loadout should be improved to reduce spillage of cake between load out. Currently the loadout is just a horizontal plain end pipe.

Summary

The following summarizes the review for biosolids dewatering at the future anticipated flow and load demands:

- Condition related improvements as noted.

OTHER CONSIDERATIONS

Other considerations at the facility include those capital improvements which serve the community but are not directly part of the wastewater treatment process. These considerations contribute to flow and load at the facility and are included in the capacity review considerations for both solids and liquids processes.

Administration

The facility has a multi-use administration building which houses the:

- Office space,

- Laboratory and testing equipment,
- Effluent total phosphorus online monitor,
- Waste sludge storage blower room (considered previously as part of Biosolids Stabilization),
- Ultraviolet disinfection (considered previously as part of Finishing and Discharge),
- RAS/WAS control valve and flow meter (considered previously as part of Secondary Treatment), and
- Effluent measurement (considered previously as part of Finishing and Discharge).

The administration and control building was constructed in 1976 and modified during the 2001 and 2019 projects. Open-top process tanks introduces humidity and filter flies to the otherwise administrative workspace which both impact environment control equipment, process control equipment, and administrative equipment in the building.

Condition-Related Issues

The Administration Building was constructed in 1976 and has a number of condition related issues including:

- The roof is original to 1976 and requires replacement.
- Existing conditioning system consists of a boiler original to 1976 and an air conditioning unit which does not operate. The HVAC system should be replaced with a forced air and central conditioning system for the administration building, separate from process rooms.
- Raw sludge piping running through the administrative building requires clean air exchanges to avoid hazardous classification of the building space. Separate or re-route raw sludge piping from remainder of administrative building.
- Automatic controls including programmable logic controllers (PLCs) with human machine interface (HMI) displays for remote control and monitoring should come back to the administration building supervisory control and data acquisition (SCADA) system for the entire facility. System should include a data logging historian, remote controls, and monitoring for all treatment processes.
- Existing in-plant sanitary waste wetwell, pump, controls, and piping are past serviceable life. Replace with new in-plant suction lift station with top-mounted fiberglass valve and pump enclosure.
- The existing lavatory and shower facilities house process monitoring equipment and are non-functional.
- Interior and exterior architectural coatings are original to 1976 and should be replaced.
- Repair of exterior CMU walls is required to provide water-tight seal for joint cracks.

Vactor Receiving

The facility currently operates a Vactor receiving station for septage haulers at the facility. The current station is small, precast concrete receiving structure near the preliminary treatment building. The current structure:

- Is located in a difficult to access location for inexperienced drivers,
- Does not allow for metering a septage to the head of the treatment facility,
- Does not measure volume of septage received, and
- Does not facilitate site security and requires a plant operator to facilitate access to the station.

The current vactor receiving station does not meet the growing demand for septage treatment services in the community. The septage receiving, site access, and operation of the receiving station should be addressed as part of the capacity improvements at the facility.

Utilities

Backup Power

The wastewater treatment site has a 100-kW backup generator installed in the administration building. The generator is insufficiently sized to power then entire treatment facility during utility outages. The generator is original to the 1976 improvements project and is at the end of its useful life.

Site Lighting

Site lighting is original to the 2001 improvements project on the south site of the project site. Site lighting through the facility requirements improvements and replacement.

Communications

Currently buildings on the north site of the site (Biosolids Processing Building and Preliminary Treatment Building) have fiber communications. The buildings on the south side of the site does not. Fiber communications should be run to all treatment buildings to allow for centralized control, monitoring, and alarms by plant SCADA from Administration Building.
Lift stations in collection system communicate via radio to plant control and monitoring system.

Hardscape

Asphalt pavement on south side of site is original to 2001 improvements project and is new the end of useful life. Asphalt pavement should be replaced throughout site due to age and related construction activities.

Summary

The following summarizes the review for other considerations at the future anticipated flow and load demands:

- Relocate UV disinfection to separate, purpose-built structure.
- Relocate RAS/WAS piping and controls to separate structure.
- Relocate septage receiving, increase accessibility, capacity, and include the ability to meter and measure flows.
- Add card access and motorized gate with security camera to main drive of facility. Provide capability of issuing access cards to septage haulers.
- Replace backup generator with appropriately size unit.
- Run new fiber communications to all treatment building and equipment.
- Condition related improvements as noted.

A summary of the recommended improvements for facilities can be found in attachment 5 of this memorandum.

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Attachments:
Attachment 1: Liquid Treatment Flow and Load Memorandum
Attachment 2: Solids Treatment Flow and Load Memorandum
Attachment 3: Condition Assessment Survey
Attachment 4: Preliminary Effluent Limit Request Electronic Response Letter Dated Nov. 2, 2022
Attachment 5: Summary of Recommendations

c: Eric Miller, SEH Inc.
Colin Marcusen, SEH Inc.

Attachment 1

Liquid Treatment Flow and Load Memorandum

Building a Better World for All of Us®

MEMORANDUM

TO: Equipment Suppliers and Manufacturers

FROM: Eric Miller

DATE: April 6, 2023

RE: Big Lake Wastewater Treatment Facilities Plan Flow and Load Conditions
SEH No. BIGLK 167307 14.00

The purpose of the memorandum is to serve as a reference for preparation of a preliminary proposal package to be referenced in the Big Lake Wastewater Treatment Facilities Plan being prepared by SEH Inc. on behalf of the City of Big Lake. Flow and load conditions referenced may change between preliminary design as part of the facilities plan and final design for construction. Anticipated construction for this project is during summer 2024.

As part of the preliminary proposal package, please include:

- Budgetary proposal.
- General description of space requirement for major equipment, a non-site-specific general arrangement drawing, or similar drawing from equipment proposed elsewhere.
- Identify specific utility, piping, or ancillary process requirements associated with the proposed equipment (ie electrical, wash water, drains, plant air, etc.).

Please refer to Tables 1 and 2 below for the anticipated flow and load demand to the facility at startup (existing) and design capacity (anticipated).

Table 1: Flow Demand Design Parameters

Parameter	Current Flow Demand [3]	Anticipated Flow Demand [3]
Average Dry Weather (ADW) Flow, mgd	0.699	1.366
Calendar Average Day (ADF) Flow, mgd	0.721	1.446
Average Wet Weather (AWW) Flow, mgd	0.838	1.682
Calendar Day Maximum Flow, mgd	1.208	2.475
Peak Hourly Wet Weather (PHWW) Flow, mgs	2.204	4.467
Peak Instantaneous Wet Weather (PIWW) Flow, mgd	2.204	4.467
Return Activated Sludge Flow, Minimum, mgd [1]	0.361	0.723
Return Activated Sludge Flow, Maximum, mgd [2]	1.082	2.169

Notes:
1. Corresponds to 50% of calendar average day influent flow demand.
2. Corresponds to 150% of calendar average day influent flow demand.
3. Does not include flow as a result of supernatant, decant, centrate, or drier water.

Table 2: Load Demand Design Parameters

Parameter	Current Load Demand [1]	Anticipated Load Demand [1]
Calendar Day, Average $cBOD_5$, ppd	2,141	4,621
Maximum Month as Day Average $cBOD_5$, ppd	3,679	7,773
Calendar Day, Maximum $cBOD_5$, ppd	7,386	14,988
Calendar Day, Average TSS, ppd	**2,963**	**5,465**
Maximum Month as Day Average TSS, ppd	6,702	12,227
Calendar Day, Maximum TSS, ppd	11,202	19,984
Calendar Day, Average TP, ppd	**47**	**87**
Maximum Month as Day Average TP, ppd	75	138
Calendar Day, Maximum TP, ppd	107	195
Calendar Day, Average TKN, ppd	**358**	**652**
Maximum Month as Day Average TKN, ppd	496	894
Calendar Day, Maximum TKN, ppd	496	894

Notes:
1. Does not include load as a result of recirculation, supernatant, decant, centrate, or drier water.

ejm

c: Jessica Hedin, SEH Inc.

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Attachment 2

Solids Treatment Flow and Load Memorandum

Building a Better World for All of Us®

MEMORANDUM

TO: Equipment Suppliers and Manufacturers

FROM: Eric Miller

DATE: April 6, 2023

RE: Big Lake Wastewater Treatment Facilities Plan Flow and Load Conditions
SEH No. BIGLK 167307 14.00

The purpose of the memorandum is to serve as a reference for preparation of a preliminary proposal package to be referenced in the Big Lake Wastewater Treatment Facilities Plan being prepared by SEH Inc. on behalf of the City of Big Lake. Flow and load conditions referenced may change between preliminary design as part of the facilities plan and final design for construction. Anticipated construction for this project is during summer 2024.

As part of the preliminary proposal package, please include:

- Budgetary proposal.
- General description of space requirement for major equipment, a non-site-specific general arrangement drawing, or similar drawing from equipment proposed elsewhere.
- Identify specific utility, piping, or ancillary process requirements associated with the proposed equipment (ie electrical, wash water, drains, plant air, etc.).

Please refer to Table 1 below for the anticipated flow and load demand to the facility at startup (existing) and design capacity (anticipated).

Table 1: Flow and Load Demand Design Parameters

Parameter	Current Flow Demand [3]	Anticipated Flow Demand [3]
Calendar Average Day (ADF) Flow, mgd	0.721	1.446
Average Wet Weather (AWW) Flow, mgd	0.838	1.682
Peak Hourly Wet Weather (PHWW) Flow, mgd	2.204	4.467
Waste Activated Sludge Flow, Average, mgd [1]	0.048	0.099
Waste Activated Sludge Flow, Maximum, mgd [1]	0.156	0.314
Waste Activated Sludge Flow, Average, mgd [2]	0.027	0.055
Waste Activated Sludge Flow, Maximum, mgd [2]	0.085	0.170
Waste Activated Sludge Flow, Average, mgd [3]	0.015	0.029
Waste Activated Sludge Flow, Maximum, mgd [3]	0.044	0.086
Liquid Biosolids Flow, Average, mgd [2]	0.031	0.060
Liquid Biosolids Flow, Average, mgd [3]	0.021	0.040

Notes:
1. Assumes 0.85% total solids by weight and 2,400 gpd unthickened scum and scum carrier water.
2. Assumes 1.50% total solids by weight and 2,400 gpd unthickened scum and scum carrier water.
3. Assumes 3.00% total solids by weight and 2,400 gpd unthickened scum and scum carrier water.

ejm

c: Jessica Hedin, SEH Inc.

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Attachment 3

Condition Assessment Survey

Project: Big Lake Wastewater Treatment Facilities Plan
SEH Proj. No.: BIGLK 167307
Project Manager: Jessica Hedin
Title: Condition Assessment

Condition Score Legend	
1	Very good
2	Minor defects
3	Maintenance required
4	Requires renewal
5	Unserviceable

Risk Score Legend	
1	High-Impact
2	Medium-Impact
3	Low-Impact

Preliminary Treatment (01)	Condition Score	Risk Score	Notes
Building			
Structural Concrete	2	2	Channel concrete and vortex grit appear to be in good condition, the hollow core planks on ceiling have been sagging since construction in 2011. The City has a support member installed to hold up the sagging ceiling. Recommend structural engineer visual inspection and assesment before assuming the structures can be reused.
Roof / Cover	1	3	Roof in good condition.
Mechanical Equipment	4	2	Two electric unit heaters have failed in screening room due to harsh environments. MAU provides heat for this space and the EUHs are no longer operational. A/C replacement is required. MAU maintenance required.
Plumbing and Piping	4	2	All plumbing (W1, W2 and SAN) needs to be replaced in the building with corrosion resistant materials such as PVC. There are a lot of hose bibs provided currently throughout the building, less bibs have been requested by the Operations staff because of maintenance concerns with more valves and staff do not ever use all of the available hose connections.
Electrical Equipment	2	1	City is requesting to consolidate plant PLC HMIs in each building for use of tablets. Rockwell system requested, City is working with Total Control as a system integrator. The PLC for Lakeside Raptor Screen 1 is still installed in the electricla room, this will need to be removed to make room for Huber PLC with replacement perforated plate fine screen to be installed. Electrical equipment in the Preliminary Treatment Building appeared to be in fair condition and is relatively new, installed in 2011.
Controls / SCADA	4	1	Upgrade plant PLC with tablet interface, no HMIs requested as a lot of these HMIs around the plant have had connectivity issues. Total Control is aware of this issue and can be named as the system integrator for next improvements project.
Coatings	4	3	All existing piping requires new coatings, wall coatings appear to be in fair condition but may need touchups. No coatings observed in the channels or vortex grit chamber. Coatings on grit classifier need touchup if the cyclone is not replaced during the next improvements project.
NFPA Code Compliance	2	3	Separate electrical room provided, appears to meet NFPA code. Possibly further investigation to confirm code requirements of Preliminary Treatment Buildings.
Building Code Complaince (ingress/egress)	1	3	No concerns from staff
Doors and Windows	4	3	All existing doors are coated steel doors and have corroded. Replace with either FRP or aluminum doors, aluminum preferred. Some of the doors have swollen such that they cannot be easily opened and closed.
Fine Screen Equipment			
Fine screens	4	2	2011 Lakeside Raptor screen no longer has the ability to run washwater. Operations staff need to hand spray down the screen which reduces efficiency and requires more of the staff's time to maintain the equipment. One of the two original screens have been replaced with Huber RPPS perforated plate fine screen, the second screen should be replaced to match this screen.
Wash water Booster Pumps and Pressure Tank	4	3	The pressure tank is residential grade and has failed previously. This tank needs to be replaced with industrial grade pressure tank. Booster pumps appear to be in good condition, however the capacity needs to be evaluated when a second perforated plate fine screen is installed and will require high pressure washwater for operation. The City has mentioned that at this high pressure, a lot of W1 city water is used for screen washing. The City would like to investigate installing a plant effluent water loop to provide alternative water source for washwater in the Preliminary Treatment Building and elsewhere around the facility.
vortex grit removal	3	2	Installed in 2011, the Operators mentioned that the vortex grit removal system runs well. Maintenance may be required on the drive unit itself, however there have not been any known issues with the vortex grit system drive to date.
Grit Removal Equipment			
grit pump	4	1	One grit pump is installed, Operations staff requested installing a second grit pump for redundancy. Recently the grit pump required replacement and there was no backup pump to operate during the time needed to obtain a new grit pump. The replacement grit pump is in good operating condition, but a redundant pump is requested to be installed.
grit classifier	2	2	Installed in 2011, the grit classifier is in fair condition. Surface corrosion has been observed and a replacement cyclone may be required to extend the service life of the equipment.
Flow Control Equipment			
Parshall flume and instrumentation	2	2	Installed in 2011, the flume and instrumentation are in good working condition. The instrumentation is likely near its useful life.
Slide gates / stop logs	2	2	There are stop logs for isolating channels, screens are pivoted out of the channel for maintenance.
Automatic Sampler	2	2	Influent sampler appears to be in fair condition, installed in 2011. May want to consider replacing when the sampler hits useful life.

Project: Big Lake Wastewater Treatment Facilities Plan
SEH Proj. No.: BIGLK 167307
Project Manager: Jessica Hedin
Title: Condition Assessment

Condition Score Legend		Risk Score Legend	
1	Very good	1	High-Impact
2	Minor defects	2	Medium-Impact
3	Maintenance required	3	Low-Impact
4	Requires renewal		
5	Unserviceable		

Selector Basin (02)	Condition Score	Risk Score	Notes
Building			
Structural Concrete	2	2	Concrete appears to be in fair condition, the selector tank was added in 2001. Concrete cover appears to have minor defects.
Roof / Cover	N/A	N/A	Uncovered.
Mechanical Equipment	N/A	N/A	There is no mechanical equipment installed in the anaerobic selector tank.
Plumbing and Piping	4	2	Piping original to structure.
Electrical Equipment	4	2	Installed in 2001, the electrical equipment has reached its useful life.
Controls / SCADA	4	2	Mixers run continuously, new controls will likely be required with new mixers being installed.
Coatings	N/A	N/A	Unable to observe the condition and/or presence of coatings due to concrete cover
NFPA Code Compliance	N/A	N/A	Unoccupied, no instrumentation.
Building Code Complaince (ingress/egress)	N/A	N/A	Unoccupied.
Doors and Windows	N/A	N/A	No windows or doors.
Selector Tank Equipment			
Mixers	4	2	Installed in 2001, the current mixers have reached their useful life and ragging issues have been observed. Replace with non-clogging style submersible mixers as a part of the next improvements project.
Gates	3	2	Installed in 2001, the gates have reached their useful life and replacement should be considered to extend the useful life of this process another 20 years.
Baffle wall	2	3	Unable to observe the condition of the baffle wall due to concrete cover
Instrumentation	4	2	There is no instrumentation in this tank, consider adding ORP probes for process control purposes to improve biological phosphorus removal operations.

Oxidation Ditches (03)	Condition Score	Risk Score	Notes
Building			
Structural Concrete	2	3	Building appears to have minor defects and is quite old. Improvements to the building HVAC and doors should be considered during the next improvements project.
Roof / Cover	4	3	Control building roof original to tanks. Tanks uncovered.
Mechanical equipment	4	3	Mechanical equipment in the old building above Oxidation Ditch 1 aeration equipment likely needs to be replaced due to age.
Plumbing and Piping	4	2	Piping and valves original to structure.
Electrical equipment	4	2	Oxidation Ditch 1 and 2 aeration equipment electrical needs to be replace with VFD for improved aeration control based on DO control.
Controls / SCADA	4	2	Oxidation Ditch controls for 1 and 2 need to be replaced, DO control improvements can be made for more efficient use of aeration energy.
Coatings	N/A	N/A	No coatings observed in the oxidation ditches.
NFPA Code Compliance	N/A	N/A	Was not entered for consideration.
Building Code Complaince (ingress/egress)	N/A	N/A	Was not entered for consideration.
Doors and Windows	N/A	N/A	Was not entered for consideration.
Aeration Tank Equipment			
Structural Concrete	2	1	Oxidation Ditch 1 and 2 are old, but the concrete appears to be in fair condition for reuse of these structures long term. Recommend structural engineer visual inspection and assesment before assuming the structures can be reused.
Aeration equipment	4	1	Existing equipment is brush rotor style surface aeration, Oxidation Ditch 1 and 2 aeration equipment has reached or exceeded useful life and is in need of replacement. During summer months and times of high influent loading, the current aeration equipment in Oxidation Ditch 1 and 2 cannot maintain a DO concentration of 2 mg/L.
Instrumentation	4	3	1 DO probe currently installed per basin, Operations staff would like 1 DO probe tied to the operation of each brush rotor aeration equipment for improved DO control.

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Project Manager: Jessica Hedin
Title: Condition Assessment

Condition Score Legend		Risk Score Legend	
1	Very good	1	High-Impact
2	Minor defects	2	Medium-Impact
3	Maintenance required	3	Low-Impact
4	Requires renewal		
5	Unserviceable		

Secondary Clarifiers (04)	Condition Score	Risk Score	Notes
Building			
Structural Concrete	2	2	Installed in 2001. Recommend structural engineer visual inspection and assesment before assuming the structures can be reused.
Roof / Cover	4	3	Existing covers are FRP and leak. Doors freeze in the winter. Consider replacement.
Mechanical Equipment	4	3	Fans appear to be in poor condition on covers.
Plumbing and Piping	3	1	The telescoping valves appear to be in fair condition, the operation of telescoping valves to control RAS and WAS is not ideal for Operations staff. Consider designing a new building in between new final clarifiers with dedicated RAS and WAS pumps for improved control of return and wasted solids. Telescoping valve configuration may be reused if existing final clarifiers are used for flow equalization to return post equalized flow back to the anaerobic selector area.
Electrical Equipment	4	2	Installed in 2001, electrical gear is nearing useful life.
Controls / SCADA	4	2	Sludge blanket monitoring equipment requested by Operations staff.
Coatings	4	3	New coatings required for effluent launders at a minimum.
NFPA Code Compliance	2	3	Existing equipment appears to be rated for Class 1 Division 1.
Building Code Complaince (ingress/egress)	1	3	No issues observed
Doors and Windows	5	3	Doors damaged and require replacement.
Secondary Clarifier Equipment			
Bridges	4	1	I-beams are badly corroded inside final clarifiers when taken out of service for maintenance August 2022.
Mechanisms	4	1	Installed in 2001, the clarifier mechanisms have reached their useful life.
Effluent weir and launders	2	1	Effluent weirs and launders appear to be in okay condition, however difficult to see all around the final clarifiers from the bridge. Consider small repairs needed if the effluent weirs and launders will be reused for flow equalization.
Slide Gates	4	2	Installed in 2001 the slide gates for isolating clarifiers have reached useful life. Consider replacing during the next improvements project.
Influent Structure Equipment			
Structural Concrete	2	2	Influent splitter structure appears to be in fair condition. Recommend structural engineer visual inspection and assesment before assuming the structures can be reused.

Chemical Feed Building (05)	Condition Score	Risk Score	Notes
Building			
Structural Concrete	3	3	Existing garage is residential grade, consider upgrading overhead door to protect chemical storage tanks. Staff are worried about the overall condition of the building.
Roof / Cover	1	3	Asphalt shingle roof, relatively new. Could be replaced with standing seam steel for 20 year design life.
Mechanical equipment	3	3	Aging equipment may need upgraded to last another 20 years.
Plumbing and Piping	3	2	Piping and valving is complicated, separate line to each oxidation ditch is provided currently, staff requested an additional dose point to the influent splitter structure. This is where they would prefer to dose coagulant in the future opposed to each oxidation ditch individually. Staff agreed that keeping the existing piping and valves in place for operational flexibility makes sense.
Electrical equipment	2	2	All electrical in this building appears to be fed from a lighting panel, 120V. May be approaching useful life.
Controls / SCADA	2	2	Would like automated dosing in SCADA system, currently the dose needs to be adjusted at the peristaltic pumps within the chemical storage building.
Coatings	2	3	Architectural caotings appear to be in good condition.
NFPA Code Compliance	N/A	N/A	No issues observed.
Building Code Complaince (ingress/egress)	N/A	N/A	No issues observed.
Doors and Windows	2	3	Hollow-metal steel door installed in residnetnial grade exterior finish. No drip edge over door.
Chemical Feed Equipment			
Metering pumps	4	1	Existing metering pumps are oversized (on the order of 100 gph capacity where 5 gph dose is desired), the pumps are all the way turned down.
Instrumentation	3	2	Generally there is not a lot of instrumentation in the chemical storage building, perhaps addition of radar level instrumentation in chemical storage tanks would be helpful for monitoring chemical volume at any given time.
Chemical Feed Points	4	2	Requested to add a dose point to the oxidation ditch influent splitter box.

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Condition Score Legend	
1	Very good
2	Minor defects
3	Maintenance required
4	Requires renewal
5	Unserviceable

Risk Score Legend	
1	High-Impact
2	Medium-Impact
3	Low-Impact

Administration and Disinfection Building (06)	Condition Score	Risk Score	Notes
Administration Building Portion			
Structural Concrete	3	3	Restrooms and shower improvements, drinking fountain requested, coatings improvements, general upgrades to last another 20 years. New microscope requested in Lab.
Roof / Cover	4	3	All buildings on south end of plan need roof replacement.
Mechanical Equipment	4	3	A/C unit needs to be replaced. Boiler can be replaced with forced air system.
Plumbing and Piping	4	2	Original to building. Hydronic piping failing.
Electrical Equipment	4	3	Aging equipment needs replacing.
Controls / SCADA	4	1	New SCADA workstation required.
Coatings	4	3	Architectural coatings should be replaced.
NFPA Code Compliance	5	A	Sludge piping pumped through disinfection portion which is connected to entirey or building.
Building Code Complaince (ingress/egress)	N/A	N/A	None observed in administrative portion
Doors and Windows	4	3	Original hollow-metal doors to building. No windows.
UV Disinfection Building Portion			
Structural Concrete	2	2	Concrete appears to be in fair condition, the existing UV structures were repurposed from final clarifiers and chlorine contact tank connected to Admin Building. Owner would like new UV building with better access.
Roof / Cover	4	3	All buildings on south end of plan need roof replacement.
Mechanical Equipment	4	2	Ventilation improvements likely required, potentially for NFPA code.
Plumbing and Piping	4	2	Original to building. Hydronic piping failing.
Electrical Equipment	3	2	There is no available room for electrical gear expansion in the Admin Building where UV system is also installed. Equipment has been updated over previous projects, further investigation required if electrical upgrades would be required for a new UV system.
Controls / SCADA	4	2	Controls need to be updated with new UV system, existing controls are unable to modulate lamp intensity due to issues with effluent flow meter.
Coatings	4	3	Room coatings could use replacement
NFPA Code Compliance	5	1	Sludge piping pumped through disinfection portion which is connected to entirey or building.
Building Code Complaince (ingress/egress)	5	1	Likely egress issues with lower level from UV equipment.
Doors and Windows	4	3	Original hollow-metal doors to building. No windows. Would like to convert UV room to garage with man-door and overhead door.
UV Disinfection Equipment			
UV Equipment	4	1	Current UV system is no longer supported by Trojan and is approaching useful life.
Instrumentation	4	2	Effluent flow meter needs to be replaced.
Flow Control Equipment			
Effluent Flow Meter	4	1	Does not read properly. Located in valt adjacent to UV channel and difficult to access/maintain.
Automatic Sampler	4	2	Sampler itself is in fair condition, however the controls need to be updated.

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2	Minor defects	2	Medium-Impact
3	Maintenance required	3	Low-Impact
4	Requires renewal		
5	Unserviceable		

Waste Sludge Holding Tank (07)	Condition Score	Risk Score	Notes
Building			
Structural Concrete	3	2	Existing tanks are old but seem to be in fair condition. These tanks are roughly 70,000 gal and could be used for future biosolids hauling tank from other communities. If this is the case, City would like to allow for easy dumping. Look at SRT of digester to see if thickening is required.
Roof / Cover	4	3	Fiberglass cover is aging and in need of replacement.
Mechanical Equipment	N/A	N/A	Not mechanical equipment.
Plumbing and Piping	4	2	Original to building.
Electrical equipment	3	2	Electrical equipment is aging and may need replacement.
Controls / SCADA	N/A	N/A	No controls
Coatings	N/A	N/A	No coatings
NFPA Code Compliance	N/A	N/A	Not occupiable.
Building Code Compliance (ingress/egress)	N/A	N/A	Not occupiable.
Doors and Windows	N/A	N/A	No windows or doors.
Thickening Equipment			
Diffusers/ mixers	4	2	Aging equipment, need to be replaced.
Instrumentation	4	3	New level instrumentation requested for monitoring tank contents. Currently only a high level float switch installed.
Blowers	3	2	Blowers are located in the Admin Building, appear to be in fair condition but it is not known by staff if all three blowers are in operating condition. Only one blower is operated periodically in Hand to mix tank contents.
Decanter	5	3	Decanter not serviceable, currently tied up so it does not fall into the tank. No need to decant from this tank, as any thicker solids does not help centrifuge dewatering equipment performance. If digester SRT is low for projected flows, a new decanter may be required to thicken WAS prior to digestion.
Pumps	4	2	2 pumps are aging and need to be replaced.

Biosolids Control Building (08)	Condition Score	Risk Score	Notes
Building			
Structural Concrete	4	1	Staff have concerns about the concrete walls of the aerobic digester tank structural integrity with respect to the cover/roof, and no longer go up on the roof for Operator safety reasons. Recommend structural engineer visual inspection and assesment before assuming the structures can be reused.
Roof / Cover	4	1	Staff have concerns about the roof of the aerobic digester tank structural integrity, and no longer go up on the roof for Operator safety reasons. Recommend structural engineer visual inspection and assesment before assuming the structures can be reused.
Mechanical equipment	3	2	Mechanical equipment appeared to be aging and may need maintenance or replacement to last another 20 years.
Plumbing and Piping	2	2	Piping appears to be in fair condition. City would like to add to suction line in order to pump down tank contents completely, currently there is a few feet of solids left at the bottom of the tank that needs to be pumped out with a trash pump. All valves in the digester building are aging and will likely need to be replaced to extend the
Electrical equipment	4	2	Aging electrical equipment will likely need to be replaced to extend the useful life of this process for another 20 years.
Controls / SCADA	4	2	Aging controls will likely need to be updated if blowers and pumps are replaced.
Coatings	3	2	No known coatings in the aerobic digester. Room coatings may need touched up, piping coatings appeared to be in fair condition with touchup required.
NFPA Code Compliance	N/A	N/A	No issues observed.
Building Code Complaince (ingress/egress)	N/A	N/A	No issues observed.
Doors and Windows	4	3	Original hollow-metal doors. No windows.
Aerobic Digester Equipment			
Diffusers	4	2	Diffusers are aging and likely need replacement
Blowers	3	2	Blowers appear to be in fair condition, however are aging and will likely need maintenance or replacement to extend the useful life of this process another 20 years. The capacity of the blowers will also need to be reviewed.
Pumps	3	2	Pumps appear to be aging but in fair condition, either maintenance or replacement would be recommended to extend the useful life of this process another 20 years.
Instrumentation	4	2	Aging instrumentation will need to be replaced, level, pH, ORP and DO controls would be ideal for process control purposes.

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1	Very good	1	High-Impact
2	Minor defects	2	Medium-Impact
3	Maintenance required	3	Low-Impact
4	Requires renewal		
5	Unserviceable		

Biosolids Holding Tank (09)	Condition Score	Risk Score	Notes
Building			
Structural Concrete	2	2	Concrete appeared to be in better condition than the aerobic digester, this tank was installed in 1996 and may need some repairs.
Roof / Cover	4	3	There is currently no cover, staff would like to install a cover over this tank to maintain process water temperature in the cold months.
Mechanical equipment	N/A	N/A	No mechanical equipment inside storage tank
Plumbing and Piping	2	2	Piping appears to be in fair condition. City would like to add to suction line in order to pump down tank contents completely, currently there is a few feet of solids left at the bottom of the tank that needs to be pumped out with a trash pump. Insulation of aeration piping may need replaced. All valves in the digester building are aging and will likely need to be replaced to extend the useful life of this process another 20 years.
Electrical equipment	4	2	Aging electrical equipment will likely need to be replaced to extend the useful life of this process for another 20 years.
Controls / SCADA	4	2	There are not much for controls in this process, updated controls for process control would be preferred.
Coatings	N/A	N/A	No known coatings in the solids holding tank
NFPA Code Compliance	N/A	N/A	Not occupiable.
Building Code Complaince (ingress/egress)	N/A	N/A	Not occupiable.
Doors and Windows	N/A	N/A	No windows or doors.
Biosolids Holding Tank Equipment			
Diffusers	4	2	Diffusers are aging and likely need replacement
Blowers	3	2	Blowers appear to be in fair condition, however are aging and will likely need maintenance or replacement to extend the useful life of this process another 20 years. The capacity of the blowers will also need to be reviewed.
Pumps	3	2	Pumps appear to be aging but in fair condition, either maintenance or replacement would be recommended to extend the useful life of this process another 20 years.

Biosolids Processing Building (10)	Condition Score	Risk Score	Notes
Building			
Structural Concrete	2	2	Fair condition
Roof / Cover	1	3	Roof in good condition.
Mechanical equipment	4	2	Most of the mechanical equipment is in fair condition, A/C unit needs to be replaced. Maintenance required on Boiler for in-floor heating, Honeywell control is not reliable.
Plumbing and Piping	1	3	Piping and valves in good condition.
Electrical equipment	5	2	Plant PLC not serviceable. See above for electrical equipment associated by process equipment.
Controls / SCADA	1	3	SCADA and controls new to building Would like to standardize rest of plant around these controls.
Coatings	2	3	Coatings appear to be in fair condition
NFPA Code Compliance	N/A	N/A	No issues observed.
Building Code Complaince (ingress/egress)	N/A	N/A	No issues observed.
Doors and Windows	2	3	Hollow-metal exterior doors to be replaced. No windows.
Dewatering Equipment			
Building components	2	2	Fair condition
Biosolids batch tanks x 2	3	2	150,000 gal batch tanks appear to be in fair condition - maintenance is required of pumps.
Dewatering centrifuge x 2	4	2	Alfa Laval is scheduled to do maintenance on major components Summer 2022. PLC may need to be replaced for each centrifuge. VFD #1 needs to be replaced. Feed pumps, polymer feed need to be upgraded for easier control of dose to centrifuges. Achieve 20-25% solids.
Drying Equipment			
Conveyors	2	2	Need a deflector plate at top of vertical conveyor at a minimum, possibly look for alternatives. Staff are constantly having issues with this vertical conveyor.
Biosolids hopper/bunker to feed dryer	2	2	This hopper's progressive cavity pumps can also loadout to dump truck outdoors for dewatered sludge hauling without use of dryer. This system seems a bit messy and could be improved. Heat tracing and insulation provided on this loadout pipe outside the building.
Komline Sanderson solids drying system	2	2	Used quarterly for exercising equipment. Rotate equipment monthly. Use 130,000 gal of water each use, which causes issues with the final clarifier hydraulic capacity. Runs for 10 hours. Honeywell boiler controller needs to be reset often and is not reliable. Offgas cooling system has had issues.

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3	Maintenance required	3	Low-Impact
4	Requires renewal		
5	Unserviceable		

General Site	Condition Score	Risk Score	Notes
Odor Control Equipment			
Carbon adsorber odor control system	3	2	Appears to be in fair condition but likely needs media replacement. This equipment is in the way of accessing other equipment with large vehicles, it is in the middle of the floor plan.
Loadout Equipment			
Biosolids storage silo with dust collection	3	2	Minor air pressure power valve issues. Retractable extension cord with bucket system used may need maintenance.
Loadout System	2	2	Need to use dryer silo for using the loadout system, separate loadout provided for dewatered solids (not dried) needs improvements as it is a messy process. There was a pile of biosolids on the ground when on site. Dump truck is used for dewatered solids to landfill for cheaper O&M costs than running the dryer system.
Progressive Cavity Pumps	3	2	Can rotary lobe pumps be used instead of PC. 24% solids with polymer being pumped to batch tanks.
Site Improvements			
Generator	2	1	Staff have been told that the generator will not run all equipment in future. New generator may be required on south end of facility with improvements project.
Lighting	4	3	Upgrade site lighting needed consisting of new poles and fixtures.
Pavement	4	3	New pavement needed through main drive and on south end of facility, north end pavement appears to be in fair condition.
Stormwater	1	3	No stormwater issues known on site.
Electrical	3	2	Lighting upgrades needed, electrical between buildings on south end of facility may need to be upgraded.
Front Gate	4	3	New automated front gate requested - swing gate with key card access for plant staff tied back to City Hall system and key pad with multiple codes for haulers to keep track of time stamped comings and goings.
Septage receiving	4	3	Would like a way to measure flow being discharged.
Surveylance System	4	3	Requested for site security, especially with septic haulers. Camera at front gate and septage receiving.
Coordination and Utilities			
Integrator	N/A	N/A	Total Control - Craig is the main contact for Big Lake
Utilities (water, nat. gas,)			Add plant effluent water loop connected to buildings with washwater and 2 inch site hydrants requested for washdown. New effluent flow meter required.
Fiberoptic / cable / phone	3	3	Fiber between buildings on north end of site, but not in south end. Phone used for dialer.
Radio communications / telemetry	2	3	Cellular coms from lift stations

Attachment 4

Preliminary Effluent Limit Request Response Letter

RE: Preliminary Effluent Limits for the Proposed Big Lake Discharge
NPDES/SDS Permit MN0041076-SD001

Mr. Wolohan:

This electronic-letter is in response to your request for preliminary effluent limits for an expansion of the City of Big Lake wastewater treatment plant (WWTP). It summarizes the preliminary effluent limits for the WWTP proposed expansion. The preliminary limits are draft values. Effluent limits only become final after the National Pollutant Discharge Elimination System (NPDES) permit has undergone a complete review, been public noticed, the public's comments considered and either our Commissioner or a delegated representative signs the permit.

Please be aware that receiving the preliminary effluent limits in the table below does not mean that your proposed expansion/new facility has been approved. As part of the permitting process, your project must comply with antidegradation requirements (see the Antidegradation Requirement section below for important details). You must demonstrate that there is no way to avoid water quality degradation and that the chosen project alternative is the least degrading prudent and feasible alternative. In many cases, the least degrading prudent and feasible alternative may not be your preferred option or the option(s) discussed in this letter. (7050.0280, subp. 2).

Scenario descriptions

The City of Big Lake requested preliminary effluent limits for one scenario at their Big Lake WWTF discharge:

	Average Wet Weather Design (MGD)	Average Dry Weather Design (MGD)	Discharge Type
Existing Facility	0.958	0.746	Continuous
Scenario #1	2.206	1.413	Continuous

The receiving water will remain the Mississippi River. This section of the Mississippi River is classified as a 1C, 2Bdg, 3,4,5,6 river and is also designated as a restricted outstanding resource value water.

The 7Q10 flow rate of this reach of the Mississippi River is 1074 cfs and this 7Q10 flow rate represents a dilution ratio of 1746:1 at the expanded flow rate.

Table 1: Limits Table

	Existing Discharge		Scenario 1	
AWWDF (MGD)	0.958		2.206	
ADWDF (MGD)	0.746		1.413	
River flow- 7q10	1074		1074	
Dilution Ratio	2685		1746	
Antideg review needed?	No		Yes	
Environmental review needed?	No		No	
Frozen Mass Limits Possible?			Yes	
$cBOD_5$-Ammonia Linkage Eligible?	NA		No	
POLLUTANT / PARAMETER	Conc.	Mass	Conc.	Mass
$cBOD_5$, mg/L (kg/day)	25	34.3	25	34.3[1]
TSS, mg/L (kg/day)	30	41.2	30	41.2[1]
Fecal Coliform Organisms, orgs/100 mL	200 (Apr-Oct)	---	200 (Jan-Dec)	---
Ammonia-N (June 1 - September 30)	---	---	---	---
Ammonia-N (October 1 - November 30)	---	---	---	---
Ammonia-N (December 1 - March 31)	---	---	---	---
Ammonia-N (April 1 - May 31)	---	---	---	---
Dissolved Oxygen, mg/L	---	---	---	---
pH (Standard Unit)	6.0 - 9.0	---	6.0 - 9.0	---
Mercury[3]	---	---	---	---
Phosphorus, mg/L	---		1.0	
Phosphorus, kg/yr (12 month rolling avg)	---	1,160	---	1,160
Chloride, mg/L as Mo. Avg. (kg/day)	---	---	---	---

1. Mass limits associated with previous permit 0.84 MGD AWWDF frozen mass limits.
2. The disinfection limits would be required all year to ensure protection of the ORVW and ensure protection of water at the metro drinking water intakes.
3. Mercury limits and antidegradation analysis of mercury loading would not be required if frozen TSS mass limits are accepted.

Impaired Waters

There are numerous waters impaired for a variety of pollutants ranging from PFAS to mercury and nutrients. Not all of these impairments are relevant for any of the proposed scenarios. The impaired waters of primary importance for effluent limit setting are nutrients, TSS and fecal coliform and all three of these parameters have wasteload allocations in approved TMDLS. It would be very difficult and time intensive to officially modify these TMDLs for Big Lake to receive a larger wasteload allocation.

Phosphorus Details

The current facility has a 1,160 kg/yr 12-month moving total mass limit. The proposed facility has an average wet weather design flow (AWWDF) of 2.206 mgd (Table 2). The new facility will have an annual 1.0 mg/L concentration limit regardless of design flow (Minnesota Rule 7053.0255 subpart 3) because the AWWDF is greater than 1.0 MGD. The Mississippi River and Lake Pepin TMDL established an annual wasteload allocation of 1,160 kg/yr for the Big Lake WWTF (MPCA and Limnotech 2021). The annual mass limit for the proposed expansion is 1,160 kg/yr. As flows at the Big Lake WWTF increase, the facility will have to achieve well below 1.0 mg/L to comply with the 1,160 kg/yr annual mass limit.

Table 2. Total phosphorus (TP) effluent concentrations to achieve Lake Pepin based mass allocation of 1,160 kg/yr at proposed average wet weather design flows (AWWDF) and average dry weather design flows (ADWDF).

Design	flow (mgd)	TP mg/L	TP kg/d	kg/yr
Current AWWDF	0.958	0.8765	3.18	1,160
Current ADWDF	0.746	1.00	2.82	1,031
Proposed AWWDF 1	2.206	0.3805	3.18	1,160
Proposed ADWDF 1	1.413	0.594	3.18	1,160

The proposed expansion will continue to be to the Mississippi River. Kaufenberg (2017) found that the Lake Pepin based limits were sufficient to protect the Mississippi River reaches within the Mississippi River – St. Cloud Watershed. An antidegradation review for phosphorus is not needed since no additional mass of phosphorus is authorized from the proposed expansion.

Class 3 and 4 Water Quality Standards

In 2020 the MPCA submitted a rulemaking proposal to make changes to the existing class 3 and 4 water quality standards. On July 13th, 2021 these rules became effective in state law. The new draft class 3 and 4 standards now have translators effective (Class 3 & Class 4A) in rule that the MPCA must use to determine whether a discharger requires an effluent limit to protect the class 3 and 4 beneficial uses. These translators turn the protective narrative goals of the class 3 and 4A designated uses into enforceable numeric effluent limits. The MPCA does not expect that Big Lake will need a new limit because of these translators, but the MPCA must document that the translators were used upon issuing the permit.

Monitoring requirements

All municipal NPDES permit holders need to monitor for pH, TSS, CBOD5, and DO, fecal coliform. In addition, this permittee will have to monitor the following parameters at the frequencies specified in the table below. The WET testing and priority pollutant scans are required because the facility would become a Major facility (AWWDF > 1MGD).

Table 3 Additional required monitoring beyond standard monitoring

Analyte	Units	Options 1-3 Mechanical Frequency & Influent/Effluent
Mercury, Total	ng/L	4X per year I/E
Mercury, Dissolved	ng/L	4X per year I/E
TSS (grab w/Mercury)	mg/L	4X per year I/E
Ammonia nitrogen, Total	mg/L	4X per year E
Kjeldahl nitrogen, Total	mg/L	4X per year I/E
Nitrate/nitrite nitrogen	mg/L	4X per year I/E
TDS	mg/L	2X per year E
Sulfate	mg/L	2X per year E
Chloride	mg/L	---
Sodium, Calcium & Magnesium	mg/L, umhos/cm	---
Acute Wet Testing	NA	1X per Year
Priority Pollutant Scan	NA	3X per 5 yr cycle

Regulatory Certainty

In response to listening session comments, a voluntary option — part of the Governor's Community Water Infrastructure bonding investment package — would provide up to 20 years of regulatory certainty for wastewater treatment facilities that are willing to accept phosphorus and nitrogen effluent limits and design, construct, and fully operate a biological nutrient removal (BNR) treatment system[1],[2]. BNR systems remove both phosphorous and nitrogen, and are considered the best available technology for wastewater treatment. Indeed, BNR is the only known cost-effective wastewater removal technology for nitrate.

Once the BNR system is in place, the facility would not be required to comply with any new phosphorous or nitrogen limits, beyond those in their discharge permit, for the estimated useful life of the new BNR system. The proposal is linked to a bonding request for water infrastructure grants, and is intended to incentivize facility upgrades to BNR systems.

Communities that volunteer to participate by installing and operating BNR systems would no longer have to speculate what future nitrogen water quality standards might mean for them. Rather than needing to upgrade to meet phosphorus limits now and potentially upgrade again to meet nitrogen limits in five or ten years, communities that install a BNR system would comprehensively address all nutrients for up to 20 years and obtain regulatory certainty. Over time, communities could also save money by reducing both energy usage and the purchase of chemicals for phosphorus removal. Water quality in Minnesota lakes and rivers would also benefit from more treatment plants converting to the best available technology. Notably, we could get a jump on reducing nitrogen in state waters, years ahead of when we can institute a new nitrogen standard. And because Minnesota is home to the headwaters of the Mississippi River, the Great Lakes, and the Red River of the North, the impact of reducing phosphorus and nitrogen in the state will be felt in all our downstream waters, including the Hudson Bay, the Gulf of Mexico, and all the Great Lakes.

[1] Minnesota Statute 115.426

[2] Fact sheet on regulatory certainty

Antidegradation Assessments and Capped Mass Limits

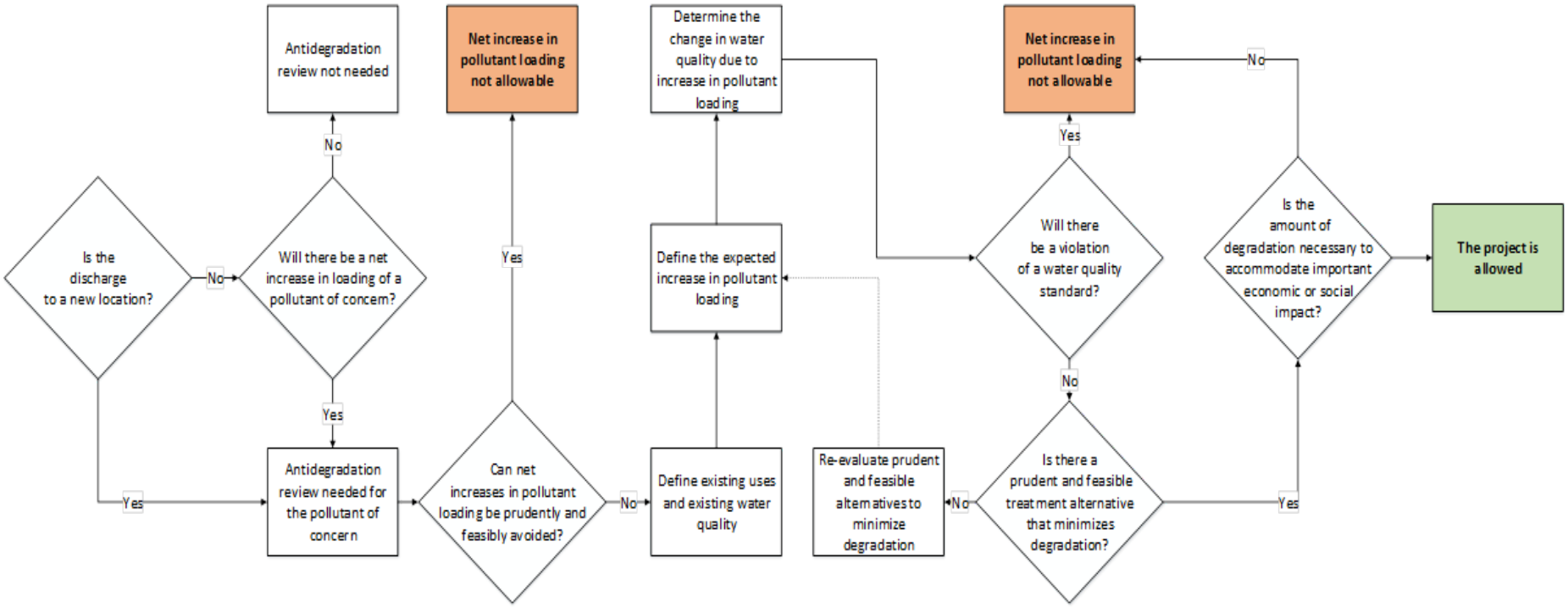
Antidegradation is one of the fundamental protections in the Clean Water Act, and all newly issued or re-issued wastewater permits must comply with both state and federal antidegradation Rules. The goal of antidegradation is to preserve waters of high quality and to ensure that they are not degraded unless balanced by important economic or social development. See Minn. R. 7050.0250 to 7050.0335. The antidegradation assessment process may result in more restrictive effluent limits.

For wastewater permitting, antidegradation concerns are triggered when a new discharge is proposed or when an existing discharger is proposing to increase the loading of any parameter of concern in its discharge. An antidegradation assessment is a substantial evaluation that must consider all beneficial uses of the receiving water, potential economic impacts, all possible treatment options and the potential environmental degradation for every pollutant that triggers the need for an antidegradation assessment. The applicant (permittee) must demonstrate that the chosen project alternative cannot be avoided and is the least degrading prudent and feasible alternative. The permittee must also examine the socioeconomic impacts of the project as compared to the environmental changes in water quality. The environmental degradation must be offset by the socioeconomic benefit. A flowchart summary of the antidegradation assessment process required by state rules (Minn. R. 7050.0280) can be seen below.

New and expanded NPDES permits that result in net increases in pollutant loading to surface waters are required to undergo an antidegradation review (Minn. R. 7050.0280). When applied to a proposed activity that is not regulated by an existing control document (i.e. permit), any loading or other causes of degradation resulting from the proposed activity constitute a net increase (7050.0255 Subp. 26). In this situation, the proposed new treatment system constitutes a net increase in loading; and therefore, an antidegradation review must be completed and approved in order for the effluent limitations to be final for the selected option.

The permittee must submit the antidegradation assessment to the Minnesota Pollution Control Agency (MPCA). MPCA staff will review the assessment to determine if it satisfies state and federal rules. The MPCA has recently developed a guidance document for developing antidegradation assessments that you may find helpful.

Antidegradation assessments frequently require permittees to perform additional water quality monitoring to ensure that appropriate water quality evaluations are performed. The water quality monitoring required for an antidegradation assessment is permit-specific and is intended to fill gaps in existing water quality knowledge. Filling these water quality gaps could require additional monitoring of the discharge, receiving waters upstream and downstream of the discharger or significant industrial users permitted by the discharger.



Summary of the antidegradation assessment process required by Minn. R. 7050.0280

Completing an antidegradation assessment can require a significant amount of time, data and writing effort. It is reasonable to expect at least six to twelve months of effort to complete an antidegradation assessment. The permittee is expected to complete the antidegradation assessment, but the MPCA must approve it as a part of permit documents. The MPCA is responsible for defending the assessment during public comment and in any future legal proceedings. Antidegradation assessments are frequently legally contested, and as such, the MPCA will only approve an assessment of high quality that complies with state and federal antidegradation rules. MPCA staff may provide assistance to the permittee with the antidegradation process.

Because of the workload associated with completing an antidegradation assessment, most permittees looking to expand their permitted flow rates choose to accept “frozen mass limits”. “Frozen mass limits” represent the full authorized load in the previous permit for the pollutants of interest. If the permittee is willing to accept “frozen mass limits” while also expanding their flow rates, then the receiving water would receive no net increase in authorized loading because of the expansion, and an antidegradation assessment would not be needed for that parameter. In this scenario, permitted concentration limits would stay the same as in the last permit issuance, however “effective” concentration limits would be lower in order to comply with voluntary mass limits. If the permittee voluntarily accepts frozen mass limits for the pollutants of concern, they will have satisfied antidegradation rules for that parameter, and they will not need to submit an antidegradation assessment for that parameter.

It must be noted that the receiving water for Big Lake is a restricted outstanding resource value water and the requirements in Minn. R. 7050.0265 subp. 6 are applicable (see statute below).

> **Subp. 6.** Protecting restricted outstanding resource value waters.
>
> The commissioner shall restrict a proposed activity in order to preserve the existing water quality as necessary to maintain and protect the exceptional characteristics for which the restricted outstanding resource value waters identified under part 7050.0335, subparts 1 and 2, were designated.

This statute requires the MPCA to restrict loading to ORVW waters to a higher degree than for non-ORVW waters. The functional result of this statute to Big Lake is that it would be difficult to justify expanding the frozen mass limits for any parameter and Big Lake would be wise to consider accepting frozen mass limits as they are found in the current permit.

Chloride is the only pollutant of concern that must be addressed in an antidegradation review that doesn’t currently have a limit in the permit. Big Lake will not receive a chloride limit in the current or future permit, but because of the expansion there will be a net increase in chloride loading. An antidegradation review must address this net increase in loading of chloride and demonstrate that the exceptional characteristics of the Mississippi River will be maintained. It would be prudent to collect at least five chloride samples in Big Lake’s effluent to characterize Big Lake’s current chloride loading and fulfill the requirements in Minn. R. 7050.0265 with regards to calculating changes in receiving water quality because of the expansion. The MPCA can provide surface water quality data that would help with this calculation and has attached the Otsego West antidegradation assessment that contains a similar calculation for reference.

Environmental Review

An Environmental Assessment Worksheet (EAW) is likely to be required for the expanded facility. This is because for the expansion the flow rate would increase by both 200,000 GPD and by >50% (Minn. R. 4410.4300 subp. 18b). Please contact current MPCA Environmental Review (ER) Wastewater Liaison (Kim Grosenheider) with questions on MPCA ER interpretation. More information can be found in Minn. R. 4410.4300 or at https://www.eqb.state.mn.us/content/mandatory-environmental-review-categories-legislative-assessment-report. A full environmental review is not likely to be needed.

According to the *Preliminary Effluent Limit Review Request* document, the building of a new continuous WWTP will not impact wetlands. If building of the WWTP were to result in the physical alteration of a wetland, then wetland mitigation sequencing in compliance with Minn. R. 7050. 0186 would be required.

References

Kaufenberg, L. 2017. Total phosphorus effluent limit review: Upper Subwatershed of the Mississippi River – St. Cloud Watershed. MPCA St. Paul 17 pp.

If you have any questions, comments or concerns, please contact me at 651-757-2665 or email me at *Scott.Kyser@state.mn.us*

Sincerely,

Scott Kyser, PE
Minnesota Pollution Control Agency
Environmental Analysis and Outcomes Division

Attachment 5

Summary of Capacity and Condition Recommendations

Building a Better World for All of Us®

MEMORANDUM

TO: Dan Childs

FROM: Jessica Hedin, PE (Lic. MN 41639)

DATE: March 24, 2023

RE: Big Lake Wastewater Treatment Facilities Plan, Summary of Capacity and Condition Recommendations
SEH No. BIGLK 167301 14.00

The following memorandum is a summary of capacity and condition related recommendations based upon the evaluation details in the "Big Lake Wastewater Treatment Facilities Plan, Capacity and Condition Evaluation" memorandum.

Refer to Attachment 1 for a process flow diagram for the facility.

CONVEYANCE

Old Main Lift Station

- Demolish existing abandoned old main lift station structure.

Main Lift Station

- Interior process piping, equipment, and architectural coatings.
- Automatic controls including programmable logic controllers (PLCs) with human machine interface (HMI) displays for remote control and monitoring.
- Capacity Review
  - 20 HP submersible pumps are likely insufficient.
  - 43 HP high flow submersible pumps are likely insufficient.
  - 8-inch forcemain will likely be undersized based on high flow pump operation.
  - 12-inch high flow forcemain may be reused for regular flow.
  - A new forcemain will likely need to be furnished to economically meet wastewater flow demand. A phasing approach is recommended to meet minimum flow velocity at startup of new equipment.

PRELIMINARY TREATMENT

Preliminary Treatment Building

- Replace influent screens with system suitable for recommended secondary treatment alternative.
- Add redundant grit pump.
- Replace grit classify and washer cyclone.
- Electric unit heaters.
- Makeup air unit.
- Plumbing piping, fittings, hangers, and accessories.
- Interior process piping, equipment, and architectural coatings.
- Automatic controls including programmable logic controllers (PLCs) with human machine interface (HMI) displays for remote control and monitoring.
- Automatic sampler.

- Influent flow measurement instrumentation.
- Exterior personnel and overhead doors.

SECONDARY TREATMENT

Selector Basin

- Minor concrete repair on concrete cover.
- Process piping and flow control gates were installed in 2001 and near the end of useful life.
- Electrical, controls, and instrumentation were installed in 2001 and near the end of useful life.
- Add instrumentation to monitor oxidation reduction potential (ORP) for process control.
- Mixers operate continuously. Remote controls and communication to SCADA would allow for process monitoring and the potential for a more efficient operating scheme.
- Current mixers were installed in 2001 and experience ragging issues. Mixers are new end of useful life. Replace mixers with non-ragging type mixers.

Oxidation Ditch 1

- Control building roof is original to 1976 and should be replaced.
- Surface aerator is original to 1976 and is at the end of its useful life.
- Piping and valves are original to 1976 and are at the end of their useful life.
- Existing surface aerators are brush rotor type and have exceeded their useful life. During summer months, aerator is unable to maintain a DO in the basins of 2 mg/L.
- Surface aerator runs at constant speed. Replacing constant speed starters with variable speed will allow for dissolved oxygen control in the basins.
- Electrical, controls, and instrumentation were installed in 2001 and near the end of useful life. Include automatic controls to allow for adjustment of aerator speed based on DO measurement in basin.
- Control building is original to 1976. Exterior brick requires repair. HVAC equipment and controls are at the end of their useful life.

Oxidation Ditch 2

- Surface aerator runs at constant speed. Replacing constant speed starters with variable speed will allow for dissolved oxygen control in the basins.
- Existing surface aerators are brush rotor type and have exceeded their useful life. During summer months, aerator is unable to maintain a DO in the basins of 2 mg/L.
- Electrical, controls, and instrumentation were installed in 2001 and near the end of useful life. Include automatic controls to allow for adjustment of aerator speed based on DO measurement in basin.

Secondary Clarifiers

- Fiberglass Reinforced Plastic (FRP) covers are original to 2001 and leak. Doors freeze shut during winter months. Exhaust fans have exceeded useful life. Covers, doors, dormers, lighting, and HVAC equipment should be replaced.
- Existing clarifier mechanism and access bridges are original to 2001 and have reached the end of their useful life. Replace clarifier mechanisms and access bridges in each clarifier.
- Slide gates at influent splitter structure are original to 2001 and have reached the end of their useful life. Replace slide gates at influent splitter structure.
- Telescopic control valves for sludge draw-off are difficult to control. Alternative method for sludge removal which can be operated per tank should be considered.
- Electrical, controls, and instrumentation were installed in 2001 and near the end of useful life. Include level indicators to monitor sludge blanket in each basin.
- Blast and recoat existing clarifier launderers and top of sidewalls.

Chemical Feed

- Existing structure is a wood timber walled structure covered in gypsum board. Not suitable for wet work environments.
- Current chemical feed pumps are oversized for coagulant demand and unable to turn down for cost effective phosphorus control.
- Current chemical feed pumps discharge into a common chemical feed header. Piping does not allow for even flow of coagulant to oxidation ditches.
- Existing chemical feed is limited to oxidation ditch effluent boxes. Consider addition of alternative coagulant feed locations at oxidation ditches influent structures and secondary clarifier influent splitter structure.
- Electrical, controls, and instrumentation were installed in 2001 and near the end of useful life. Include level indicator for chemical fill in bulk chemical storage tanks.

Capacity Review

- The selector basin is likely undersized for future flow demands.
- The oxidation ditches are undersized for current and anticipated load demand.
- The secondary clarifiers are undersized for anticipated flow and load demand.
- Existing chemical feed pumps and piping would be replaced for process control. Additional chemical feed alternate dose locations provided at secondary clarifier splitter structure in addition to oxidation ditch effluent boxes.

FINISHING AND DISCHARGE

Administration Building (Disinfection Portion)

- The roof is original to 1976 and requires replacement.
- Interior and exterior architectural coatings are original to 1976 and should be replaced.
- Repair of exterior CMU walls is required to provide water-tight seal for joint cracks.
- Existing hydronic piping and equipment is failing and requires replacement.
- Raw sludge piping running through the administrative building requires clean air exchanges to avoid hazardous classification of the building space. Separate or re-route raw sludge piping from remainder of administrative building.
- Automatic controls including programmable logic controllers (PLCs) with human machine interface (HMI) displays for remote control and monitoring. Current controls cannot modulate lamp intensity.
- Interior and exterior architectural coatings are original to 1976 and should be replaced.
- Egress occupancy requirements are likely exceeded from lower level.

Capacity Review

- Replace ultraviolet disinfection system with an appropriately sized disinfection system.
- Relocate disinfection to a standalone building to better control work environment and conditions. Relocation to reduce the required amount of conditioning equipment and allow for proper maintenance and operation of equipment.
- Replace effluent measurement with reliable, and accessible system.

BIOSOLIDS STABILIZATION

Waste Sludge Storage

- Roof of blower room is original to 1976 and should be replaced.
- Interior and exterior architectural coatings are original to 1976 and should be replaced.
- Repair of exterior CMU walls is required to provide water-tight seal for joint cracks.
- Existing fiberglass covers are at end of serviceable life.
- Mixing blowers are located in Administration Building and area at the end of serviceable life.

- Coarse bubble differs are at the end of serviceable life.
- Electrical, controls, and instrumentation were installed in 1995 and near the end of useful life. Include level indictors for each storage cell.
- Existing floating decanter is not serviceable preventing thickening in holding tank. Rectangular tanks are not ideal for gravity thickening.
- Submersible sludge transfer pumps are at the end of serviceable life.
- Submersible supernatant transfer pumps are at the end of serviceable life.
- There is local demand to receiving of sludge from other communities. Operating staff would like the ability to receive solids directly to holding tank for feed to aerobic digesters.

Sludge Control Building

- Roof of control building is original to 1995 and should be replaced.
- Roof of aerobic digester is original to 1995 and should be replaced.
- Interior and exterior architectural coatings are original to 1995 and should be replaced.
- Minor concrete repair is likely required on interior walls of aerobic digester.
- HVAC equipment is original to 1995 and should be replaced.
- Evaluate options to fully draw-down contents of aerobic digester and biosolids storage. Currently a few feet remain in tank with requirements manually installing trash pump.
- Electrical, controls, and instrumentation were installed in 1995 and near the end of useful life. Include level indictors for each treatment tank. Include ORP and DO instrumentation for aerobic digester.
- Blowers are original to 1995 and should be replaced.
- Coarse bubble diffused aeration equipment is aerobic digester and biosolids storage tank are original to 1995 and should be replaced.
- Boiler and recirculation pumps for heating aerobic digester are not used and at serviceable life. Equipment should be removed.
- Current biosolids storage is not covered to maintain water temperature during winter months.
- Exterior personnel doors need replacement.

Capacity Review

- Aerobic digester capacity is likely exceeded at anticipated flow and load demand.
- Liquid biosolids storage capacity requires weekly dewatering at future flow and load demand.

BIOSOLIDS DEWATERING

Biosolids Conditioning Building

- The air conditioning unit for the electrical room has exceeded its useful service life and requires replacement.
- Radiant heat boiler controls are not reliable and should be replaced.
- Plant PLC panel is no longer serviceable and should be replaced.
- Centrifuge liquid sludge feed pumps are approaching the end of serviceable life.
- Centrifuges are near major overhaul. It is anticipated that the PLC panels for the centrifuges will be recommended for replacement at this time. The VFD drive for centrifuge #1 should be replaced.
- Central odor control system requires media replacement. Location of media tank obstructs service of process equipment and should be relocated.
- Provide provisions for cake biosolids storage in addition to the dried biosolids silo.
- Alternate cake loadout should be improved to reduce spillage of cake between load out. Currently the loadout is just a horizontal plain end pipe.

OTHER CONSIDERATIONS

Administration Building

- The roof is original to 1976 and requires replacement.

- Existing conditioning system consists of a boiler original to 1976 and an air conditioning unit which does not operate. The HVAC system should be replaced with a forced air and central conditioning system for the administration building, separate from process rooms.
- Raw sludge piping running through the administrative building requires clean air exchanges to avoid hazardous classification of the building space. Separate or re-route raw sludge piping from remainder of administrative building.
- Automatic controls including programmable logic controllers (PLCs) with human machine interface (HMI) displays for remote control and monitoring should come back to the administration building supervisory control and data acquisition (SCADA) system for the entire facility. System should include a data logging historian, remote controls, and monitoring for all treatment processes.
- The existing lavatory and shower facilities house process monitoring equipment and are non-functional.
- Interior and exterior architectural coatings are original to 1976 and should be replaced.
- Repair of exterior CMU walls is required to provide water-tight seal for joint cracks.

Summary

- Relocate UV disinfection to separate, purpose-built structure.
- Relocate RAS/WAS piping and controls to separate structure.
- Relocate septage receiving, increase accessibility, capacity, and include the ability to meter and measure flows.
- Add card access and motorized gate with security camera to main drive of facility. Provide capability of issuing access cards to septage haulers.
- Replace backup generator with appropriately size unit.
- Run new fiber communications to all treatment building and equipment.

ejm
Attachments:
Attachment 1: Process Flow Diagram for the Big Lake Wastewater Treatment Facility.

c: Eric Miller, SEH Inc.
Colin Marcusen, SEH Inc.

A-3 – Facilities Plan Treatment Alternatives Memorandum

Building a Better World for All of Us®

MEMORANDUM

TO: Dan Childs

FROM: Jessica Hedin, PE (Lic. MN 41639)

DATE: May 10, 2023

RE: Big Lake Wastewater Treatment Facilities Plan, Treatment Alternatives
SEH No. BIGLK 167307 14.00

The purpose of this memorandum is to evaluate the treatment alternatives to meet the anticipated design year flow and load demand at the Big Lake Wastewater Treatment Facility (WWTF). Each structure, equipment, or treatment process considered for condition, age, or capacity replacement or rehabilitation at the wastewater treatment facility was considered.

SUMMARY OF THE MAJOR PROCESS-CENTRIC RECOMMENDATIONS

Liquid Treatment Processes:

- Conveyance:
  - Demolish abandoned-in-place old main lift station.
  - Increase design capacity of main lift station.
  - Add additional forcemain to preliminary treatment.
- Preliminary Treatment:
  - Replace influent fine screening and compacting equipment.
  - Replace grit classifying and washing cyclone and add redundant grit pump.
- Secondary Treatment:
  - Replace existing selector basin mixers and baffle.
  - Expand selector basin hydraulic capacity for biological phosphorus removal.
  - Expand secondary treatment organic capacity:
    - Alternative 1 – Additional extended aeration oxidation ditches, brush aerated.
    - Alternative 2 – Modification of existing oxidation ditches for IFAS.
    - Alternative 3 – Modifications of existing oxidation ditches for MOB.
  - Expand secondary clarifier hydraulic and solids capacity:
    - Alternative 1 – Rehabilitation and expansion of existing secondary clarifiers.
    - Alternative 2 – Conversion of existing for a different process and construction of new secondary clarifiers.
  - Replace existing waste and return activated sludge pumps and structure at a proposed Disinfection and Pumping Building.
  - Replace existing coagulant feed equipment.
    - Alternative 1 – Rehabilitate existing chemical storage building.
    - Alternative 2 – Relocate to new Disinfection and Pumping Building.
- Finishing and Discharge:
  - Replace existing ultraviolet disinfection equipment and relocate to new Disinfection and Pumping Building.
  - Replace existing effluent flow measurement and relocate to new Disinfection and Pumping Building.

Solid Treatment Processes:

- Biosolids Stabilization:
  - Provide waste sludge and scum thickening prior to aerobic digestion:
    - Alternative 1 – Gravity thickening.
    - Alternative 2 – Dissolved air floatation thickening.
  - Expand solids treatment capacity of existing aerobic digester, replace existing aeration equipment and diffusers with selected mixing and aeration alternative:
    - Alternative 1 – Rehabilitate primary cell 1, convert liquid biosolids storage to secondary cell 1.
    - Alternative 2 – Rehabilitate primary cell 1, construct primary cell 2, convert liquid biosolids storage to secondary cell 1.
  - Evaluate mixing and aeration alternatives for Waste Sludge Holding Tank, Aerobic Digester, and Liquid Biosolids Storage:
    - Alternative 1 – Diffused aeration and mixing.
    - Alternative 2 – Diffused aeration, compressed aerated mixing.
    - Alternative 3 – Jet aeration and mixing.
  - Centralized sludge and biosolids low-pressure aeration at Biosolids Control Building.
  - Convert existing Waste Sludge Storage Tank to sludge receiving station.
  - Cover liquid sludge storage.
- Biosolids Dewatering:
  - Replace centrifuge controls and drives.
  - Replace centrifuge feed pumps.
  - Relocate odor control equipment.
  - Furnish emergency eyewash and lavatory shower.
  - Replace vertical shaftless screw conveyor.
  - Provide permanent gate and controls for dewatered biosolids loadout.

Other Considerations

- Administration Building
  - Replace HVAC with forced air.
  - Demolish equipment from lower level, fill lower level, convert upper level of process room to maintenance garage.
  - New PLC and SCADA system.
  - Replace backup generator with sufficiently sized unit in all-weather enclosure.
- Site
  - New fiber communications.
  - Replace site lighting.
  - Replace site asphalt.
  - Replace site stormwater system as needed.
  - Replace and relocate septage receiving.
  - Replace front gate with motor-operated gate, card scanner, and camera.
- Disinfection and Pumping Building
  - Construct new multi-purpose process building on south side of site for:
    - Ultraviolet disinfection equipment (lower level)
    - Effluent flow measurement (lower level)
    - WAS and RAS pumping (lower level)
    - Other process specific pumping requirements based on alternatives (lower level)
    - Chemical storage and feed (upper level, as applicable to alternatives)
    - Electrical equipment and south site generator (upper level)

ALTERNATIVE EVALUATION

Improvement considered are identified based on the associated treatment process and generally categorized as liquid treatment processes and solids treatment processes. Where appropriate, alternatives are identified and considered. Improvements recommended based on age, condition, or where alternative consideration are not applicable present the recommended improvements and associate Preliminary Engineer's Opinion of Probable Costs.

LIQUID TREATMENT ALTERNATIVES

Refer to Attachment 1 for process schematics for proposed liquid treatment alternatives.

Conveyance

Conveyance consists of the following processes:

- Main Lift Station, and
- Influent Forcemain.

Old Main Lift Station

The old main lift station which was replaced by the current main lift station is abandoned-in-place. The existing old main lift station is recommended for demolition. Its removal would eliminate the existing facilities, which are degrading and pose a concern for safety.

Main Lift Station:

Alternatives for the main lift station building consist of replacement due to condition. Alternatives for the main lift station pumps are capacity related. The recommended improvements align with the future capacity for replacement of existing pumps as indicated in the Record Drawings for the Main Lift Station. Additional work may be required if the proposed high-flow pumps, lifting system, controls or other equipment require additional room for operation and maintenance than what is planned in the current main lift station building.

Summary of Recommended Improvements:

Condition-Based Replacement:

- Replace electrical service, generator, transfer switch for larger pumps.
- Replace existing controls with new PLC, radio transmitter to WWTF.
- Replace jib crane.
- Interior coatings for piping, equipment, and architecture.
- Replace existing high-flow pumps in-kind or new to serve as low-flow pumps.
- Coarse bubble aerator and regenerative blower to reduce ragging and grease accumulation.

Capacity-Based Replacement:

- Replace existing low-flow pumps with new high-flow pumps.

Note that the replacement of the submersible pumps may deviate pending flow and head determination as part of design.

Influent Forcemain

The recommended improvements align with the future capacity for an additional high flow forcemain as indicated in the Record Drawings for the Main Lift Station. Additional work may be required if the proposed high flow forcemain piping, pumps, or other equipment require additional room for operation and maintenance than what is planned in the current main lift station building.

Summary of Recommended Improvements:

Condition-Based Replacement:

- Replace isolation valve, relief valve, piping, and accessories as existing air relief structures for existing forcemains.

Capacity-Based Replacement:

- New 16-inch DIP piping in valve building with magnetic flow meter.
- New 18-inch HDPE DR9 forcemain for WWTF. Interconnect with 12-inch for future or high-flow.

Note that the forcemain size and quantity of relief structures may deviate pending flow and alignment determination as part of design.

Preliminary Engineer's Opinion of Probable Costs

Refer to Table 1 for a summary of the anticipated Preliminary Engineer's Opinion of Probable Costs associated with the recommended improvements. These costs reflect the opinion of probable costs at the time of preparation of this report. Probable costs are likely to change between preparation of the facility plan and bidding of improvements.

Table 1: Preliminary Engineer's Opinion of Probable Costs for Conveyance Improvements

Description	Opinion of Probable Cost
Electrical and Controls	$187,000
Jib Crane	$13,000
Process Equipment	$395,000
Forcemain and Relief Structures	$1,357,000
Restoration and Coatings	$90,000
Selective Demolition	$3,000
Old Main Lift Station Demolition	$80,000
Subtotal for Construction [1]	$2,301,000
Contingency [2]	$691,000
Engineering and Design [3]	$415,000
Legal, Fiscal, and Administrative [4]	$24,000
Total for Project	$3,431,000

General Notes:

- Preliminary Engineer's Opinion of Probable Costs does not include costs associated with right-of-way and permitting for forcemain alignment.
- Assumes one direction drill crossing for County Road 14.
- Assumes no structural modifications are required at Main Lift Station for installation of new pumps and forcemain.

Notes:

1. Includes 5.0% construction contingency, 3.0% mobilization, bonding, and insurance, 0.1% permitting as part of Construction Costs.
2. Includes 30% contingency of preliminary anticipated capital improvements costs as Design Contingency.
3. Includes 18% of preliminary anticipated capital improvements costs for Engineering, Design, and Field Services.
4. Includes 1% of preliminary anticipated capital improvements costs for Legal, Fiscal, and Administrative.

Preliminary Treatment

Preliminary Treatment consists of the following processes:

- Preliminary Treatment Building,
- Fine Screening,
- Grit Removal, and
- Influent Flow Measurement.

Preliminary Treatment Building

Alternatives for the preliminary treatment building consist of replacement due to condition. Major process treatment units will be considered separately.

Summary of Recommended Improvements:

Condition-Based Replacement:

- Replace (2) existing Class I Division 1 Group D rated electric unit heaters in screening room with roof mounted unit, ductwork, and roof repair.
- Replace existing natural gas, direct fire Make-up Air Unit.
- Replace existing potable water plumbing piping, fittings, valves, insulation, hose bibs, and hydrants in screening room.
- Interior piping, equipment, and architectural coatings.
- Replace existing controls with new PLC.
- Replace (3) existing 36" wide exterior hollow metal doors with new aluminum doors.
- Replace (1) existing 8' wide x 10' tall exterior overhead door with new aluminum overhead door. Replace overhead door operator with new Class I Division 1 Group D rated operator and local controls. No safety eyes, open/close are spring opening pushbuttons.
- Replace existing refrigerated automatic influent sampler.

Note that the replacement of the HVAC may deviate pending occupancy review and room classification determination as part of design.

Fine Screening

Alternatives for fine screening consist of replacement due to condition of existing equipment. Facility currently operates drum-type automatic fine screens. Screen opening of current and proposed screens is 6 mm, which is suitable for secondary treatment alternatives.

Summary of Recommended Improvements:

Condition-Based Replacement:

- Replace existing fine screening and compaction equipment and controls with new 6mm drum screens. Furnish with wash nozzles suitable for plant effluent. Discharge to roll-off container.

Grit Removal

Alternatives for grit removal consist of replacement due to condition of existing equipment. The facility has recently replaced the existing grit pump and was without grit removal due to difficulty sourcing a replacement pump. A standby pump would allow for reliable process operation.

Summary of Recommended Improvements:

Condition-Based Replacement:

- Replace grit classifier and washer cyclone.
- Add second standby grit pump, replace suction and discharge piping as needed.
- Replace existing grit pump suction and discharge valves (4-inch flanged ductile).

Influent Flow Measurement

Alternatives for influent flow measurement consist of replacement due to condition of existing equipment.

Summary of Recommended Improvements:

Condition-Based Replacement:

- Replace existing flow measurement instrument.
- Add recirculation submersible pump after flow measurement to a sample chamber on wall in screen room opposite automatic sampler.
- Add online pH meter after flow measurement.

Preliminary Engineer's Opinion of Probable Costs

Refer to Table 2 on the following page for a summary of the anticipated Preliminary Engineer's Opinion of Probable Costs associated with the recommended improvements. These costs reflect the opinion of

probable costs at the time of preparation of this report. Probable costs are likely to change between preparation of the facility plan and bidding of improvements.

Table 2: Preliminary Engineer's Opinion of Probable Costs for Preliminary Treatment Improvements

Description	Opinion of Probable Cost
Electrical and Controls	$163,000
Mechanical and HVAC Equipment and Controls	$265,000
Plumbing Piping and Accessories	$30,000
Coatings	$67,000
Architectural Doors	$25,000
Automatic Sampler, Piping, and Recirculation Pump	$25,000
Fine Screening and Compacting Equipment and Controls	$659,000
Grit Cyclone, Pump, Piping, and Controls	$49,000
Influent Flow Measurement Instrumentation and Controls	$3,000
Selective Demolition	$6,000
Subtotal for Construction [1]	$1,398,000
Contingency [2]	$420,000
Engineering and Design [3]	$252,000
Legal, Fiscal, and Administrative [4]	$14,000
Total for Project	$2,084,000

Notes:
1. Includes 5.0% construction contingency, 3.0% mobilization, bonding, and insurance, 0.1% permitting as part of Construction Costs.
2. Includes 30% contingency of preliminary anticipated capital improvements costs as Design Contingency.
3. Includes 18% of preliminary anticipated capital improvements costs for Engineering, Design, and Field Services.
4. Includes 1% of preliminary anticipated capital improvements costs for Legal, Fiscal, and Administrative.

Secondary Treatment

The design intent for the wastewater treatment facility is for biological phosphorus removal. Current flow and load demands do not allow for biological phosphorus removal due to insufficient treatment capacity in the secondary treatment process. Benefits to the facility for biological phosphorus removal include:

- Reduced solids production as compared to chemical precipitation.
- Reduced operating costs associated with purchase of coagulant.
- Conducive to existing aerobic digestion, reducing risk of rerelease of phosphorus.
- Reduced environmental impact reducing the requirement for production, transportation, and discharge of coagulant by the facility.

Secondary Treatment consists of the following processes:

- Selector Basin,
- Biological Treatment,
- Secondary Clarifiers, and
- Chemical Phosphorus Removal.

Selector Basin

The selector basin does not provide the recommended hydraulic retention time at the anticipated flow demand. Increasing the treatment volume through either additional cells or through an additional treatment train will allow for greater range of operational control.

Parameters for the existing selector basin are:

- Quantity: 1 tank, 2 cells separated by baffle (may be 1 anaerobic/1anoxic, 2 anoxic, or 2 anaerobic).
- Mixing: Mechanical, static impeller.
- Length: 27'-0", each cell.
- Width: 22'-0", each cell
- Side Water Depth: 13'-0".
- Total Volume: 57,750 gallons, each cell.

Summary of Recommended Improvements:

Condition-Based Replacement:

- Replace (2) existing mechanical mixers with submersible mixers.
- Provide ORP instrumentation for enhanced process control.
- Replace existing redwood baffle wall.
- Apply interior coatings from 1 foot below normal water elevation to top of sidewall and undersize of concrete cover slab.
- Replace isolation slide gate.

Capacity-Based Replacement:

- Refer to Biological Treatment Alternatives for selector basin improvements.

Biological Treatment

Several alternatives are considered for biological treatment with biological phosphorus removal. Consideration for alternatives includes the potential for nitrogen effluent limits. The parameters for the existing biological treatment are:

- Quantity: (3) oxidation ditches.
- Mixing: (2) brush aerators, per ditch.
- Run: 258'-0" total run (100'-0" each channel, 29'-0" each radius), per ditch.
- Width: 18'-0" each channel, 18'-6" each radius.
- Side Water Depth: 10'-9", maximum.
- Total Volume: 368,500 gallons, each ditch.

ALTERNATIVES CONSIDERED:

ALTERNATIVE 1 – EXPANSION OF EXISTING OXIDATION DITCHES (EXTENDED AERATION)

There is insufficient organic capacity at the anticipated load demand for the existing oxidation ditches. This alternative would add additional tankage for additional oxidations ditches to meet future load demand. When possible, future oxidation ditches will be sized and configured similar to existing tankage for ease of operation.

The existing oxidation ditches provide a combined organic treatment capacity of 2,250 pounds of $cBOD_5$ per day. The anticipated calendar day average $cBOD_5$ load demand exceeds the current capacity by approximately 2,350 pounds of $cBOD_5$ per day. The addition of three additional oxidation ditches, each approximately 375,000 gallons would provide sufficient organic load capacity at a design organic load of 15 pounds of $cBOD_5$ per day per 1,000 cuft of tank volume. Typical hydraulic retention time for an oxidation ditch ranges from 8 to 30 hours. At anticipated the Average Wet Weather (Maximum Month as Day Average) flow, the HRT, with all six trains operating, would be 33 hours.

The current splitter structure as part of the selector basin can split flow between the three existing oxidation ditches. As part of this alternative, an additional upstream splitter structure would divide flow between the existing selector basin and a second, additional, selector basin. From there, the additional selector basin would be identical to the existing and split flow to the three additional oxidation ditches. Interconnected piping between the selector basin splitter structure would allow flow from either selector tank to any oxidation ditch, though hydraulics will influence the split.

A return activated sludge splitter structure would also be added to facilitate even splitting of RAS between the two selector basin treatment trains regardless of secondary clarifier operation scheme. The splitter structure also allows for observation and sampling of RAS prior to mixing with influent.

Condition-Based Replacement:

- Replace Oxidation Ditch 1 and 2 aerator building roof with fully adhered EPDM.
- Repair Oxidation Ditch 1 and 2 aerator building exterior CMU.
- Replace Oxidation Ditch 1 and 2 aerator building interior architectural coatings.
- Replace Oxidation Ditch 1 and 2 aerator building exterior coatings.
- Replace Oxidation Ditch 1 and 2 aerator building brush aerator with new system, including VFD which can adjust speed based on DO measurement in basin.
- Add dissolved oxygen online analyzer to Oxidation Ditch 1, 2, and 3.
- Replace Oxidation Ditch 1 and 2 aerator building (1) existing 36” wide and (1) 60” wide double-leaf exterior hollow metal doors with new aluminum doors.
- Provide condition related improvements to existing selector basin, refer to selector basin portion of this memorandum.

Capacity-Based Replacement:

- Construct three additional oxidation ditches similar in size, configuration, and capacity as existing ditches.
- Construct new additional selector basin similar in size, configuration, and capacity as existing basin.
- Construct new RAS splitter structure.
- Construct new selector basin influent splitter structure.

Note that the aerator motor and selector basin mixer horsepower may deviate pending biological treatment aeration requirement determination as part of design.

ALTERNATIVE 2 – CONVERSION TO INTEGRATED FIXED FILM ACTIVATED SLUDGE (IFAS)

This alternative would introduce IFAS mobile biofilm media for growth of biofilm into an aeration basin within the existing oxidation ditches. The mobile biofilm media supports a very high concentration of attached biomass; and maintains excellent mass transfer conditions. The neutrally buoyant biofilm media within the bioreactor tank provide a stable base for growth of a diverse community of microorganisms. Every biofilm media has a very high surface-to-volume ratio, allowing for a high concentration of biological growth to thrive within the internally protected areas.

The media is retained in a separate aeration basin constructed in the existing oxidation ditches by submerged static screens. Effluent is allowed to flow from the IFAS aeration basin into the remainder of the converted oxidation ditch through a cast-in-place concrete diver wall. Separate fine-bubble aeration diffuser grids installed in the oxidation ditches will facilitate step aeration. The modifications convert the oxidation ditch to a flow-through, completely mixed process tank rather than a recirculating, plug flow process tank.

For this alternative, the splitter structure for the existing selector tank is sufficient as additional activated sludge tanks are not required. The selector tank would be rehabilitated with new mixing equipment, baffle wall, and instrumentation. A third selector cell is still recommended. RAS is returned from the secondary clarifiers to the front of the selector basins. WAS is wasted from the secondary clarifier to the aerobic digesters.

The self-regulating nature of biofilm adjusts to variations in process load. As the contaminant load increases, the microbial population in the biofilm increases enabling additional treatment capacity. Likewise, during low loading conditions, the population self-adjusts and decreases.

Fixed film processes are resistant to toxic contaminants as the inner layer of biofilm is protected. In the case of a toxic shock, the outer layer of dead bacteria will be removed by normal detachment mechanisms present in the bioreactor while the inner layer will provide a seed for microbial growth and enabling the system to continue meeting the contaminant load.

Combination of suspended growth and fixed film processes enhances the treatment reaction such that the volume necessary to conduct certain level of treatment is significantly lower than those required by activated sludge alone. As a result, a given volume of reactor can handle significantly larger flow and load by addition of media, without the need to add any new tank volume, and associated capital expense.

The alternative requires conversion of existing oxidation ditches into IFAS process tanks. The third basin may either remain in place for future expansion or be removed, however; it is assumed to remain in place for flexibility of expansion in the future.

It is assumed at this time that influent wastewater characteristics are appropriate for effective biological phosphorus removal such that a supplemental carbon source is not required to meet the anticipated total phosphorus effluent limits. Additionally, it is assumed that the speciation of phosphorus can be removed via the mechanisms of biological phosphorus removal and tertiary treatment for filtration is not required. Coagulant feed is provided for polishing and sized for chemical precipitation. A preliminary design phase is recommended for detailed modeling for the treatment process and determination of additional processes which may be required to meet effluent water quality parameters.

Condition-Based Replacement:

- Remove oxidation ditch 1 and the associated aerator building.
- Remove oxidation ditch 2 and 3 brush motor enclosures.
- Provide condition related improvements to existing selector basin, refer to selector basin portion of this memorandum.

Capacity-Based Replacement:

- Construction of baffle walls and installation of retention screens to create separate IFAS aeration basin and step aeration basin within existing oxidation ditch 2 and 3.
- Fine-bubble diffused aeration equipment installed in each oxidation ditch.
- Blowers, controls, and piping for each converted oxidation ditch.
- Construction of a blower building for aeration blowers.

ALTERNATIVE 3 – CONVERSION TO MOBILE ORGANIC BIOFILM (MOB) ACTIVATED SLUDGE

This alternative would introduce MOB mobile fixed-film media to the existing oxidation ditches. The alternative is intended to address stringent nutrient removal requirements, improve secondary sludge settleability, and intensify secondary treatment process capacities to address existing activated sludge footprint. The media is 100% plant-derived hybrid technology that combines the advantages of integrated fixed-film activated sludge (IFAS) and aerobic granular sludge (AGS). The process utilizes a renewable plant material as a medium for biofilm growth. The ballasted media core provides a backbone for the establishment of organically ballasted granular sludge. The biomedia acts as an adsorptive ballast, which provides a high degree of stability that enhances the granular sludge process.

The media would recirculate within the oxidation ditch and secondary clarifier. Media granules are fully mobile and free to circulate throughout wastewater treatment plant's secondary treatment processes. A 500-micron drum screen on the WAS line would separate media from WAS. The separated media would be returned with RAS to the front of the selector basins. Screened WAS would be transferred to the aerobic digester.

For this alternative, the splitter structure for the existing selector tank is sufficient as additional activated sludge tanks are not required. The selector tank would be rehabilitated with new mixing equipment, baffle wall, and instrumentation. A third selector cell is still recommended.

WAS screen equipment and screened WAS pumps will be located in the Disinfection and Pumping Building with WAS and RAS pumping. It is assumed that additional storage will be required for the screened WAS and WAS screenings. The existing secondary clarifier tank may be converted and utilized for storage with the addition of mixing equipment. Final determination of suitability for existing tanks to be reused will be included as part of design.

For the purpose of the facility plan evaluation, the current surface aerators would be replaced with a more efficient fine-bubble aeration system. The MOB process is suitably aerated through surface aerators, though the age, condition, and efficiency of the current equipment would benefit from replacement. Blowers may also be furnished in weather-proof enclosures which negate the need for a blower building, however for ease of operation and maintenance a blower building is included in the evaluation.

It is assumed at this time that influent wastewater characteristics permit are appropriate for biological phosphorus removal such that a supplemental carbon is not required to meet the anticipated total phosphorus effluent limits. Additionally, it is assumed that the speciation of phosphorus can be removed via the mechanisms of biological phosphorus removal and tertiary treatment for filtration is not required. Coagulant feed is provided for polishing and sized for chemical precipitation. A preliminary design phase is recommended for detailed modeling of the treatment process and determination of additional processes which may be required to meet effluent water quality parameters.

Condition-Based Replacement:

- Remove oxidation ditch 1 aerator building.
- Remove oxidation ditch 2 and 3 brush motor enclosures.
- Provide condition related improvements to existing selector basin, refer to selector basin portion of this memorandum.

Capacity-Based Replacement:

- Introduction of mobile fixed-film media at 1.25% fill.
- Installation of WAS drum screen,
- Screened WAS pumps.
- Screened WAS media pumps.
- Fine-bubble diffused aeration equipment installed in each oxidation ditch.
- Blowers, controls, and piping for each converted oxidation ditch.
- Construction of a blower building for aeration blowers.

NON-ECONOMIC CONSIDERATIONS

Non-economic factors weight heavily in the comparison between alternatives for biological treatment. All alternatives are technically possible however the following pros and cons associated with Alternative 3 are substantive:

- Pro
  - Alternative can utilize either 2 or 3 existing oxidation ditches depending on the desired percent media fill.
  - Additional treatment capacity can be added by increasing percent media fill.
  - Does not require static retention screens.
  - Provide ballasted settling in secondary clarifier, improving settleability.
  - May use surface aerators or diffused air for aeration.
  - Replacement media is added yearly rather than all at once.

- Con
  - Media is proprietary to manufacturer.
  - Requires WAS screening and additional pumping for recirculation.
  - Requires blower building and blowers.

Refer to Table 3 for the preliminary Engineer's opinion of probable costs associated with each alternative considered.

Table 3: Preliminary Engineer's Opinion of Probable Costs for Biological Treatment Alternatives

Alternative	Description	Opinion of Probable Cost [1, 2, 3, 4]
Alternative 1:	Expansion of Existing Oxidation Ditches	$9,407,000
	Second Selector Basin Train	$1,734,000
	Total	**$11,141,000**
Alternative 2:	Conversion to Integrated Fixed Film Activated Sludge	$7,458,000
	Selector Basin Expansion	$1,103,000
	Total	**$8,561,000**
Alternative 3: [5]	Conversion to Mobile Organic Biofilm Activated Sludge	$6,181,000
	Selector Basin Expansion	$1,103,000
	Total	**$7,284,000**

Notes:
1. Includes 5.0% construction contingency, 3.0% mobilization, bonding, and insurance, 0.1% permitting as part of Construction Costs.
2. Includes 30% contingency of preliminary anticipated capital improvements costs as Design Contingency.
3. Includes 18% of preliminary anticipated capital improvements costs for Engineering, Design, and Field Services.
4. Includes 1% of preliminary anticipated capital improvements costs for Legal, Fiscal, and Administrative.
5. Alternative requires replacement of secondary clarifier tanks and reuse for WAS pumping.

The recommended alternative is Alternative 3. The alternative provides process intensification without the need for additional basins at the lowest anticipated capital cost. The alternative provides the advantages of ballasted settling for secondary clarification and can have additional media added at a later date to increase the organic capacity of the treatment process.

The recommended alternative meets the anticipated flow and load demands with the following advantages:

- The technology may be installed in either two or three existing oxidation ditches; however, this estimate assumes all three basins are converted to provide flexibility for future expansion. The preliminary opinion of probable cost reflects three existing tanks being converted. This allows for either continued operation of the existing oxidation ditches with equipment in place for future expansion projects or limiting of capital and operation costs and installation of equipment in two of the three existing oxidation ditches.
- The alternative adds the benefit of ballasted settling to the secondary sedimentation process, which given the relatively low total phosphorus effluent limit requirements will benefit the facility by increasing sludge settleability and solids capture rate.
- With considerations for other alternatives considered, the additional pumping required by screening of waste activated sludge can be combined with other processes. This eliminates the needs for dedicated pumping as a result of the additional screening step.
- Alternative 2 and 3 both utilize fine-bubble diffused aeration and blowers for the same converted tankage. During preliminary design, decoupling for separate mixing and aeration may be evaluated to further increase energy efficiency.

Secondary Clarifier

Influent Splitter Structure:

The secondary clarifier splitter structure is setup for combining oxidation ditch effluent from the three existing oxidation ditches and splitting that flow between three existing secondary clarifier tanks. There are facilities for splitting flow to a future fourth secondary clarifier. Considerations for the influent splitter structure will be discussed as part of the secondary clarifier alternatives due to the need to split flow evenly between the process tanks.

Capacity-Based Replacement:

- Refer to Secondary Clarifier Alternatives for selector basin improvements.

Basins:

Two alternatives were developed for providing sufficient treatment capacity to meet anticipated flow and load demands. The secondary clarifiers are solids limited, meaning the solids loading to the treatment process will drive the recommended alternatives.

ALTERNATIVES CONSIDERED:

ALTERNATIVE 1 – REHABILITATION AND EXPANSION OF EXISTING SECONDARY CLARIFIERS

For this alternative the existing secondary clarifier tanks would be rehabilitated. This would include:

- Replacement of the (3) existing 34’-0” suction arm clarifier mechanisms.
- Replacement of the (3) existing clarifier bridges.
- Replacement of the (3) existing fiberglass clarifier domes with aluminum domes, doors, and HVAC equipment.
- Coatings from 1 foot below normal water elevation across top of tank wall, including all of the concrete launderer.

Additional capacity will be provided by additional secondary clarifiers, similar to those currently installed. This is to allow for ease of operation without having imbalanced flow to differently sized clarifier tanks.

The maximum allowable peak solids loading rate as recommended by 10 States Standards for Wastewater Facilities (2014 Edition) is 35 lbs per day per sqft. To achieve this loading rate, two additional secondary clarifier tanks with a weir diameter of 34’-0” and interior tank diameter of 39’-6” would need to be constructed.

Condition-Based Replacement:

- Secondary clarifier mechanism, bridge, domes, doors, HVAC, and coatings as noted above.
- Expand the existing influent splitter structure for capacity to split flow between five secondary clarifiers.
- Coagulant chemical feed location at weir for each secondary clarifier.

Capacity-Based Replacement:

- (2) additional secondary clarifier tanks, identical to existing.
- (2) suction arm clarifier mechanisms.
- (2) aluminum dome covers, doors, and HVAC equipment.
- Coatings from 1 foot below normal water elevation across top of tank wall, including all of the concrete launderer.
- Scum, drain, influent, effluent, and sludge yard piping to and from new secondary clarifier tanks.
- Add ultrasonic sludge level transducers with wipers to each tank for monitoring sludge blanket depth.

ALTERNATIVE 2 – NEW SECONDARY CLARIFIERS

For this alternative the existing secondary clarifier tanks would be rehabilitated. This would include:

- Conversion of the existing three secondary clarifiers holding or other process tanks as noted in treatment alternatives.
- Removal of the existing clarifier mechanisms, domes, doors, and HVAC equipment, unless noted otherwise in treatment alternatives.

All required capacity, including the additional capacity needed, will be provided by two new clarifier mechanisms with a 60'-0" weir diameter. This is to allow for ease of operation while taking advantage of scale and volume efficiency of round tanks. Construction of the new clarifiers can be done with the facility operating and allows for conversion of the existing tankage to supplement the current, limited waste sludge storage capacity.

The maximum allowable peak solids loading rate as recommended by 10 States Standards for Wastewater Facilities (2014 Edition) is 35 lbs per day per sqft. To achieve this loading rate, two secondary clarifier tanks with weir diameter of 60'-0" and interior tank diameter of 65'-0" would be constructed.

Condition-Based Replacement:

- Conversion of the existing three secondary clarifiers as noted above.
- Replace existing influent splitter structure for capacity to split flow between two secondary clarifiers.
- Coagulant chemical feed location at weir for each secondary clarifier.

Capacity-Based Replacement:

- (2) additional secondary clarifier tanks.
- (2) suction arm clarifier mechanisms.
- (2) dome covers, doors, and HVAC equipment.
- Coatings from 1 foot below normal water elevation across top of tank wall, including all of the concrete launderer.
- Scum, drain, influent, effluent, and sludge yard piping to and from new secondary clarifier tanks.
- Add ultrasonic sludge level transducers with wipers to each tank for monitoring sludge blanket depth.

Refer to Table 4 on the following page for the preliminary Engineer's opinion of probable costs associated with each alternative considered.

Table 4: Preliminary Engineer's Opinion of Probable Costs for Secondary Clarification Alternatives

Description	Opinion of Probable Cost [1, 2, 3, 4, 5]
Alternative 1: Rehabilitation and Expansion of Existing Secondary Clarifiers	$17,475,000
Alternative 2: Conversion of Existing and Construction of New Secondary Clarifiers	$7,222,000

Notes:

1. Includes 5.0% construction contingency, 3.0% mobilization, bonding, and insurance, 0.1% permitting as part of Construction Costs.
2. Includes 30% contingency of preliminary anticipated capital improvements costs as Design Contingency.
3. Includes 18% of preliminary anticipated capital improvements costs for Engineering, Design, and Field Services.
4. Includes 1% of preliminary anticipated capital improvements costs for Legal, Fiscal, and Administrative.
5. Costs associated with modifications to the existing clarifier tanks are included as part of other alternatives. Cost includes demolition of existing equipment and covers.

It is recommended to proceed with alternative 2. The purpose-built clarifiers allow for mechanisms designed to operate with thicker mixed liquor and sludge blankets resulting from process intensification from either secondary treatment Alternatives 2 or 3. New basins will allow for a sludge draw-off sump and piping dedicated for each tank. The reduced number of operating basis will also simplify process operation.

The recommended alternative meets the anticipated flow and load demands with the following advantages:

- Increases treatment capacity to meet anticipated flow and load demand.
- Provide purpose-built facilities with dedicated sludge return and wasting pumps.
- Allows for secondary sedimentation tanks to be tailored to higher-efficiency solids removal equipment with considerations for the recommended biological treatment alternative.

WAS/RAS Pumping Station:

Existing WAS/RAS Pumping Station improvements include replacement of the structure to meet future flow demands and modify operation to allow for additional process control related to:

- Independent pumping for RAS from each clarifier tank.
- Independent pumping for WAS from each clarifier tank.

New WAS/RAS Pumping Equipment will be relocated to a proposed Disinfection and Pumping Building which will provide:

- Sufficient space for separate RAS and WAS pumps for each clarifier tank.
- Safe egress access for operation and maintenance.
- Relocated WAS controls from Administration Building.
- Flow-paced pump controls.

Summary of Recommended Improvements:

Condition-Based Replacement:

- Replace existing pumps and controls for WAS/RAS submersible pumps.
- Remove existing WAS/RAS structure.
- Provide new PLC and controls for pump operation.

Capacity-Based Replacement:

- Provide sufficient hydraulic capacity of WAS pumps for future flow demand.
- Provide sufficient hydraulic capacity of RAS pumps for future flow demand.
- Provide instrumentation and controls for reliable operation of RAS and WAS pumps.

Chemical Phosphorus Removal

Recommended improvements to the chemical phosphorus removal equipment are intended to:

- Provide additional operation flexibility by providing additional coagulant dose locations.
- Improvement process efficiency by providing chemical feed pumps with sufficient turndown for coagulant demand.
- Address health and safety for bulk chemical storage.

The secondary treatment process is anticipated to operate for biological phosphorus removal with coagulant feed equipment in place for polishing and backup. The capacity of coagulant feed equipment is intended to be sufficient for a facility operating as a chemical precipitation for phosphorus removal but allow for turn-down to meet anticipated operating conditions. Jar testing for anticipated coagulant consumption rates at the total phosphorus effluent limit is recommended. The following recommendation assume 90 mg/L ferric chloride demand.

Summary of Recommended Improvements:

Condition-Based Replacement:

- Existing coagulant feed pumps are obsolete.
- Existing coagulant bulk storage tanks lack sufficient fill indicators for measurement and overfill. Furnish instrumentation and controls to record and report chemical tank levels.
- Existing chemical storage building lacks appropriate ventilation and sprinkling for storage of hazardous materials.
- Existing chemical feed header is a combined discharge, unable to reliably dose coagulant evenly to existing chemical feed locations.

Capacity-Based Replacement:

- Furnish dedicated coagulant feed pump for each secondary clarifier, with the ability to dose to either the oxidation ditch effluent box or influent clarifier splitter structure.
- Additional chemical feed locations recommended at secondary clarifier influent splitter structure to provide additional operation flexibility.
- Additional chemical storage where needed.

ALTERNATIVES CONSIDERED:

ALTERNATIVE 1 – REHABILITATION OF EXISTING CHEMICAL STORAGE BUILDING

This alternative reuses the existing chemical storage building, tanks, and piping where possible while providing new equipment and piping as noted.

Condition-Based Replacement:

- Replace existing chemical feed pumps. The quantity of pumps will be sufficient for one dedicated pump for each biological treatment tank or secondary clarifier tank, whichever quantity is greater.
- Replace existing chemical feed common header with dedicated piping to ensure even distribution of coagulant to dose locations.
- Replace chemical feed tubing to existing coagulant feed locations at biological treatment tanks.
- Replace intake and exhaust HVAC equipment.
- Extend water main, add sprinkler riser, sprinkler control panel, and sprinkler system to chemical storage building.

Capacity-Based Replacement:

- Provide new secondary containment, pull boxes, and primary carrier tubing for coagulant feed to additional biological treatment tanks as necessary and all secondary clarifier influent splitter box feed locations.

ALTERNATIVE 2 – RELOCATION TO DISINFECTION AND PUMPING BUILDING

This alternative relocates the chemical storage to the proposed Disinfection and Pumping Building. The proposed location will reduce the length of yard coagulant piping required to feed locations and allow for occupancy and building improvements to be incorporated into a new concrete structure.

Condition-Based Replacement:

- Replace existing chemical feed pumps. The quantity of pumps will be sufficient for one dedicated pump for each biological treatment tank or secondary clarifier tank, whichever quantity is greater.
- New dedicated chemical feed piping to ensure even distribution of coagulant to dose locations.
- Provide new secondary containment, pull boxes, and primary carrier tubing for coagulant feed to all biological treatment feed locations.
- New intake and exhaust HVAC equipment.
- Extend water main, add sprinkler riser, sprinkler control panel, and sprinkler system. Include floor drains and sump.

Capacity-Based Replacement:

- Provide new secondary containment, pull boxes, and primary carrier tubing for coagulant feed to additional biological treatment tanks as necessary and all secondary clarifier influent splitter box feed locations.

Refer to Table 5 for the preliminary Engineer's opinion of probable costs associated with each alternative considered.

Table 5: Preliminary Engineer's Opinion of Probable Costs for Chemical Phosphorus Removal Alternatives

Description	Opinion of Probable Cost [1, 2, 3, 4]
Alternative 1: Rehabilitation of Existing Chemical Storage Building	$219,000
Alternative 2: Replacement of Disinfection and Effluent Metering Equipment	$472,000

General Notes:

- The cost comparison is for replacement of chemical feed equipment and piping to the existing treatment facilities to establish an equal comparison.
- Costs include the additional feed location at the secondary clarifier splitter structural. Actual preliminary costs may change if additional tankage is recommended by other alternatives.
- Cost for Alternative 2 does not include additional building costs as it is assumed to fit within the proposed upper-level floor plan of the Disinfection and Pumping Building.

Notes:

1. Includes 5.0% construction contingency, 3.0% mobilization, bonding, and insurance, 0.1% permitting as part of Construction Costs.
2. Includes 30% contingency of preliminary anticipated capital improvements costs as Design Contingency.
3. Includes 18% of preliminary anticipated capital improvements costs for Engineering, Design, and Field Services.
4. Includes 1% of preliminary anticipated capital improvements costs for Legal, Fiscal, and Administrative.

It is recommended to proceed with Alternative 2. The alternative provides an industrial-grade, durable, and safe facility which has been designed and constructed for hazardous material storage. The existing chemical building has been relocated and rehabilitated in at least two major expansion projects and is nearing the useful service lift for a timber structure.

The recommended alternative meets the anticipated flow and load demands with the following advantages:

- The alternative provides the lowest capital cost for improvements while reusing existing facilities.
- Removes hazardous chemical storage from proposed Disinfection and Pumping Building.
- Allows for coagulant feed to remain in place during construction.

Preliminary Engineer's Opinion of Probable Costs

Refer to Table 6 on the following page for a summary of the anticipated Preliminary Engineer's Opinion of Probable Costs associated with the recommended improvements. These costs reflect the opinion of probable costs at the time of preparation of this report. Probable costs are likely to change between preparation of the facility plan and bidding of improvements.

Table 6: Preliminary Engineer's Opinion of Probable Costs for Secondary Treatment Improvements

Description	Opinion of Probable Cost
Selector Basin Improvements	$739,000
Biological Treatment Alternative 3	$4,147,000
Secondary Clarifier Alternative 2	$4,846,000
Chemical Phosphorus Removal Alternative 1	$417,000
Subtotal for Construction [1]	$9,878,000
Contingency [2]	$2,965,000
Engineering and Design [3]	$1,781,000
Legal, Fiscal, and Administrative [4]	$101,000
Total for Project	$14,725,000

General Notes:
- Refer to individual treatment sections for additional information and discussion for alternatives considered and associated Preliminary Engineer's Opinion of Probable Costs.

Notes:
1. Includes 5.0% construction contingency, 3.0% mobilization, bonding, and insurance, 0.1% permitting as part of Construction Costs.
2. Includes 30% contingency of preliminary anticipated capital improvements costs as Design Contingency.
3. Includes 18% of preliminary anticipated capital improvements costs for Engineering, Design, and Field Services.
4. Includes 1% of preliminary anticipated capital improvements costs for Legal, Fiscal, and Administrative.

Finishing and Disinfection

Finishing and Disinfection consists of the following processes:
- Ultraviolet Disinfection,
- Effluent Flow Measurement, and
- Outfall.

Ultraviolet Disinfection

The location of the existing ultraviolet disinfection system structure is in a repurposed rectangular secondary clarifier basin. The location poses the following issues for operation:
- Inadequate egress.
- Insufficient space for sufficient expansion of equipment banks in current channels.
- Obsolete controls.
- Limited space for operation and maintenance of existing equipment.

Existing ultraviolet disinfection system controls are obsolete. Though planned space is noted for addition banks, it is insufficient for anticipated flow demand. Modulation of lamp intensity is not currently feasible due to issues with effluent flow measurement.

Summary of Recommended Improvements:

<u>Condition-Based Replacement:</u>
- Replace existing PLC and Controls.
- Relocate and/or separate from raw sludge piping and to provide adequate egress.
- Provide ability to modulated lamp intensity by either influent or effluent flow measurement.

<u>Condition-Based Replacement (included with Other Considerations):</u>
- Demolish and infill lower level of process room in Administration Building.
- Pour at-grade floor with trench drain and flammable waste interceptor for maintenance garage. Remove exterior wall for overhead garage door.
- Replace interior architectural coatings.

- Repair exterior CMU wall grout joints.
- Replace roof.

Capacity-Based Replacement:

- Remove and relocate disinfection equipment to new adequately sized structure. Furnish new ultraviolet disinfection system, channel, control weirs and controls.
- Davit hoist and base for lamp bank removal.
- Sufficient rolling storage racks for removal and storage outside of channel of all lamp racks.

Effluent Flow Measurement

Existing effluent flow measurement does not have the ability to measure current peak instantaneous flow events. Instrumentation also is not able to be used to operate ultraviolet disinfection equipment.

Summary of Recommended Improvements:

Capacity-Based Replacement:

- Remove and relocate effluent flow measurement equipment to new adequately sized structure.

Outfall

No condition or capacity related improvements are required for the Outfall.

Preliminary Engineer's Opinion of Probable Costs

Costs associated with recommended finishing and disinfection improvements are included as part of administration building and disinfection and pumping building improvements. Both facilities are described in further detail in the Other Considerations section of this memorandum. Refer to that section for Preliminary Engineer's Opinion of Probable Costs at each building.

SOLID TREATMENT ALTERNATIVES

Refer to Attachment 2 for process schematics for proposed solid treatment alternatives.

Biosolids Stabilization

Biosolids stabilization consists of the following processes:

- Biosolids Control Building,
- Considerations
- Waste Sludge and Scum Thickening
- Aerated Digestion
- Liquid Biosolids Storage
- Solids and Biosolids Mixing
- Waste Sludge Storage

Biosolids Control Building

Alternatives for the Biosolids Control Building are divided into improvements for the control building gallery space, the aerobic digester, and liquid biosolids storage. The Biosolids Control Building has several recommended improvements to address the age and condition of the building in additional to those pertaining to treatment processes.

Summary of Recommended Improvements:

Condition-Based Replacement:

- Replace roof with fully adhered EPDM.
- Replace interior architectural coatings.
- Replace exterior architectural coatings.
- Replace exhaust/supply HVAC equipment and gas-fired unit heaters.
- Replace electrical service equipment, motor control centers, and PLC.
- Remove unused boiler and recirculation pumps from aerobic digester.

- Replace (2) existing 36” wide and (1) 72” wide double-leaf exterior hollow metal doors with new aluminum doors.

Note that the replacement of the HVAC may deviate pending occupancy review and room classification determination as part of design.

Considerations

The current aerobic digester stabilizes unthickened sludge due to failure of the decant mechanism in the waste sludge storage tank. The current primary aerobic digester cell is at treatment capacity and unable to produce biosolids compliant to EPA 503 requirements for land application. The City retains permitted application site for land application and would prefer to resume land application of biosolids rather than landfilling. The current primary digester cell volume is insufficient for stabilization of biosolids for EPA 503 compliance, even when thickening is considered. Functionally, aerobic digestion is limited to a maximum solids concentration around 4.0% total solids. The facility does not operate anaerobic digestion and the existing flat-bottom tank is not suitable for conversion. Expansion of aerobic digestion will then consist of a combination of additional aerobic digester tankage and thickening.

Challenges to this approach include:

- Aerobic digestion is recommended to not exceed 4.0% total solids. The total air demand increases significantly at higher solids concentrations due to a reduced oxygen transfer efficiency.
- 10 States Standards for Wastewater Facilities recommended guidance for providing a minimum of two aerobic digester cells for facilities above 100,000 gallons per day of flow demand.
- Dewatering centrifuge performance is best when liquid feed sludge is below 2.0% total solids.
- A single aerobic digester limits the application of fine-bubble diffusers due to the need to access the aeration grid for maintenance. Fine-bubble diffusers would allow for more efficient oxygen transfer, lower air volume demand, and reduced blower operation and maintenance as compared to coarse bubble diffusers.
- The degree of thickening and method of stabilization may be explored in greater detail during design.

To address these concerns, it is recommended that the liquid biosolids storage have equipment installed for operation as a secondary aerobic digestion cells. A second aerobic digester cell could be constructed parallel to the existing digester providing redundancy and additional treatment volume. The additional volume would allow for:

- Reduction in thickening required for waste sludge and scum being fed to the aerobic digesters which:
  - Reduced the oxygen demand and power consumption of blowers.
  - Reduces the chemical consumption which may be a required for thickening.
  - Recused the energy demand for mixing of the aerobic digesters.
- Allow for process redundancy which:
  - Allows for installation of fine-bubble diffusers which reduced the oxygen demand and power consumption of blowers.
  - Provides operation flexibility for equipment repair and replacement.
  - Meets redundancy recommendation of 10 States Standards.

A gallery would be installed between the primary aerobic tanks to eliminate a hydrophilic water stop in the corners of the new digester cell and provide access for piping and equipment to the tanks. The existing gallery would be utilized for large equipment, shared between aerobic digester cells and storage tanks. The existing primary aerobic digestion cell would be modified to include a suction sump for transfer and draining of the tank. Typical operation would be designed for parallel operation of the primary aerobic digesters and series operations of the primary aerobic digesters to a common secondary aerobic digester.

With a second primary aerobic digester cell, the total primary treatment volume will be approximately 61,500 cuft. Conversion of the liquid biosolids storage as a secondary aerobic digester would provide a

total treatment volume of approximately 126,000 cuft. At this volume, the anticipated solids load demand would require thickening to 1.6% total solids to attain 60 days of solids retention time. Without the second primary treatment cell, the total storage volume would be approximately 95,000 cuft. The anticipated solids load demand would require thickening to 2.2% total solids to attain 60 days of solids retention time.

Waste Sludge and Scum Thickening

Two considerations for reuse of existing tanks were evaluated for thickening:

- Reuse of an existing secondary clarifier tank.
- Reuse of the existing waste sludge storage tank.

ALTERNATIVES CONSIDERED:

ALTERNATIVE 1 – DISSOLVED AIR FLOATATION THICKENING

An existing secondary clarifier tank is oversized for conversion to a circular dissolved air floatation (DAF) thickener, and the existing waste sludge storage is appropriately sized, however in poor condition, and difficult to modify as a dissolved air floatation thickener (DAFT). A nominal 12'-0" diameter circular tank would be constructed on site for the DAFT. The existing secondary clarifier tanks may be reused as waste sludge holding to equalize scum and waste activated sludge being fed to the DAFT, and as underflow holding prior to being pumped ahead of secondary treatment.

DAFT thickening and would include:

- DAFT mechanism, weirs, and floatable box.
- Rehabilitation or construction of a DAFT feed tank for scum and WAS with mixers and flat aluminum cover.
- Rehabilitation or construction of a DAFT underflow tank for underflow with mixers and flat aluminum cover.
- Construction of a new DAFT cast-in-place concrete tank with aluminum dome cover, bridge, lighting, and ventilation.
- Air compressor, saturation tank, recirculation pumps, DAFT feed pumps, underflow pumps and controls.
- Thickened sludge transfer pumps from gravity thickener tank.
- Polymer blending and feed equipment.

Opportunities:

- The underflow holding tank may be combined with storage decant and Administration Building sanitary drains to eliminate the submersible wetwells at the Waste Sludge Holding Tank.
- Air compressor, saturation tank, recirculation pumps, DAF feed pumps, underflow pumps and controls may be located in the proposed Disinfection and Pumping Building.
- Can thicken total solids as needed by digester alternatives.
- Repurposes existing secondary clarifier tanks if not used as part of other alternatives.
- Mixing may be combined with sludge and biosolids mixing equipment from the Biosolids Control Building.
- Does not require plant effluent for dilution water to prevent septic conditions and odor.

ALTERNATIVE 2 – GRAVITY THICKENING

Conversion of a secondary clarifier tank for gravity thickening is feasible. The existing waste sludge storage is appropriately sized, however in poor condition and require the continued use of a floating decanter. The anticipated maximum performance for gravity thickening of extended aeration secondary solids is 2-3% total solids at a solid loading rate of 5-8 pounds per square foot per day. Gravity thickening does require plant effluent recirculation to prevent septic conditions and odor in the thickener.

Conversion of an existing clarifier tank to a gravity thickener would include:

- Gravity thickener mechanism.
- Modifications to existing suction-arm clarifier structure to a hopper-bottom gravity thickener.
- Replacement dome cover, bridge, lighting, and ventilation.
- Rehabilitation or construction of a tank for clarified effluent with submersible mixers and flat aluminum cover.
- Construction of a tank for scum with submersible mixers and flat aluminum cover.
- Thickened sludge transfer pumps from gravity thickener tank.
- Plant effluent pumps for dilution water.
- Oxidizing chemical feed system for odor and septicity control to dilution water.

Operation of the gravity thickener requires dilution water, which is estimated to be approximately 100 gpm (0.14 MGD) at startup and reducing to 60 gpm (0.08 MGD) as sludge production increases at anticipated flow and load demand. Clarified effluent would flow to a replacement supernatant wetwell and be pumped to the manhole prior to the selector basins.

Opportunities:

- The clarified effluent holding tank may be combined with storage decant and Administration Building sanitary drains to eliminate the submersible wetwells at the Waste Sludge Holding Tank.
- Plant effluent pumps, feed pumps, clarified effluent pumps, scum pumps, and controls may be located in the proposed Disinfection and Pumping Building.
- Mixing may be combined with sludge and biosolids mixing equipment from the Biosolids Control Building.

NON-ECONOMIC CONSIDERATIONS

Non-economic factors weigh heavily in the comparison between alternatives for thickening of waste activated sludge and scum. Both alternatives are technically possible however the following pros and cons associated with Alternative 1 are substantive:

- Pro
  - Smaller footprint as the second aerobic digester cell is not needed. Less mechanism, less dome cover.
  - Only alternative which can reliably meet a variety of totals solids operating conditions with low operator time monitoring requirements.
  - Does not require a separate scum wetwell.
  - Plant effluent water required to prevent septic conditions is not necessary.
  - Significantly more operator control over process performance.
- Con
  - Additional compressor, saturation tank, and recirculation pump.
  - Polymer feed equipment is recommended.

Aerobic Digestion

As noted, the current single aerated digester cell is at treatment capacity. Thickening is not feasible due to the age and condition of the floating decanter in the waste sludge storage tank.

A second aerobic digester cell may be provided. A two-cell configuration will allow for parrel, series, or batch operation of the aerobic digesters. In either one or two cells, a cut-in suction sump will be added to the existing aerobic digester cell and included in the proposed cell for transfer and draining.

Conversion of the existing liquid biosolid storage for secondary aerobic digestion is also recommended. At startup conditions the secondary aerobic digester is not likely required, however as load demand increases to design conditions the additional treatment volume will be necessary.

Summary of Recommended Improvements to Existing Aerobic Digester:

Condition-Based Replacement:

- Replace Roof with fully adhered EPDM.
- Cut-in suction sump for new transfer and drain pumps to existing aerobic digester.

ALTERNATIVES CONSIDERED:

ALTERNATIVE 1 – REHABILITATE PRIMARY CELL 1, CONVERT LIQUID BIOSOLIDS STORAGE TO SECONDARY CELL 1

This alternative would focus on rehabilitation of the existing primary aerobic digestion cell. EPA 503 compliant digestion suitable for land application requires 60 days of SRT in the aerobic digester. To achieve this SRT with one cell, waste sludge would need to be thickened prior to digester to at least 2.2% total solids at design year flow and load demand.

The alternative would require conversion of the existing liquid biosolid storage for secondary aerobic digestion.

There are several operational challenges which will also need to be addressed by the facility staff. They include:

- Dewatering centrifuge performance is best when liquid feed sludge is below 2.0% total solids.
- Use of coarse-bubble diffusers due to limited accessibility.
- Greater aeration demand for mixing and oxygen transfer due to higher total solids content and diffuser type.

Condition-Based Replacement:

- Replace and construction aeration and mixing system (refer to Sludge and Biosolids Mixing section of this memorandum).
- Replace blowers and controls in gallery of Biosolids Control Building.
- Add common header instrumentation and controls to monitor and control air discharge to system.

Capacity-Based Replacement:

- Convert liquid biosolid storage to a secondary aerobic digester.
- Add dissolved oxygen instrumentation to primary and secondary aerobic digester cells.

ALTERNATIVE 2 – REHABILITATE PRIMARY CELL 1, CONSTRUCT PRIMARY CELL 2, CONVERT LIQUID BIOSOLIDS STORAGE TO SECONDARY CELL 1

This alternative would rehabilitate the existing primary aerobic digestion cell, as well as construct an identical second primary digestion cell adjacent to the existing cell. A 12’-0” gallery would be sited between the treatment cells for piping, valve, and controls between the tanks.

It is assumed the alternative would utilize the existing gallery for equipment and controls used to operate of the aerobic digester cells. Additional gallery space may be needed for equipment as determined during design. Piping would allow for either parallel, series, or batch operation of the digestion cells.

With a second primary aerobic digester cell, the total treatment volume will be 126,000 cuft. At this volume, the anticipated solids load demand would require thickening to 1.6% total solids to attain 60 days of solids retention time at the anticipate future load demand.

The alternative would require conversion of the existing liquid biosolid storage for secondary aerobic digestion.

Condition-Based Replacement:

- Replace and construction aeration and mixing system (refer to Sludge and Biosolids Mixing section of this memorandum).
- Replace blowers and controls in gallery of Biosolids Control Building.
- Add common header instrumentation and controls to monitor and control air discharge to system.

Capacity-Based Replacement:

- Convert liquid biosolid storage to a secondary aerobic digester.
- Add dissolved oxygen instrumentation to primary and secondary aerobic digester cells.
- Construct primary aerobic digester cell 2 adjacent to existing primary aerobic digester cell 1.
- Construct piping and valve gallery between digester tanks.
- Additional piping for series, parallel, or batch operation of primary aerobic digester cells.

NON-ECONOMIC CONSIDERATIONS

Non-economic factors weigh heavily in the comparison between alternatives for aerobic digestion. Both alternatives are technically possible however the following pros and cons associated with Alternative 1 are substantive:

- Pro
  - Lower capital cost associated with less structure and for a single primary aerobic digester.
- Con
  - Centrifuge performance decreases significantly above 2.0% total solids.
  - Oxygen transfer efficiency is reduced by the increased solids requirement, increasing blower capacity and energy requirements.
  - Coarse bubble diffusion recommended due to limited accessibility to tank for maintenance, increasing blower capacity and energy requirements.
  - Greater mixing energy requirement for higher solids content.
  - No process redundancy and less operation flexibility with a single aerobic digester.

Liquid Biosolids Storage

The biosolids sludge storage provides temporary storage prior to dewatering and alternative liquid biosolids loadout if needed. The exiting liquid biosolids storage tank has a decant tree for thickening and is uncovered, resulting in freezing which impacts the staff's ability to thicken and transfer biosolids for dewatering. Alternatives considered are condition-based to address operational challenges with the existing tank.

It is recommended that the liquid sludge storage tank be converted to a secondary aerobic digester to meet the volume requirements in lieu of additional primary aerobic digester cells above those noted in the aerobic digester alternatives. Under startup conditions, the secondary aerobic digester will likely not be used to limit the pH reduction due to nitrification.

Summary of Recommended Improvements:

Condition-Based Replacement:

- Cover and vent for existing tank.
- Cut-in suction sump for new transfer and drain pumps.
- Replace mixing system (refer to Sludge and Biosolids Mixing section of this memorandum).

Capacity-Based Replacement:

- Construction aeration system (refer to Sludge and Biosolids Mixing section of this memorandum).

Sludge and Biosolids Mixing

Sludge and biosolids process tanks with mixing systems which had condition related improvements include:

- Aerobic Digester.
- Liquid Biosolids Storage Tank.
- Waste Sludge Storage Tank.
- Waste Sludge and Scum Storage Tank (as applicable to alternatives)

The proximity of the treatment process allows for implementation of a common mixing system. Use of similar technologies will also reduce the number of spare parts required on site and allow for more commonly applied specialized knowledge for operation, maintenance, and troubleshooting by the facility operators. The three processes currently have air-based mixing and the facility staff or knowledgeable and comfortable with its application. Consideration is given to the mixing alternatives as they interact with aeration in the aerobic digester. The aeration and mixing technology evaluation for the aerobic digester will inform the aerated mixing alternative for liquid biosolids storage and waste sludge storage tanks.

Oxygen transfer efficiency is largely driven by the total solids content is the tank being aerated. For this reason, it is important to understand that the air flow requirements increase dramatically as the design solids concentration increases. A comparison is then appropriate when consider additional tank at a lower concentration as compared to a single tank at a higher solid concentration. Regardless of the aeration technology, oxygen transfer is essentially negligible above 4.0% total solids.

It is assumed the alternatives would utilize the existing gallery for equipment and controls used to operate of the aeration and mixing equipment. Additional gallery space may be needed for equipment as determined during design.

AERATION AND MIXING ALTERNATIVES CONSIDERED:

ALTERNATIVE 1 –DIFFUSED AERATION AND MIXING

For this alternative coarse bubble diffused air would be utilized for both aeration and mixing. Coarse bubble aeration has the advantage of not requiring access to the diffuser grid for period maintenance at the cost of oxygen transfer efficiency. A single coarse bubble diffused aeration grid with aerators would be installed near the bottom of process tanks. A common discharge air header from blowers located in the Solids Control Building would supply air to maintain a preset discharge air header pressure. Electrically modulated valves would allow air to each process tank for mixing and aeration. Typically, the volume of air required for mixing exceeds the air requirement for aerobic digestion resulting in additional air demand for operation.

Condition-Based Replacement:

- Remove existing blowers in Administration Building.
- Replace existing blowers Biosolids Control Building.
- Create common discharge header for all process tanking being mixed and aerated.
- Replace existing primary aerobic digester cell 1 diffused aeration and mixing grid.
- Add new primary aerobic digester cell 2 diffused aeration and mixing grid, as applicable.
- Replace existing liquid biosolids storage diffused aeration and mixing grid.
- Replace existing waste sludge storage diffused aeration and mixing grid.

Capacity-Based Replacement:

- Provide new instrumentation and modulated control valves for aeration system.
- Provide new aeration header between Biosolids Control Building and Waste Sludge Storage Tank.

ALTERNATIVE 2 – DIFFUSED AERATION, COMPRESSED AERATED MIXING

For this alternative the primary aerobic digester(s) and liquid biosolids storage would have two distinct aeration grids installed:

- One grid, used for providing dissolved oxygen would consist of diffusers. If a single primary aerobic digester is installed, it is recommended the grid utilize coarse-bubble diffusers as access for maintenance of the diffusers is not required. If two primary aerobic digesters are installed, it is recommended the grid utilize fine-bubble diffusers for an increase in oxygen transfer efficiency and reduced aeration requirements.
- The second would have a compressed air mixing system consisting of a control valve assembly and mixing heads which are used to create much larger aeration bubbles that are more effective at mixing, but ineffective at oxygen transfer. The compressed air mixing system only utilized one valve at a time for mixing, reducing the over air flow requirements.

Separate compressors would supply air for the compressed air mixing system, and conventional rotary lobe blowers would provide air from fine-bubble aeration. The compressed air mixing controls, as part of a Manufacturer PLC package, allow for periodic mixing. Only one mixing valve is opened at a time reducing the volume of air required at any given time. The compressed air mixing uses separate compressors from aeration blowers. A common compressed air discharge air header from compressors and a surge tank would supply air for mixing. The aerobic digester cells would utilize a common header from blowers located in the Solids Control Building for aeration.

Condition-Based Replacement:

- Replace existing blowers in Administration Building and Biosolids Control Building to meet aeration demand of common discharge header.
- Replace existing primary aerobic digester cell 1 diffused aeration grid and construct new compressed air mixing grid.
- Add new primary aerobic digester cell 2 diffused aeration grid and construct new compressed air mixing grid, as applicable.
- Add new existing liquid sludge storage diffused aeration grid and construct new compressed air mixing grid.
- Add new existing waste sludge storage compressed air mixing grid.

Capacity-Based Replacement:

- Provide new instrumentation, manufacturer PLC, and modulated control valves for aeration system.
- Provide new manufacturer PLC, and modulated control valves for compressed air mixing system.
- Provide new aeration header between Biosolids Control Building and process tanks.

ALTERNATIVE 3 – JET AERATION AND MIXING

This alternative provides separate mechanisms for aeration and mixing of the aerobic digester. A liquid and aeration common header feed a set of jet mixing nozzles along the process tank. While mixing, only the recirculation pumps would operate to draw solids from the process tank and through the jet mixing nozzles. For aeration, air is introduced into the mixing nozzles and sheered into smaller bubbles which have an oxygen transfer efficiency between fine and coarse bubble. Storage tanks would have only the jet mixing system installed. Separate mixing pumps would be required for each process tank to prevent mixing of digested and undigested solids.

Condition-Based Replacement:

- Replace existing blowers in Administration Building and Biosolids Control Building.
- Replace existing primary aerobic digester cell 1 diffused aeration grid with:
  - (1) duty and (1) standby mixing recirculation pump,
  - (1) jet mixing lateral and jet diffusers, and
  - (1) aeration header to jet diffusers.
- Construct new primary aerobic digester cell 2, as applicable:
  - (1) duty and (1) standby mixing recirculation pump,
  - (1) jet mixing lateral and jet diffusers, and
  - (1) aeration header to jet diffusers.
- Replace existing liquid biosolids storage diffused aeration grid with:
  - (1) duty and (1) standby mixing recirculation pump,
  - (1) jet mixing lateral and jet diffusers, and
  - (1) aeration header to jet diffusers.
- Replace existing waste sludge storage diffused aeration grid with:
  - (1) duty and (1) standby mixing recirculation pump, and
  - (1) jet mixing lateral and jet diffusers.

Capacity-Based Replacement:

- Provide new instrumentation and modulated control valves for aeration system.

Waste Sludge Storage

Convert waste sludge storage basin to a sludge receiving facility for discharge to aerobic digesters. Replace aerated mixing equipment and blowers. Centralize aeration for mixing from Biosolids Control Building using common header and yard piping. As applicable, existing blower room may be suitable for jet mixing pumps, however the location does not provide for flooded-suction installation. Furnish level control instrumentation for tanks. Replace submersible sludge transfer pumps to aerobic digester.

Summary of Recommended Improvements:

Condition-Based Replacement:

- Add quick coupling piping to pump into storage tank from sludge hauling truck.
- Replace existing submersible sludge transfer pumps with drywell-mounted pumps in Disinfection and Pumping Building.
- Relocate aeration blowers to Biosolids Control Building, install new yard aeration piping.
- Replace mixing system in sludge storage tank (refer to Sludge and Biosolids Mixing section of this memorandum).

Preliminary Engineer's Opinion of Probable Costs

Refer to Table 7 on the following page for the preliminary Engineer's opinion of probable costs associated with each alternative considered. Costs presented in Table 7 include Aerated Digester and Thickening Alternatives, Liquid Sludge Storage recommended improvements, and Sludge and Biosolids Mixing Alternatives.

Table 7: Preliminary Engineer's Opinion of Probable Costs for Sludge and Biosolids Mixing Alternatives

Mixing Alternative	Digestion Alternative	Opinion of Probable Cost [1, 2, 3, 4]	
		Gravity Thickening	DAF Thickening
Alternative 1: Diffused Aeration and Mixing	Alternative 1: One Primary Cell	$6,296,000	$6,257,000
	Alternative 2: Two Primary Cells	$8,520,000	$8,481,000
Alternative 2: Diffused Aeration, Compressed Aerated Mixing	Alternative 1: One Primary Cell	$8,570,000	$8,531,000
	Alternative 2: Two Primary Cells	$10,372,000	$10,333,000
Alternative 3: Jet Aeration and Mixing [5]	Alternative 1: One Primary Cell	$10,068,000	$10,029,000
	Alternative 2: Two Primary Cells	$13,767,000	$13,728,000

Notes:
1. Includes 5.0% construction contingency, 3.0% mobilization, bonding, and insurance, 0.1% permitting as part of Construction Costs.
2. Includes 30% contingency of preliminary anticipated capital improvements costs as Design Contingency.
3. Includes 18% of preliminary anticipated capital improvements costs for Engineering, Design, and Field Services.
4. Includes 1% of preliminary anticipated capital improvements costs for Legal, Fiscal, and Administrative.
5. Cost alternatives do not include additional building required for ancillary equipment.

In addition to the capital costs for equipment, it is likely that alternative 3 would require an additional pumping building on site for installation of the jet mixing recirculation pumps. Having the largest capital cost without consideration of additional building required for installation, results in alternative 3 not being considered further.

Table 8 on the following page summarizes the anticipated operation and maintenance associated with mixing alternatives 1 and 2. Note that the compressed aerated mixing alternative allows for decoupling of aeration and mixing resulting in reduced operational requirements for the blowers, electrical consumption, and wear. Alternative 2 does not include, but would be applicable for, Green Project Reserve funding (GPR) due to the increase in process operation efficiency. Both alternatives would be applicable to biosolids related funding through the Clean Water State Revolving Funds (CWSRF).

Table 8: Preliminary Engineer's Opinion of Net Present Value for Sludge and Biosolids Mixing Alternatives

Mixing Alternative	Digestion Alternative	Thickening Alternative	Opinion of Yearly OM	Opinion of 20-yr NPV [1,2,3,4]
Alternative 1: Diffused Aeration and Mixing	One Cell	DAF	$202,403	$9,269,000
		Gravity	$199,801	$9,269,000
	Two Cells	DAF	$215,306	$11,685,000
		Gravity	$154,586	$10,820,000
Alternative 2: Diffused Aeration, Compressed Aerated Mixing	One Cell	DAF	$111,581	$10,192,000
		Gravity	$108,980	$10,192,000
	Two Cells	DAF	$122,244	$12,152,000
		Gravity	$114,194	$12,071,000

General Notes:
- OM: Operation and Maintenance, presented as one year cost. Costs are for May 2023.
- NPV: Net Present Value given the assumptions noted below.
- DAF: Dissolved Air Flotation.
- Includes capital costs described in Table 7.

Notes:
1. Estimated labor hours per year based on *The Northeast Guide for Estimating Staffing at Publicly and Privately Owned Wastewater Treatment Plants*.
2. Assumes operator total compensation labor rate of $35.00 per hour. Represents year one O&M rate.
3. Cost per year assumes an electrical utility rate of $0.0773 per kWhr.
4. 20 year period at 3.0% annual rate.

The recommended alternative is Alternative 2 using two primary aerobic digestion cells and DAF thickening. The alternative provides the greatest degree of process control. The DAF thickening is much less operator intensive and reliable, with a greater degree of control over the finished solids concentration. The additional aerobic digester cell meets reliability recommendation and provides for future capacity of the facility. Decoupling mixing and aeration allows for the ability to meet mixing requirements without the risk of souring the digester, resulting in labor intensive foam removal.

The recommended alternative meets the anticipated flow and load demands with the following advantages:

Aeration and Mixing:
- Diffused aeration and compressed aerated mixing provides the lowest operation and maintenance costs of the proposed mixing alternatives.
- Diffused aeration and compressed aerated mixing is the middle capital costs of the proposed mixing alternatives.
- The reduction in aeration equipment better fits the existing Biosolids Control Building gallery space.
- Allows the ability to mix without aerating to control nitrification, thereby reducing the risk of low pH, foaming, and digester upset.

Though not the lowest capital cost alternative for aerobic digestion, a two cell digester:
- Allows for one cell to be removed from service for maintenance of fine-bubble aeration equipment, as well as other maintenance activities.
- Meets the redundancy recommendations of 10 States Standards.

Thickening:

- Capital cost and operation and maintenance of the processes is equivalent whether thickening by DAFT for gravity thickener.
- DAFT thickening provides operation flexibility which can be various operating conditions between startup and design capacity treatment conditions.
- DAFT thickening does not require significant plant effluent recirculation, reducing the additional capital an O&M costs associated with a large recirculation stream being returned through secondary treatment.

Refer to Table 9 for a summary of the anticipated Preliminary Engineer's Opinion of Probable Costs associated with the recommended improvements. These costs reflect the opinion of probable costs at the time of preparation of this report. Probable costs are likely to change between preparation of the facility plan and bidding of improvements.

Table 9: Preliminary Engineer's Opinion of Probable Costs for Biosolids Stabilization Improvements

Description	Opinion of Probable Cost
Biosolids Control Building Architectural Improvements	$128,000
Biosolids Control Building HVAC Improvements	$214,000
Biosolids Control Building Electrical Improvements	$77,000
DAF Thickening and Clarifier Modifications	$1,717,000
Aerobic Digester Tank Cell 1 Modifications	$202,000
Aerobic Digester Tank Cell 2 and Gallery	$1,233,000
Liquid Sludge Storage Tank Cover	$534,000
Liquid Sludge Storage Tank Modifications	$20,000
Waste Sludge Storage Tank Modifications	$196,000
Diffused Aeration and Compressed Aerated Mixing	$2,484,000
Subtotal for Construction [1]	$7,150,000
Contingency [2]	$2,148,000
Engineering and Design [3]	$1,288,000
Legal, Fiscal, and Administrative [4]	$73,000
Total for Project	$10,659,000

Notes:
1. Includes 5.0% construction contingency, 3.0% mobilization, bonding, and insurance, 0.1% permitting as part of Construction Costs.
2. Includes 30% contingency of preliminary anticipated capital improvements costs as Design Contingency.
3. Includes 18% of preliminary anticipated capital improvements costs for Engineering, Design, and Field Services.
4. Includes 1% of preliminary anticipated capital improvements costs for Legal, Fiscal, and Administrative.

Biosolids Dewatering

Biosolids dewatering consists of the following processes:

- Biosolids Processing Building,
- Dewatering Equipment, and
- Drying Equipment.

Biosolids Processing Building

The Biosolids Processing Building is anticipated to have sufficient capacity; however, several existing conditions and condition-related improvements have been identified.

Summary of Recommended Improvements:

Condition-Based Replacement:

- Replace electrical room air conditioning unit.
- Replace radiant heat boiler controls.
- Replace existing PLC panel.
- Add emergency eyewash and shower near liquid polymer feed equipment in dryer room.
- Add corner shower to existing lavatory (remove floor and connect to floor drain sanitary pipe, new vent through roof).
- Relocate existing activated carbon odor control skid outside and re-route existing fiberglass duct to new location. Replace media. Provide media access. Assumes replacement of exhaust fan in enclosure are required due to relocation.

Dewatering Equipment

The dewatering centrifuge are near major maintenance overhaul and have a few electrical-related improvements which have been identified.

The existing dewatering cake loadout was designed as an alternate loadout. The dewatered cake loadout is operated as the primary loadout and additional controls would reduce operator maintenance time as a result of cake biosolids spilling during loadout.

Cake biosolids would be discharged and conveyed to a cake storage building. The building would consist of a concrete pad with channel drain. The building would have 8-foot push walls and be 60-feet by 200-feet. The approximate storage volume for design would be 3,600 cubic yards. The concrete storage would be covered using a pre-engineered steel frame and 28 oz PVC fabric roof system. The roofing system would include ice breaker cleats and the steel frame system would be galvanized.

Summary of Recommended Improvements:

Condition-Based Replacement:

- Replace both dewatering centrifuge progressive cavity-type feed pumps.
- Replace existing dewatering centrifuge PLC in PLC control panel.
- Replace dewatering centrifuge #1 main drive variable frequency drive (VFD).
- Water heater for polymer dilution and carrier water.
- Current dewatered cake shaftless screw convey vertical section plugs with solids. Replace conveyor with horizontal-vertical-horizontal cleated belt conveyor.
- Provide cake biosolids storage in addition to dried biosolids silo.
- Add slide gate and controls to dewatered cake loadout.

Drying Equipment

No condition or capacity related improvements are required for the Drying Equipment.

Preliminary Engineer's Opinion of Probable Costs

Refer to Table 10 on the following page for a summary of the anticipated Preliminary Engineer's Opinion of Probable Costs associated with the recommended improvements. These costs reflect the opinion of probable costs at the time of preparation of this report. Probable costs are likely to change between preparation of the facility plan and bidding of improvements.

Table 10: Preliminary Engineer's Opinion of Probable Costs for Biosolids Dewatering Improvements

Description	Opinion of Probable Cost
Biosolids Processing Building HVAC Improvements	$40,000
Biosolids Processing Building Electrical Improvements	$62,000
Biosolids Processing Building Plumbing Improvements	$16,000
Biosolids Processing Building Odor Control Relocation	$40,000
Dewatering Centrifuge Feed Pumps, PLC, Drive, and Polymer Feed	$132,000
Dewatered Cake Biosolids Loadout Slide Gate	$41,000
Dewatered Cake Biosolids Storage	$744,000
Subtotal for Construction [1]	$1,165,000
Contingency [2]	$350,000
Engineering and Design [3]	$210,000
Legal, Fiscal, and Administrative [4]	$12,000
Total for Project	$1,737,000

Notes:
1. Includes 5.0% construction contingency, 3.0% mobilization, bonding, and insurance, 0.1% permitting as part of Construction Costs.
2. Includes 30% contingency of preliminary anticipated capital improvements costs as Design Contingency.
3. Includes 18% of preliminary anticipated capital improvements costs for Engineering, Design, and Field Services.
4. Includes 1% of preliminary anticipated capital improvements costs for Legal, Fiscal, and Administrative.

OTHER CONSIDERATIONS

Other considerations have been broken down for review into the following processes:
- Administrative Building,
- Site Improvements, and
- Disinfection and Pumping Building.

Administration Building

Existing Administration Building is a combined process and administrative structure. Recommended improvements separate process and administrative elements for occupancy and fire rating requirements. Most recommendations are condition-based and related to the age of the building. The facility backup generator is located in the administration building and is recommended for replacements as it is insufficient to operate existing or anticipated facilities.

Summary of Recommended Improvements:

Condition-Based Replacement:
- Demolish and infill lower level of process room in Administration Building.
- Pour at-grade floor with trench drain and flammable waste interceptor for:
  - Maintenance garage,
  - Functional bathroom group, and
  - Separate shower facilities.
- Destratification exhaust fans and gas detection equipment.
- Remove exterior wall for overhead garage door.
- Replace Roof with fully adhered EPDM.
- Repair exterior CMU.
- Replace interior architectural coatings.
- Replace exterior architectural coatings.
- Remove existing boiler, replace with forced air furnace, and air conditioning.

- New PLC and SCADA system.
- Remove and route sanitary drain to intermediate plant lift station.
- Replace (6) existing 36” wide and (1) 72” wide double-leaf exterior hollow metal doors with new aluminum doors.

Note that the replacement of the HVAC may deviate pending occupancy review and room classification determination as part of design.

Capacity-Based Replacement:

- Replace backup generator with sufficiently sized unit in all-weather enclosure (see Site for this item).

Site Improvements

Existing facility communications, controls and monitoring equipment is not facility wide. New equipment and existing equipment are recommended to be connected to new facility-wide PLC control and SCADA supervisory system. Construction related traffic, excavation, and age of existing facilities contribute to replacement of existing site hardscape and lighting.

The existing septage receiving station is small, difficult to meter and supervise, and difficult to access for an average over-sized vehicle. Improvements to the gate, monitoring, access, and septage receiving structure are recommended to address these issues.

The current backup generator is undersized for the existing facility and located in the administrative building. A new generator has been located at the Biosolids Processing Building but does not include backup power for the Biosolids Control Building. It is assumed the existing generator at the Biosolids Processing Building is sufficient for the services currently supported. A new generator would be constructed for the Biosolids Control Building and Disinfection and Pumping Building. It is recommended that the generator be relocated to outside of the building in an all-weather enclosure as a cost-effective replacement of the existing system. The initial estimate assumed a 750-kW generator is required. Actual size will be verified during design.

Summary of Recommended Improvements:

Condition-Based Replacement:

- New fiber communications.
- Generator with sufficiently sized unit in all-weather enclosure.
- Replace site lighting.
- Replace site asphalt.
- Replace site stormwater system as needed.
- Replace and relocate septage receiving.
- Replace front gate with motor-operated gate, card scanner (software by City), and camera (software by City).

Note that the replacement of the site generator may deviate pending electrical load determination as part of design.

Disinfection and Pumping Building

As part of other improvements to address age and capacity issues, it is recommended a new multi-purpose disinfection and pumping building be located on site. A new multi-purpose building will allow for construction of new process critical facilities to be constructed while the existing facility remains in service. Critical processes intended to be relocated to this building are:

- RAS and WAS Pumping,
- Thickener Sludge Pumping (as applicable to solids alternatives),
- Recirculation Pumping (as applicable to solids alternatives),
- Plant Effluent Pumping (as applicable to solids alternatives),
- Decant Pumping (as applicable to solids alternatives),
- Ultraviolet Disinfection,
- Effluent Flow Measurement,
- Electrical Equipment, Emergency Backup Generator, and Services for:
    - Selector Basins,
    - Biological Treatment,
    - Secondary Clarification,
    - Chemical Feed,
    - Waste Sludge Storage,
    - Waste Sludge Thickening,
    - Biosolids Control Building, and
    - Administration Building.

The building will consist of a lower level to provide a drywell for submerged suction pumping from secondary clarifiers and gravity flow of facility effluent for disinfection. The lower-level requirements create and upper-level building space with can be suitable for electrical equipment, pump retrieval, and maintenance. The recommended alternative assumes a separate blower building as applicable for the biological treatment alternatives. During design, integration of the blower equipment to the disinfection and pumping building may be evaluated. Additional space may also be identified as necessary based on the final building layout during design. Refer to individual equipment sections discussed above for equipment costs. Facilities and utilities associated with the Disinfection and Pumping Building are presented below.

Preliminary Engineer's Opinion of Probable Costs

Refer to Table 11 on the following page for a summary of the anticipated Preliminary Engineer's Opinion of Probable Costs associated with the recommended improvements. These costs reflect the opinion of probable costs at the time of preparation of this report. Probable costs are likely to change between preparation of the facility plan and bidding of improvements.

Table 11: Preliminary Engineer's Opinion of Probable Costs for Other Improvements

Description	Opinion of Probable Cost
Administrative Building Electrical and Controls	$105,000
Administrative Building HVAC Improvements	$63,000
Administrative Building Process Room Conversion	$97,000
Administrative Building Architectural Improvements	$176,000
Administrative Building Sanitary Service	$20,000
Site Grading and Restoration	$32,000
Site Water, Process, and Sanitary Piping and Utilities	$274,000
Site Electrical Improvements	$470,000
Site Paving and Hardscape	$418,000
Site Septage Receiving Improvements	$194,000
Disinfection and Pumping Building	$2,714,000
Subtotal for Construction [1]	$4,743,000
Contingency [2]	$1,424,000
Engineering and Design [3]	$855,000
Legal, Fiscal, and Administrative [4]	$50,000
Total for Project	$7,072,000

General Notes:

- Opinion of Probable Cost does not include capital coast for process equipment. Process equipment capital costs are included in the process alternatives considered in each applicable section. Refer to individual sections for further discussion.
- Costs are associated with improvements are based on the recommended treatment alternatives.
- Site improvement costs do not include a stormwater retention pond. A retention pond, or expanded retention pond, may be required as determined during preparation of the SWPPP.

Notes:

1. Includes 5.0% construction contingency, 3.0% mobilization, bonding, and insurance, 0.1% permitting as part of Construction Costs.
2. Includes 30% contingency of preliminary anticipated capital improvements costs as Design Contingency.
3. Includes 18% of preliminary anticipated capital improvements costs for Engineering, Design, and Field Services.
4. Includes 1% of preliminary anticipated capital improvements costs for Legal, Fiscal, and Administrative.

Table 12 on the following page summarizes the preliminary Engineer's opinion of capital costs associated with recommended improvements.

Refer to Attachment 3 for a preliminary layout of proposed facilities associated with the recommended improvements.

Table 12: Preliminary Engineer's Opinion of Probable Costs for Recommended Improvements

Description	Opinion of Probable Cost
Main Lift Station and Forcemain [1]	$2,301,000
Preliminary Treatment [1]	$1,398,000
Selector Basin, Biological Alternative 3 [1]	$739,000
Biological Alternative 3 [1]	$4,147,000
Secondary Sedimentation Alternative 2 [1]	$4,846,000
Chemical Phosphorus Removal Alternative 2 [1]	$316,000
Disinfection and Pumping Building [1]	$2,714,000
Sludge and Biosolids Mixing Alternative 2 [1]	$2,484,000
Waste Sludge and Scum Thickening Alternative 2 [1]	$1,861,000
Waste Sludge Storage Conversion [1]	$217,000
Biosolids Control Building and Aerobic Digestion Alternative 2 [1]	$2,588,000
Biosolids Conditioning Building and Dewatering [1]	$1,165,000
Administration Building [1]	$526,000
Site Improvements [1]	$1,503,000
Subtotal for Construction	$26,805,000
Contingency [2]	$8,049,000
Engineering and Design [3]	$4,831,000
Legal, Fiscal, and Administrative [4]	$276,000
Total for Project	$39,961,000

Notes:
1. Includes 5.0% construction contingency, 3.0% mobilization, bonding, and insurance, 0.1% permitting as part of Construction Costs.
2. Includes 30% contingency of preliminary anticipated capital improvements costs as Design Contingency.
3. Includes 18% of preliminary anticipated capital improvements costs for Engineering, Design, and Field Services.
4. Includes 1% of preliminary anticipated capital improvements costs for Legal, Fiscal, and Administrative.

ejm

Attachments:
- Attachment 1: Liquid Treatment Alternatives
- Attachment 2: Solid Treatment Alternatives
- Attachment 3: Preliminary Layout of Recommended Improvements

c: Eric Miller, SEH Inc.
Colin Marcusen, SEH Inc.

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Attachment 1

Liquid Treatment Alternatives

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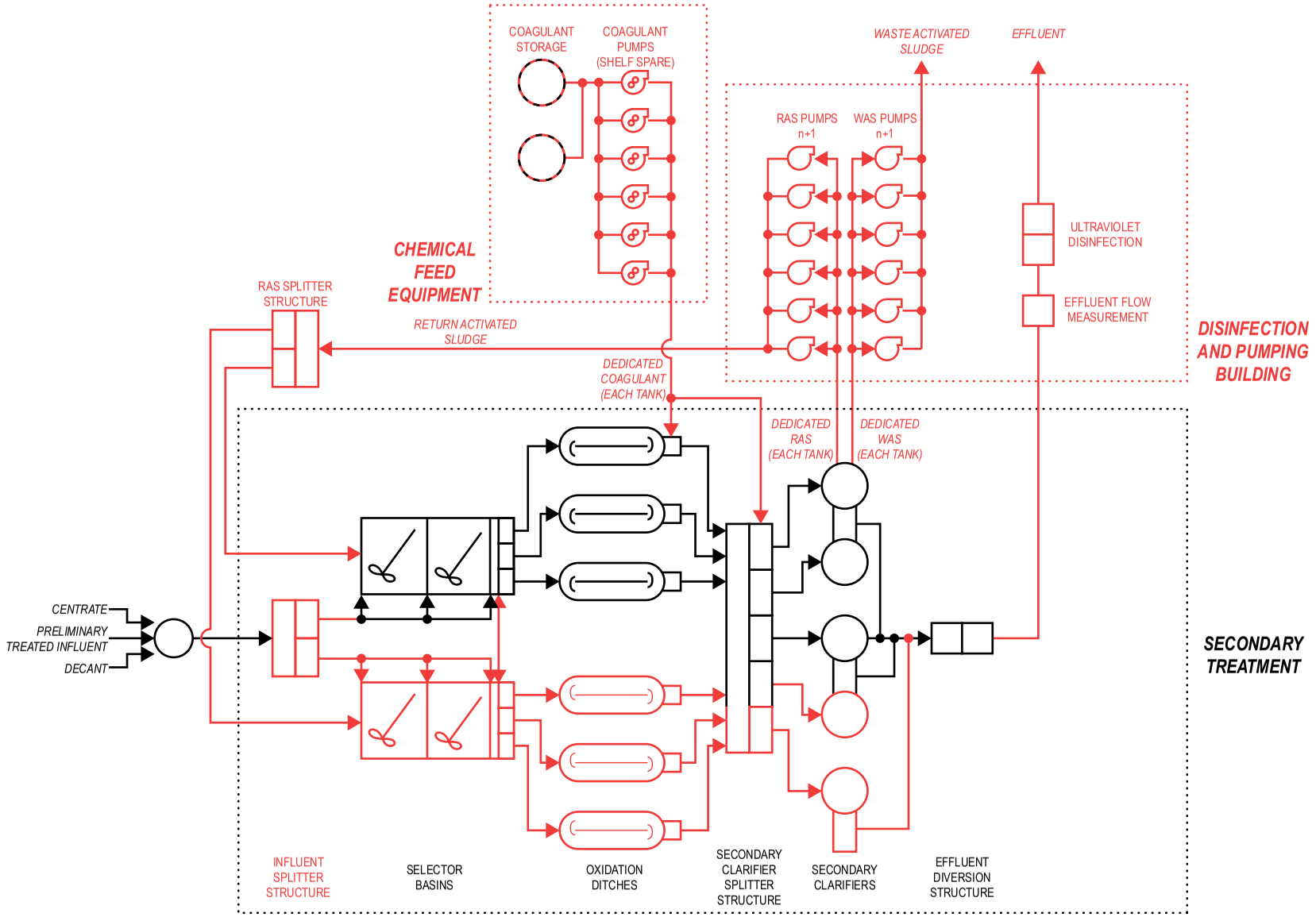

BIOLOGICAL TREATMENT ALTERNATIVE 1
SECONDARY TREATMENT ALTERNATIVE 1

01

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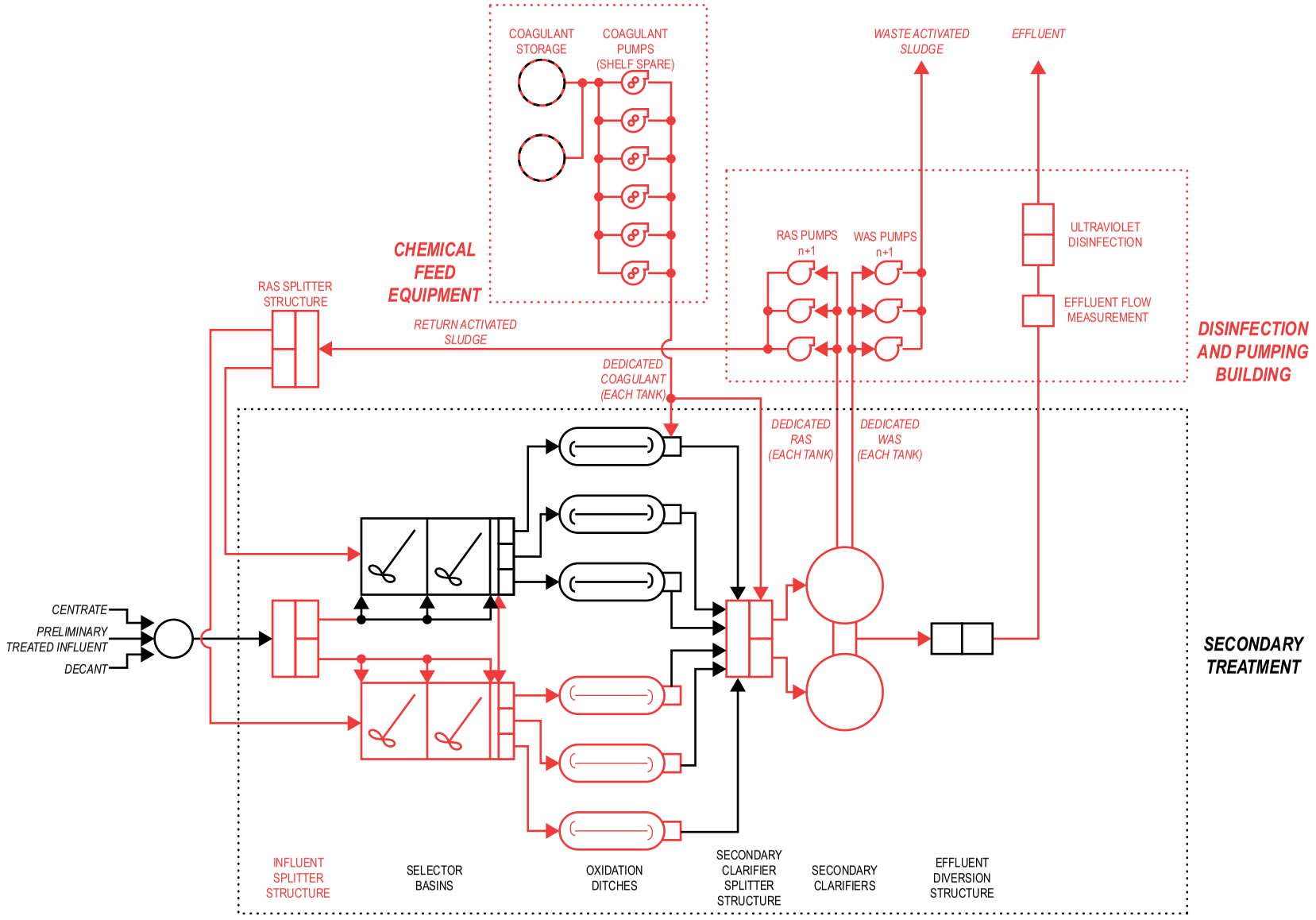

BIOLOGICAL TREATMENT ALTERNATIVE 1
SECONDARY TREATMENT ALTERNATIVE 2

02

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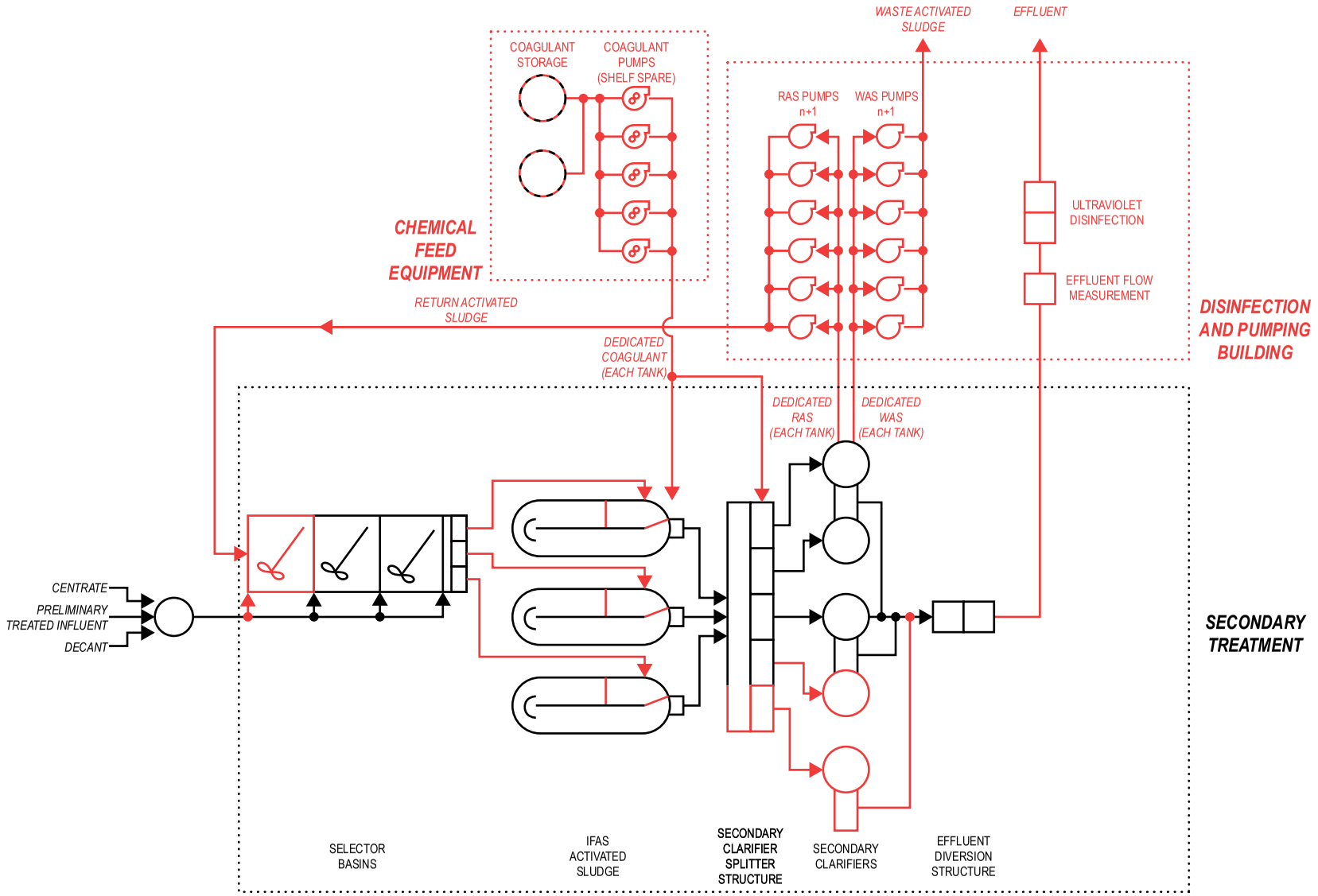

BIOLOGICAL TREATMENT ALTERNATIVE 2
SECONDARY TREATMENT ALTERNATIVE 1

03

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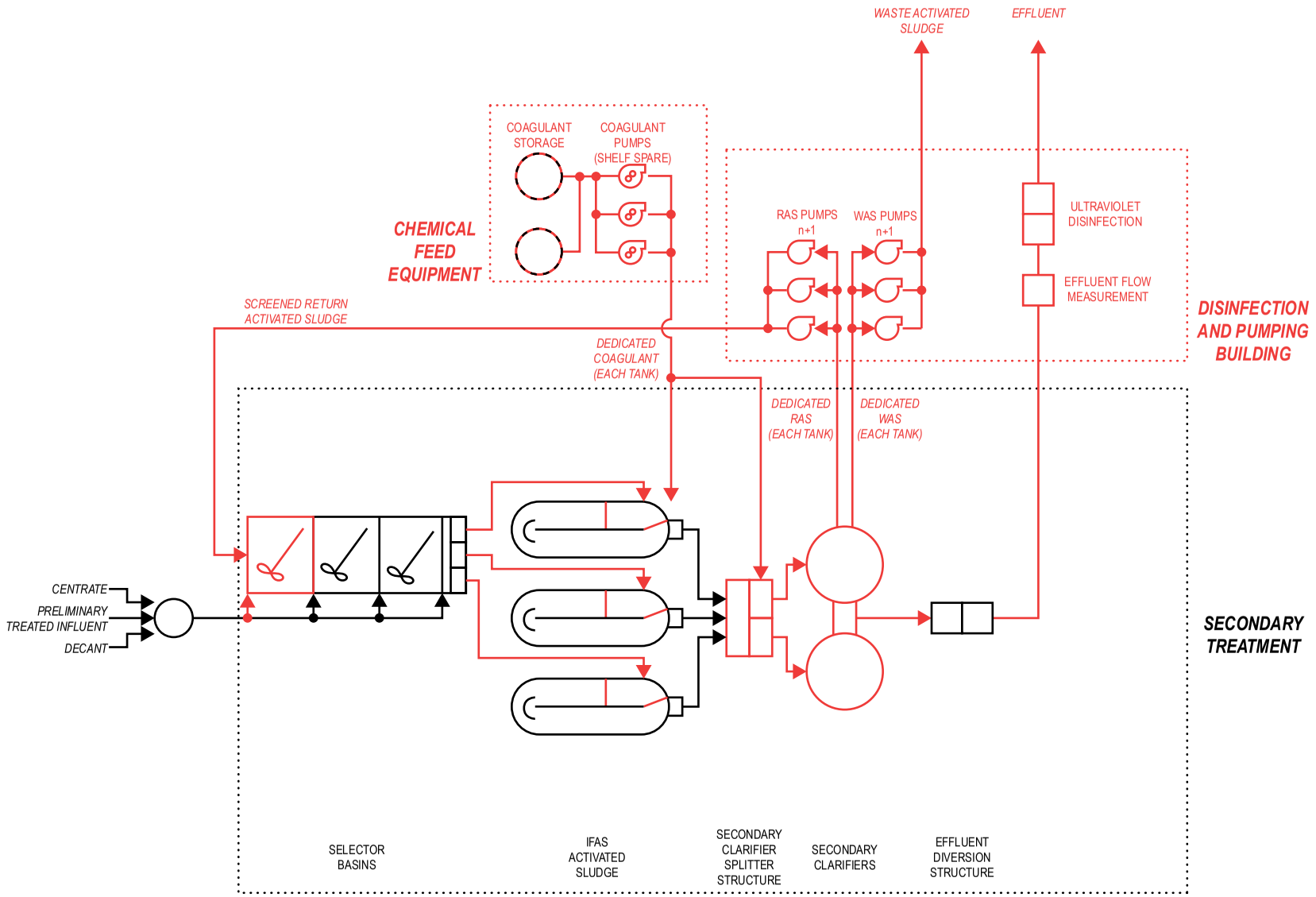

BIOLOGICAL TREATMENT ALTERNATIVE 2
SECONDARY TREATMENT ALTERNATIVE 2

04

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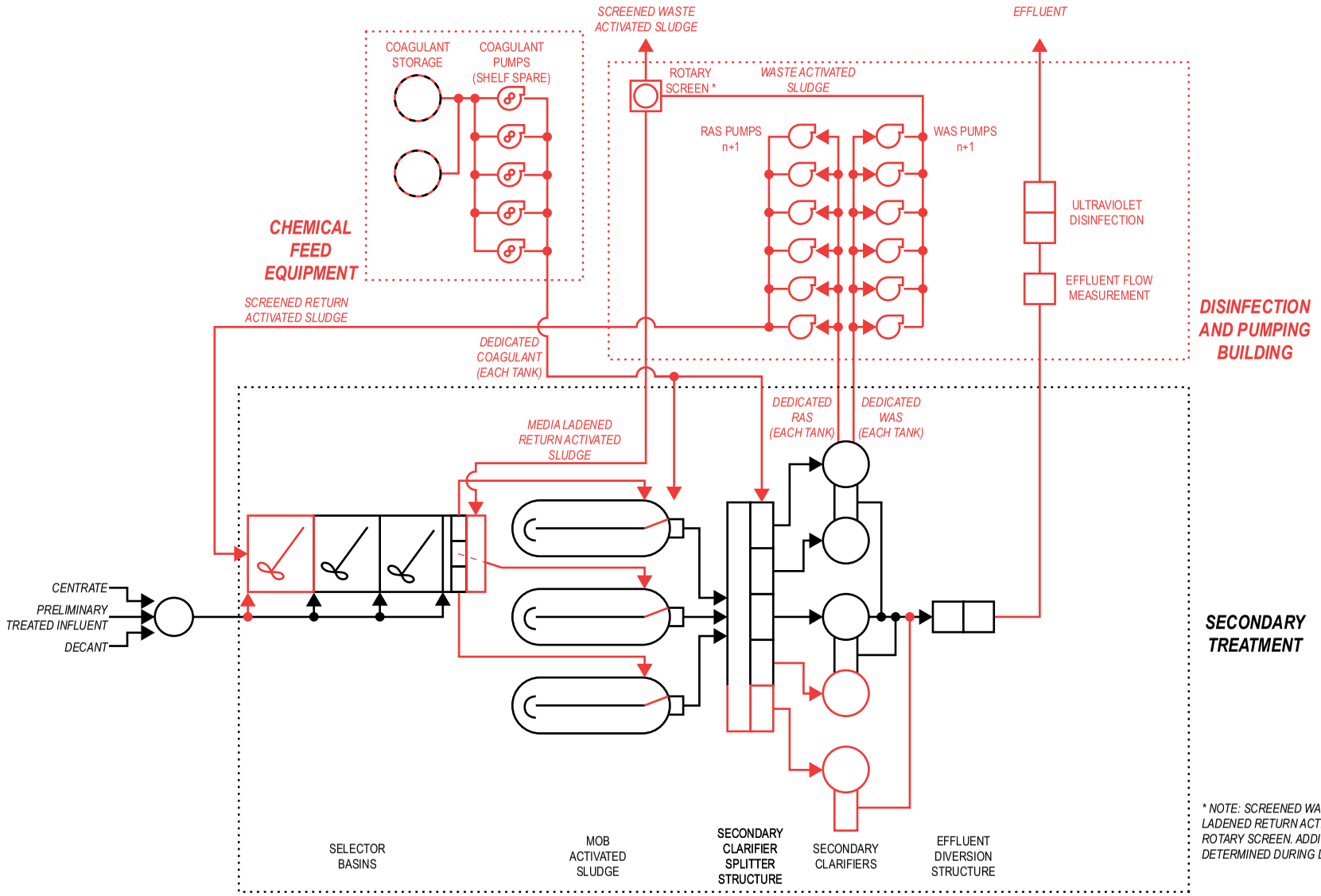

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BIOLOGICAL TREATMENT ALTERNATIVE 3
SECONDARY TREATMENT ALTERNATIVE 1

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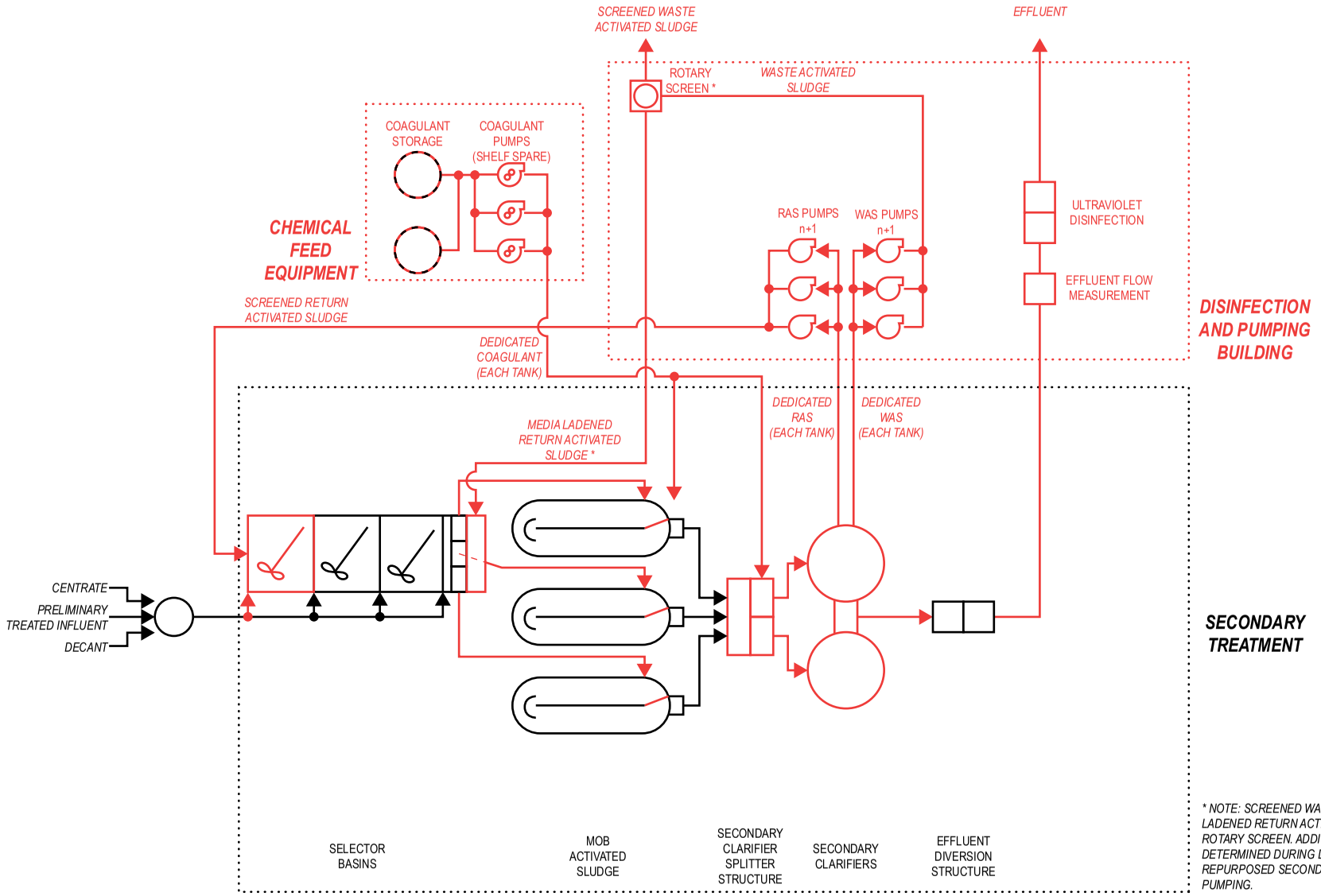

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BIOLOGICAL TREATMENT ALTERNATIVE 3
SECONDARY TREATMENT ALTERNATIVE 2

06

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Attachment 2

Solids Treatment Alternatives

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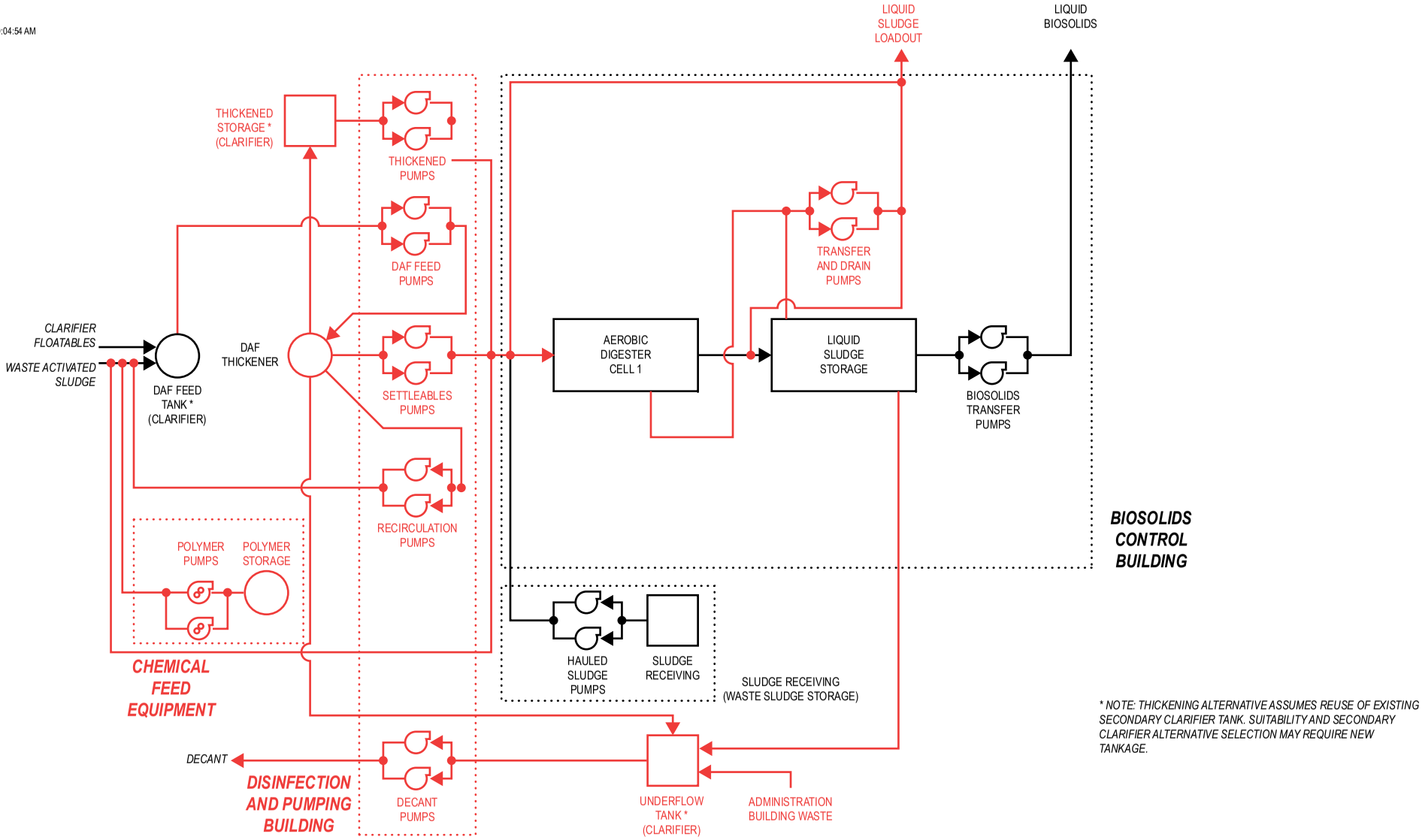

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AEROBIC DIGESTION
ALTERNATIVE 1
MIXING ALTERNATIVES
1 AND 2

01

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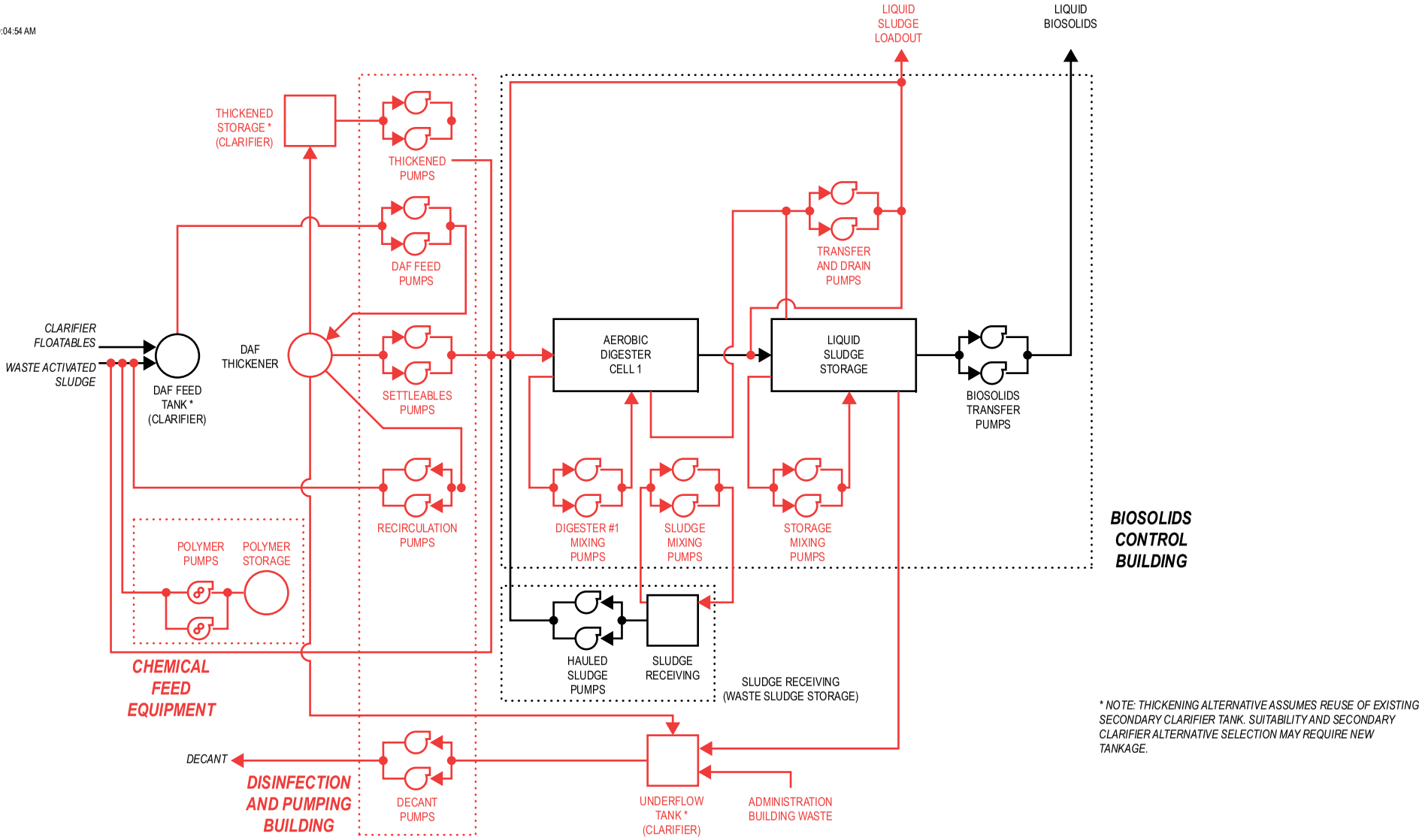

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AEROBIC DIGESTION
ALTERNATIVE 1
MIXING ALTERNATIVE 3

02

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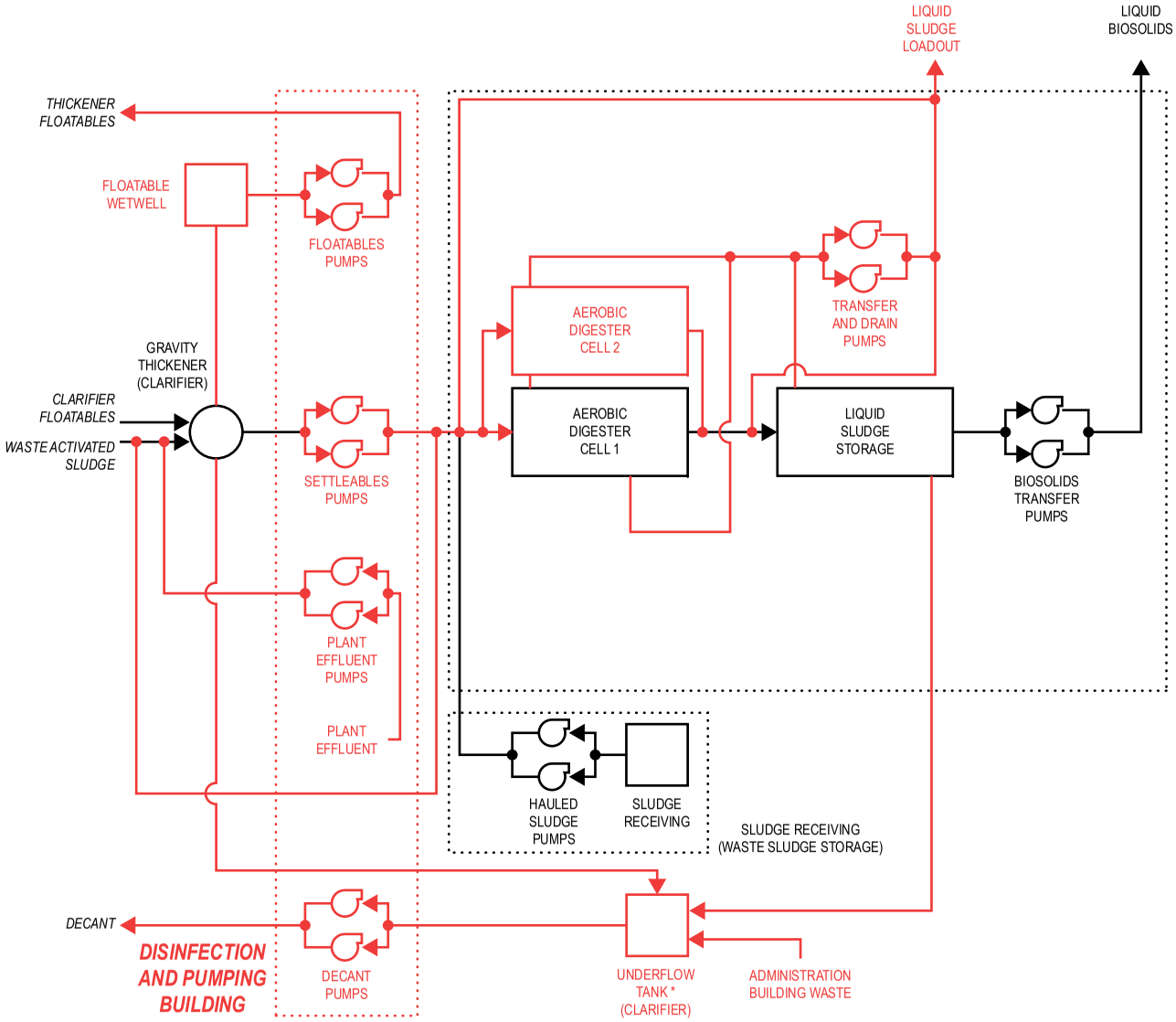

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AEROBIC DIGESTION ALTERNATIVE 2 MIXING ALTERNATIVES 1 AND 2

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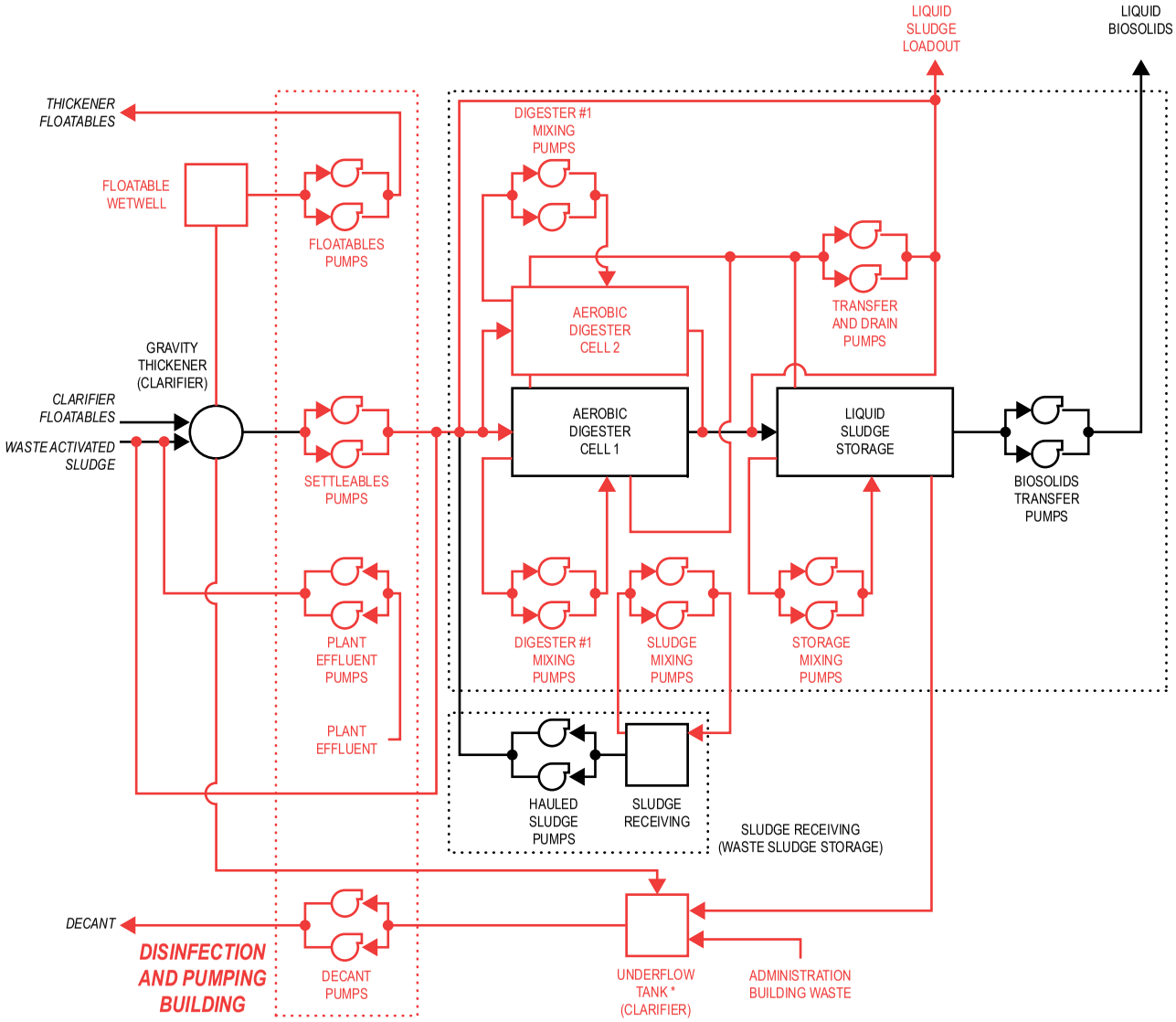

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AEROBIC DIGESTION
ALTERNATIVE 2
MIXING ALTERNATIVE 3

04

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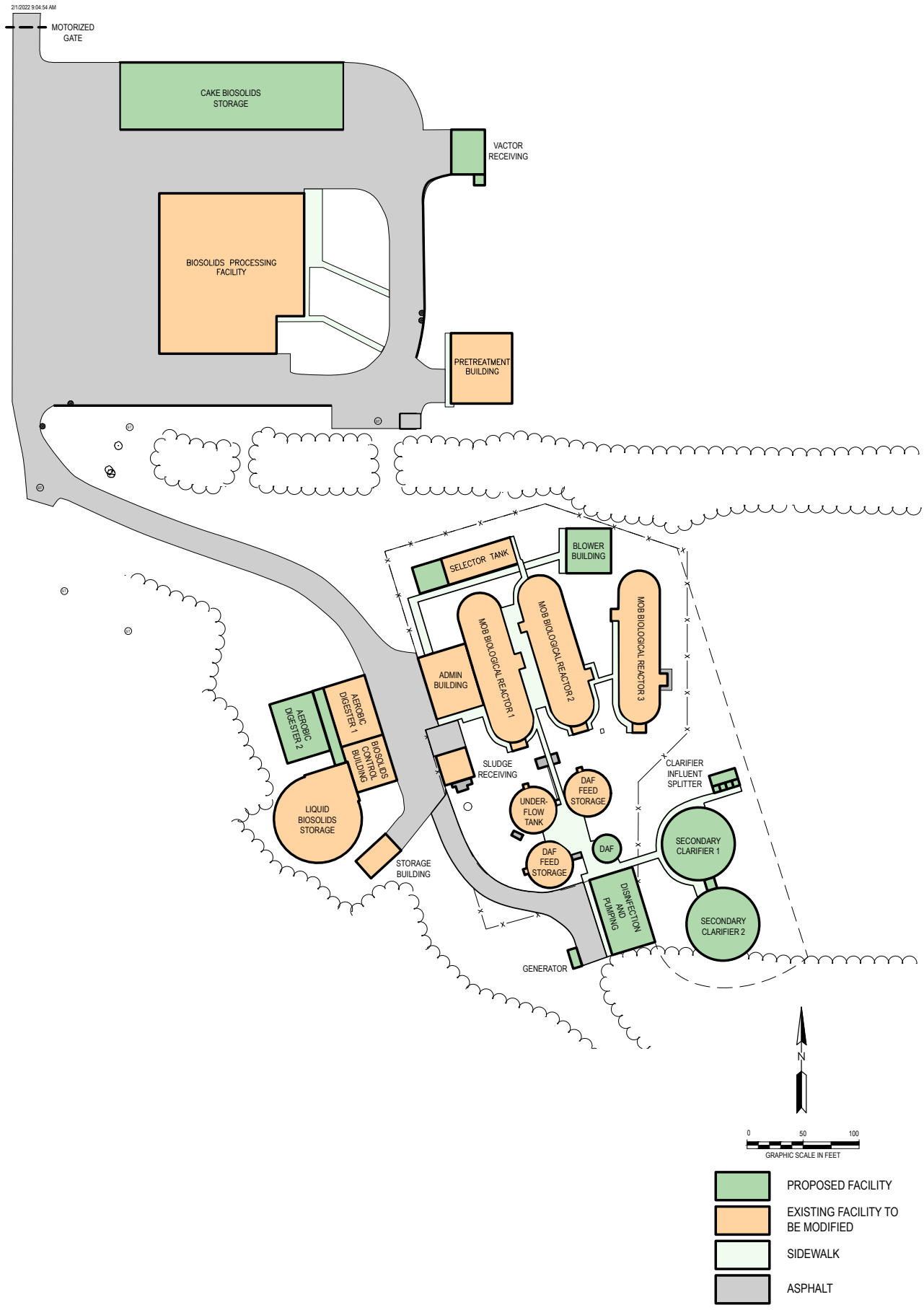
Attachment 3

Preliminary Layout of Recommended Improvements



RECOMMENDED IMPROVEMENTS FOR WASTEWATER TREATMENT FACILITIES

2C

REVISION SCHEDULE

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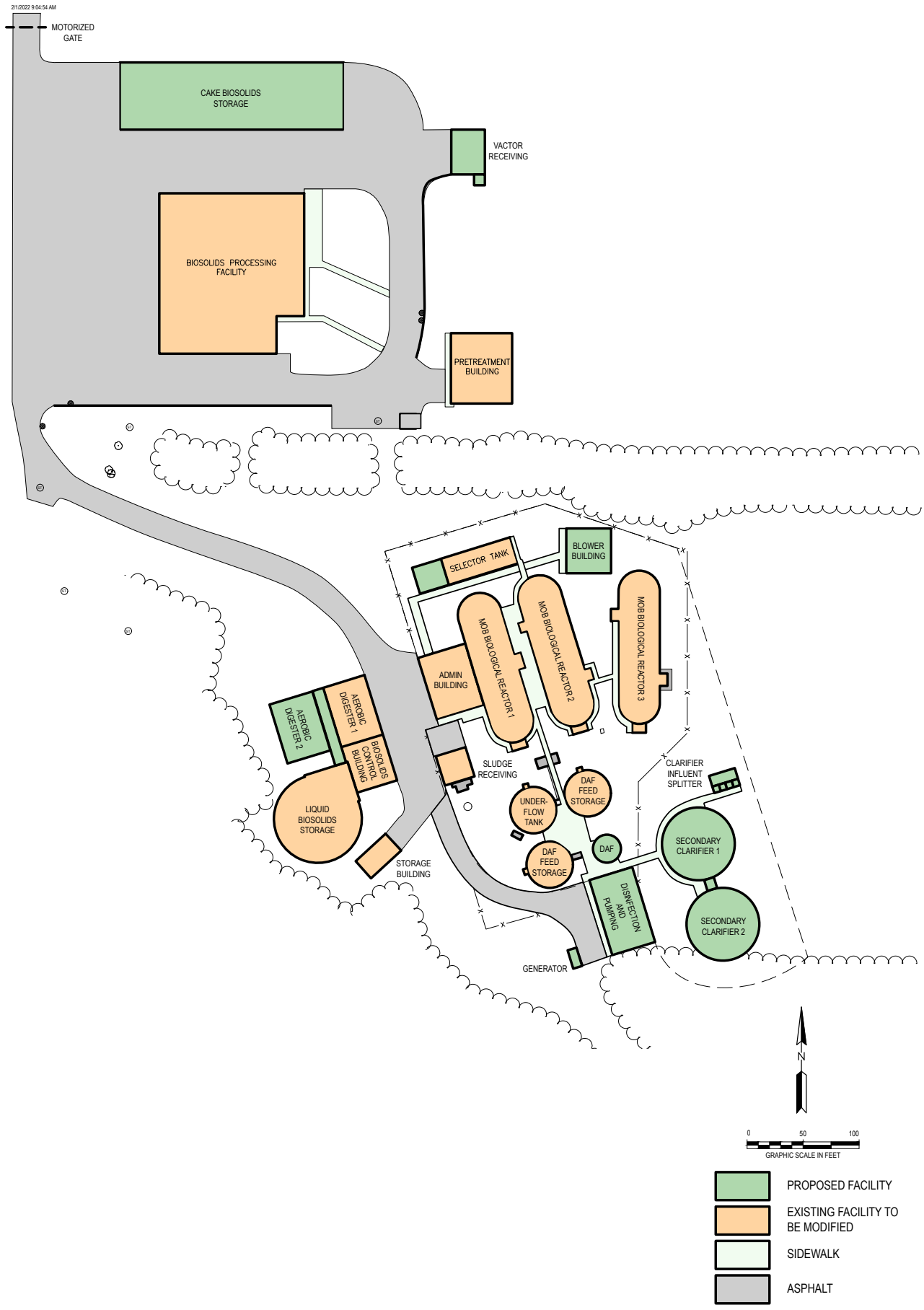
A-4 – Preliminary Site Plan of the Recommended Alternative



RECOMMENDED IMPROVEMENTS FOR WASTEWATER TREATMENT FACILITIES

2C

REVISION SCHEDULE

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Appendix B

Economic Impact Worksheets

B-1 – Municipal Preliminary Screener Worksheets
B-2 – Secondary Indicator Worksheets
B-3 – Substantial Impact Worksheets

B-1 – Municipal Preliminary Screener Worksheets

Alternative 1 – Conventional Secondary Treatment Improvements

Municipal Preliminary Screener (Worksheet D in the Guidance)

Description: This worksheet calculates and displays the Municipal Preliminary Screener (MPS), which is the total annual pollution control costs per household (existing annual cost per household plus the incremental cost related to the proposed project) as a percentage of median household income.

Total Annual Pollution Control Cost per Household / Adjusted Median Household Income × 100

The MPS indicates if a public entity would clearly not incur substantial economic impacts as a result of the proposed pollution control project.

Instructions: Evaluate the MPS by noting which cell is highlighted in **orange** and **marked with an asterisk (*).** If the MPS is less than 1.0 percent of median household income, EPA does not expect the pollution control project to impose a substantial economic impact on the community; do not continue to the secondary affordability test. If the MPS is greater than 2.0 percent of median household income, then the pollution control project may interfere with development; continue to the secondary affordability test. If the MPS is between 1.0 and 2.0 percent of median household income, the community may incur a mid-range economic impact; continuing to the secondary affordability test is optional. See the Guidance documentation below for additional information.

A. Calculation of the MPS

Total Annual Pollution Control Cost per Household [**Worksheet Q**, (11) or **Worksheet Q: Option A**, (10)]	$1,497.12	(1)
Adjusted Median Household Income	$105,777	(2)
MPS [[(1) / (2)] × 100]	1.4%	(3)

B. Evaluation of the MPS

Note column of cell **marked with an asterisk (*)** below:

Little Impact	**Mid-Range Impact**	**Large Impact**
Less than 1.0%	1.0% - 2.0% *	Greater than 2.0%
	---------->	
Indication of no substantial economic impacts	Proceed to Secondary Test	

Guidance Documentation

Component	***Section***	***Page***
MPS	5.2.a	5-5
Annual Pollution Control Cost per Household	5.1.b	5-3
Median Household Income	5.2.a	5-5
Interpreting Municipal Preliminary Screener	5.2.a	5-5
Determining Need for Secondary Test	5.2.a	5-5

Alternative 2 – Conventional Secondary and Tertiary Improvements

Municipal Preliminary Screener (Worksheet D in the Guidance)

Description: This worksheet calculates and displays the Municipal Preliminary Screener (MPS), which is the total annual pollution control costs per household (existing annual cost per household plus the incremental cost related to the proposed project) as a percentage of median household income.

Total Annual Pollution Control Cost per Household / Adjusted Median Household Income × 100

The MPS indicates if a public entity would clearly not incur substantial economic impacts as a result of the proposed pollution control project.

Instructions: Evaluate the MPS by noting which cell is highlighted in **orange** and **marked with an asterisk (*).** If the MPS is less than 1.0 percent of median household income, EPA does not expect the pollution control project to impose a substantial economic impact on the community; do not continue to the secondary affordability test. If the MPS is greater than 2.0 percent of median household income, then the pollution control project may interfere with development; continue to the secondary affordability test. If the MPS is between 1.0 and 2.0 percent of median household income, the community may incur a mid-range economic impact; continuing to the secondary affordability test is optional. See the Guidance documentation below for additional information.

A. Calculation of the MPS

Total Annual Pollution Control Cost per Household [**Worksheet Q**, (11) or **Worksheet Q: Option A**, (10)]	$1,579.95	(1)
Adjusted Median Household Income	$105,777	(2)
MPS [[(1) / (2)] × 100]	1.5%	(3)

B. Evaluation of the MPS

Note column of cell **marked with an asterisk (*)** below:

Little Impact	**Mid-Range Impact**	**Large Impact**
Less than 1.0%	1.0% - 2.0% *	Greater than 2.0%
	---------->	
Indication of no substantial economic impacts	Proceed to Secondary Test	

Guidance Documentation		
Component	***Section***	***Page***
MPS	5.2.a	5-5
Annual Pollution Control Cost per Household	5.1.b	5-3
Median Household Income	5.2.a	5-5
Interpreting Municipal Preliminary Screener	5.2.a	5-5
Determining Need for Secondary Test	5.2.a	5-5

Alternative 3 – Membrane Secondary Treatment

Municipal Preliminary Screener (Worksheet D in the Guidance)

Description: This worksheet calculates and displays the Municipal Preliminary Screener (MPS), which is the total annual pollution control costs per household (existing annual cost per household plus the incremental cost related to the proposed project) as a percentage of median household income.

Total Annual Pollution Control Cost per Household / Adjusted Median Household Income × 100

The MPS indicates if a public entity would clearly not incur substantial economic impacts as a result of the proposed pollution control project.

Instructions: Evaluate the MPS by noting which cell is highlighted in **orange** and **marked with an asterisk (*).** If the MPS is less than 1.0 percent of median household income, EPA does not expect the pollution control project to impose a substantial economic impact on the community; do not continue to the secondary affordability test. If the MPS is greater than 2.0 percent of median household income, then the pollution control project may interfere with development; continue to the secondary affordability test. If the MPS is between 1.0 and 2.0 percent of median household income, the community may incur a mid-range economic impact; continuing to the secondary affordability test is optional. See the Guidance documentation below for additional information.

A. Calculation of the MPS

Total Annual Pollution Control Cost per Household [**Worksheet Q**, (11) or **Worksheet Q: Option A**, (10)]	$1,685.46	(1)
Adjusted Median Household Income	$105,777	(2)
MPS [[(1) / (2)] × 100]	1.6%	(3)

B. Evaluation of the MPS

Note column of cell **marked with an asterisk (*)** below:

Little Impact	**Mid-Range Impact**	**Large Impact**
Less than 1.0%	1.0% - 2.0% *	Greater than 2.0%
	---------->	
Indication of no substantial economic impacts	Proceed to Secondary Test	

Guidance Documentation

Component	***Section***	***Page***
MPS	5.2.a	5-5
Annual Pollution Control Cost per Household	5.1.b	5-3
Median Household Income	5.2.a	5-5
Interpreting Municipal Preliminary Screener	5.2.a	5-5
Determining Need for Secondary Test	5.2.a	5-5

B-2 – Secondary Indicator Worksheets

Alternative 1 – Conventional Secondary Treatment Improvements

Calculation of the Secondary Test Score (Worksheet U in the Guidance)

Description: This worksheet calculates the secondary test score, which characterizes the affected community's current financial and socioeconomic condition. The secondary test score is used in combination with the MPS to evaluate whether or not substantial economic impacts are likely to occur. See the Guidance documentation below for additional information.

Instructions: Verify that the appropriate cells are selected in each row and in the "Score" column to be summed below (highlighted in **orange** and **marked with an asterisk (*)**).

Indicator	Secondary Indicators			Score
	Weak [a]	Mid-Range [b]	Strong [c]	
Bond Rating **Worksheet T**, (4)	Below BBB (S&P) Below Baa (Moody's)	BBB (S&P) Baa (Moody's)	Above BBB (S&P) Above Baa (Moody's) *	3 *
Overall Net Debt as Percent of Full Market Value of Taxable Property **Worksheet T**, (12)	Above 5%	2% - 5% *	Below 2%	2 *
Overall Net Debt Per Capita[1] **Worksheet T**, (12 Alt.)	Greater than $3,000	$1,000 - $3,000	Less than $1,000	N/A
Unemployment[2] **Worksheet T**, (5) & (6)	Above National Average	National Average	Below National Average *	3 *
Median Household Income[3] **Worksheet T**, (7) & (8)	Below State Median	State Median *	Above State Median	2 *
Property Tax Revenues as a Percent of Full Market Value of Taxable Property[4] **Worksheet T**, (13)	Above 4%	2% - 4%	Below 2% *	3 *
Property Tax Collection Rate[4] **Worksheet T**, (9)	< 94%	94% - 98%	> 98% *	3 *
Average of Financial Management Indicators[4] **Worksheet T**, (13) and (9)				N/A

a. Weak is a score of 1 point
b. Mid-Range is a score of 2 points
c. Strong is a score of 3 points

SUM 16

AVERAGE 2.7

Notes:

[1] If the state has statutory limits on property tax collections and/or rates or data on full-market value of taxable property are not available, "Overall Net Debt as Percent of Full Market Value of Taxable Property" is replaced with "Overall Net Debt Per Capita" and "Property Tax Revenues as a Percent of Full-Market Value of Taxable Property" is dropped.

[2] If the community's employment rate is equal to the national average unemployment rate, plus or minus 1%, then the community's unemployment rate is assessed as being equal to the national rate.

[3] If the community's median household income is equal to the state median, plus or minus 10%, then the community's median household income is assessed as being equal to the state's median household income.

[4] If one of the debt or socioeconomic indicators is not available, the two financial management indicators are averaged and this averaged value is used as a single indicator with the remaining indicators.

Guidance Documentation

Component	*Section*	*Page*
Calculating Secondary Test Score	5.2.b; 2.4	5-6; 2-11
Interpreting Secondary Test Score	5.2.b; 2.4	5-6; 2-11
Missing Indicators	5.2.b; 2.4	5-7; 2-12
Determining Interference with Development	5.2.d	5-7

Alternative 2 – Conventional Secondary and Tertiary Improvements

Calculation of the Secondary Test Score (Worksheet U in the Guidance)

Description: This worksheet calculates the secondary test score, which characterizes the affected community's current financial and socioeconomic condition. The secondary test score is used in combination with the MPS to evaluate whether or not substantial economic impacts are likely to occur. See the Guidance documentation below for additional information.

Instructions: Verify that the appropriate cells are selected in each row and in the "Score" column to be summed below (highlighted in **orange** and **marked with an asterisk (*)**).

Indicator	Secondary Indicators			Score
	Weak [a]	Mid-Range [b]	Strong [c]	
Bond Rating **Worksheet T**, (4)	Below BBB (S&P) Below Baa (Moody's)	BBB (S&P) Baa (Moody's)	Above BBB (S&P) Above Baa (Moody's) *	3 *
Overall Net Debt as Percent of Full Market Value of Taxable Property **Worksheet T**, (12)	Above 5%	2% - 5% *	Below 2%	2 *
Overall Net Debt Per Capita[1] **Worksheet T**, (12 Alt.)	Greater than $3,000	$1,000 - $3,000	Less than $1,000	N/A
Unemployment[2] **Worksheet T**, (5) & (6)	Above National Average	National Average	Below National Average *	3 *
Median Household Income[3] **Worksheet T**, (7) & (8)	Below State Median	State Median *	Above State Median	2 *
Property Tax Revenues as a Percent of Full Market Value of Taxable Property[4] **Worksheet T**, (13)	Above 4%	2% - 4%	Below 2% *	3 *
Property Tax Collection Rate[4] **Worksheet T**, (9)	< 94%	94% - 98%	> 98% *	3 *
Average of Financial Management Indicators[4] **Worksheet T**, (13) and (9)				N/A

a. Weak is a score of 1 point
b. Mid-Range is a score of 2 points
c. Strong is a score of 3 points

SUM 16

AVERAGE 2.7

Notes:

[1] If the state has statutory limits on property tax collections and/or rates or data on full-market value of taxable property are not available, "Overall Net Debt as Percent of Full Market Value of Taxable Property" is replaced with "Overall Net Debt Per Capita" and "Property Tax Revenues as a Percent of Full-Market Value of Taxable Property" is dropped.

[2] If the community's employment rate is equal to the national average unemployment rate, plus or minus 1%, then the community's unemployment rate is assessed as being equal to the national rate.

[3] If the community's median household income is equal to the state median, plus or minus 10%, then the community's median household income is assessed as being equal to the state's median household income.

[4] If one of the debt or socioeconomic indicators is not available, the two financial management indicators are averaged and this averaged value is used as a single indicator with the remaining indicators.

Guidance Documentation

Component	*Section*	*Page*
Calculating Secondary Test Score	5.2.b; 2.4	5-6; 2-11
Interpreting Secondary Test Score	5.2.b; 2.4	5-6; 2-11
Missing Indicators	5.2.b; 2.4	5-7; 2-12
Determining Interference with Development	5.2.d	5-7

Alternative 3 – Membrane Secondary Treatment

Calculation of the Secondary Test Score (Worksheet U in the Guidance)

Description: This worksheet calculates the secondary test score, which characterizes the affected community's current financial and socioeconomic condition. The secondary test score is used in combination with the MPS to evaluate whether or not substantial economic impacts are likely to occur. See the Guidance documentation below for additional information.

Instructions: Verify that the appropriate cells are selected in each row and in the "Score" column to be summed below (highlighted in **orange** and **marked with an asterisk (*)**).

Indicator	Secondary Indicators			Score
	Weak [a]	Mid-Range [b]	Strong [c]	
Bond Rating **Worksheet T**, (4)	Below BBB (S&P) Below Baa (Moody's)	BBB (S&P) Baa (Moody's)	Above BBB (S&P) Above Baa (Moody's) *	3 *
Overall Net Debt as Percent of Full Market Value of Taxable Property **Worksheet T**, (12)	Above 5%	2% - 5% *	Below 2%	2 *
Overall Net Debt Per Capita[1] **Worksheet T**, (12 Alt.)	Greater than $3,000	$1,000 - $3,000	Less than $1,000	N/A
Unemployment[2] **Worksheet T**, (5) & (6)	Above National Average	National Average	Below National Average *	3 *
Median Household Income[3] **Worksheet T**, (7) & (8)	Below State Median	State Median *	Above State Median	2 *
Property Tax Revenues as a Percent of Full Market Value of Taxable Property[4] **Worksheet T**, (13)	Above 4%	2% - 4%	Below 2% *	3 *
Property Tax Collection Rate[4] **Worksheet T**, (9)	< 94%	94% - 98%	> 98% *	3 *
Average of Financial Management Indicators[4] **Worksheet T**, (13) and (9)				N/A

a. Weak is a score of 1 point
b. Mid-Range is a score of 2 points
c. Strong is a score of 3 points

SUM 16

AVERAGE 2.7

Notes:

[1] If the state has statutory limits on property tax collections and/or rates or data on full-market value of taxable property are not available, "Overall Net Debt as Percent of Full Market Value of Taxable Property" is replaced with "Overall Net Debt Per Capita" and "Property Tax Revenues as a Percent of Full-Market Value of Taxable Property" is dropped.

[2] If the community's employment rate is equal to the national average unemployment rate, plus or minus 1%, then the community's unemployment rate is assessed as being equal to the national rate.

[3] If the community's median household income is equal to the state median, plus or minus 10%, then the community's median household income is assessed as being equal to the state's median household income.

[4] If one of the debt or socioeconomic indicators is not available, the two financial management indicators are averaged and this averaged value is used as a single indicator with the remaining indicators.

Guidance Documentation

Component	*Section*	*Page*
Calculating Secondary Test Score	5.2.b; 2.4	5-6; 2-11
Interpreting Secondary Test Score	5.2.b; 2.4	5-6; 2-11
Missing Indicators	5.2.b; 2.4	5-7; 2-12
Determining Interference with Development	5.2.d	5-7

B-3 – Substantial Impact Worksheets

Alternative 1 – Conventional Secondary Treatment Improvements

Conclusion for Community
Description: This matrix evaluates the likelihood that maintaining high quality waters would cause substantial economic impacts that would interfere with development. See the Guidance documentation below for additional information. **Instructions:** Evaluate the combined results of the MPS and the secondary test by noting which cell in the Substantial Impacts Matrix below is highlighted in **orange** and **marked with an asterisk (*)**. If the matrix indicates the pollution control project is not likely to impose a substantial economic impact on the community, then do not proceed with the analysis. If the matrix indicates the pollution control project is likely to impose a substantial economic impact that would interfere with development, continue to determine whether the development would be important. If the matrix indicates the pollution control project may or may not impose a substantial economic impact that would interfere with development, then continuing the analysis is optional.

Assessment of Substantial Impacts Matrix (Table 5-2 from the Guidance)

MPS (%): 1.4%
Secondary Test Score: 2.7

Secondary Test Score	Municipal Preliminary Screener		
	Less than 1.0 Percent	Between 1.0 and 2.0 Percent	Greater than 2.0 Percent
Less than 1.5	?	X	X
Between 1.5 and 2.5	✓	?	X
Greater than 2.5	✓	✓ *	?

Key:
✓ : Impact is not likely to be substantial
X : Impact is likely to be substantial
? : Impact is unclear

Guidance Documentation		
Component	***Section***	***Page***
Using Substantial Impacts Matrix	5.2.d	5-7
Determining Interference with Development	5.2.d	5-7

Alternative 2 – Conventional Secondary and Tertiary Improvements

Conclusion for Community
Description: This matrix evaluates the likelihood that maintaining high quality waters would cause substantial economic impacts that would interfere with development. See the Guidance documentation below for additional information. **Instructions:** Evaluate the combined results of the MPS and the secondary test by noting which cell in the Substantial Impacts Matrix below is highlighted in **orange** and **marked with an asterisk (*)**. If the matrix indicates the pollution control project is not likely to impose a substantial economic impact on the community, then do not proceed with the analysis. If the matrix indicates the pollution control project is likely to impose a substantial economic impact that would interfere with development, continue to determine whether the development would be important. If the matrix indicates the pollution control project may or may not impose a substantial economic impact that would interfere with development, then continuing the analysis is optional.

Assessment of Substantial Impacts Matrix (Table 5-2 from the Guidance)

MPS (%): 1.5%
Secondary Test Score: 2.7

Secondary Test Score	Municipal Preliminary Screener		
	Less than 1.0 Percent	Between 1.0 and 2.0 Percent	Greater than 2.0 Percent
Less than 1.5	?	X	X
Between 1.5 and 2.5	✓	?	X
Greater than 2.5	✓	✓ *	?

Key:
✓ : Impact is not likely to be substantial
X : Impact is likely to be substantial
? : Impact is unclear

Guidance Documentation		
Component	***Section***	***Page***
Using Substantial Impacts Matrix	5.2.d	5-7
Determining Interference with Development	5.2.d	5-7

Alternative 3 – Membrane Secondary Treatment

Conclusion for Community
Description: This matrix evaluates the likelihood that maintaining high quality waters would cause substantial economic impacts that would interfere with development. See the Guidance documentation below for additional information. **Instructions:** Evaluate the combined results of the MPS and the secondary test by noting which cell in the Substantial Impacts Matrix below is highlighted in **orange** and **marked with an asterisk (*)**. If the matrix indicates the pollution control project is not likely to impose a substantial economic impact on the community, then do not proceed with the analysis. If the matrix indicates the pollution control project is likely to impose a substantial economic impact that would interfere with development, continue to determine whether the development would be important. If the matrix indicates the pollution control project may or may not impose a substantial economic impact that would interfere with development, then continuing the analysis is optional.

Assessment of Substantial Impacts Matrix (Table 5-2 from the Guidance)

MPS (%): 1.6%
Secondary Test Score: 2.7

Secondary Test Score	Municipal Preliminary Screener		
	Less than 1.0 Percent	Between 1.0 and 2.0 Percent	Greater than 2.0 Percent
Less than 1.5	?	X	X
Between 1.5 and 2.5	✓	?	X
Greater than 2.5	✓	✓ *	?

Key:
✓ : Impact is not likely to be substantial
X : Impact is likely to be substantial
? : Impact is unclear

Guidance Documentation		
Component	***Section***	***Page***
Using Substantial Impacts Matrix	5.2.d	5-7
Determining Interference with Development	5.2.d	5-7

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Appendix B

Historical, Archeological, Cultural, and Environmental Elements

B-1 – Environmental Assessment Worksheet
B-2 – Natural Heritage Information System Survey
B-3 – State Historic Preservation Office Survey
B-4 – Section 106 Consultation Survey
B-5 – FEMA National Flood Hazard Layer (NFHL)
B-6 – USDA NRCS Web Soil Survey

B-1 – Environmental Assessment Worksheet

THIS SECTION IS TO BE INSERTED AS A SUPPLIMENTAL AT A LATER DATE

B-2 – Natural Heritage Information System Survey

DEPARTMENT OF NATURAL RESOURCES

Minnesota Department of Natural Resources
Division of Ecological & Water Resources
500 Lafayette Road, Box 25
St. Paul, MN 55155-4025

August 4, 2023
Correspondence # MCE 2023-00460

Eric Miller
Short Elliott Hendrickson, Inc.

Natural Heritage Review of the proposed Big Lake Wasterwater Treatment Facilities Plan NH Review, T32N R27W Section 6, T33N R27W Sections 30-31; Sherburne County

Dear Eric Miller,

As requested, the Minnesota Natural Heritage Information System has been reviewed to determine if the proposed project has the potential to impact any rare species or other significant natural features. Based on the project details provided with the request, the following rare features may be impacted by the proposed project:

State-listed Species

- Blanding's turtles (*Emydoidea blandingii*), a state-listed threatened species, have been documented in the direct vicinity of the proposed project. Blanding's turtles use upland areas up to and over a mile distant from wetlands, waterbodies, and watercourses. Uplands are used for nesting, basking, periods of dormancy, and traveling between wetlands. Factors believed to contribute to the decline of this species include collisions with vehicles, wetland drainage and degradation, and the development of upland habitat. Any added mortality can be detrimental to populations of Blanding's turtles, as these turtles have a low reproduction rate that depends upon a high survival rate to maintain population levels.

  This project has the potential to impact this rare turtle through direct fatalities and habitat disturbance/destruction due to excavation, fill, and other construction activities associated with the project. Minnesota's Endangered Species Statute (*Minnesota Statutes*, section 84.0895) and associated Rules (*Minnesota Rules*, part 6212.1800 to 6212.2300 and 6134) prohibit the take of threatened or endangered species without a permit. **Given the project details and the potential for a take of a Blanding's turtle, an avoidance plan is required. There does not appear to be any**

overwintering habitat in the project area but there is potential for nesting and other spring and summer activities and the avoidance plan should address those.

We do not currently have a template for avoidance plans. The plan needs to:

- Provide a description of the project activities and construction methods,
- Identify measures that will be taken to avoid take and minimize disturbance to the species, and
- Include a map of disturbance areas.

Measures to avoid or minimize disturbance include, but are not limited to, the following:

- Exclusion of turtles from the work area,
- Timing the impacts to avoid incidental take,
- The recommendations listed in the Blanding's turtle fact sheet,
- Training for construction crew.

Please submit the completed avoidance plan to the NH Review Team (Reports.NHIS@state.mn.us).

- Please visit the DNR Rare Species Guide for more information on the habitat use of this species and recommended measures to avoid or minimize impacts. For further assistance with this species, please contact the appropriate DNR Regional Nongame Specialist or Regional Ecologist.

Federally Protected Species

- To ensure compliance with federal law, conduct a federal regulatory review using the U.S. Fish and Wildlife Service's (USFWS) online Information for Planning and Consultation (IPaC) tool.

Environmental Review and Permitting

- The Environmental Assessment Worksheet should address whether the proposed project has the potential to adversely affect the above rare features and, if so, it should identify specific measures that will be taken to avoid or minimize disturbance. Sufficient information should be provided so the DNR can determine whether a takings permit will be needed for any of the above protected species.

- Please include a copy of this letter and the MCE-generated Final Project Report in any state or local license or permit application. Please note that measures to avoid or minimize disturbance to the above rare features may be included as restrictions or conditions in any required permits or licenses.

The Natural Heritage Information System (NHIS), a collection of databases that contains information about Minnesota's rare natural features, is maintained by the Division of Ecological and Water

Resources, Department of Natural Resources. The NHIS is continually updated as new information becomes available, and is the most complete source of data on Minnesota's rare or otherwise significant species, native plant communities, and other natural features. However, the NHIS is not an exhaustive inventory and thus does not represent all of the occurrences of rare features within the state. Therefore, ecologically significant features for which we have no records may exist within the project area. If additional information becomes available regarding rare features in the vicinity of the project, further review may be necessary.

For environmental review purposes, the results of this Natural Heritage Review are valid for one year; the results are only valid for the project location and project description provided with the request. If project details change or the project has not occurred within one year, please resubmit the project for review within one year of initiating project activities.

The Natural Heritage Review does not constitute project approval by the Department of Natural Resources. Instead, it identifies issues regarding known occurrences of rare features and potential impacts to these rare features. Visit the Natural Heritage Review website for additional information regarding this process, survey guidance, and other related information. For information on the environmental review process or other natural resource concerns, you may contact your DNR Regional Environmental Assessment Ecologist.

Thank you for consulting us on this matter and for your interest in preserving Minnesota's rare natural resources.

Sincerely,

James Drake

James Drake
Natural Heritage Review Specialist
James.F.Drake@state.mn.us

Cc: Melissa Collins

B-3 – State Historic Preservation Office Survey

From:	MN_MNIT_Data Request SHPO
To:	Eric Miller
Cc:	Jessica Hedin
Subject:	RE: BIGLK 167307 SHPO Information Request for preparation of Wastewater Treatment Facilities Plan
Date:	Friday, June 16, 2023 4:53:15 PM
Attachments:	image001.png image002.png image003.png image004.png Archaeology.xls History.xls

---

Hello Eric,

Please see attached.

Jim

DEPARTMENT OF ADMINISTRATION
STATE HISTORIC PRESERVATION OFFICE

SHPO Data Requests
Minnesota State Historic Preservation Office
50 Sherburne Avenue, Suite 203
Saint Paul, MN 55155
(651) 201-3299
datarequestshpo@state.mn.us

Notice: This email message simply reports the results of the cultural resources database search you requested. The database search is only for previously known archaeological sites and historic properties. **IN NO CASE DOES THIS DATABASE SEARCH OR EMAIL MESSAGE CONSTITUTE A PROJECT REVIEW UNDER STATE OR FEDERAL PRESERVATION LAWS –** please see our website at https://mn.gov/admin/shpo/protection/ for further information regarding our Environmental Review Process.

Because the majority of archaeological sites in the state and many historic/architectural properties have not been recorded, important sites or properties may exist within the search area and may be affected by development projects within that area. Additional research, including field surveys, may be necessary to adequately assess the area's potential to contain historic properties or archaeological sites.

Properties that are listed in the National Register of Historic Places (NRHP) or have been determined eligible for listing in the NRHP are indicated on the reports you have received, if any. The following codes may be on those reports:

NR – National Register listed. The properties may be individually listed or may be within the boundaries of a National Register District.

CEF – Considered Eligible Findings are made when a federal agency has recommended that a property is eligible for listing in the National Register and MN SHPO has accepted the recommendation for the purposes of the Environmental Review Process. These properties need to be further assessed before they are officially listed in the National Register.

SEF – Staff eligible Findings are those properties the MN SHPO staff considers eligible for listing in the National Register, in circumstances other than the Environmental Review Process.

DOE – Determination of Eligibility is made by the National Park Service and are those properties that are eligible for listing in the National Register, but have not been officially listed.

CNEF – Considered Not Eligible Findings are made during the course of the Environmental Review Process. For the purposes of the review a property is considered not eligible for listing in the National Register. These properties may

need to be reassessed for eligibility under additional or alternate contexts.
Properties without NR, CEF, SEF, DOE, or CNEF designations in the reports may not have been evaluated and therefore no assumption to their eligibility can be made. Integrity and contexts change over time, therefore any eligibility determination made ten (10) or more years from the date of the current survey are considered out of date and the property will need to be reassessed.
If you require a comprehensive assessment of a project's potential to impact archaeological sites or historic/architectural properties, you may need to hire a qualified archaeologist and/or historian. If you need assistance with a project review, please contact Kelly Gragg-Johnson, Environmental Review Specialist @ 651-201-3285 or by email at kelly.graggjohnson@state.mn.us.
The Minnesota SHPO Archaeology and Historic/Architectural Survey Manuals can be found at https://mn.gov/admin/shpo/identification-evaluation/.

Please subscribe to receive SHPO notices for the most current updates regarding office hours, accessing research files, or changes in submitting materials to the SHPO.

To access historic resource information please visit our webpage on Using SHPO's Files.

From: Eric Miller <emiller@sehinc.com>
Sent: Thursday, June 15, 2023 9:59 AM
To: MN_MNIT_Data Request SHPO <DataRequestSHPO@state.mn.us>
Cc: Jessica Hedin <jhedin@sehinc.com>
Subject: BIGLK 167307 SHPO Information Request for preparation of Wastewater Treatment Facilities Plan

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Do not select links or open attachments unless verified. Report all suspicious emails to Minnesota IT Services Security Operations Center.

Good Morning,

I am writing to the Survey and Inventory Coordinator for a State Historic preservation Office Statewide Inventory Review request pertaining to preparation of an Environmental Impact Worksheet for the Big Lake Wastewater Treatment Facilities Plan.

Please refer to the attached memorandum for project information and attachments.

We are initiating consultation on this project under Section 106 of the National Historic Preservation Act and implementing regulations at 36 CFR 800 and pursuant to the 2016 Memorandum of Understanding between the Minnesota Pollution Control Agency and the Minnesota State Historic Preservation Office (SHPO). This project is being funded under the Clean Water State Revolving Fund administered by the Minnesota Public Facilities Authority and the Minnesota Pollution Control Agency. Below is the information about this project:

Project Title:
Big Lake Wastewater Treatment Facilities Plan

Detailed Project Description:
The purpose of the wastewater treatment facilities plan is to provide the City of Big Lake with a planning document to determine future wastewater flow and load demands for the treatment facility, evaluate the condition of existing equipment, determine is sufficient capacity existing within the existing facilities to meet future flow and load demand, and provide recommendations for improvements to meet those future demands. Recommended improvements at the wastewater facility plant are within the current, city-owner parcel. Recommended improvements at the old main and current main lift stations are within the current, city-owner parcel. Recommended forcemain improvements follow the alignment of the existing influent forcemains and are intended to remain within the current road right-of-way and/or utility easements.
The recommended alternatives from the facilities plan review are:

- Secondary Treatment: Modifications of existing oxidation ditches for MOB.
- Secondary Clarification: Conversion of existing and construction of new secondary clarifiers.
- Coagulant Feed: Relocate chemical storage and feed equipment o the proposed Disinfection and Pumping Building.
- Waste Sludge and Scum Thickening: Dissolved air floatation thickening.
- Aerobic Digestion: Second primary aerobic digester, conversion of liquid biosolids storage to secondary aerobic digester.
- Sludge and Biosolids Aeration and Mixing: Fine-bubble aeration and compressed aerated mixing.
- Other condition, capacity, and age-related improvements as described.

Refer to attachment 1 for a summary of condition, capacity, and age-related improvements.

Project Location (Township-Range-Section):
The wastewater treatment facilities:

- SE 1/4 of the SW 1/4 Section 31 Township 33N Range 27W
- SW 1/4 of the SE 1/4 Section 31 Township 33N Range 27W

Old main lift station:

- NW 1/4 of the SE 1/4 Section 30 Township 33N Range 27W

Main lift station

- SW 1/4 of the SE 1/4 Section 30 Township 33N Range 27W

Forcemain route includes:

- SW 1/4 of the SE 1/4 Section 30 Township 33N Range 27W
- SE 1/4 of the SW 1/4 Section 30 Township 33N Range 27W
- NE 1/4 of the NW 1/4 Section 31 Township 33N Range 27W
- SE 1/4 of the NW 1/4 Section 31 Township 33N Range 27W
- NE 1/4 of the SW 1/4 Section 31 Township 33N Range 27W
- SE 1/4 of the SW 1/4 Section 31 Township 33N Range 27W

Area of Potential Effects (APE) discussion (see enclosed map):
Wastewater Facility: The proposed project is within the existing wastewater treatment facility parcel. A portion of the parcel is used for agricultural land and will be converted for municipal use (approximately 0.33 acres). The proposed use is consistent with the current land use practices. Internal to the site, sever existing process tanks will be removed and new tanks built in their place.
Lift Stations and Forcemain: Proposed improvements at the existing main lift station will not change the site, land use, or exterior views as replacement is limited to equipment in the existing structure. The old main lift station is abandoned, and the project will demolish the equipment and structure. The adjacent land use is residential. The result of the project will eliminate the existing above and below grade facilities and be converted to a turf parcel. The forcemain route will follow the existing forcemain alignment using existing utility easements. The land use adjacent to the roadway along the route is agricultural. Some short-term construction related impacts to the agricultural land use may be

required, but long-term land use impacts are not anticipated.

Identification of historic properties within the APE:
There are no know historic properties within the APE.

Eric Miller
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Big Lake Wastewater Treatment Facilities Plan
State Historic Preservation Office Solicitation Response
Historical Sites
6/16/2023

COUNTY	CITYTWP	PROPNAME	ADDRESS	TWN	RNG	SEC	QUARTERS	USGS	REPORTNUM	NRHP	CEF	DOE	INVENTNUM
Sherburne	Big Lake	Trunk Highway 25	TH 25	33	27	30			XX-2020-10H				XX-ROD-113
Sherburne	Big Lake	A. J. Johnson House	310 Ormsbee St. S.	33	27	30	NW-NW-NE	Big Lake					SH-BLC-001
Sherburne	Big Lake	J. M. Haven House	300 Lake St. S.	33	27	30	NE-NE-NW	Big Lake					SH-BLC-002
Sherburne	Big Lake		321 Lake St. S	33	27	30	NW-NE-NE						SH-BLC-027
Sherburne	Big Lake	Saron Lutheran Church	331 Lake St. S	33	27	30	NW-NE-NE	Big Lake					SH-BLC-028
Sherburne	Big Lake	house	340 Lake St. S	33	27	30	NW-NE-NE	Big Lake					SH-BLC-029
Sherburne	Big Lake	house	341 Lake St. S	33	27	30	NW-NE-NE	Big Lake					SH-BLC-030
Sherburne	Big Lake	house	351 Lake St. S	33	27	30	NW-NE-NE	Big Lake					SH-BLC-031
Sherburne	Big Lake	house	360 Lake St. S	33	27	30	NW-NE-NE	Big Lake					SH-BLC-032
Sherburne	Big Lake	house	361 Lake St. S	33	27	30	NW-NE-NE	Big Lake					SH-BLC-033
Sherburne	Big Lake	house	370 Lake St. S	33	27	30	NW-NE-NE	Big Lake					SH-BLC-034
Sherburne	Big Lake	house	381 Lake St. S	33	27	30	NW-NE-NE	Big Lake					SH-BLC-035
Sherburne	Big Lake	house	380 Lake St. S	33	27	30	NW-NE-NE	Big Lake					SH-BLC-036
Sherburne	Big Lake	house	410 Lake St. S	33	27	30	NW-NE-NE	Big Lake					SH-BLC-037
Sherburne	Big Lake	house	420 Lake St. S	33	27	30	NW-NE-NE	Big Lake					SH-BLC-038
Sherburne	Big Lake	house	441 Lake St. S	33	27	30	NW-NE-SW	Monticello					SH-BLC-039
Sherburne	Big Lake	house	480 Lake St. S	33	27	30	NW-NE-SW	Monticello					SH-BLC-040
Sherburne	Big Lake	house	500 Lake St. S	33	27	30	NW-NE-SW	Monticello					SH-BLC-041
Sherburne	Big Lake	house	531 Lake St. S	33	27	30	NW-NE-SW	Monticello					SH-BLC-042
Sherburne	Big Lake	house	551 Lake St. S	33	27	30	NW-NE-SW	Monticello					SH-BLC-043
Sherburne	Big Lake	house	555 Lake St. S	33	27	30	NW-NW-SE	Monticello					SH-BLC-044
Sherburne	Big Lake	house	171 Norwood Dr.	33	27	30	NW-NW-SW	Monticello					SH-BLC-045
Sherburne	Big Lake	house	19233 CR 68	33	27	30	SE-NW-NW	Big Lake					SH-BLC-046
Sherburne	Big Lake	house	770 CR 68	33	27	30	NE-SW-SW	Big Lake					SH-BLC-047
Sherburne	Big Lake	house	106 Fair Meadows Dr.	33	27	30	NE-SW-NW	Big Lake					SH-BLC-048
Sherburne	Big Lake	house	510 Ormsbee St.	33	27	30	NE-SW-NW	Big Lake					SH-BLC-049
Sherburne	Big Lake	house	471 Ormsbee St.	33	27	30	NW-SE-NE	Big Lake					SH-BLC-050
Sherburne	Big Lake	house	460 Ormsbee St.	33	27	30	NE-SW-NW	Big Lake					SH-BLC-051

Big Lake Wastewater Treatment Facilities Plan
State Historic Preservation Office Solicitiation Response
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COUNTY	CITYTWP	PROPNAME	ADDRESS	TWN	RNG	SEC	QUARTERS	USGS	REPORTNUM	NRHP	CEF	DOE	INVENTNUM
Sherburne	Big Lake	house	451 Ormsbee St.	33	27	30	NW-NE-SE	Big Lake					SH-BLC-052
Sherburne	Big Lake	house	431 Ormsbee St.	33	27	30	NW-NE-SE	Big Lake					SH-BLC-053
Sherburne	Big Lake	house	421 Ormsbee St.	33	27	30	NW-NE-SE	Big Lake					SH-BLC-054
Sherburne	Big Lake	house	110 Monroe St.	33	27	30	NW-NE-NE	Big Lake					SH-BLC-055
Sherburne	Big Lake	house	140 Monroe St.	33	27	30	NW-NE-NE	Big Lake					SH-BLC-056
Sherburne	Big Lake	house	150 Monroe St.	33	27	30	NW-NE-SE	Big Lake					SH-BLC-057
Sherburne	Big Lake	house	160 Monroe St.	33	27	30	NW-NE-SE	Big Lake					SH-BLC-058
Sherburne	Big Lake	house	171 Monroe St.	33	27	30	NW-NE-SE	Big Lake					SH-BLC-059
Sherburne	Big Lake	house	381 Ormsbee St.	33	27	30	NW-NE-SE	Big Lake					SH-BLC-060
Sherburne	Big Lake	house	371 Ormsbee St.	33	27	30	NW-NE-NE	Big Lake					SH-BLC-061
Sherburne	Big Lake	house	370 Ormsbee St.	33	27	30	NE-NW-NW	Big Lake					SH-BLC-062
Sherburne	Big Lake	house	361 Ormsbee St.	33	27	30	NW-NE-NE	Big Lake					SH-BLC-063
Sherburne	Big Lake	house	360 Ormsbee St.	33	27	30	NE-NW-NW	Big Lake					SH-BLC-064
Sherburne	Big Lake	house	341 Ormsbee St.	33	27	30	NW-NE-NE	Big Lake					SH-BLC-065
Sherburne	Big Lake	house	321 Ormsbee St.	33	27	30	NW-NE-NE	Big Lake					SH-BLC-066
Sherburne	Big Lake	house	330 Ormsbee St.	33	27	30	NE-NW-NW	Big Lake					SH-BLC-067
Sherburne	Big Lake Tv	farmstead	18863 CR 68	33	27	31	NE-NW-NW	Big Lake					SH-BLT-024

Big Lake Wastewater Treatment Facilities Plan
State Historic Preservation Office Solicitation Response
Archaeological Sites
6/16/2023
Sheet 1 of 1

COUNTY	SITENUM	SITENAME	TWN	RNG	SEC	XQUARTERS	ACRES	WORK TYPE	DESCRIPT	TRADITION	CONTEXT	ReportNum	Natreg	CEF	DOE
Sherburne	21SHp		33	27	31	SE-SE	2	7	HD,EW,CEM	W-1					

B-4 – Section 106 Consultation Survey

THIS SECTION IS TO BE INSERTED AS A SUPPLIMENTAL AT A LATER DATE

B-5 – FEMA National Flood Hazard Layer (NFHL)

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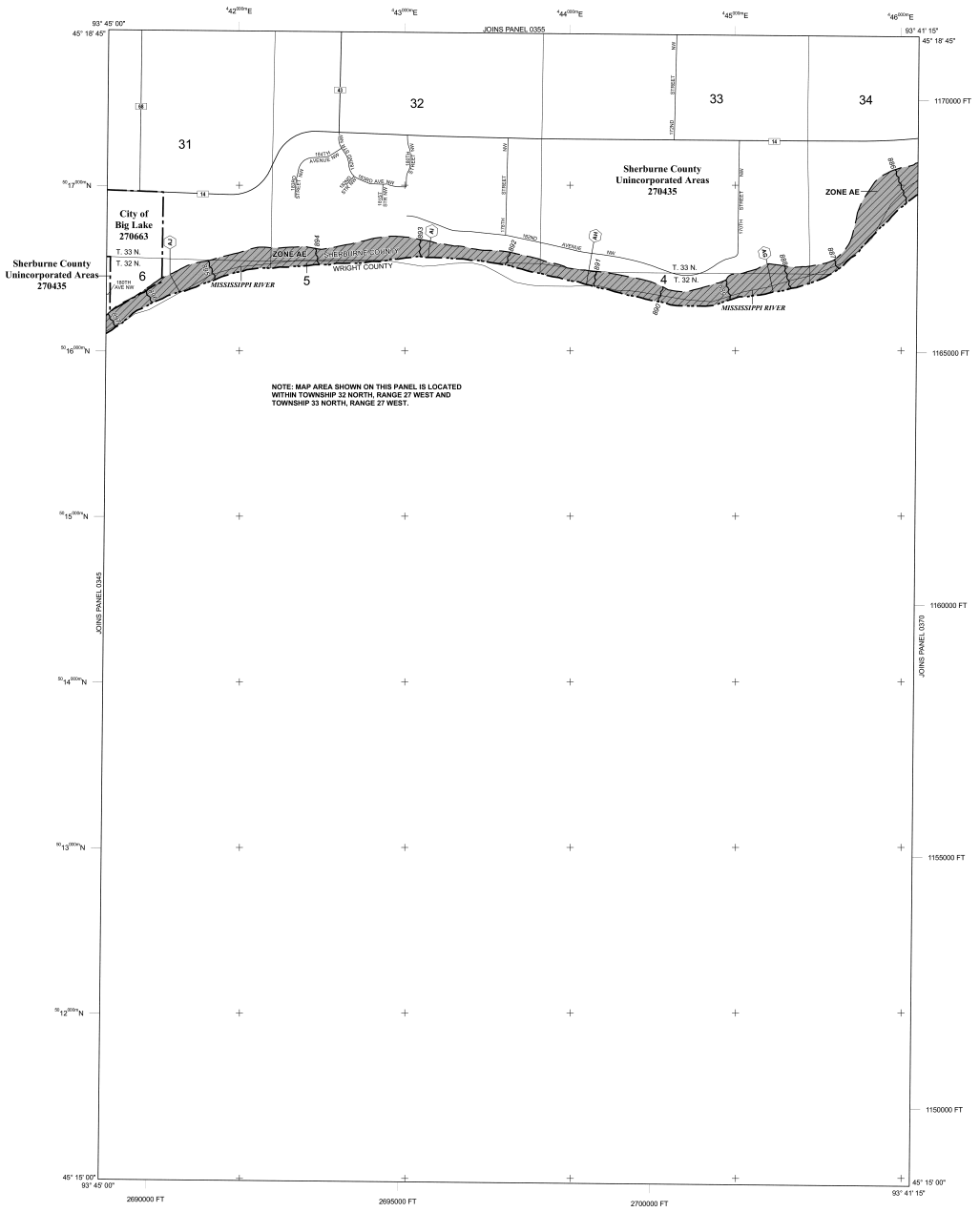

LEGEND

SPECIAL FLOOD HAZARD AREAS (SFHAs) SUBJECT TO INUNDATION BY THE 1% ANNUAL CHANCE FLOOD

The 1% annual chance flood (100-year flood), also known as the base flood, is the flood that has a 1% chance of being equaled or exceeded in any given year. The Special Flood Hazard Area is the area subject to flooding by the 1% annual chance flood. Areas of Special Flood Hazard include Zones A, AE, AH, AO, AR, A99, V, and VE. The Base Flood Elevation is the water-surface elevation of the 1% annual chance flood.

ZONE A No Base Flood Elevations determined.

ZONE AE Base Flood Elevations determined.

ZONE AH Flood depths of 1 to 3 feet (usually areas of ponding); Base Flood Elevations determined.

ZONE AO Flood depths of 1 to 3 feet (usually sheet flow on sloping terrain); average depths determined. For areas of alluvial fan flooding, velocities also determined.

ZONE AR Special Flood Hazard Areas formerly protected from the 1% annual chance flood by a flood control system that was subsequently decertified. Zone AR indicates that the former flood control system is being restored to provide protection from the 1% annual chance or greater flood.

ZONE A99 Area to be protected from 1% annual chance flood by a Federal flood protection system under construction; no Base Flood Elevations determined.

ZONE V Coastal flood zone with velocity hazard (wave action); no Base Flood Elevations determined.

ZONE VE Coastal flood zone with velocity hazard (wave action); Base Flood Elevations determined.

FLOODWAY AREAS IN ZONE AE

The floodway is the channel of a stream plus any adjacent floodplain areas that must be kept free of encroachment so that the 1% annual chance flood can be carried without substantial increases in flood heights.

OTHER FLOOD AREAS

ZONE X Areas of 0.2% annual chance flood; areas of 1% annual chance flood with average depths of less than 1 foot or with drainage areas less than 1 square mile; and areas protected by levees from 1% annual chance flood.

OTHER AREAS

ZONE X Areas determined to be outside the 0.2% annual chance floodplain.

ZONE D Areas in which flood hazards are undetermined, but possible.

COASTAL BARRIER RESOURCES SYSTEM (CBRS) AREAS

OTHERWISE PROTECTED AREAS (OPAs)

CBRS areas and OPAs are normally located within or adjacent to Special Flood Hazard Areas.

1% Annual Chance Floodplain Boundary

0.2% Annual Chance Floodplain Boundary

Floodway boundary

Zone D boundary

CBRS and OPA boundary

Boundary dividing Special Flood Hazard Area Zones and boundary dividing Special Flood Hazard Areas of different Base Flood Elevations, flood depths, or flood velocities.

513 Base Flood Elevation line and value; elevation in feet*

(EL 987) Base Flood Elevation value where uniform within zone; elevation in feet*

*Referenced to the North American Vertical Datum of 1988

A — A Cross section line

23 — 23 Transect line

45° 02' 08", 93° 02' 12" Geographic coordinates referenced to the North American Datum of 1983 (NAD 83) Western Hemisphere

4989000 N 1000-meter Universal Transverse Mercator grid values, zone 15

DX5510 Bench mark (see explanation in Notes to Users section of this FIRM panel)

M1.5 River Mile

MAP REPOSITORIES
Refer to Map Repositories list on Map Index

EFFECTIVE DATE OF COUNTYWIDE FLOOD INSURANCE RATE MAP
May 4, 2000

EFFECTIVE DATE(S) OF REVISION(S) TO THIS PANEL
November 16, 2011 - to add Base Flood Elevations, to add Special Flood Hazard Areas, to decrease Base Flood Elevations, to update corporate limits, to add roads and road names, to increase Base Flood Elevations, to change Special Flood Hazard Areas and to change zone designations.

For community map revision history prior to countywide mapping, refer to the Community Map History table located in the Flood Insurance Study report for this jurisdiction.

To determine if flood insurance is available in this community, contact your insurance agent or call the National Flood Insurance Program at 1-800-638-6620.

MAP SCALE 1" = 1000'

500 0 1000 2000 FEET

300 0 300 600 METERS

NFIP

NATIONAL FLOOD INSURANCE PROGRAM

PANEL 0365F

FIRM

FLOOD INSURANCE RATE MAP

SHERBURNE COUNTY, MINNESOTA (AND INCORPORATED AREAS)

PANEL 365 OF 410

(SEE MAP INDEX FOR FIRM PANEL LAYOUT)

CONTAINS:

COMMUNITY	NUMBER	PANEL	SUFFIX
BIG LAKE, CITY OF	270663	0365	F
SHERBURNE COUNTY	270435	0365	F

Notice to User: The **Map Number** shown below should be used when placing map orders; the **Community Number** shown above should be used on insurance applications for the subject community.

MAP NUMBER
27141C0365F
MAP REVISED
NOVEMBER 16, 2011

Federal Emergency Management Agency

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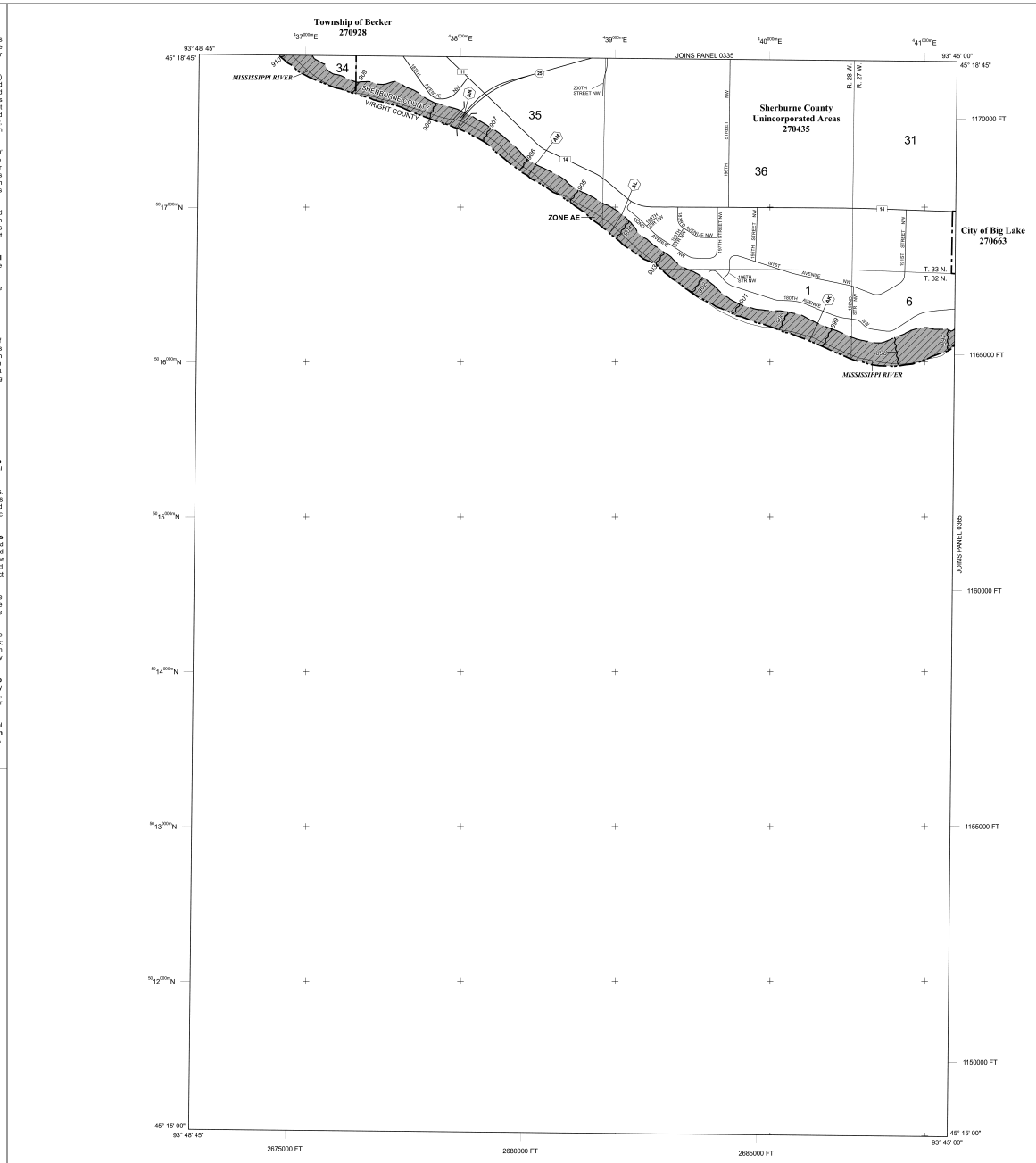

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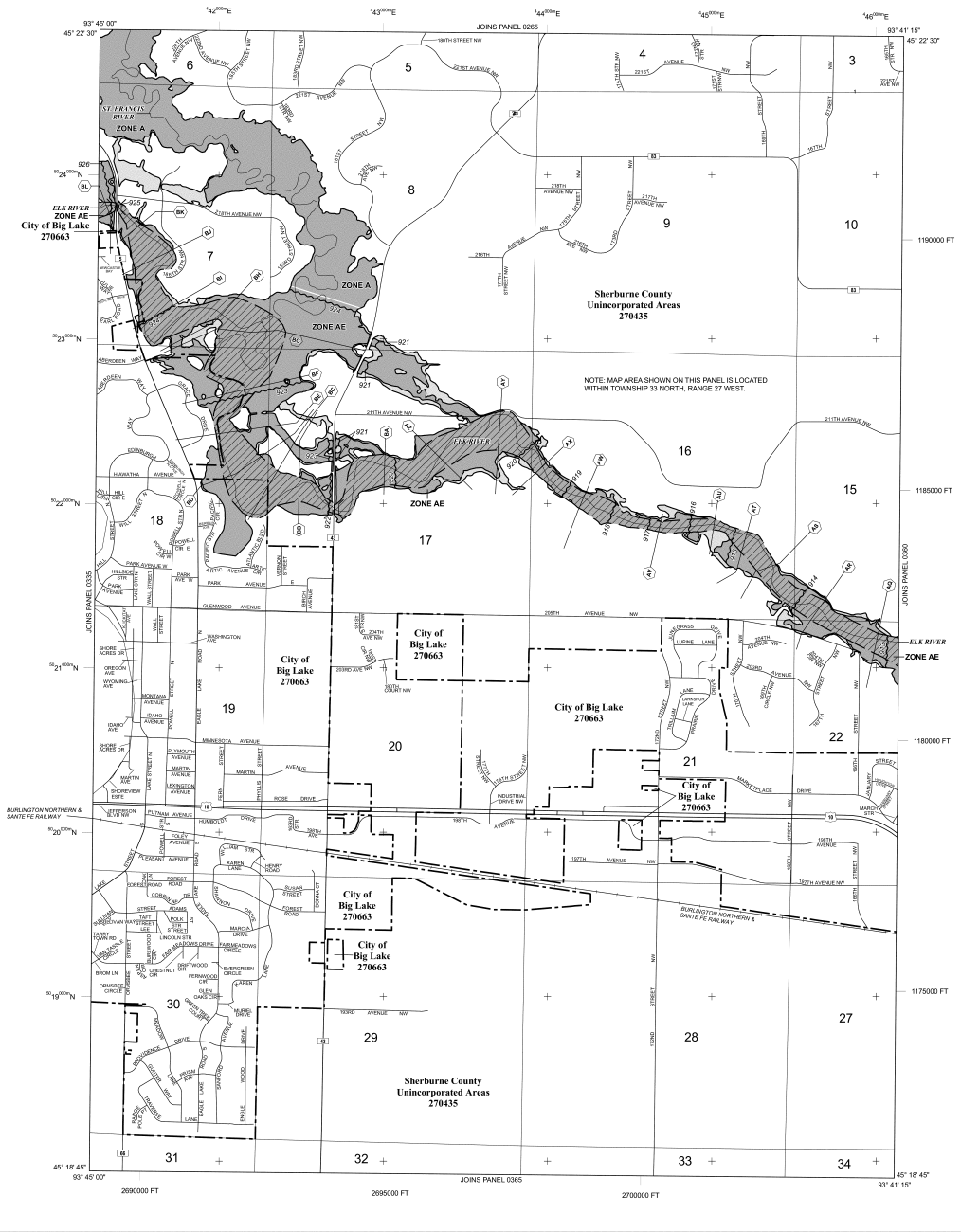
Corporate limits shown on this map are based on the best data available at the time of publication. Because changes due to annexations or de-annexations may have occurred after this map was published, map users should contact appropriate community officials to verify current corporate limit locations.

Please refer to the separately printed **Map Index** for an overview map of the county showing the layout of map panels; community map repository addresses; and a Listing of Communities table containing National Flood Insurance Program dates for each community as well as a listing of the panels on which each community is located.

For information on available products associated with this FIRM visit the **Map Service Center (MSC)** website at http://msc.fema.gov. Available products may include previously issued Letters of Map Change, a Flood Insurance Study Report, and/or digital versions of this map. Many of these products can be ordered or obtained directly from the MSC website.

If you have **questions about this map,** how to order products, or the National Flood Insurance Program in general, please call the **FEMA Map Information eXchange (FMIX)** at **1-877-FEMA-MAP** (1-877-336-2627) or visit the FEMA website at http://www.fema.gov/business/nfip.



LEGEND

SPECIAL FLOOD HAZARD AREAS (SFHAs) SUBJECT TO INUNDATION BY THE 1% ANNUAL CHANCE FLOOD

The 1% annual chance flood (100-year flood), also known as the base flood, is the flood that has a 1% chance of being equaled or exceeded in any given year. The Special Flood Hazard Area is the area subject to flooding by the 1% annual chance flood. Areas of Special Flood Hazard include Zones A, AE, AH, AO, AR, A99, V, and VE. The Base Flood Elevation is the water-surface elevation of the 1% annual chance flood.

ZONE A No Base Flood Elevations determined.

ZONE AE Base Flood Elevations determined.

ZONE AH Flood depths of 1 to 3 feet (usually areas of ponding); Base Flood Elevations determined.

ZONE AO Flood depths of 1 to 3 feet (usually sheet flow on sloping terrain); average depths determined. For areas of alluvial fan flooding, velocities also determined.

ZONE AR Special Flood Hazard Areas formerly protected from the 1% annual chance flood by a flood control system that was subsequently decertified. Zone AR indicates that the former flood control system is being restored to provide protection from the 1% annual chance or greater flood.

ZONE A99 Area to be protected from 1% annual chance flood by a Federal flood protection system under construction; no Base Flood Elevations determined.

ZONE V Coastal flood zone with velocity hazard (wave action); no Base Flood Elevations determined.

ZONE VE Coastal flood zone with velocity hazard (wave action); Base Flood Elevations determined.

FLOODWAY AREAS IN ZONE AE

The floodway is the channel of a stream plus any adjacent floodplain areas that must be kept free of encroachment so that the 1% annual chance flood can be carried without substantial increases in flood heights.

OTHER FLOOD AREAS

ZONE X Areas of 0.2% annual chance flood; areas of 1% annual chance flood with average depths of less than 1 foot or with drainage areas less than 1 square mile; and areas protected by levees from 1% annual chance flood.

OTHER AREAS

ZONE X Areas determined to be outside the 0.2% annual chance floodplain.

ZONE D Areas in which flood hazards are undetermined, but possible.

COASTAL BARRIER RESOURCES SYSTEM (CBRS) AREAS

OTHERWISE PROTECTED AREAS (OPAs)

CBRS areas and OPAs are normally located within or adjacent to Special Flood Hazard Areas.

1% Annual Chance Floodplain Boundary

0.2% Annual Chance Floodplain Boundary

Floodway boundary

Zone D boundary

CBRS and OPA boundary

Boundary dividing Special Flood Hazard Area Zones and boundary dividing Special Flood Hazard Areas of different Base Flood Elevations, flood depths, or flood velocities.

513 Base Flood Elevation line and value; elevation in feet*

(EL 987) Base Flood Elevation value where uniform within zone; elevation in feet*

*Referenced to the North American Vertical Datum of 1988

A — A Cross section line

23 — 23 Transect line

45° 02' 08", 93° 02' 12" Geographic coordinates referenced to the North American Datum of 1983 (NAD 83) Western Hemisphere

4990000 mN 1000-meter Universal Transverse Mercator grid values, zone 15

DX5510 × Bench mark (see explanation in Notes to Users section of this FIRM panel)

M1.5 River Mile

MAP REPOSITORIES
Refer to Map Repositories list on Map Index

EFFECTIVE DATE OF COUNTYWIDE
FLOOD INSURANCE RATE MAP
May 4, 2000

EFFECTIVE DATE(S) OF REVISION(S) TO THIS PANEL
November 16, 2011 - to add Base Flood Elevations, to add Special Flood Hazard Areas, to decrease Base Flood Elevations, to increase Base Flood Elevations, to update corporate limits, to add roads and road names, to change Special Flood Hazard Areas and to change zone designations.

For community map revision history prior to countywide mapping, refer to the Community Map History table located in the Flood Insurance Study report for this jurisdiction.

To determine if flood insurance is available in this community, contact your insurance agent or call the National Flood Insurance Program at 1-800-638-6620.

MAP SCALE 1" = 1000'

500 0 1000 2000 FEET

300 0 300 600 METERS

NFIP

PANEL 0355F

FIRM

FLOOD INSURANCE RATE MAP

SHERBURNE COUNTY, MINNESOTA (AND INCORPORATED AREAS)

PANEL 355 OF 410

(SEE MAP INDEX FOR FIRM PANEL LAYOUT)

CONTAINS:

COMMUNITY	NUMBER	PANEL	SUFFIX
BIG LAKE, CITY OF	270663	0355	F
SHERBURNE COUNTY	270435	0355	F

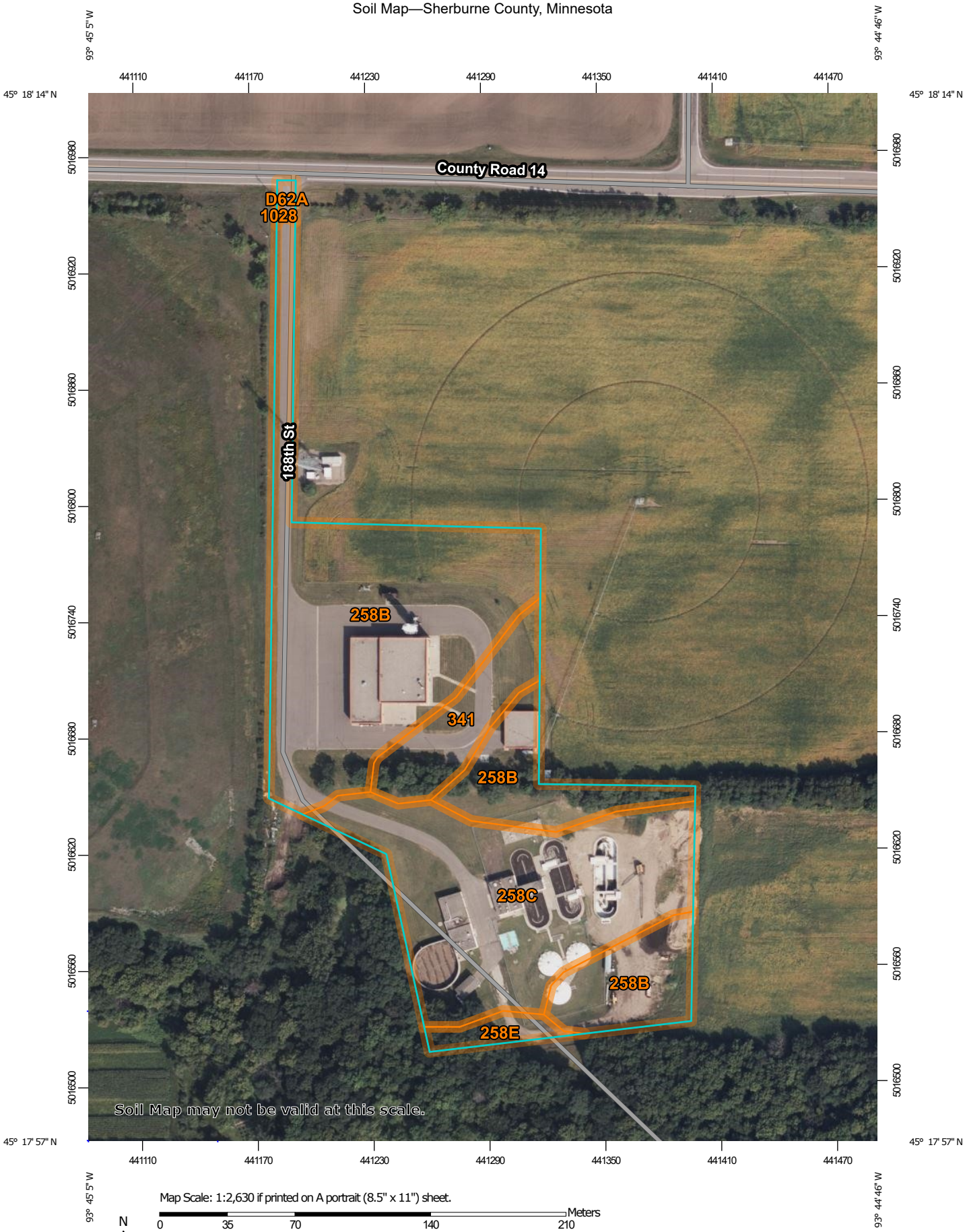
Notice to User: The **Map Number** shown below should be used when placing map orders; the **Community Number** shown above should be used on insurance applications for the subject community.

MAP NUMBER
27141C0355F
MAP REVISED
NOVEMBER 16, 2011

Federal Emergency Management Agency

NATIONAL FLOOD INSURANCE PROGRAM

B-6 – USDA NCRS Web Soil Survey



Map Scale: 1:2,630 if printed on A portrait (8.5" x 11") sheet.

N

Meters: 0 35 70 140 210

Feet: 0 100 200 400 600

Map projection: Web Mercator Corner coordinates: WGS84 Edge tics: UTM Zone 15N WGS84

MAP LEGEND

Area of Interest (AOI)
- Area of Interest (AOI)

Soils
- Soil Map Unit Polygons
- Soil Map Unit Lines
- Soil Map Unit Points

Special Point Features
- Blowout
- Borrow Pit
- Clay Spot
- Closed Depression
- Gravel Pit
- Gravelly Spot
- Landfill
- Lava Flow
- Marsh or swamp
- Mine or Quarry
- Miscellaneous Water
- Perennial Water
- Rock Outcrop
- Saline Spot
- Sandy Spot
- Severely Eroded Spot
- Sinkhole
- Slide or Slip
- Sodic Spot
- Spoil Area
- Stony Spot
- Very Stony Spot
- Wet Spot
- Other
- Special Line Features

Water Features
- Streams and Canals

Transportation
- Rails
- Interstate Highways
- US Routes
- Major Roads
- Local Roads

Background
- Aerial Photography

MAP INFORMATION

The soil surveys that comprise your AOI were mapped at 1:15,800.

Warning: Soil Map may not be valid at this scale.

Enlargement of maps beyond the scale of mapping can cause misunderstanding of the detail of mapping and accuracy of soil line placement. The maps do not show the small areas of contrasting soils that could have been shown at a more detailed scale.

Please rely on the bar scale on each map sheet for map measurements.

Source of Map: Natural Resources Conservation Service
Web Soil Survey URL:
Coordinate System: Web Mercator (EPSG:3857)

Maps from the Web Soil Survey are based on the Web Mercator projection, which preserves direction and shape but distorts distance and area. A projection that preserves area, such as the Albers equal-area conic projection, should be used if more accurate calculations of distance or area are required.

This product is generated from the USDA-NRCS certified data as of the version date(s) listed below.

Soil Survey Area: Sherburne County, Minnesota
Survey Area Data: Version 20, Sep 6, 2022

Soil map units are labeled (as space allows) for map scales 1:50,000 or larger.

Date(s) aerial images were photographed: Aug 29, 2020—Sep 5, 2020

The orthophoto or other base map on which the soil lines were compiled and digitized probably differs from the background imagery displayed on these maps. As a result, some minor shifting of map unit boundaries may be evident.

Map Unit Legend

Map Unit Symbol	Map Unit Name	Acres in AOI	Percent of AOI
258B	Sandberg loamy sand, 1 to 6 percent slopes	5.7	55.9%
258C	Sandberg loamy sand, 2 to 12 percent slopes	3.4	33.5%
258E	Sandberg loamy coarse sand, 6 to 30 percent slopes	0.2	2.2%
341	Arvilla sandy loam, 0 to 2 percent slopes	0.8	7.9%
1028	Udorthents-Pits, gravel, complex	0.0	0.0%
D62A	Hubbard-Mosford complex, Mississippi River Valley, 0 to 3 percent slopes	0.0	0.4%
Totals for Area of Interest		**10.3**	**100.0%**

Appendix C

Technical Memoranda

C-1 – Facilities Plan Anticipated Flow and Load Review
C-2 – Facilities Plan Capacity and Condition Evaluation
C-3 – Facilities Plan Treatment Alternatives
C-4 – Preliminary Site Plan of the Recommended Alternative

C-1 – Facilities Plan Anticipated Flow and Load Review

Building a Better World for All of Us®

MEMORANDUM

TO: Dan Childs

FROM: Jessica Hedin, PE (Lic. MN 41639)

DATE: March 20, 2023

RE: Big Lake Wastewater Treatment Facilities Plan, Anticipated Flow and Load Review
SEH No. BIGLK 167307 14.00

The purpose of this memorandum is to summarize the current wastewater facilities flow and load, basis of population and wastewater demand projections, and basis of projected wastewater facilities flow and load for the design year of 2045. The projected flows and loadings for the facility are summarized in Table 1.

Table 1: Design Year Combined Wastewater Anticipated Flow and Load Demand

Flow Condition		**Value**	
Average Dry Weather (ADW), mgd		1.366	
Calendar Average Day Flow (ADF), mgd		1.446	
Average Wet Weather (AWW), mgd [A]		1.682	
Peak Hour Wet Weather (PHWW), mgd [B, C]		4.379	
Peak Instantaneous Wet Weather (PIWW), mgd [B]		4.379	
Load Parameter	**Calendar Day Average**	**Maximum Month as Day**	**Calendar Day Maximum**
5-Day Carbonaceous Biochemical Oxygen Demand ($cBOD_5$), ppd [D]	4,621	7,773	14,988
Total Suspended Solids (TSS), ppd [E]	5,465	12,227	19,984
Total Phosphorus (TP), ppd [F]	87	138	195
Total Kjeldahl Nitrogen (TKN), ppd [F]	562	894	894

Notes:
A. Corresponds to a flow rate of 62 gpcd for non-industrial users and 100 gpcd for domestic users.
B. Instantaneous flow data unavailable. PIWW determined using existing lift station pump capacity.
C. Corresponds to a calendar day average to peak hourly wet weather peaking factor of 2.6, which is equal to the 10 States Standards for Wastewater Facilities (2014 Edition) recommendation of 2.6 based on service population.
D. Corresponds to MPCA recommended minimum design value for parameter.
E. Corresponds to observed loading based on reported DMR sampling values.
F. Corresponds to Metcalf and Eddy recommended minimum design value for loading.

Refer to the remainder of the memorandum for the justification and methodology used to develop the projected flows and loads above.

Note that the City receives industrial flow from two identified industrial users, referred to as industrial user 1 and industrial user 2 for the purpose of this report. Unless noted otherwise, current and design flows and loads reference the combined flow and load from both industrial and non-industrial users.

FLOW AND LOAD DEMAND

The City provided SEH with historical influent and effluent data from discharge monitoring reports (DMRs) for the Big Lake Wastewater Treatment Facility (WWTF) for January 1, 2017 through February 28, 2022. The following sections summarize the existing flows and loads to the WWTF.

The purpose of this memorandum is to evaluate the capacity of the current wastewater facilities to meet the anticipated design year flow and load demand. Each treatment process at the wastewater treatment facility (WWTF) was reviewed for suitability.

Flow Definitions

The MPCA defines several flow conditions that are used to design process units. The existing system design and the capacities of existing process units reference the following flow conditions:

- **Average dry weather (ADW)** flow: ADW flow is defined as the flow that occurs during dry periods when the groundwater level is low or normal. This flow would include the normal sanitary sewer flows from homes, commercial establishments, public institutions, and any industrial facilities. This flow level normally becomes apparent in winter months (December, January, and February), when there is little to no inflow.
- **Average wet weather (AWW) flow:** AWW or peak month flow is the daily average flow for the 30 consecutive days with the highest precipitation for continuous dischargers. AWW of peak month flow is the daily average for the approximately 180 consecutive days between November 15 and May 15 and May 15 to November 15 for controlled dischargers.
- **Peak hourly wet weather (PHWW) flow:** PHWW is the peak flow during the peak hour of the day at a time when the groundwater is high and a five-year, one-hour storm event is occurring. For the City of Big Lake, a five-year, one-hour storm event corresponds to a precipitation event of 1.7 inches in one hour (MPCA, 2019).
- **Peak Instantaneous Wet Weather (PIWW) flow:** PIWW is the peak instantaneous flow during the day at a time when the groundwater is high and a 25-year, one-hour storm even is occurring. For the City of Big Lake, a 25-year, one-hour storm event corresponds to a precipitation event of 2.4 inches in one hour (MPCA, 2019).

Load Definitions

The MPCA refers to the Ten States Standards for design load determination. The Ten States Standards defines several load conditions that are used to design process units. The existing system design and the capacities of existing process units reference the following flow conditions:

- Design Average Load: The design average load is generally the average of the load to be received for a continuous 12-month period for the design year, expressed as weight per day.
- Design Maximum Month as Day Load: The design maximum month as day load is the largest amount of load to be received for a continuous 30-day period for the design year, expressed as weight per day.
- Design Maximum Day Load: The design maximum day load is the largest amount of load to be received during a continuous 24-hour period, expressed as weight per day.

The design load for facilities having critical seasonal high loading periods (e.g., recreational areas, campuses, industrial facilities) shall be based on the average organic load to be received during the seasonal period.

The determination for projected design loads is calculated as follows:

$$\text{Design Load} = \text{Calculated Peaking Factor} \times \left[\left(\text{Design Per Capita Load} \times \text{Domestic Service Population} \right) + \left(\text{Actual Per Capita Load} \times \text{Commercial and Light Industrial REU} \right) \right] + \text{Industrial Load}$$

where,

- Calculated peaking factor is based on the reported DMR sampling data.
- Design per capita load is based on the larger of the calculated per capita loading based on the reported DMR sampling data minus industrial contribution, MPCA design minimums, or other reference values.
- Domestic service population is the projected service population for the design year.
- Actual per capita load is based on the reported DMR sampling data minus industrial contribution.
- Commercial and light industrial residential equivalent units (REU) is based upon the anticipated non-significant industrial user (SIU) / categorical industrial user (CIU) industrial growth and non-domestic growth converted to a population equivalent.
- Industrial load is based on the anticipated growth and planned additional capacity for SIUs and CIUs.

Planning Definitions

Review of the current flows and loads and the determination for future flow and load capacities can generally be divided into four planning categories. The categories can generally be described as follows:

- **Domestic Capacity:** The domestic capacity reflects the residential contribution of wastewater flows and loads for current and future capacities. The basis of current flows is associated with the Minnesota Demographic Center population projections for determination of current per capita flows and loads, and the population projection determined in this report for future flow and load capacity. At a minimum, the MPCA requires minimum flow and load per capita loadings for design of future capacities as discussed later in this report.
- **Commercial and Light Industrial Capacity:** The commercial and light industrial capacity reflects the non-domestic and non-SIU/CIU industrial contribution of wastewater flows and loads for current and future capacities. The current flows and loads are included in the per capita flow and load contribution determination. The future flow and load contribution is based on the approved comprehensive growth plan acreage identified for commercial and light industrial development. An assumed flow per acre based on land use is utilized and associated to a residential equivalent unit. The actual per capita load is then used based on the equivalent residential unit to determine a future load condition.
- **Industrial Capacity:** The industrial capacity reflects the identified significant industrial and categorical industrial users identified by the City. The basis of current flows and loads reflect the industrial suer agreements prepared by the City, and the future flow and load conditions reflect discussions between the industrial users and the City based on projected future wastewater generation.
- **In-Plant Recirculation Capacity:** The in-plant recirculation capacity reflects the flows and loads generated by recirculation waste streams generated by wastewater treatment. The recirculation capacity may include washdown water, decant, process drains, filtrate, and other treatment side streams. These side streams may reflect existing processes and be impacted by proposed alternatives. For the facility, the side stream flows and loads are introduced after influent flow measurements and sampling. Although treatment capacity for individual units will reflect in-plant recirculation capacity, the permitted facility design capacity review does not.

Refer to Figure 1 for the components of the design capacity planning definitions.

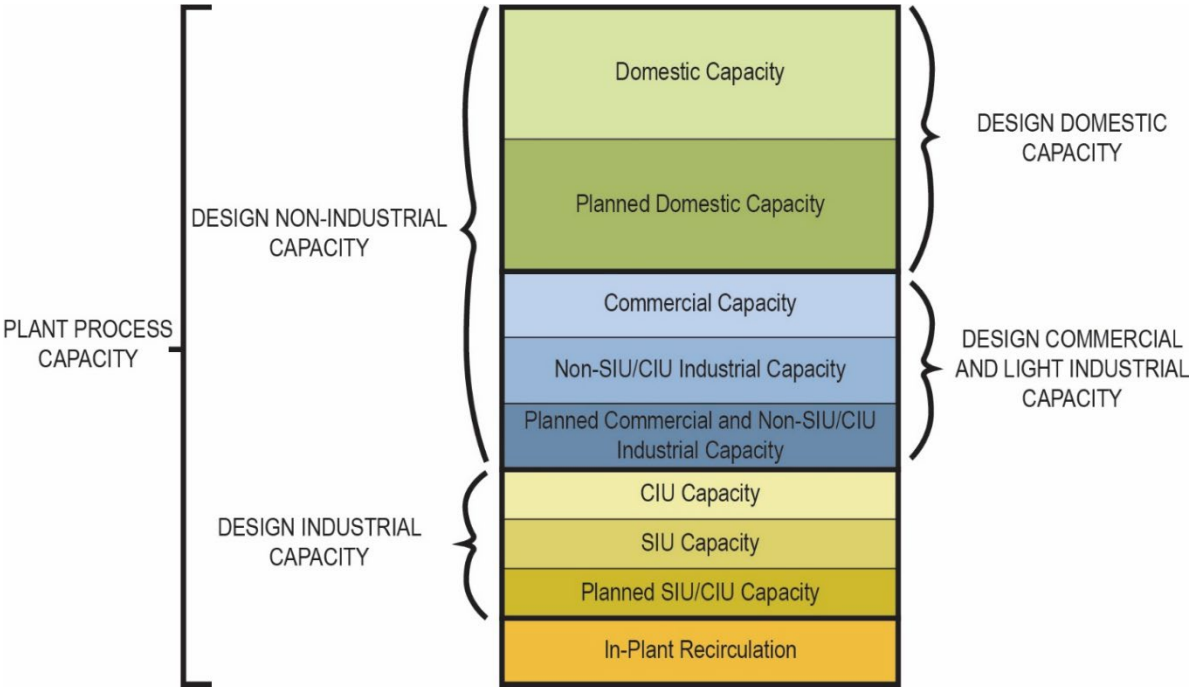


Figure 1: Design Capacity Planning Definitions

Infiltration and Inflow

Infiltration and inflow (I/I) are essentially clean water that enters the collection system as a result of rainfall or elevated groundwater levels. The MPCA has established guidelines to assist in evaluating the extent of both infiltration and inflow by comparing average flows during periods of high groundwater levels with and without precipitation events to established threshold values. If either inflow or infiltration is found to be excessive, the MPCA recommends an analysis to determine the feasibility of removing I/I.

The collection system in Big Lake is well maintained and relatively new, resulting in lower-than-average per capita flow rates observed at the wastewater treatment facility. The typical age of the collection system for the community is as follows:

- Total of 60 miles of gravity sanitary sewer piping and 8 miles of forcemain.
- 10% of sewer are >50 years old.
- 20% of sewer are 30-50 years old.
- 70% of sewer are <30 years old.

The community does not have major I/I reduction projects under construction, planning, or incorporated into a capital improvements plan. There are no project lists for the community for state funding on either the Intended Use Plan (IUP) or Project Priority List (PPL) list.

The community has identified two manholes for replacements and a number of vented sanitary sewer castings in the system which are to be replaced. Continuing efforts to ensure sump pumps and other sources of inflow have been disconnected are ongoing.

Infiltration

Infiltration is groundwater that enters the collection system through defective pipes, pipe joints, and manholes. Infiltration occurs when groundwater is high, and runoff is not occurring (i.e. no rain event). To determine the magnitude of the infiltration, the influent flow for a base condition must be compared with the influent flow during an infiltration condition. The base condition occurs when the groundwater is low, and runoff is not occurring.

Groundwater would be expected to be high in the spring season. The average infiltration condition for each year was determined by averaging the influent flows on days without precipitation during the wet period of March through June. To eliminate the effect of time of concentration following precipitation events and differences in the recording of precipitation and flow, days that were one day prior to or following a precipitation event were excluded from the average.

2022 was excluded as the review period only includes January and February, both of which are considered winter months.

The averages for each year are presented in Table 2. The average base condition is the minimum month as calendar day flow for the corresponding year's review period.

Table 2: Infiltration Conditions

Year	Infiltration Condition [A]	Base Condition [B]	Infiltration (MGD)	Per Capita Flow During Infiltration Conditions [C] (gpcd)
	Average Influent Flow on for Dry Days (MGD)	Minimum Month as Day Flow (MGD)		
2017	0.678	0.629	0.049	60.7
2018	0.697	0.676	0.021	60.8
2019	0.716	0.670	0.046	62.0
2020	0.694	0.694	0.001	57.6
2021	0.655	0.617	0.038	53.8
Average	**0.688**	**0.657**	**0.031**	**59.0**

Notes:
A. Influent condition represents averaging the influent flows on days without precipitation during the wet period of March through June.
B. Base condition occurs when the groundwater is low, and runoff is not occurring.
C. Based on a service population for each corresponding year as provided by the Minnesota Demographic Center population estimate.

Comparing the infiltration condition with the base condition flow for municipal flows, contribution from infiltration appears to average approximately 31,000 gpd during infiltration conditions. Infiltration is considered excessive if the average flow during periods with seasonal high groundwater exceeds 120 gallons per capita per day (gpcd) for domestic base flow and infiltration. The service population was used for each corresponding year based on the Minnesota Demographic Center population estimate. The average per capita wastewater flow during a period of high groundwater was determined using the combined industrial and non-industrial flow, which was approximately 59.0 gpcd, which on average does not exceed the threshold criterion.

Inflow

Inflow is rainfall contribution from sources such as flooded manhole covers, roof drains, foundation drains, storm water collection system cross connections, and other drain areas. Inflow occurs when groundwater is average or low and runoff is occurring (i.e., during a rain event). The high day reported influent flow for

the three days following the rain event is compared to the 30-day average flow proceeding the rain event to determine the amount of inflow.

The five days with the highest total rainfall during the spring, summer, or fall for the review period. The review period extends from March through November for each year of reporting data. Winter was excluded due to freezing precipitation. The wastewater flows during high precipitation events are compared with the average wastewater flows during the precipitation event month.

Table 3 summarizes the five days with the highest total rainfall during the review period.

Table 3: Inflow Conditions

Date of Precipitation	Amount of Precipitation (inches)	Inflow Event [A] Influent WW Flow (MGD)	Average Month Prior Influent WW Flow (MGD)	Inflow (MGD)	Per Capita Contribution During Inflow Conditions [B] (gpcd)
10/2/2017	4.70	0.815	0.784	0.031	72.9
6/28/2020	3.40	0.744	0.714	0.030	64.9
7/15/2019	2.50	0.827	0.782	0.045	71.6
7/1/2018	2.20	0.782	0.720	0.062	64.9
9/20/2021	2.10	0.820	0.746	0.074	67.4
Average	**2.98**	**0.798**	**0.749**	**0.048**	**68.4**

Notes:
A. Largest reported influent flow within three days preceding the rain event.
B. Based on a service population for each corresponding year as provided by the Minnesota Demographic Center population estimate.

The maximum inflow was 0.961 MGD, which occurred on 10/3/2017 during a 4.70 inch rainfall event that occurred the day before. Inflow is considered excessive if the flow during periods of significant rainfall exceeds 275 gpcd for domestic and industrial base flow plus infiltration and inflow. The service population was used for each corresponding year based on the Minnesota Demographic Center population estimate. The average per capita wastewater flow during a period of increased precipitation was determined using the combined industrial and non-industrial flow and was approximately 68.4 gpcd, which does not exceed the threshold criterion.

Current Wastewater Flow and Load Demand

Discharge monitoring reports (DMRs) for the review period are included in Appendix A-2. The reported flows are measured with a Parshall flume located in the preliminary treatment building at the wastewater treatment facility and represents the combined flow to the facility, including any I/I and industrial contributions.

The facility receives industrial flow from 2 significant industrial users and zero categorical industrial users.

Over the review period, the combined average dry weather influent flow was 699,000 gallons per day. The highest 30 consecutive days of flow were evaluated for a maximum month as day average (also referred to as the average wet weather) flow of 838,000 gallons per day. With two significant industrial users contributing approximately 52,000 gallons per calendar day of average flow and 78,000 gallons per maximum month as calendar day of flow, the adjusted average dry weather and maximum month as day flows for non-industrial users are then 647,000 gallons per day and 786,000 gallons, respectively. Based on an estimated 2022 service population of 12,278 residents from the Minnesota Demographic Center, the non-industrial user portion of the average wet weather flow correspond to a per capita flow contribution of approximately 55 gallons per capita day.

Peak hourly wet weather (PHWW) and peak instantaneous wet weather (PIWW) flows are also important for unit process capacity determination. Flow and precipitation data is required for determining the PHWW and PIWW flows. Instantaneous flow data is not available at the facility. Although the facility has a Parshall flume flow meter, it does not have a historian with sufficient enough data for a determination of measured data. Instantaneous precipitation data is not available for the facility, however daily rainfall totals from DMR data were used. The peak hourly flow was determined using the existing pump capacity for the facility's main influent lift station. The corresponding peaking factor is 3.1, which was calculated based on the projected average day flow to peak hour wet weather flow. The utilized peaking factor is greater than the 10 States Standard recommended peaking factor for the corresponding population, which would be 2.6.

Table 4 summarizes the current flows to the treatment facility.

Table 4: Current Combined Wastewater Flow Demand

Flow Condition	Value
Average Dry Weather (ADW), mgd	0.699
Calendar Average Day Flow (ADF), mgd	0.721
Average Wet Weather (AWW), mgd [A]	0.838
Maximum Calendar Day, mgd	1.208
Peak Hour Wet Weather (PHWW), mgd [B, C]	2.204
Peak Instantaneous Wet Weather (PIWW), mgd [B]	2.204

Notes:
A. Day average flow for 30 consecutive highest flow days reported.
B. Instantaneous flow data unavailable. Peak determined using existing lift station pump capacity base on sewer flow rates.
C. Corresponds to a calendar day average to peak hourly wet weather peaking factor of 2.6, which is equal to the 10 States Standards for Wastewater Facilities (2014 Edition) recommendation of 2.6 based on service population.

Table 5 summarizes the assumed industrial flow based on the monitoring data available and the user agreements between the industries and the City. The table also provides the revised non-industrial flow to the facility which corresponds to the residential, commercial, and light industrial user discharge.

Table 5: Current Industrial and Non-Industrial Wastewater Flow Demand

User	Calendar Day Average	Maximum Month as Day	Calendar Day Maximum
Significant Industrial User 1 Wastewater Flow, mgd [A]	0.004	0.005	0.005
Significant Industrial User 2 Wastewater Flow, mgd	0.048	0.073	0.073
Total Industrial Wastewater Flow, mgd	0.052	0.078	0.078
Flow Condition	**Value**		
Non-Industrial Average Dry Weather, mgd	0.647		
Non-Industrial Calendar Average Day Flow, mgd	0.670		
Non-Industrial Average Wet Weather, mgd [B, C]	0.760		
Non-Industrial Maximum Calendar Day, mgd	1.130		
Non-Industrial Peak Hour Wet Weather, mgd [D, E]	2.126		
Non-Industrial Peak Instantaneous Wet Weather, mgd [D]	2.126		

Notes:
A. Assumed wastewater flow rate based on metered water usage.
B. Corresponds to a flow rate of 59 gpcd.
C. Day average flow for 30 consecutive highest flow days reported.
D. Instantaneous flow data unavailable. Peak determined using existing lift station pump capacity base on sewer flow rates.
E. Corresponds to a calendar day average to peak hourly wet weather peaking factor of 2.6, which is equal to the 10 States Standards for Wastewater Facilities (2014 Edition) recommendation of 2.6 based on service population.

In addition to flow data, the following loadings were determined for the review period:

- 5-day carbonaceous biochemical oxygen demand ($cBOD_5$),
- Total suspended solids (TSS),
- Total phosphorus (TP),
- Total nitrogen (TN), and
- Total Kjeldahl nitrogen (TKN).

Table 6 summarizes the current loading to the treatment facility.

Table 6: Current Combined Wastewater Load Demand

Load Parameter	Calendar Day Average	Maximum Month as Day	Calendar Day Maximum
5-Day Carbonaceous Biochemical Oxygen Demand ($cBOD_5$), ppd [A]	2,141	3,679	7,386
Total Suspended Solids (TSS), ppd [B]	2,963	6,702	11,202
Total Phosphorus (TP), ppd [C]	47	75	107
Total Kjeldahl Nitrogen (TKN), ppd [D]	358	496	496

Notes

A. Non-Industrial portion of load parameter corresponds to a per capita loading rate of 0.10 ppcd.
B. Non-Industrial portion of load parameter corresponds to a per capita loading rate of 0.22 ppcd.
C. Non-Industrial portion of load parameter corresponds to a per capita loading rate of 0.003 ppcd.
D. Non-Industrial portion of load parameter corresponds to a per capita loading rate of 0.027 ppcd.

Monthly organics loading, analyzed as 5-day carbonaceous biochemical oxygen demand, averaged approximately 2,141 pounds per day (ppd) over the period, with a maximum month as day average load of 3,679 pounds per day. The most recent 2018 facilities plan indicated a calendar day average load of 2,481 ppd, indicated a general reduction in loading since the last facility plan update. The daily maximum during the review period occurred December 19, 2017 with a reported 7,386 ppd. The following peak events were excluded from the data analysis as operational outliers:

- August 30, 2017 the influent 5-day carbonaceous biochemical oxygen demand was 9,165 ppd, corresponding to a concentration of 1,350 mg/L as a result of atypical flow from industrial discharge to the facility.

Monthly solids loading, analyzed as total suspended solids, averaged approximately 2,963 pounds per day (ppd) over the period, with a maximum month as day average load of 6,702 pounds per day. The most recent 2018 facilities plan indicated a calendar day average load of 4,240 ppd, indicated a general reduction in loading since the last facility plan update. The daily maximum during the review period occurred December 19, 2017 with a reported 11,202 ppd. The following peak events were excluded from the data analysis as operational outliers:

- August 30, 2017 the influent total suspended solids concentration was 20,909 ppd, corresponding to a concentration of 3,080 mg/L as a result of atypical flow from industrial discharge to the facility.

Monthly total phosphorus loading, analyzed as phosphorus, averaged approximately 47 pounds per day (ppd) over the period, with a maximum month as day average load of 75 pounds per day. The most recent 2018 facilities plan indicated a calendar day average load of 113 ppd, indicated a general reduction in loading since the last facility plan update. The daily maximum during the review period occurred October 25, 2017 with a reported 107 ppd. The following peak events were excluded from the data analysis as operational outliers:

- August 6, 2019 influent total phosphorus concentration was 218 ppd, corresponding to a concentration of 32.0 mg/L as a result of atypical flow from industrial discharge to the facility.

Monthly total Kjeldahl nitrogen loading, analyzed as nitrogen, averaged approximately 358 pounds per day (ppd) over the period, with a maximum month as day average load of 496 pounds per day. The most recent 2018 facilities plan did not include analysis of TKN. The daily maximum during the review period occurred June 5, 2018 with a reported 496 ppd. No peak events were excluded from the data analysis as a result of operations.

Table 7 summarizes the assumed industrial loading based on the monitoring data available and the user agreements between the industries and the City. The table also provides the revised non-industrial loading to the facility.

Table 7: Current Industrial and Non-Industrial Wastewater Load Demand

Load Parameter	Calendar Day Average	Maximum Month as Day	Calendar Day Maximum
Significant Industrial User 1 $cBOD_5$, ppd	322	490	618
Significant Industrial User 2 $cBOD_5$, ppd	548	928	2,505
Total Industrial $cBOD_5$, ppd	870	1,418	3,122
Non-Industrial $cBOD_5$, ppd [A]	**1,271**	**2,261**	**4,263**
Significant Industrial User 1 TSS, ppd	70	184	232
Significant Industrial User 2 TSS, ppd	204	430	1,094
Total Industrial TSS, ppd	275	614	1,325
Non-Industrial TSS, ppd	**2,689**	**6,088**	**9,877**
Significant Industrial User 1 TP, ppd	2.1	3.7	4.6
Significant Industrial User 2 TP, ppd	2.1	3.5	12.4
Total Industrial TP, ppd	4.3	7.2	17.0
Non-Industrial TP, ppd [B]	**42.5**	**67.6**	**89.9**
Significant Industrial User 1 TKN, ppd [C]	3.5	4.3	4.3
Significant Industrial User 2 TKN, ppd [D]	22.9	36.7	36.7
Total Industrial TKN, ppd	26.4	40.9	40.9
Non-Industrial TKN, ppd [B]	**331.4**	**455.0**	**455.0**

Notes:
A. Reported Current calendar average load corresponds to a per capita loading which is less than the MPCA and 10 States Standards recommended minimum design value for the parameter.
B. Reported Current calendar average load corresponds to a per capita loading which is less than the Metcalf and Eddy recommended minimum design value for the parameter.
C. Sample information not provided. Values used based on references in SIU agreement. It is possible there may be TKN component to both industrial user's flow to WWTF that is not accounted for.
D. Special sampling completed consisting of 2 samples collected 7/14/2022 and 7/19/2022.

Nutrient loading to the facility is based upon present calculated per capita loading compared to reference design standards. The more conservative per capita design loading was used for facility design for the community population under design conditions. The per capita loading is referenced against accepted design standards from the Recommended Standards for Wastewater Facilities (2014), often referred to as "Ten States Standards," the Fourth Edition of the Wastewater Engineering Treatment and Reuse text by Metcalf and Eddy (2003), Water Environment Federation Manual of Practice No. 8, and the MPCA guidance for minimum design standards.

The calculated non-industrial per capita $cBOD_5$ load is 0.10 pounds per capita per day (ppcd). According to the Recommended Standards for Wastewater Facilities (Ten States Standards) and the MPCA Flow and Load Guidance, the design of domestic waste treatment shall be based upon at least 0.17 ppcd $cBOD_5$, or 0.22 ppcd where garbage comminutors are commonly used. The recommended reference per

capita load of 0.17 ppcd $cBOD_5$ was used for the domestic and the calculated per capita load of 0.10 was used for the commercial and light industrial portions of the design capacity, respectively.

The calculated non-industrial per capita TSS load is 0.22 ppcd. According to the Recommended Standards for Wastewater Facilities (Ten States Standards) and the MPCA Flow and Load Guidance, the design of domestic waste treatment shall be based upon at least 0.20 ppcd TSS, or 0.25 ppcd where garbage disposals are commonly used. The calculated per capita load of 0.22 ppcd TSS was used for the domestic, commercial, and light industrial portions of the design capacity.

The calculated non-industrial per capita TP load is 0.003 ppcd. Metcalf and Eddy (2003) Wastewater Engineering suggest a typical design range for total phosphorus of 0.004-0.010 ppcd, with a typical per capita loading of 0.006 ppcd. The recommended reference per capita load of 0.004 ppcd TP was used for the domestic and the calculated per capita load of 0.003 was used for the commercial and light industrial portions of the design capacity, respectively.

The calculated non-industrial per capita TKN load is 0.027 ppcd. Metcalf and Eddy (2003) Wastewater Engineering suggest a typical design range for ammonia as nitrogen of 0.011-0.026 ppcd, with an average of 0.019 ppcd. Ammonia, as nitrogen, in domestic wastewater can be expected to comprise 60% of the total Kjeldahl nitrogen. Therefore, the expected NH_3-N / TKN would be expected to be 0.60. The recommended range for total Kjeldahl nitrogen would then be 0.018-0.043 ppcd TKN. The reported value of 0.028 ppcd TKN was used.

Anticipated Flow and Load Demand

For facility plans, the MPCA prescribes specific design parameters. Specifically, the four flow conditions, defined in Section 3.1, must be established for the planning period. These flow conditions are used to quantify the range of flows observed and provide a basis for future planning. Population projections are also important to assess the requirements of new or existing treatment processes. The flow conditions, described below, account for future population growth and industrial expansion estimates. No new significant industrial users are anticipated; however, the City has included future capacity to either attract or expand existing industrial users.

Planning Period

The typical planning period for collection system infrastructure is 50 to 70 years and 20 years for wastewater treatment facilities. Determination of the planning period includes the additional time required for facility design, bidding, and construction.

The future capacity of the WWTF will be based upon the higher value of either:

- Projections of flows and loading to a design year of 2045, or
- The existing permitted capacity of the WWTF.

Anticipated Flow and Load Demand from Domestic Users

Two anticipated population demand scenarios were evaluated for the determination of the domestic wastewater flow and load demand associated with the design year:

- Constant growth based on historical City growth maximum.
- Growth similar to County based on Minnesota Demographic Center estimates.

The community has observed a maximum growth rate of 3.0% year-to-year during the planning period. This growth scenario assumes the 2.0% growth rate remains the average during the planning period of the report. This alternative will serve as a “high” growth scenario.

The State Demographic Center prepares population growth estimates for counties within Minnesota. Historically, this has been well reflected in the growth rate of the community as well and would serve as the basis for population projections during the planning period. This alternative will serve as a “typical” growth scenario.

Figure 2 illustrates the predicted service populations for the design year based on the growth scenarios identified.

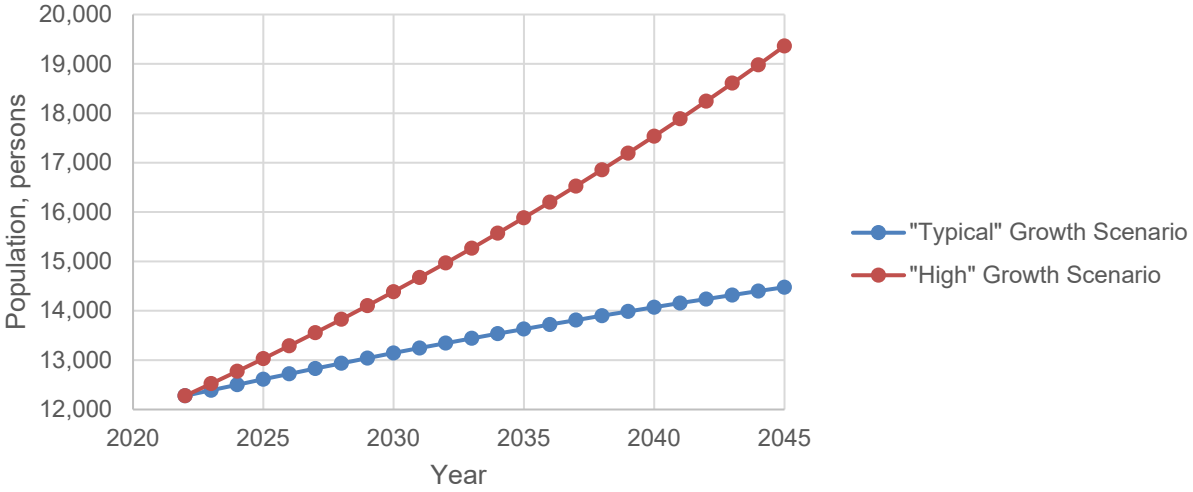


Figure 2: Anticipated Population Demand Scenarios

The 2021 estimated service population is 12,165 residents based on the Minnesota Demographic Center estimate. The “high” growth scenario would result in a service population of 19,361 residents for the design year, while the “typical” growth scenario would result in a service population of 14,447 residents for the design year.

The “typical” growth rate was determined to be the likely rate of development for the community and will be used as the basis for the non-industrial flow and load determination. The future design condition will also account for addition flows and loads from the following growth components:

- Additional wastewater generated from new and existing Industrial users (SIU and CIU users).
- Additional wastewater generated from new and existing Non-Industrial and Non-Domestic users (commercial and light industrial users).

Anticipated Flow and Load Demand from Non-Industrial and Non-Domestic Users

The community had developed and adopted a comprehensive growth plan in 2018. As part of the comprehensive plan, zoning maps were developed to indicate the areas in and around the City which are targeted for particular types of development. As part of these maps, the following land use areas were identified for non-industrial and non-residential development:

- 180 acres of General Business (B-3)
- 160 acres of Industrial Park (I-1)
- 150 acres of General Industrial (I-2)
- 50 acres of Isolated Industrial (I-3)

The comprehensive plan identifies the anticipated land uses for each area. Each area is assumed to generate residential strength wastewater and not contain SIU or CIU users, which would be identified as Industrial users for the purposed of flow and load design capacities.

- **General Business (B-3):** Retail, service, office, civic, cultural and entertainment uses, R-C mixed-use, conference centers, convenience stores, brew pubs, day care, motels, long-term care, auto repair, theatres. It is assumed this land use will generate 1,200 gallons of wastewater per day per acre at The City’s current wastewater loading rate.

- **Industrial Park (I-1):** Animal hospitals, distribution centers, hospitals, offices, PUD, accessory retail. It is assumed this land use will generate 900 gallons of wastewater per day per acre at The City's current wastewater loading rate.
- **General Industrial (I-2):** Animal hospitals, distribution centers, hospitals, offices, PUD, accessory retail, radio antennas, shooting range, incineration. It is assumed this land use will generate 900 gallons of wastewater per day per acre at The City's current wastewater loading rate.
- **Isolated Industrial (I-3):** Animal hospitals, distribution centers, hospitals, offices, PUD, accessory retail, radio antennas, shooting range, incineration, satellite dishes, oil storage, outdoor storage, freight terminals, trash disposal. It is assumed this land use will generate 900 gallons of wastewater per day per acre at The City's current wastewater loading rate.

Additional commercial and light industrial flow can be characterized by the residential equivalent unit. This unit is a helpful tool in understanding the available capacity for non-domestic wastewater generation in terms of household equivalents. For the City, the typical wastewater generation is approximately 55 gallons per capita per day. According to the Minnesota Demographic Center, the typical household size is 2.99 persons per household. This corresponds to an average household wastewater generation rate of 165 gallons per day per household. Since the additional planned flows and loads are required to be at or below residential strength, and does not include SIU or CIU dischargers, a similar approach can be assumed for anticipated loads as a result of additional development.

Table 8 summarizes the anticipated additional flows and loads as a result of Non-Industrial and Non-Domestic users.

Table 8: Anticipated Non-Industrial and Non-Domestic Users

Land Use	Land Use Description	Commercial			Light Industrial		
		gal/d/ acre [A]	acre [B]	gal/d	gal/d/ acre [A]	acre [B]	gal/d
B-3	Area 1. General Business	1,200	80	96,000			
B-3	Area 2. General Business	1,200	100	120,000			
I-1	Area 3. Industrial Park				900	100	90,000
I-1	Area 4. Industrial Park				900	60	54,000
I-2	Area 5. General Industrial				900	50	45,000
I-2	Area 6. General Industrial				900	60	54,000
I-3	Area 7. Isolated Industrial				900	90	81,000
		Total	180	216,000	Total	360	324,000
Flow Condition or Load Parameter		**Unit**		**Value**	**Unit**		**Value**
Wastewater Flow, gallon per capita day [B]		gpd		100	gpd		100
Population equivalents, persons		persons		2,160	persons		3,240
Persons per household, persons [C]		pph		2.99	pph		2.99
Residential equivalents, residences		REU		723	REU		1,084

Notes:
A. Based on assumed wastewater flow generation rates for associated land uses.
B. Acreage from areas identified in 2018 comprehensive growth plan.
C. Based on the Non-Industrial Calendar Average Day Flow.
D. Based on Minnesota Demographic Center Estimates.

The additional Non-Industrial and Non-Domestic wastewater anticipated to be generated from the areas identified in the 2018 comprehensive growth plan correspond to a population equivalent of 5,400 population equivalents (residents), or 1,804 residential equivalent units (households).

Table 9 summarizes the addition planned flow and load capacity for anticipated commercial and light industrial users identified in the 2018 comprehensive growth plan.

Table 9: Anticipated Flow and Load Demand from Non-Industrial and Non-Domestic Users

Flow Condition or Load Parameter	Calendar Day Average	Maximum Month as Day	Calendar Day Maximum
Wastewater Flow Condition, mgd [A]	0.476	0.540	0.803
5-Day Carbonaceous Biochemical Oxygen Demand ($cBOD_5$), ppd [B]	559	994	1,875
Total Suspended Solids (TSS), ppd [C]	1,182	2,678	4,344
Total Phosphorus (TP), ppd [D]	19	30	40
Total Kjeldahl Nitrogen (TKN), ppd [E]	146	200	200

Notes:
A. Non-Industrial portion of flow condition corresponds to a per capita flow rate of 100 gpcd.
B. Non-Industrial portion of load parameter corresponds to a reported per capita loading rate of 0.10 ppcd.
C. Non-Industrial portion of load parameter corresponds to a reported per capita loading rate of 0.22 ppcd.
D. Non-Industrial portion of load parameter corresponds to a reported per capita loading rate of 0.003 ppcd.
E. Non-Industrial portion of load parameter corresponds to a reported per capita loading rate of 0.027 ppcd.

Anticipated Flow and Load Demand from Industrial Users

The City is currently in the process of finalizing a significant industrial user agreement with significant industrial user 1. As part of the agreement, a flow charge has been determined based upon metered facility water use rates. Assumptions for corresponding wastewater generation and characterization have been applied to compare the industrial wastewater flows and loads to the equivalent residential strength wastewater. A strength charge for loading was determined using reference values for typical wastewater characteristics for that industry.

For the purpose of planning, significant industrial user 1 will increase wastewater generation to three times the current flow. Wastewater characteristics for the operation are not anticipated to change significantly during the planning period, therefore load concentration will remain constant and the current peaking factors for maximum month as day average load and maximum calendar day loads will be used for the future projection.

Table 10 on the following page summarized the anticipated current and future day average flow and loading rates for significant industrial user 1.

Table 10: Significant Industrial User 1 Flow and Load Demand

Flow Condition or Load Parameter	Current			Additional Capacity		
	Calendar Day Average	Maximum Month as Day	Calendar Day Maximum	Calendar Day Average	Maximum Month as Day	Calendar Day Maximum
Flow, mgd [A]	0.004	0.005	0.005	0.007	0.009	0.009
5-Day Carbonaceous Biochemical Oxygen Demand ($cBOD_5$), ppd [B]	322	490	618	643	980	1,235
Total Suspended Solids (TSS), ppd [B]	70	184	232	141	368	463
Total Phosphorus (TP), ppd [C]	2.1	3.7	4.6	4.3	7.4	9.3
Total Kjeldahl Nitrogen (TKN), ppd [D]	3.5	4.3	4.3	7.0	8.5	8.5

Notes:
A. Based on metered water use rates, assumed 70% wastewater production.
B. Based on typical wastewater characterization as presented in Brewer's Association. Wastewater Management Guidance Manual. 2017.
C. Based on typical wastewater characterization as presented in Enitan, A. M. et al. Characterization of Brewery Wastewater Composition. World Academy of Science, Engineering and Technology International Journal of Environmental and Ecological Engineering Vol:9, No:9. 2015.
D. Based on additional sampling performed 7/26/2022.

The City has prepared and issued a significant industrial user agreement with significant industrial user 2. As part of the agreement, flow charge has been determined based upon metered facility flow rates and sampled facility wastewater. Measured wastewater generation and characterization compare the industrial wastewater flows and loads to the equivalent residential strength wastewater. Strength charge for loading is determined based upon composite sampling completed on the wastewater generated by that industry.

It is estimated that significant industrial user will increase their wastewater generation by 20,000 gallons per day in 2023 with another increase in flow of 20,000 gallons in 2024. For the purpose of planning, significant user 2 will double the wastewater generation to three times the current flow. Wastewater characteristics for the operation are not anticipated to change significantly during the planning period, therefore load concentration will remain constant and the current peaking factors for maximum month as day and maximum day loads will be used for the future projection.

Table 11 on the following page summarized the anticipated current and future day average flow and loading rates for significant industrial user 2.

Table 11: Significant Industrial User 2 Flow and Load Demand

Flow Condition or Load Parameter	Current			Additional Capacity		
	Calendar Day Average	Maximum Month as Day	Calendar Day Maximum	Calendar Day Average	Maximum Month as Day	Calendar Day Maximum
Wastewater Flow, mgd [A]	0.048	0.73	0.128	0.048	0.073	0.128
5-Day Carbonaceous Biochemical Oxygen Demand ($cBOD_5$), ppd [B]	548	928	2,505	548	928	2,505
Total Suspended Solids (TSS), ppd [B]	204	430	1,094	204	430	1,094
Total Phosphorus (TP), ppd [B]	2.2	3.5	12.4	2.2	3.5	12.4
Total Kjeldahl Nitrogen (TKN), ppd [C]	22.9	36.7 [D]	36.7	22.9	36.7	36.7

Notes:
A. Metered value as part of SIU agreement November 2019 through April 2022.
B. Sampled value as part of SIU agreement November 2019 through April 2022.
C. Special sampling completed consisting of 2 samples collected 7/14/2022 and 7/19/2022.
D. Corresponding peaking factor assumed as 1.6 based on similar peaking factor for $cBOD_5$ and TP.

The City intends to require new industries sited in the community and discharging to the sanitary sewer system to pretreat industrial wastewater to residential strength as needed. The City is planning to reserve facility flow and load capacity for new or expansion to existing significant industrial users. The reserved capacity provides flexibility to be utilized as either new users, or additional expansion for current users.

NPDES/SDS Effluent Permit Limitations

The Big Lake WWTF is regulated by the National Pollutant Discharge Elimination System (NPDES) permit number MN0041076. Table 12 on the following page summarizes the effluent limits at the current AWW design flow of 0.958 MGD and anticipated future effluent limits as indicated by frozen mass limits provided by a preliminary effluent limit request response letter furnished by the MPCA.

The preliminary effluent limit request response letter is dated November 2, 2022 and is included in Attachment 1. The preliminary effluent request response letter is for an initial, higher-growth planning scenario. The frozen mass limits were used for projecting the anticipated effluent water quality requirements at the revised growth scenario addressed in this facilities plan report.

Table 12: Current and Anticipated NPDES/SDS Effluent Permit Limitations

Parameter	Current Effluent Limit		Anticipated Effluent Limit [6]	
	Month [1]	Week [2]	Month [1]	Week [2]
$cBOD_5$ load, kg/d	34.3	54.9	34.3	54.9
$cBOD_5$ concentration, maximum, mg/L	25.0	40.0	25.0	40.0
$cBOD_5$ concentration, at AWW flow, mg/L[5]	10.8	17.3	5.4	8.6
$cBOD_5$ percent removal	85% min		85% min	
TSS load, kg/d	41.2	61.7	41.2	61.7
TSS concentration, maximum, mg/L	30	45	30	45
TSS concentration, at AWW flow, mg/L[5]	10.8	17.3	6.5	9.7
TSS percent removal	85% min		85% min	
TP, kg/year	1160 [3]		1160 [3]	
TP load, kg/d [5]	3.2		3.2	
TP concentration. at AWW flow, mg/L[5]	0.5		0.5	
pH, SU	6.0 – 9.0 [4]		6.0 – 9.0 [4]	
Fecal Coliform, MPN (geometric mean)	200		200	

Notes:
1. Denotes Calendar Month Average effluent permit limitation.
2. Denotes Calendar Week Average effluent permit limitation.
3. 12-Month Moving Total effluent permit limitation.
4. Each Sample effluent permit limitation.
5. Parameter is not included in effluent permit limitation but is the calculated equivalent to meet required effluent limitations.
6. Corresponds to a concentration as the design flow of 1.682 MGD AWW flow based on the frozen mass limits indicated in the preliminary effluent request response letter furnished by the MPCA.

Anticipated Flow and Load Demand Scenario

The anticipated flow and load demand scenario was developed with consideration for the frozen mass limits provided with the preliminary effluent limit request response letter from the MPCA.

The anticipated flow and load scenario pursued by the City of Big Lake was developed to include:
- Anticipated Domestic Flow and Load Demand associated with the “Typical” growth scenario,
- Anticipated Significant Industrial User 1 Flow and Load Demand,
- Anticipated Significant Industrial User 2 Flow and Load Demand, and
- Anticipated Non-Industrial and Non-Domestic Flow and Load Demand.

The flow and load demand correspond to flow associated with the attainable level of effluent quality without need for tertiary treatment. This determination is based on the frozen mass limits provided by the preliminary effluent limit request response letter from the MPCA. The limiting constituent is total phosphorus. A total design flow capacity of 1.680 MGD is therefore targeted for a corresponding average effluent total phosphorus limit of 0.5 mg/L, which is required to meet the 12-month moving total mass limit of 1,1160 kg.

The historical flow data from the review period was used to help determine the design year projected flows and loads. The MPCA flow determination worksheet for the design period is included in Attachment 2. The projected average wet weather flow for the design year is 1.680 MGD.

The projected flow conditions are reported in Table 13 on the following page and account for the projected changes in the domestic service population, anticipated non-industrial and non-domestic users, and industrial users.

Projected flows were determined using the more conservative per capita flow based on:

- Reported flow from discharge monitoring reports,
- MPCA minimum design standards, and
- Reference recommended minimum design standards.

Table 13: Anticipated Wastewater Flow Demand

Flow Condition	Flow
Average Dry Weather (ADW), mgd	1.366
Calendar Average Day Flow (ADF), mgd	1.446
Average Wet Weather (AWW), mgd [A]	1.682
Peak Hour Wet Weather (PHWW), mgd [B, C]	4.467
Peak Instantaneous Wet Weather, mgd (PIWW) [B]	4.467

Notes:
A. Corresponds to a flow rate of 100 gpcd for non-industrial users and 100 gpcd for domestic users.
B. Instantaneous flow data unavailable. Peak determined using existing lift station pump capacity base on sewer flow rates.
C. Corresponds to a peaking factor of 2.6 times the average calendar day flow, which is equivalent to the 10 States Standards Recommendation of 2.6 based on service population.

Peaking factors for projected loading were calculated from the review period discharge monitoring reports. Peaking factors were determined by calculating the per capita flow or load condition based on the current service population, and projecting the future peak loading based on the increase in service population.

Peak Instantaneous Wet Weather and Peak Hourly Wet Weather flow are assumed to be the same for the facility and based upon the existing main lift station rated pump capacity of 1,500 gpm. The City has not experienced backups at the main lift station during the review period.

Table 14 summarizes the projected loading conditions for the facility.

Table 14: Anticipated Wastewater Load Demand

Load Parameter	Calendar Day Average	Maximum Month as Day	Calendar Day Maximum
5-Day Carbonaceous Biochemical Oxygen Demand, ppd [A, C]	4,621	7,773	14,988
Total Suspended Solids (TSS), ppd	5,465	12,227	19,984
Total Phosphorus (TP), ppd [B, D]	87	138	195
Total Kjeldahl Nitrogen (TKN), ppd [B, E]	562	894	894

Notes:
A. Reported Current calendar average load corresponds to a per capita loading which is less than the MPCA and 10 States Standards recommended minimum design value for the parameter.
B. Reported Current calendar average load corresponds to a per capita loading which is less than the Metcalf and Eddy recommended minimum design value for the parameter.
C. Minimum per capita load design value of 0.17 ppcd $cBOD_5$ used.
D. Minimum per capita load design value of 0.004 ppcd TP used.
E. Minimum per capita load design value of 0.027 ppcd TKN used.

The anticipated wastewater flow and load demands include sufficient capacity for:

- Additional anticipated domestic growth of 2,199 persons,
- Additional partial anticipated non-industrial and non-commercial growth, and
- Additional anticipated industrial growth for significant industrial users 1 and 2.

Equalization

The MPCA recommends investigation of equalization for projected flows and loads where the projected design peak instantaneous wet weather flow is greater than three times the projected design average wet weather flow. The projected flow values for the community correspond to PIWW flow 2.66 times larger than the AWW flow.

Design Year Conditions

The anticipated flow and loading demand is based upon the "typical" growth scenario for domestic service population. The anticipated flow and load demand also includes planned capacity for any additional commercial, light industrial users, and institutional users as well as known expansion of the current industrial users.

The MPCA flow determination worksheet was also reviewed for determination of ADW, AWW, PHWW, and PIWW flow. PHWW and PIWW flows were determined using the current main lift station pumping capacity and if greater than the peaking factor using service population as recommended by 10 States Standards for Wastewater Facilities (2014 Edition) based on the service population, sections A and B for design flow determination of table 2 will not be used. A peaking factor of 2.6 was used based on the current influent lift station design capacity. The peaking factor is equivalent to the 2.6 recommended as part of the 10 States Standards based on service population. Inflow and infiltration have also been considered and factored into the anticipate flow determination as discussed previously. A copy of the MPCA Design Flow and Loading Guidelines for Wastewater Treatment Plants is located in Attachment 3, however sections A and B for design flow determination of table 2 were not used. Rather the determination of this memorandum sufficiently discusses the flow and loads outlined by the guidance.

Table 15 summarizes the design year flows and loadings for the facility.

Table 15: Design Year Combined Wastewater Anticipated Flow and Load Demand

Flow Condition		**Value**	
Average Dry Weather (ADW), mgd		1.366	
Calendar Average Day Flow (ADF), mgd		1.446	
Average Wet Weather (AWW), mgd [A]		1.682	
Peak Hour Wet Weather (PHWW), mgd [B, C]		4.467	
Peak Instantaneous Wet Weather (PIWW), mgd [B]		4.467	
Load Parameter	**Calendar Day Average**	**Max Month as Day**	**Calendar Day Maximum**
5-Day Carbonaceous Biochemical Oxygen Demand ($cBOD_5$), ppd [D]	4,621	7,773	14,988
Total Suspended Solids (TSS), ppd [E]	5,465	12,227	19,984
Total Phosphorus (TP), ppd [F]	87	138	195
Total Kjeldahl Nitrogen (TKN), ppd [F]	562	894	894

Notes:

A. Corresponds to a flow rate of 62 gpcd for non-industrial users and 100 gpcd for domestic users.
B. Instantaneous flow data unavailable. PIWW determined using existing lift station pump capacity.
C. Corresponds to a calendar day average to peak hourly wet weather peaking factor of 2.6, which is equal to the 10 States Standards for Wastewater Facilities (2014 Edition) recommendation of 2.6 based on service population.
D. Corresponds to MPCA recommended minimum design value for parameter.
E. Corresponds to observed loading based on reported DMR sampling values.
F. Corresponds to Metcalf and Eddy recommended minimum design value for loading.

ejm
Attachments:
Attachment 1: Preliminary Effluent Limit Request Electronic Response Letter Dated Nov. 2, 2022.
Attachment 2: Summary of Monthly Flow and Load Demand
Attachment 3: MPCA Design Flow and Loading Determination Guidelines for Wastewater Treatment Plants

c: Eric Miller, SEH Inc.
Colin Marcusen, SEH Inc.

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Attachment 1

Preliminary Effluent Limit Request Response Letter

RE: Preliminary Effluent Limits for the Proposed Big Lake Discharge
NPDES/SDS Permit MN0041076-SD001

Mr. Wolohan:

This electronic-letter is in response to your request for preliminary effluent limits for an expansion of the City of Big Lake wastewater treatment plant (WWTP). It summarizes the preliminary effluent limits for the WWTP proposed expansion. The preliminary limits are draft values. Effluent limits only become final after the National Pollutant Discharge Elimination System (NPDES) permit has undergone a complete review, been public noticed, the public's comments considered and either our Commissioner or a delegated representative signs the permit.

Please be aware that receiving the preliminary effluent limits in the table below does not mean that your proposed expansion/new facility has been approved. As part of the permitting process, your project must comply with antidegradation requirements (see the Antidegradation Requirement section below for important details). You must demonstrate that there is no way to avoid water quality degradation and that the chosen project alternative is the least degrading prudent and feasible alternative. In many cases, the least degrading prudent and feasible alternative may not be your preferred option or the option(s) discussed in this letter. (7050.0280, subp. 2).

Scenario descriptions

The City of Big Lake requested preliminary effluent limits for one scenario at their Big Lake WWTF discharge:

	Average Wet Weather Design (MGD)	Average Dry Weather Design (MGD)	Discharge Type
Existing Facility	0.958	0.746	Continuous
Scenario #1	2.206	1.413	Continuous

The receiving water will remain the Mississippi River. This section of the Mississippi River is classified as a 1C, 2Bdg, 3,4,5,6 river and is also designated as a restricted outstanding resource value water.

The 7Q10 flow rate of this reach of the Mississippi River is 1074 cfs and this 7Q10 flow rate represents a dilution ratio of 1746:1 at the expanded flow rate.

Table 1: Limits Table

	Existing Discharge		Scenario 1	
AWWDF (MGD)	0.958		2.206	
ADWDF (MGD)	0.746		1.413	
River flow- 7q10	1074		1074	
Dilution Ratio	2685		1746	
Antideg review needed?	No		Yes	
Environmental review needed?	No		No	
Frozen Mass Limits Possible?			Yes	
$cBOD_5$-Ammonia Linkage Eligible?	NA		No	
POLLUTANT / PARAMETER	Conc.	Mass	Conc.	Mass
$cBOD_5$, mg/L (kg/day)	25	34.3	25	34.3[1]
TSS, mg/L (kg/day)	30	41.2	30	41.2[1]
Fecal Coliform Organisms, orgs/100 mL	200 (Apr-Oct)	---	200 (Jan-Dec)	---
Ammonia-N (June 1 - September 30)	---	---	---	---
Ammonia-N (October 1 - November 30)	---	---	---	---
Ammonia-N (December 1 - March 31)	---	---	---	---
Ammonia-N (April 1 - May 31)	---	---	---	---
Dissolved Oxygen, mg/L	---	---	---	---
pH (Standard Unit)	6.0 - 9.0	---	6.0 - 9.0	---
Mercury[3]	---	---	---	---
Phosphorus, mg/L	---		1.0	
Phosphorus, kg/yr (12 month rolling avg)	---	1,160	---	1,160
Chloride, mg/L as Mo. Avg. (kg/day)	---	---	---	---

1. Mass limits associated with previous permit 0.84 MGD AWWDF frozen mass limits.
2. The disinfection limits would be required all year to ensure protection of the ORVW and ensure protection of water at the metro drinking water intakes.
3. Mercury limits and antidegradation analysis of mercury loading would not be required if frozen TSS mass limits are accepted.

Impaired Waters

There are numerous waters impaired for a variety of pollutants ranging from PFAS to mercury and nutrients. Not all of these impairments are relevant for any of the proposed scenarios. The impaired waters of primary importance for effluent limit setting are nutrients, TSS and fecal coliform and all three of these parameters have wasteload allocations in approved TMDLS. It would be very difficult and time intensive to officially modify these TMDLs for Big Lake to receive a larger wasteload allocation.

Phosphorus Details

The current facility has a 1,160 kg/yr 12-month moving total mass limit. The proposed facility has an average wet weather design flow (AWWDF) of 2.206 mgd (Table 2). The new facility will have an annual 1.0 mg/L concentration limit regardless of design flow (Minnesota Rule 7053.0255 subpart 3) because the AWWDF is greater than 1.0 MGD. The Mississippi River and Lake Pepin TMDL established an annual wasteload allocation of 1,160 kg/yr for the Big Lake WWTF (MPCA and Limnotech 2021). The annual mass limit for the proposed expansion is 1,160 kg/yr. As flows at the Big Lake WWTF increase, the facility will have to achieve well below 1.0 mg/L to comply with the 1,160 kg/yr annual mass limit.

Table 2. Total phosphorus (TP) effluent concentrations to achieve Lake Pepin based mass allocation of 1,160 kg/yr at proposed average wet weather design flows (AWWDF) and average dry weather design flows (ADWDF).

Design	flow (mgd)	TP mg/L	TP kg/d	kg/yr
Current AWWDF	0.958	0.8765	3.18	1,160
Current ADWDF	0.746	1.00	2.82	1,031
Proposed AWWDF 1	2.206	0.3805	3.18	1,160
Proposed ADWDF 1	1.413	0.594	3.18	1,160

The proposed expansion will continue to be to the Mississippi River. Kaufenberg (2017) found that the Lake Pepin based limits were sufficient to protect the Mississippi River reaches within the Mississippi River – St. Cloud Watershed. An antidegradation review for phosphorus is not needed since no additional mass of phosphorus is authorized from the proposed expansion.

Class 3 and 4 Water Quality Standards

In 2020 the MPCA submitted a rulemaking proposal to make changes to the existing class 3 and 4 water quality standards. On July 13th, 2021 these rules became effective in state law. The new draft class 3 and 4 standards now have translators effective (Class 3 & Class 4A) in rule that the MPCA must use to determine whether a discharger requires an effluent limit to protect the class 3 and 4 beneficial uses. These translators turn the protective narrative goals of the class 3 and 4A designated uses into enforceable numeric effluent limits. The MPCA does not expect that Big Lake will need a new limit because of these translators, but the MPCA must document that the translators were used upon issuing the permit.

Monitoring requirements

All municipal NPDES permit holders need to monitor for pH, TSS, CBOD5, and DO, fecal coliform. In addition, this permittee will have to monitor the following parameters at the frequencies specified in the table below. The WET testing and priority pollutant scans are required because the facility would become a Major facility (AWWDF > 1MGD).

Table 3 Additional required monitoring beyond standard monitoring

Analyte	Units	Options 1-3 Mechanical Frequency & Influent/Effluent
Mercury, Total	ng/L	4X per year I/E
Mercury, Dissolved	ng/L	4X per year I/E
TSS (grab w/Mercury)	mg/L	4X per year I/E
Ammonia nitrogen, Total	mg/L	4X per year E
Kjeldahl nitrogen, Total	mg/L	4X per year I/E
Nitrate/nitrite nitrogen	mg/L	4X per year I/E
TDS	mg/L	2X per year E
Sulfate	mg/L	2X per year E
Chloride	mg/L	---
Sodium, Calcium & Magnesium	mg/L, umhos/cm	---
Acute Wet Testing	NA	1X per Year
Priority Pollutant Scan	NA	3X per 5 yr cycle

Regulatory Certainty

In response to listening session comments, a voluntary option — part of the Governor's Community Water Infrastructure bonding investment package — would provide up to 20 years of regulatory certainty for wastewater treatment facilities that are willing to accept phosphorus and nitrogen effluent limits and design, construct, and fully operate a biological nutrient removal (BNR) treatment system[1],[2]. BNR systems remove both phosphorous and nitrogen, and are considered the best available technology for wastewater treatment. Indeed, BNR is the only known cost-effective wastewater removal technology for nitrate.

Once the BNR system is in place, the facility would not be required to comply with any new phosphorous or nitrogen limits, beyond those in their discharge permit, for the estimated useful life of the new BNR system. The proposal is linked to a bonding request for water infrastructure grants, and is intended to incentivize facility upgrades to BNR systems.

Communities that volunteer to participate by installing and operating BNR systems would no longer have to speculate what future nitrogen water quality standards might mean for them. Rather than needing to upgrade to meet phosphorus limits now and potentially upgrade again to meet nitrogen limits in five or ten years, communities that install a BNR system would comprehensively address all nutrients for up to 20 years and obtain regulatory certainty. Over time, communities could also save money by reducing both energy usage and the purchase of chemicals for phosphorus removal. Water quality in Minnesota lakes and rivers would also benefit from more treatment plants converting to the best available technology. Notably, we could get a jump on reducing nitrogen in state waters, years ahead of when we can institute a new nitrogen standard. And because Minnesota is home to the headwaters of the Mississippi River, the Great Lakes, and the Red River of the North, the impact of reducing phosphorus and nitrogen in the state will be felt in all our downstream waters, including the Hudson Bay, the Gulf of Mexico, and all the Great Lakes.

[1] Minnesota Statute 115.426

[2] Fact sheet on regulatory certainty

Antidegradation Assessments and Capped Mass Limits

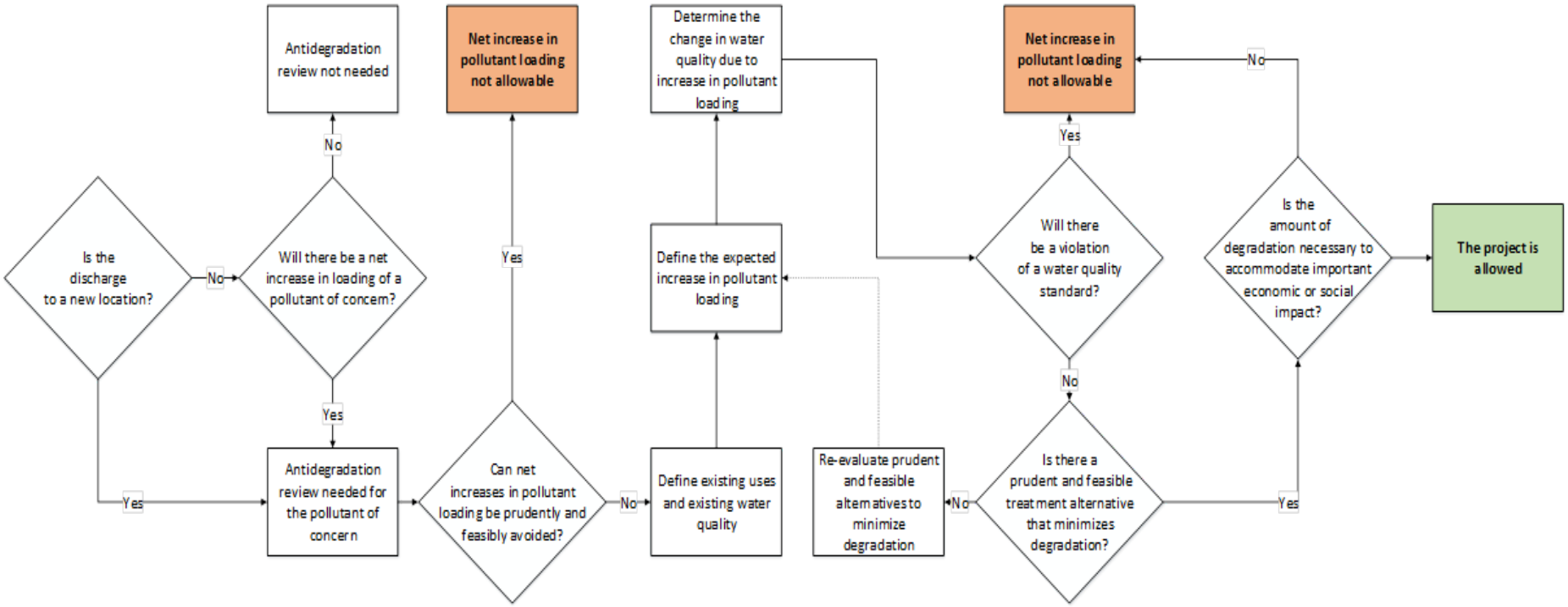
Antidegradation is one of the fundamental protections in the Clean Water Act, and all newly issued or re-issued wastewater permits must comply with both state and federal antidegradation Rules. The goal of antidegradation is to preserve waters of high quality and to ensure that they are not degraded unless balanced by important economic or social development. See Minn. R. 7050.0250 to 7050.0335. The antidegradation assessment process may result in more restrictive effluent limits.

For wastewater permitting, antidegradation concerns are triggered when a new discharge is proposed or when an existing discharger is proposing to increase the loading of any parameter of concern in its discharge. An antidegradation assessment is a substantial evaluation that must consider all beneficial uses of the receiving water, potential economic impacts, all possible treatment options and the potential environmental degradation for every pollutant that triggers the need for an antidegradation assessment. The applicant (permittee) must demonstrate that the chosen project alternative cannot be avoided and is the least degrading prudent and feasible alternative. The permittee must also examine the socioeconomic impacts of the project as compared to the environmental changes in water quality. The environmental degradation must be offset by the socioeconomic benefit. A flowchart summary of the antidegradation assessment process required by state rules (Minn. R. 7050.0280) can be seen below.

New and expanded NPDES permits that result in net increases in pollutant loading to surface waters are required to undergo an antidegradation review (Minn. R. 7050.0280). When applied to a proposed activity that is not regulated by an existing control document (i.e. permit), any loading or other causes of degradation resulting from the proposed activity constitute a net increase (7050.0255 Subp. 26). In this situation, the proposed new treatment system constitutes a net increase in loading; and therefore, an antidegradation review must be completed and approved in order for the effluent limitations to be final for the selected option.

The permittee must submit the antidegradation assessment to the Minnesota Pollution Control Agency (MPCA). MPCA staff will review the assessment to determine if it satisfies state and federal rules. The MPCA has recently developed a guidance document for developing antidegradation assessments that you may find helpful.

Antidegradation assessments frequently require permittees to perform additional water quality monitoring to ensure that appropriate water quality evaluations are performed. The water quality monitoring required for an antidegradation assessment is permit-specific and is intended to fill gaps in existing water quality knowledge. Filling these water quality gaps could require additional monitoring of the discharge, receiving waters upstream and downstream of the discharger or significant industrial users permitted by the discharger.



Summary of the antidegradation assessment process required by Minn. R. 7050.0280

Completing an antidegradation assessment can require a significant amount of time, data and writing effort. It is reasonable to expect at least six to twelve months of effort to complete an antidegradation assessment. The permittee is expected to complete the antidegradation assessment, but the MPCA must approve it as a part of permit documents. The MPCA is responsible for defending the assessment during public comment and in any future legal proceedings. Antidegradation assessments are frequently legally contested, and as such, the MPCA will only approve an assessment of high quality that complies with state and federal antidegradation rules. MPCA staff may provide assistance to the permittee with the antidegradation process.

Because of the workload associated with completing an antidegradation assessment, most permittees looking to expand their permitted flow rates choose to accept "frozen mass limits". "Frozen mass limits" represent the full authorized load in the previous permit for the pollutants of interest. If the permittee is willing to accept "frozen mass limits" while also expanding their flow rates, then the receiving water would receive no net increase in authorized loading because of the expansion, and an antidegradation assessment would not be needed for that parameter. In this scenario, permitted concentration limits would stay the same as in the last permit issuance, however "effective" concentration limits would be lower in order to comply with voluntary mass limits. If the permittee voluntarily accepts frozen mass limits for the pollutants of concern, they will have satisfied antidegradation rules for that parameter, and they will not need to submit an antidegradation assessment for that parameter.

It must be noted that the receiving water for Big Lake is a restricted outstanding resource value water and the requirements in Minn. R. 7050.0265 subp. 6 are applicable (see statute below).

> **Subp. 6.** Protecting restricted outstanding resource value waters.
>
> The commissioner shall restrict a proposed activity in order to preserve the existing water quality as necessary to maintain and protect the exceptional characteristics for which the restricted outstanding resource value waters identified under part 7050.0335, subparts 1 and 2, were designated.

This statute requires the MPCA to restrict loading to ORVW waters to a higher degree than for non-ORVW waters. The functional result of this statute to Big Lake is that it would be difficult to justify expanding the frozen mass limits for any parameter and Big Lake would be wise to consider accepting frozen mass limits as they are found in the current permit.

Chloride is the only pollutant of concern that must be addressed in an antidegradation review that doesn't currently have a limit in the permit. Big Lake will not receive a chloride limit in the current or future permit, but because of the expansion there will be a net increase in chloride loading. An antidegradation review must address this net increase in loading of chloride and demonstrate that the exceptional characteristics of the Mississippi River will be maintained. It would be prudent to collect at least five chloride samples in Big Lake's effluent to characterize Big Lake's current chloride loading and fulfill the requirements in Minn. R. 7050.0265 with regards to calculating changes in receiving water quality because of the expansion. The MPCA can provide surface water quality data that would help with this calculation and has attached the Otsego West antidegradation assessment that contains a similar calculation for reference.

Environmental Review

An Environmental Assessment Worksheet (EAW) is likely to be required for the expanded facility. This is because for the expansion the flow rate would increase by both 200,000 GPD and by >50% (Minn. R. 4410.4300 subp. 18b). Please contact current MPCA Environmental Review (ER) Wastewater Liaison (Kim Grosenheider) with questions on MPCA ER interpretation. More information can be found in Minn. R. 4410.4300 or at https://www.eqb.state.mn.us/content/mandatory-environmental-review-categories-legislative-assessment-report. A full environmental review is not likely to be needed.

According to the *Preliminary Effluent Limit Review Request* document, the building of a new continuous WWTP will not impact wetlands. If building of the WWTP were to result in the physical alteration of a wetland, then wetland mitigation sequencing in compliance with Minn. R. 7050. 0186 would be required.

References

Kaufenberg, L. 2017. Total phosphorus effluent limit review: Upper Subwatershed of the Mississippi River – St. Cloud Watershed. MPCA St. Paul 17 pp.

If you have any questions, comments or concerns, please contact me at 651-757-2665 or email me at *Scott.Kyser@state.mn.us*

Sincerely,

Scott Kyser, PE
Minnesota Pollution Control Agency
Environmental Analysis and Outcomes Division

Attachment 2

Summary of Monthly Flow and Load Demand

Building a Better World for All of Us®

MEMORANDUM

TO: Dan Childs

FROM: Jessica Hedin, PE (Lic. MN 41639)

DATE: March 25, 2023

RE: Big Lake Wastewater Treatment Facilities Plan, Summary of Monthly Flow and Load Demand
SEH No. BIGLK 167307 14.00

The following memorandum is a summary of the reported influent and effluent water quality samples summarized as monthly flow and load demand. Sampling information was provided by the City of Big Lake and serves as the basis of flow and load determination as described in the memorandum "Big Lake Wastewater Treatment Facilities Plan, Anticipated Flow and Load Demand" memorandum.

Refer to the tables on the following sheets for a monthly summary of the sampling information provided.

Table 1 – Summary of Monthly Average Flow and Load Demand as Reported by Big Lake, 2017

Month	Influent Monitoring Parameters							Effluent Monitoring Parameters					
	Total Flow	$cBOD_5$	TSS	Total P as P	$NO^-_2 + NO^-_3$ as N	TKN	TN as N	$cBOD_5$	TSS	Total P as P	$NO^-_2 + NO^-_3$ as N	TKN	TN as N
	(MGD)	(mg/L)	(mg/L)	(mg/L)	(mg/L)	(mg/L)	(mg/L)	(mg/L)	(mg/L)	(mg/L)	(mg/L)	(mg/L)	(mg/L)
January	0.681	283	42	6.5	ND	ND	ND	6.8	8.6	0.5	ND	ND	ND
February	0.662	315	25	5.6	ND	ND	ND	3.5	9.0	0.4	ND	ND	ND
March	0.640	348	17	6.0	ND	ND	ND	2.8	7.2	0.4	ND	ND	ND
April	0.656	319	36	6.3	ND	ND	ND	5.0	9.6	0.6	14.0	28.0	24.3
May	0.731	299	17	7.3	ND	ND	ND	2.6	6.5	0.5	ND	ND	ND
June	0.772	385	33	8.5	ND	ND	ND	4.4	9.8	0.8	ND	ND	ND
July	0.755	418	16	8.1	ND	ND	ND	2.5	7.0	0.7	ND	ND	ND
August	0.767	345	22	8.9	ND	ND	ND	3.0	7.1	0.8	ND	ND	ND
September	0.779	469	19	10.7	ND	ND	ND	2.8	5.9	0.7	23.8	3.5	1.3
October	0.806	455	19	9.8	ND	ND	ND	2.5	10.9	0.9	ND	ND	ND
November	0.760	327	21	7.8	ND	ND	ND	2.9	7.3	0.7	18.9	ND	ND
December	0.728	469	21	8.6	ND	ND	ND	3.0	6.6	0.8	ND	ND	ND
Average	0.728	369	24	7.8	ND	ND	ND	3.5	8.0	0.7	18.9	15.7	**12.8**
Minimum	0.640	283	16	5.6	ND	ND	ND	2.5	5.9	0.4	14.0	3.5	**1.3**
Maximum	0.806	469	42	10.7	ND	ND	ND	6.8	10.9	0.9	23.8	28.0	**24.3**

Notes:
$cBOD_5$: 5-day carbonaceous biochemical oxygen demand.
TSS: Total suspended solids.
TP: Total Phosphorus.
TKN: Total Kjeldahl Nitrogen.
1. ND: No data collected for parameter during reporting period.

Table 2 – Summary of Monthly Average Flow and Load Demand as Reported by Big Lake, 2018

Month	Influent Monitoring Parameters							Effluent Monitoring Parameters					
	Total Flow	$cBOD_5$	TSS	Total P as P	$NO^-_2 + NO^-_3$ as N	TKN	TN as N	$cBOD_5$	TSS	Total P as P	$NO^-_2 + NO^-_3$ as N	TKN	TN as N
	(MGD)	(mg/L)	(mg/L)	(mg/L)	(mg/L)	(mg/L)	(mg/L)	(mg/L)	(mg/L)	(mg/L)	(mg/L)	(mg/L)	(mg/L)
January	0.702	420	33	7.7	ND	ND	ND	5.5	9.8	0.8	ND	ND	ND
February	0.750	454	38	7.5	ND	ND	ND	5.9	12.5	0.7	ND	ND	ND
March	0.703	313	37	7.3	ND	ND	ND	5.3	7.0	0.7	ND	ND	ND
April	0.669	321	30	7.1	ND	ND	ND	5.3	10.0	0.7	0.6	32.8	31.2
May	0.727	327	40	9.2	ND	ND	ND	5.6	10.9	0.7	ND	ND	ND
June	0.718	472	16	9.0	0.05	87	25	2.4	6.8	0.7	21.9	2.7	ND
July	0.733	423	16	8.5	ND	ND	ND	2.4	5.2	0.8	ND	ND	ND
August	0.723	302	13	8.2	ND	ND	ND	2.0	6.0	0.8	ND	ND	ND
September	0.736	299	14	8.6	0.05	53	25	1.9	4.3	0.8	22.6	1.9	0.3
October	0.715	595	17	8.7	ND	ND	ND	2.4	5.1	0.8	ND	ND	ND
November	0.702	527	41	8.6	ND	ND	ND	6.7	9.0	0.7	ND	ND	ND
December	0.601	529	18	9.1	0.05	73	36	3.3	9.5	0.6	22.2	13.7	9.6
Average	**0.706**	**415**	**26**	**8.3**	**0.05**	**71**	**28**	**4.1**	**8.0**	**0.7**	**16.8**	**12.8**	**13.7**
Minimum	**0.601**	**299**	**13**	**7.1**	**0.05**	**53**	**25**	**1.9**	**4.3**	**0.6**	**0.6**	**1.9**	**0.3**
Maximum	**0.750**	**595**	**41**	**9.2**	**0.05**	**87**	**36**	**6.7**	**12.5**	**0.8**	**22.6**	**32.8**	**31.2**

Notes:
$cBOD_5$: 5-day carbonaceous biochemical oxygen demand.
TSS: Total suspended solids.
TP: Total Phosphorus.
TKN: Total Kjeldahl Nitrogen.
1. ND: No data collected for parameter during reporting period.

Table 3 – Summary of Monthly Average Flow and Load Demand as Reported by Big Lake, 2019

Month	Influent Monitoring Parameters							Effluent Monitoring Parameters					
	Total Flow	$cBOD_5$	TSS	Total P as P	$NO^-_2 + NO^-_3$ as N	TKN	TN as N	$cBOD_5$	TSS	Total P as P	$NO^-_2 + NO^-_3$ as N	TKN	TN as N
	(MGD)	(mg/L)	(mg/L)	(mg/L)	(mg/L)	(mg/L)	(mg/L)	(mg/L)	(mg/L)	(mg/L)	(mg/L)	(mg/L)	(mg/L)
January	0.652	475	26	8.8	ND	ND	ND	4.3	9.5	0.5	ND	ND	ND
February	0.672	452	25	7.9	ND	ND	ND	3.7	8.1	0.4	ND	ND	ND
March	0.717	436	30	7.3	ND	ND	ND	4.4	8.0	0.4	18.8	9.7	7.1
April	0.670	494	24	7.2	ND	ND	ND	3.9	8.3	0.6	ND	ND	ND
May	0.738	466	20	7.5	ND	ND	ND	3.0	6.9	0.5	ND	ND	ND
June	0.787	359	27	7.5	0.09	54	21	4.1	7.3	0.6	18.8	2.3	ND
July	0.795	272	13	5.7	ND	ND	ND	2.0	3.6	0.5	ND	ND	ND
August	0.771	246	11	7.2	ND	ND	ND	1.7	5.1	0.7	ND	ND	ND
September	0.777	299	11	7.2	0.05	56	26	1.7	5.0	0.5	24.0	2.2	0.2
October	0.831	312	15	7.3	ND	ND	ND	2.0	4.7	0.5	ND	ND	ND
November	0.783	261	15	5.6	ND	ND	ND	2.5	6.9	0.4	ND	ND	ND
December	0.764	295	35	6.5	0.05	48	30	3.2	9.4	0.4	27.6	2.8	ND
Average	**0.746**	**364**	**21**	**7.2**	**0.06**	**53**	**26**	**3.1**	**6.9**	**0.5**	**22.3**	**4.2**	**3.7**
Minimum	**0.652**	**246**	**11**	**5.6**	**0.05**	**48**	**21**	**1.7**	**3.6**	**0.4**	**18.8**	**2.2**	**0.2**
Maximum	**0.831**	**494**	**35**	**8.8**	**0.09**	**56**	**30**	**4.4**	**9.5**	**0.7**	**27.6**	**9.7**	**7.1**

Notes:
$cBOD_5$: 5-day carbonaceous biochemical oxygen demand.
TSS: Total suspended solids.
TP: Total Phosphorus.
TKN: Total Kjeldahl Nitrogen.
1. ND: No data collected for parameter during reporting period.

Table 4 – Summary of Monthly Average Flow and Load Demand as Reported by Big Lake, 2020

Month	Influent Monitoring Parameters							Effluent Monitoring Parameters					
	Total Flow	$cBOD_5$	TSS	Total P as P	$NO^-_2 + NO^-_3$ as N	TKN	TN as N	$cBOD_5$	TSS	Total P as P	$NO^-_2 + NO^-_3$ as N	TKN	TN as N
	(MGD)	(mg/L)	(mg/L)	(mg/L)	(mg/L)	(mg/L)	(mg/L)	(mg/L)	(mg/L)	(mg/L)	(mg/L)	(mg/L)	(mg/L)
January	0.775	259	92	5.8	ND	ND	ND	15.0	19.1	1.1	ND	ND	ND
February	0.749	290	65	6.6	ND	ND	ND	10.2	19.4	0.8	ND	ND	ND
March	0.726	263	41	7.3	ND	ND	ND	6.6	9.7	0.5	0.3	36.6	32.1
April	0.700	229	39	7.5	ND	ND	ND	6.4	9.9	0.4	ND	ND	ND
May	0.694	265	12	7.0	ND	ND	ND	2.0	4.3	0.3	ND	ND	ND
June	0.718	255	12	8.1	0.05	57	32	2.0	3.8	0.4	27.4	4.3	ND
July	0.746	330	13	8.6	ND	ND	ND	2.1	4.6	0.4	ND	ND	ND
August	0.752	317	13	8.3	ND	ND	ND	1.9	5.0	0.4	ND	ND	ND
September	0.724	301	20	7.9	0.13	42	23	3.0	9.2	0.4	22.0	1.4	0.2
October	0.698	283	13	7.9	ND	ND	ND	2.2	6.4	0.3	ND	ND	ND
November	0.727	266	9	8.0	ND	ND	ND	1.7	3.9	0.1	ND	ND	ND
December	0.659	270	11	8.0	0.28	60	34	2.0	5.6	0.2	31.9	1.8	ND
Average	**0.722**	**277**	**28**	**7.6**	**0.15**	**53**	**30**	**4.6**	**8.4**	**0.4**	**20.4**	**11.0**	**16.2**
Minimum	**0.659**	**229**	**9**	**5.8**	**0.05**	**42**	**23**	**1.7**	**3.8**	**0.1**	**0.3**	**1.4**	**0.2**
Maximum	**0.775**	**330**	**92**	**8.6**	**0.28**	**60**	**34**	**15.0**	**19.4**	**1.1**	**31.9**	**36.6**	**32.1**

Notes:
$cBOD_5$: 5-day carbonaceous biochemical oxygen demand.
TSS: Total suspended solids.
TP: Total Phosphorus.
TKN: Total Kjeldahl Nitrogen.
1. ND: No data collected for parameter during reporting period.

Table 4 – Summary of Monthly Average Flow and Load Demand as Reported by Big Lake, 2021

Month	Influent Monitoring Parameters							Effluent Monitoring Parameters					
	Total Flow	$cBOD_5$	TSS	Total P as P	$NO^-_2 + NO^-_3$ as N	TKN	TN as N	$cBOD_5$	TSS	Total P as P	$NO^-_2 + NO^-_3$ as N	TKN	TN as N
	(MGD)	(mg/L)	(mg/L)	(mg/L)	(mg/L)	(mg/L)	(mg/L)	(mg/L)	(mg/L)	(mg/L)	(mg/L)	(mg/L)	(mg/L)
January	0.661	360	17	8.2	ND	ND	ND	2.8	4.1	0.2	ND	ND	ND
February	0.732	327	25	7.3	ND	ND	ND	3.7	9.1	0.2	ND	ND	ND
March	0.645	413	16	7.0	ND	ND	ND	2.5	5.8	0.2	24.1	1.7	0.1
April	0.621	387	9	7.4	ND	ND	ND	1.6	3.6	0.4	ND	ND	ND
May	0.645	365	13	7.0	ND	ND	ND	2.2	4.5	0.5	ND	ND	ND
June	0.718	364	8	7.1	0.05	61	33	1.3	4.0	0.5	30.8	1.7	ND
July	0.738	324	7	7.6	ND	ND	ND	1.1	2.2	0.6	ND	ND	ND
August	0.733	310	6	8.1	ND	ND	ND	1.1	3.6	0.6	ND	ND	ND
September	0.728	335	9	6.4	0.05	67	41	1.5	4.4	0.5	39.4	2.0	0.3
October	0.683	289	7	7.1	ND	ND	ND	1.2	4.6	0.4	ND	ND	ND
November	0.719	283	11	7.5	ND	ND	ND	2.0	3.3	0.2	ND	ND	ND
December	0.761	283	7	7.1	0.18	53	23	1.2	2.3	0.1	22.2	0.7	ND
Average	**0.699**	**337**	**11**	**7.3**	**0.09**	**60**	**32**	**1.9**	**4.3**	**0.4**	**29.1**	**1.5**	**0.2**
Minimum	**0.621**	**283**	**6**	**6.4**	**0.05**	**53**	**23**	**1.1**	**2.2**	**0.1**	**22.2**	**0.7**	**0.1**
Maximum	**0.761**	**413**	**25**	**8.2**	**0.18**	**67**	**41**	**3.7**	**9.1**	**0.6**	**39.4**	**2.0**	**0.3**

Notes:
$cBOD_5$: 5-day carbonaceous biochemical oxygen demand.
TSS: Total suspended solids.
TP: Total Phosphorus.
TKN: Total Kjeldahl Nitrogen.
1. ND: No data collected for parameter during reporting period.

Table 5 – Summary of Monthly Average Flow and Load Demand as Reported by Big Lake, 2022

Month	Influent Monitoring Parameters							Effluent Monitoring Parameters					
	Total Flow	$cBOD_5$	TSS	Total P as P	$NO^-_2 + NO^-_3$ as N	TKN	TN as N	$cBOD_5$	TSS	Total P as P	$NO^-_2 + NO^-_3$ as N	TKN	TN as N
	(MGD)	(mg/L)	(mg/L)	(mg/L)	(mg/L)	(mg/L)	(mg/L)	(mg/L)	(mg/L)	(mg/L)	(mg/L)	(mg/L)	(mg/L)
January	0.858	268	13	7.0	ND	ND	ND	2.1	3.1	0.1	ND	ND	ND
February	0.813	348	20	7.0	ND	ND	ND	6.0	5.0	0.1	ND	ND	ND
March													
April													
May													
June													
July													
August													
September													
October													
November													
December													
Average	**0.836**	**308**	**17**	**7.0**	**ND**	**ND**	**ND**	**4.1**	**4.1**	**0.1**	**ND**	**ND**	**ND**
Minimum	**0.813**	**268**	**13**	**7.0**	**ND**	**ND**	**ND**	**2.1**	**3.1**	**0.1**	**ND**	**ND**	**ND**
Maximum	**0.858**	**348**	**20**	**7.0**	**ND**	**ND**	**ND**	**6.0**	**5.0**	**0.1**	**ND**	**ND**	**ND**

Notes:
$cBOD_5$: 5-day carbonaceous biochemical oxygen demand.
TSS: Total suspended solids.
TP: Total Phosphorus.
TKN: Total Kjeldahl Nitrogen.
1. ND: No data collected for parameter during reporting period.

ejm

c: Eric Miller, SEH Inc.
Colin Marcusen, SEH Inc.

x:\ae\b\biglk\167307\4-prelim-dsgn-rpts\tech memos\facilities plan anticipated flow and load review\20230325 attachment 2 big lake wastewater treatment facilities plan, summary of monthly flow and load demand.docx

Attachment 3

MPCA Flow and Load Determination Guidance

Design flow and loading determination guidelines for wastewater treatment plants

Introduction

Determination of design flow and loadings is one of the most important items when planning a new or expanded wastewater treatment facility. Sound engineering judgement along with these minimum guidelines will determine the hydraulic and pollutant load capacity required by the proposed facility to meet all permitted limits.

All influent sources must be accounted for when completing design flow and loading determination including residential, seasonal, institutional, commercial, industrial, inflow, infiltration, any recycle streams, and any other unique aspect of flow and pollutant contributions. During the treatment facility design process, possible impacts of design flows and loadings on each upstream and downstream unit process should be considered.

Definitions

Existing flow data for critical low and peak wet weather events are used to estimate the following flow conditions critical to the design of wastewater treatment plants.

Term	Definition
ADW	**Average dry weather** flow is the daily average flow when the groundwater is at or near normal and a runoff condition is not occurring.
AWW	**Average wet weather** or peak month flow is the daily average flow for the wettest 30 consecutive days for mechanical plants or for the wettest 180 consecutive days for controlled discharge pond systems. The 180 consecutive days for pond systems should be based on either the storage period from approximately November 15 through May 15 or the storage period from approximately May 15 through November 15.
PHWW	**Peak hourly wet weather** **Existing collection system:** flow is the peak flow during the peak hour of the day at a time when the groundwater is high and a five-year one-hour storm event is occurring. To determine this five-year one-hour storm event for a specific location, please refer to Map Number 1. **New collection system:** 2.5 or higher multiplier or AWW for residential, commercial + peak hourly industrial. (Ten States Standards Figure 1, Chapter 10)
PIWW	**Peak instantaneous wet weather** **Existing collection system:** flow is the peak instantaneous flow during the day at a time when the ground water is high and a twenty-five year one-hour storm event is occurring. To determine the twenty-five year one-hour storm event for a specific location, please refer to Map Number 2. **New collection system:** 2.5 or higher multiplier or AWW for residential, commercial + peak hourly industrial. (Ten States Standards Figure 1, Chapter 10)

Minimum design requirements

Table 1 contains a summary of the minimum recommended flow and loading conditions for only a select group of processes. Specific design parameter details for individual treatment process units shall be in accordance with **Ten States Standards.**

Where the Minnesota Pollution Control Agency (MPCA) determines that the above design flow considerations will not provide adequate protection to the receiving waters, facility capacity in excess of peak instantaneous wet weather and/or organic loading calculation may be required.

Table 1: Design conditions summary.

Item	Design
Collection system	Must be capable of transporting all flow to the treatment facility without bypassing.
Lift station	Must be capable of transporting all flow to the treatment facility without bypassing.
Flow equalization basin	If PHWW/ADW > 3, or if PHWW/AWW > 3, flow equalization must be considered. If equalization is not provided, a discussion of how the facility will handle the transition in flow must be included. See flow equalization section of this document.
Facility piping and pumping	PIWW
Preliminary treatment unit (screens, grit removal, influent filters, etc.)	PIWW
Clarifiers (surface settling rate and weir loading rate)	PHWW + recirculation flow see "Ten States Standards"
Disinfection (detention time)	PHWW see (Ten States Standards)
Organic loading	Minimum BOD of 0.17 #pcd plus commercial, industrial, and other non-residential flow Minimum TSS of 0.20 #pcd plus commercial, industrial, and other non-residential flow

Design flows

Actual flow data should be used to determine design flow when possible. At a minimum, 100 gallons per capita per day should be used. Include the following information with design flow calculations.

- Data used and data excluded. At least 5-years of facility flow records should be evaluated. Extreme wet or dry weather events may be excluded where appropriate. Map 1 and 2 can be used to analyze wet weather events to determine if an event exceeds the rainfall event for design purposes.
- Water use information, particularly during dry weather flow periods.
- Total and per capita pollutant loadings during a range of flow events.
- Reliability of flow monitoring equipment, pump station performance and methods used to estimate flow reductions or contributions from inflow and infiltration.

Discussion of a method to use when existing flow data is and is not available is included below.

New treatment system and new collection system (no existing flow data)

Use Table 2 for flow calculations. Table 3 should be used to determine the design loadings for a new or upgraded wastewater treatment plant. Table 2 and 3 can also be found electronically in Excel format here: https://www.pca.state.mn.us/sites/default/files/wq-wwtp5-20a.xlsx

For mechanical plants, if the industrial flow varies during the day or week, the design flow should be based on the average flow on the peak day during the period when the industry or industries are operating. This condition is called "rated flow." For example, if the industry discharges 10,000 gallons over eight of the twenty-four hours, the rated flow is 30,000 gallons per day. For controlled discharge pond systems, if the industrial flow varies during the day or week, the average design flow may be based on a weekly average.

The MPCA may approve of an alternative flow design with appropriate justification. For determining the design of the collection system (including design flow), refer to Chapter 30 of Ten State Standards).

Some form of permit "control language" may be included for wastewater treatment facilities if the per capita design flow is less than what is recommended in this document. For this situation, it may become a permit violation when the permitted design flow is reached. Violation of the permitted flow could result in "no more connections" being allowed to the system, or the requirement for submittal of a report that examines the flow in comparison to the number of connections and the number of people using the system. The permittee could also be required to plan, design, and build additional treatment units upon reaching the design capacity.

Existing treatment systems and collection system (existing flow data)

For a mechanical plant, the attached Table 2 should also be used to determine the peak hourly wet weather flow, the peak instantaneous wet weather flow, the average dry weather flow, and the average wet weather flow.

Part A of Table 2 and Figure 1 are used to determine the peak hourly wet weather flow. The measured flow should be plotted for a twenty-four hour period when **groundwater is at or near normal and a runoff condition is not occurring** (Curve X on Figure 1). This should include flows data from overflows, bypasses, and emergency pumping events. The ground water elevation in relation to the sewer elevation should be noted. The present peak hourly dry weather flow is indicated by point (1) on Figure 1, and row 1 in Table 2.

The measured flow should be plotted for a twenty-four hour period when **groundwater is high and a runoff condition is not occurring** (Curve Y). This should include overflow, bypasses, and emergency pumping. The ground water elevation in relation to the sewer elevation should be noted. Point (2) on Figure 1 and row 2 in Table 2 is the peak hourly flow during a high groundwater period when a runoff condition is not occurring. The peak flow at point (2) minus the present peak hourly dry weather flow at point (1) is the peak hourly infiltration.

The measured flow should be plotted for a twenty-four hour period when the **groundwater is high and a runoff condition is occurring** (Curve Z). This should include flow data from overflows, bypasses, and emergency pumping events. The amount of rainfall and its duration should be plotted on the same graph. The peak inflow is represented by the greatest distance between Curve Y and Curve Z. The present hourly flow at the point of greatest distance between Curve Y and Z [point (5) on Figure 1 and row 5 in Table 2] minus the present hourly flow during high ground water at the same time of day on Curve Y [point (6) on Figure 1 and row 6 in Table 2] is the peak hourly inflow.

It may be necessary to adjust the measured flow based on a relationship between the data attained during a major storm event and the five-year one-hour designed storm event. Items (10) and (13) in Table 2 are determined through a cost effectiveness evaluation. The gallons per capita per day (gpcd) contribution for population increase in item (15), (25), (33), and (41) should all be 100 gpcd.

Part B of Table 2 determines the peak instantaneous wet weather flow. The present peak hourly inflow adjusted for a five-year one-hour rainfall event [see part A row (8)] is subtracted from the peak hourly wet weather flow [see part A row (19)]. To this number, add the present peak hourly inflow adjusted for a twenty-five year one-hour storm event. The resulting number is the peak instantaneous wet weather flow.

Part C of Table 2 determines the average dry weather flow. The present average dry weather flow (24) is the average flow received over a twenty-four hour period when the ground water is at or near normal and a runoff condition is not occurring. If the industrial flow varies during the day or week, the present average dry weather flow should be based on the average flow of the peak day during the period when the industry or industries are operating (rated flow). This also applies to the average flow from industrial increases.

Part D of Table 2 determines the thirty-day average wet weather design flow. The average infiltration and inflow after rehabilitation (where rehabilitation is cost effective) is the wettest thirty-day average. The amount of infiltration after rehabilitation averaged over the thirty wettest days should be the same or nearly the same as the peak infiltration after rehabilitation. This is due to the fact that the ground water could stay high for a fairly extended period of time. The amount of inflow after rehabilitation averaged over the thirty wettest days depends on the type of sources, their location, the amount of rainfall that affects the source, etc.

Part E of Table 2 correlates all related information that can impact the degree of accuracy of the determination of design flows. It is recommended that a minimum of six months of accurate data be recorded. Data associated with the critical peak wet weather flow events for a sustained wet weather period are essential for accurate estimation of design flows. Critical peak wet weather flow events typically occur in the spring (March-June) and must include the condition of high ground water with inflow.

Controlled discharge pond systems with existing sanitary sewer systems

The peak hourly wet weather and the peak instantaneous wet weather design flows to a pond system with an existing sanitary sewer system are arrived at in the same manner as in Parts A and B of the previous section. If the present industrial flow varies during the day or week, the present average dry weather flow (24) and (30) may be based on a weekly average. When computing the average wet weather flow, the average infiltration after rehabilitation (31), and the average inflow after rehabilitation (32) are averages over the wettest 180 consecutive days.

Flow equalization

This section applies to all treatment facilities except pond systems.

If the ratios described below are three or more, flow equalization should be considered. If flow equalization is not employed, an explanation must be provided describing how the facility will handle the transition from these average design flows to peak hourly wet weather design flow.

A. During a period of high ground water for that area and system, calculate the ratio of peak hourly wet weather design flow to average wet weather design flow [which is (19) divided by (37)]

B. During a normal ground water period, calculate the ratio of the peak hourly design flow during the five-year one-hour storm event [(1)+(14)+(15)+(17)+(18)] to the average dry weather design flow (29).

Infiltration and inflow

Infiltration and inflow (I/I) is a part of every collection system and must be taken into account in the determination of an appropriate design flow.

Inflow means water other than wastewater that enters a sewer system directly from sources such as roof leaders, foundation drains, yard drains, manhole covers, cross connections between storm sewers and sanitary sewers, catch basins, storm water runoff and other drainage structures.

Infiltration means water other than wastewater that enters the sewer system from the ground through defective pipe, pipe joints, and manholes.

Excessive infiltration means the quantity of flow that is more than 120 gpcd (domestic base flow and infiltration).

Excessive inflow means the quantity of flow during storm events that results in chronic operational problems related to hydraulic overloading of the treatment system or that results in a total flow of more than 275 gpcd (domestic and industrial base flow plus infiltration and inflow). Chronic operational problems may include surcharging, backups, bypasses, and overflows.

Bypasses/overflows and releases

Determining the design flow is one of the most challenging parts of the design process. It is not cost effective to design a system that can capture and treat flows from every extreme event, however, bypasses, overflows and releases of any kind are prohibited by permit and rules.

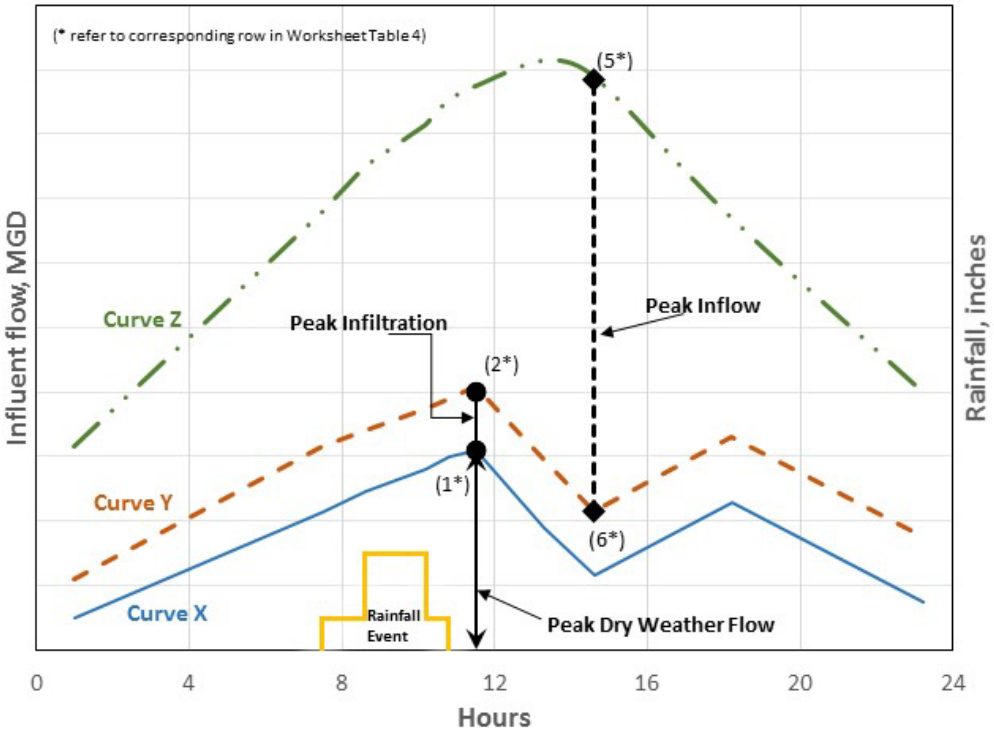
For more information

Please contact the engineer assigned to the project or district. If the engineer is unknown, contact the Customer Assistance Center.

MPCA 651-296-6300

Toll-free 800-657-3864

Figure 1: Determination of peak hourly flows before adjustment for storm event.



- Curve X: 24 hour flow with NORMAL groundwater conditions and no runoff
- Curve Y: 24 hour flow with HIGH groundwater conditions and no runoff
- Curve Z: 24 hour flow with HIGH groundwater conditions and runoff

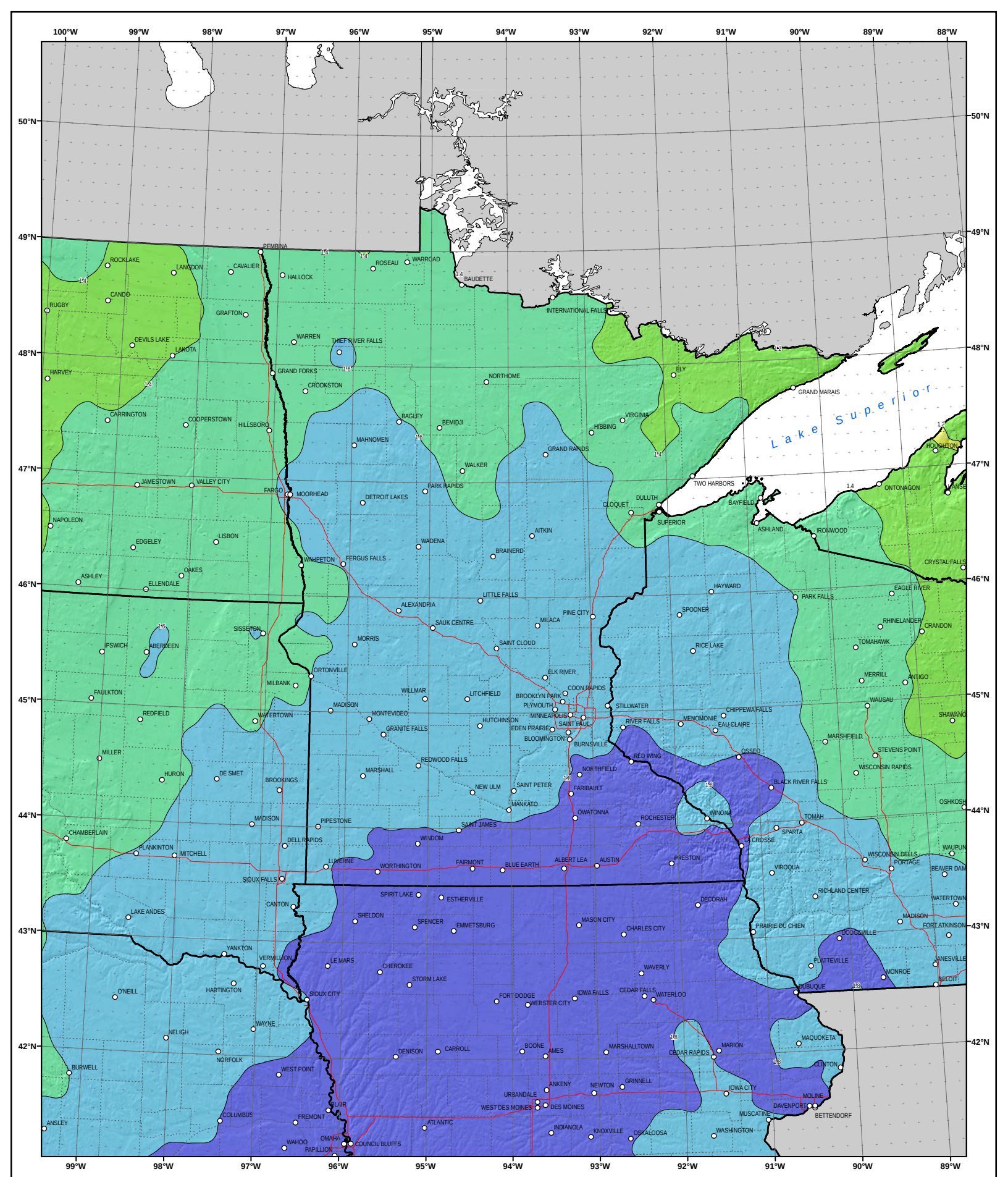
All of these flows should include any bypassing, overflows or bypass pumping.

For more detail see discussion in previous pages.

Note: All flow measurements taken at treatment plant with adjustments for bypasses, overflows and emergency pumping. Groundwater elevation in relation to sewers should be stated for several points in the sewer system. Dates of flow measurements should be stated.

Design Flow and Loading Determination Guidelines for Wastewater Treatment Plants (Table 2 and 3): https://www.pca.state.mn.us/sites/default/files/wq-wwtp5-20a.xlsx

Map 1 and Map 2 are taken from the NOAA website. An interactive site specific map can also be used. Found here: https://hdsc.nws.noaa.gov/hdsc/pfds/pfds_map_cont.html?bkmrk=mn



NOAA Atlas 14, Volume 8, Version 2
Midwestern States

MINNESOTA

Isopluvials of 5-year 60-minute precipitation in inches

SCALE 1:2,250,000

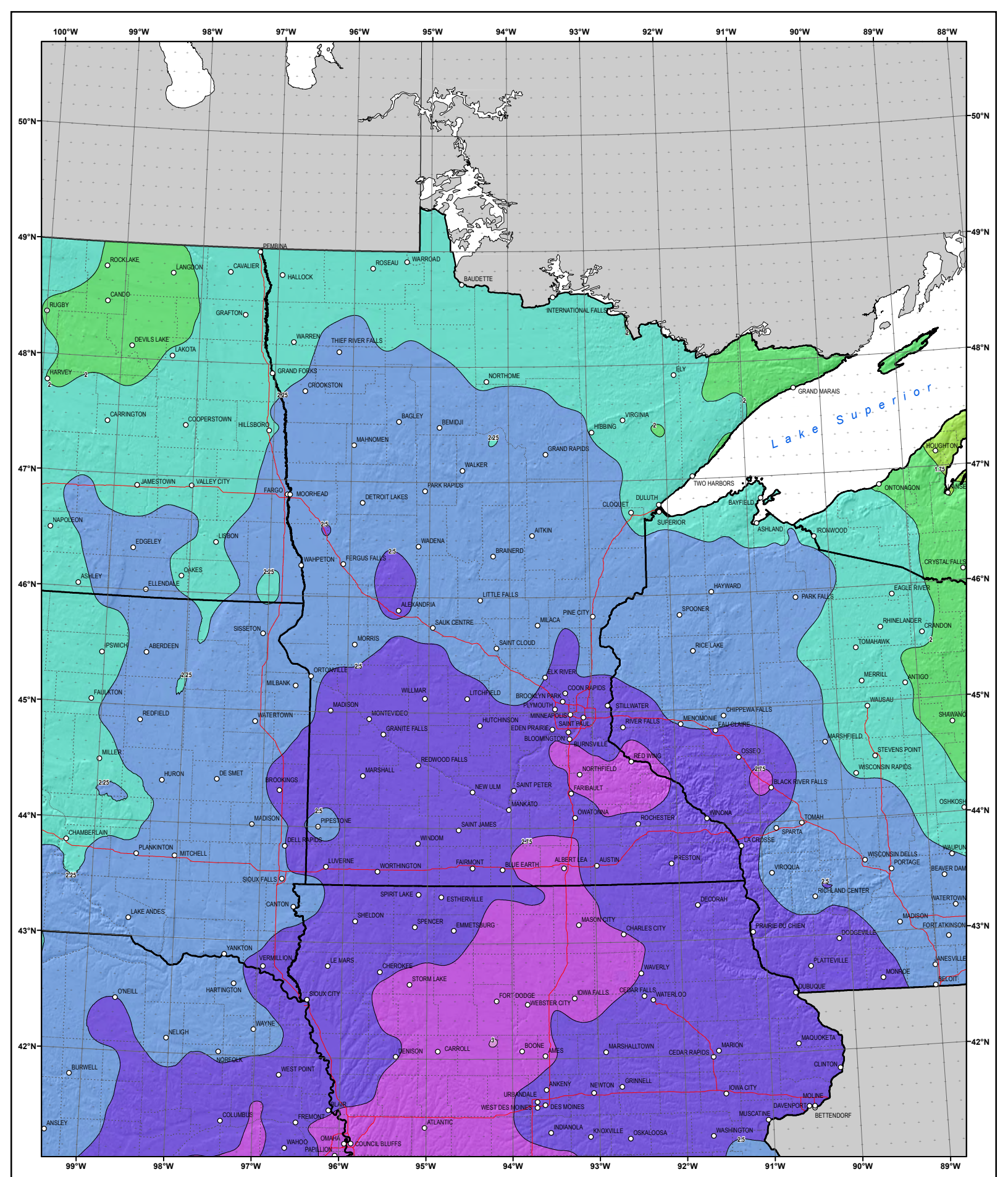
Prepared by U.S. DEPARTMENT OF COMMERCE
NATIONAL OCEANIC AND ATMOSPHERIC ADMINISTRATION
NATIONAL WEATHER SERVICE
OFFICE OF HYDROLOGIC DEVELOPMENT
HYDROMETEOROLOGICAL DESIGN STUDIES CENTER
April 2013

0 5 10 20 30 Miles
0 10 20 40 60 Kilometers

Projection: Lambert Conformal Conic; Datum NAD83; Standard Parallels: 44°N and 48°N; Central Meridian 94.5°W.

0.47 - 0.60 | 0.61 - 0.80 | 0.81 - 1.00 | 1.01 - 1.20 | 1.21 - 1.40 | 1.41 - 1.60 | 1.61 - 1.80 | 1.81 - 2.00 | 2.01 - 2.20 | 2.21 - 2.40 | 2.41 - 2.45

Legend based on entire Volume 8 project area.



NOAA Atlas 14, Volume 8, Version 2
Midwestern States

MINNESOTA

Isopluvials of 25-year 60-minute precipitation in inches

SCALE 1:2,250,000

0.74 - 0.75 | 1.26 - 1.50 | 2.01 - 2.25 | 2.76 - 3.00
0.76 - 1.00 | 1.51 - 1.75 | 2.26 - 2.50 | 3.01 - 3.25
1.01 - 1.25 | 1.76 - 2.00 | 2.51 - 2.75 | 3.26 - 3.33

Legend based on entire Volume 8 project area.

0 5 10 20 30 Miles
0 10 20 40 60 Kilometers

Projection: Lambert Conformal Conic; Datum NAD83; Standard Parallels: 44°N and 48°N; Central Meridian 94.5°W.

Prepared by U.S. DEPARTMENT OF COMMERCE
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HYDROMETEOROLOGICAL DESIGN STUDIES CENTER
April 2013

C-2 – Facilities Plan Capacity and Condition Evaluation

Building a Better World for All of Us®

MEMORANDUM

TO: Dan Childs

FROM: Jessica Hedin, PE (Lic. MN 41639)

DATE: March 20, 2023

RE: Big Lake Wastewater Treatment Facilities Plan, Capacity and Condition Evaluation
SEH No. BIGLK 167307 14.00

The purpose of this memorandum is to evaluate the capacity of the current wastewater facilities to meet the anticipated design year flow and load demand. Each treatment process at the wastewater treatment facility (WWTF) was reviewed for suitability.

BASIS OF DESIGN

A basis of design was developed for treatment processes and utilized to determine if the process has sufficient capacity to meet the anticipated flow and/or load demand anticipated at the design year. Each treatment process may have a distinct set of flow and load requirements based on the process requirements, location of the treatment process in the overall facility, return and side streams, and accepted design practices.

Attachments 1 and 2 include the liquid and solids current and anticipate flow and load demand which serves as a basis of capacity evaluation and for solicitation of equipment as part of the alternatives analysis.

Attachment 3 includes the condition assessment survey for facilities which was completed during visits to the facilities and serves as a reference for the condition of existing facilities, and criticality of those facilities in meeting effluent water quality limitations.

Wastewater Influent Characteristics

The liquids treatment unit process capacity analyses were performed based on the current influent wastewater characteristics observed for the time period including January 2017 to February 2022. To determine if additional capacity is available, the treatment potential for each process was compared to the future flows and loadings. Refer to the Technical Memorandum *Big Lake Wastewater Treatment Facilities Plan, Flow and Load Determination* for more detail regarding the development of these flows and loads.

The influent wastewater characteristics includes flows and loads from all external sources to the wastewater facility, which includes:

- Domestic wastewater contributors,
- Commercial Wastewater contributors,
- Institution wastewater contributors,
- Industrial wastewater contributors, and
- Septage receiving.

LIQUID AND SOLID TREATMENT PROCESS CAPACITY AND CONDITION EVALUATION ELEMENTS:

- Liquid Treatment Processes
  - Main Lift Station
  - Preliminary Treatment
    - Screening
    - Grit Removal
    - Influent Flow Measurement
  - Secondary Treatment
    - Selector Basins
    - Oxidation Ditches
    - Secondary Sedimentation
    - Chemical Phosphorus Removal
  - Finishing and Discharge
    - Disinfection
    - Effluent Flow measurement
    - Outfall
- Solid Treatment Processes
  - Biosolids Stabilization
    - Waste Sludge Storage
    - Aerobic Digestion
    - Liquid Biosolids Storage
  - Biosolids Dewatering
    - Biosolids Thickening
    - Biosolids Drying
  - Other Considerations
    - Administration
    - Vactor Receiving
    - Utilities

Minor contributing flow and load sources such as seal water, small quantity wash water, and lab fixtures are not considered as part of the capacity evaluation. Detailed flow and load calculations are included as part of process design during the preparation of Plans and Specifications. A facilities plan accomplishes a high-level review of suitability of existing processes for anticipated design flow and load demand.

NPDES/SDS Effluent Permit Limitations

The Big Lake WWTF is regulated by the National Pollutant Discharge Elimination System (NPDES) permit number MN0041076. Table 1 on the following page summarizes the effluent limits at the current AWW design flow of 0.958 MGD and anticipated future effluent limits as indicated by frozen mass limits provided by a preliminary effluent limit request response letter furnished by the MPCA. The preliminary effluent limit request response letter from the Minnesota Pollution Control Agency (MPCA) is dated November 2, 2022 and is included in attachment 4 of this memorandum. The initial preliminary effluent response requested limits for a design flow of approximately 2.2 MGD. The design flow has been revised to 1.682 MGD, which corresponds to the limitations in this memorandum.

Table 1: Current and Anticipated NPDES/SDS Effluent Permit Limitations

Parameter	Current Effluent Limit		Anticipated Effluent Limit [6]	
	Month [1]	Week [2]	Month [1]	Week [2]
$cBOD_5$ load, kg/d	34.3	54.9	34.3	54.9
$cBOD_5$ concentration, maximum, mg/L	25.0	40.0	25.0	40.0
$cBOD_5$ concentration, at AWW flow, mg/L[5]	10.8	17.3	5.4	8.6
$cBOD_5$ percent removal	85% min		85% min	
TSS load, kg/d	41.2	61.7	41.2	61.7
TSS concentration, maximum, mg/L	30	45	30	45
TSS concentration, at AWW flow, mg/L[5]	10.8	17.3	6.5	9.7
TSS percent removal	85% min		85% min	
TP, kg/year	1160 [3]		1160 [3]	
TP load, kg/d [5]	3.2		3.2	
TP concentration. at AWW flow, mg/L[5]	0.5		0.5	
pH, SU	6.0 – 9.0 [4]		6.0 – 9.0 [4]	
Fecal Coliform, MPN (geometric mean)	200		200	

Notes:
1. Denotes Calendar Month Average effluent permit limitation.
2. Denotes Calendar Week Average effluent permit limitation.
3. 12-Month Moving Total effluent permit limitation.
4. Each Sample effluent permit limitation.
5. Parameter is not included in effluent permit limitation, but is the calculated equivalent to meet required effluent limitations.
6. Corresponds to a concentration as the design flow of 1.682 MGD AWW flow based on the frozen mass limits indicated in the preliminary effluent request response letter furnished by the MPCA.

LIQUID TREATMENT CAPACITY REVIEW

Liquid treatment at the facility is considered the “main line” treatment for influent wastewater. Liquid treatment includes influent entering the head of the treatment facility through the discharge outfall into the receiving water. For Big Lake, this can generally be outlined as:

- Conveyance
- Preliminary Treatment
- Secondary Treatment
- Finishing and Discharge

The following sections will review each liquid treatment process in greater detail for suitability to meet the anticipated future flow and load capacity.

Conveyance

The conveyance at Big Lake consists of the following treatment processes:

- Old Main Lift Station
- Main Lift Station
- Influent Forcemain

Wastewater generated in the community is collected through a gravity collection system. The gravity system conveys wastewater to a main lift station. Wastewater is then pumped through one of two forcemains to the preliminary treatment building at the wastewater treatment facility.

Condition-Related Issues

The main lift station was constructed in 2001 and has a number of condition related issues including:

- Interior process piping, equipment, and architectural coatings.
- Frequent ragging and grease accumulation.

- Automatic controls including programmable logic controllers (PLCs) with human machine interface (HMI) displays for remote control and monitoring.
- Automatic transfer switch for backup generator.

Old Main Lift Station

The old main lift station which was replaced by the current main lift station is abandoned-in-place. The existing old main lift station is recommended for demolition. Its removal would eliminate the existing facilities, which are degrading and pose a concern for safety.

Main Lift Station

The main lift station is located approximately 1 mile from the WWTF. The lift station was constructed in 2009, at which time the existing main lift station was decommissioned. The existing main lift station remains in place and is recommended for removal due to condition and compliance with modern building code requirements.

The main lift station consists of the wetwell with four submersible pumps, a piping and instrumentation room, and a generator room. Two 20 horsepower (HP) pumps discharge to an 8-inch forcemain, and the two 43 HP pumps discharge to a 12-inch force main. The 20 HP pumps have a design maximum flow rate of 470 gallons per minute (gpm) per pump and provide a combined flow of 600 gpm with both units operating. The 43 HP pumps have a design maximum flow rate of 1,530 gpm per pump. The MPCA requires the lift station to be able to handle peak hourly wet weather design flow with the largest unit out of service, therefore the consideration for operating both high flow pumps simultaneously is not considered when evaluating design capacity.

Accommodations to provide a future 16-inch force main are provided. Flow through each force main is measured separately by magnetic flowmeters. The main lift station is configured to achieve the current permitted peak hourly flow of 2.204 MGD (1,530 gpm) with one high flow pump in service.

The main lift station has a 100 kW/125 kVA emergency backup generator.

Influent Forcemain

The main lift station discharges to an 8-inch forcemain and a 12-inch high flow forcemain. Both forcemains were reused as part of the 2009 main lift station construction project. There are three air relief structures on each of the 8-inch and 12-inch forcemains. The relief valves are no longer serviceable and should be replaced.

Force main capacity is a function of velocity and head loss. Ten States Standards for Wastewater Facilities (2014 Edition) recommends a liquid velocity through forcemains of 4 feet per second (fps) to 8 fps and not less than 4-inches in diameter.

At the existing design flows, the 8-inch forcemain has a liquid velocity of 2.8 fps with one 20 HP pump operating and 3.5 fps with both operating. The 8-inch forcemain reaches a fluid velocity of 8.0 fps at a design flow of 1,350 gpm. 1,350 gpm corresponds to a daily flow rate of approximately 1.94 MGD. The forcemain may be utilized effectively up to this flow condition.

At the existing design flows, the 12-inch forcemain has a liquid velocity of 4.0 fps with one 43 HP pump operating. At the anticipated flow demand of 3,040 gpm, the anticipated liquid velocity would be 8.1 fps. The forcemain has sufficient capacity for the future flow condition, though the liquid velocity is on high-end of suitability and replacement of the forcemain may be considered.

Summary

The following summarizes the review for conveyance at the future anticipated flow and load demands:

- 20 HP submersible pumps are insufficient for the design year flow demand..
- 43 HP high flow submersible pumps insufficient for the design year flow demand.
- Coarse bubble aerator and regenerative blower to reduce ragging and grease accumulation.
- Replace isolation valve, relief valve, piping, and accessories for existing forcemains.
- Forcemain:
  - 8-inch forcemain will likely be undersized based on high flow pump operation.
  - 12-inch high flow forcemain may be reused for regular flow.
  - A new forcemain will likely need to be furnished to economically meet wastewater flow demand. A phasing approach is recommended to meet minimum flow velocity at startup of new equipment.
- Condition related improvements as noted.

Preliminary Treatment

The preliminary treatment at Big Lake consists of the following treatment processes:

- Screening
- Grit Removal
- Influent Flow Measurement

Preliminary Treatment at the Big Lake facility is done at the Preliminary Treatment Building. Influent is split between one of two rotary drum screens. The screens remove, wash, and compact solids. Wash waster is returned to the screen channel and screenings are collected in a bin for disposal. Screened wastewater then flows to a vortex grit basin. Grit is collected at the bottom of the basin and pumped to a classifier, separated, and washed. Overflow is returned to the screen channel and grit is collected in a bin for disposal. Wastewater then flows through a Parshall flume with ultrasonic level measurement which is used as the basis of influent flow reporting. Influent is sampled via automatic sampler from this location. Wastewater flows by gravity after measurement to secondary treatment.

Condition-Related Issues

The Preliminary Treatment Building was constructed in 2009 and has a number of condition related issues including:

- Electric unit heaters.
- Makeup air unit.
- Plumbing piping, fittings, hangers, and accessories.
- Interior process piping, equipment, and architectural coatings.
- Automatic controls including programmable logic controllers (PLCs) with human machine interface (HMI) displays for remote control and monitoring.
- Automatic sampler.
- Influent flow measurement instrumentation.
- Exterior personnel and overhead doors.

Screening

The preliminary treatment building as originally constructed in 2009. Since then, the original screens have been replaced as part of a 2011 improvements project with drum type screens. The screens have 1/4-inch perforated plate screens with wash water and a compacting system. The screens have an odor control surround installed.

Operators have reported issues with rags and other debris bypassing the screening system and accumulating in downstream treatment process, such as the biosolids processing facility. The wash water also no longer works for the screens due to condition. Secondary treatment alternatives which have been identified by the City include process intensification such as Integrated Fixed-Film Activated Sludge

(IFAS) systems. Depending on the alternative reviewed, the 1/4-inch would be sufficient for removal of debris to protect the media included with these alternatives, however other alternatives such as Membrane Bioreactors (MBRs) would require an additional 1 or 2 mm screening step.

The screens are installed in 4'-0" wide channels with 4'-2" channel depth. Upstream floats are used to trigger screen wash in additional to automatic controls. Each screening channel has an upstream and downstream isolation stop plate.

The design capacity of the preliminary treatment building is 7.0 MGD, however the capacity of individual process equipment may be larger. This nominal capacity is sufficient for the anticipated wastewater flow demand.

Grit Removal

The grit removal basin was constructed as part of the preliminary treatment building in 2001. The grit basin has a 10'-0" diameter upper chamber and 5'-0" diameter lower chamber. The upper chamber is 5'-0" to finished floor, and lower chamber is 5'-6" lower than the upper chamber. The vortex drive unit was installed in 2011. A single grit pump conveys grit from the lower chamber to the cyclone of a grit classify and washer. The grit pump has been replaced since the 2011 project. The grit washer and classifier were also replaced in 2011.

The vortex grit drive and mechanism appear to be in good working condition. Operators have mentioned wanting a redundant grit pump as when the current pump was replaced, they were unable to operate the grit removal system as the equipment had a long lead time. The grit washer appears to be in good condition, however the classifier is recommended to be replaced due to age and condition.

Influent Flow Measurement

Influent flow measurement is read at a Parshall flume in the preliminary treatment building. The Parshall flume is an 18-inch flume and was installed as part of the 2001 improvements project. The flume is in good working order; however, the level instrumentation is near the end of its anticipated service life.

An 18-inch Parshall flume is suitable up to approximately 11,000 gpm of flow measurement. The anticipated PIWW flow demand is 3,100 gpm, which is well below the capacity of the flume for measurement.

The flow measurement is used for flow-paced sampling by the influent sampler. The existing length of suction tube results in frequent issues with the automatic sampler.

The facility receives influent flow for two industrial users. An online influent pH meter after preliminary treatment may be useful in determining if non-compliant wastewater has been discharged to the facility and allow for staff to adjust operation accordingly.

Summary

The following summarizes the review for preliminary treatment at the future anticipated flow and load demands:

- Replace influent screens, washers, and compactors with system suitable for recommended secondary treatment alternative.
- Add redundant grit pump.
- Replace grit classify and washer cyclone.
- Add recirculation submersible pump after flow measurement to a sample chamber on wall in screen room opposite automatic sampler.
- Add online pH meter after flow measurement.
- Condition related improvements as noted.

Secondary Treatment

The secondary treatment at Big Lake consists of the following treatment processes:

- Selector Basin
- Oxidation Ditch
- Secondary Sedimentation
- Chemical Phosphorus Removal

The selector basin is continuously mixed, combining influent flow, return activated sludge, and other internal plant recirculation streams. The facility has the ability to create anaerobic and anoxic zones by using one of three influent pipes for introducing influent flow to return activated sludge, either at the head, mid-point after a baffle wall, or end of the selector basin. The selector tank is also the splitter structure to the existing oxidation ditches.

Flow from the selector tank flows to one of three oxidation ditches. Each oxidation ditch has mechanical surface aerators. The ditches can be run in series or parallel. Effluent is controlled by an adjustable weir at each ditch. Coagulant for chemical phosphorus removal is introduced at the effluent box after the adjustable effluent weir.

Effluent from the oxidation ditches combines in a secondary clarifier splitter structure. The structure splits flow between the secondary clarifiers. The secondary clarifiers are center-feed with the influent pipe entering the sidewall of the tank, an influent well, and peripheral v-notch effluent weirs. Scum flows by gravity to the waste sludge holding tank. Return activated sludge (RAS) and waste activated sludge (WAS) flow by gravity to a common RAS/WAS pumping structure. The sludge withdrawal rate is controlled by telescopic valve located at the RAS/WAS pumping structure. Combined RAS/WAS is pumped through the Administration building where a modulated valve and WAS flow meter are used to direct a portion of sludge to the waste sludge holding tank. The remaining sludge is recirculated to the selector basin.

Effluent from secondary clarifiers 1 and 2 combine in an effluent box, and effluent from secondary clarifier 3 flows to a common effluent box designed for a future secondary clarifier 4. Effluent from the boxes is combined via buried piping and flows to an effluent diversion structure. The diversion structure is not currently utilized but provides piping to divert secondary clarifier effluent for future tertiary treatment. Effluent from the diversion structure flows to the administration building for disinfection.

Coagulant used for chemical phosphorus removal is stored in a chemical storage building. Coagulant is fed through chemical feed pumps to a common header and discharged to chemical feed locations at each oxidation ditch effluent box.

Condition-Related Issues

The Selector Basin was constructed in 2001 and has a number of condition related issues including:

- Minor concrete repair on concrete cover.
- Process piping and flow control gates were installed in 2001 and near the end of useful life.
- Electrical, controls, and instrumentation were installed in 2001 and near the end of useful life.
- Limited process control. Addition of instrumentation to monitor oxidation reduction potential (ORP).
- Mixers operate continuously. Remote controls and communication to SCADA would allow for process monitoring and the potential for a more efficient operating scheme.
- Current mixers were installed in 2001 and experience ragging issues. Mixers are near end of useful life. Replace mixers with non-ragging type mixers.

Oxidation Ditch 1 was constructed in 1976. Oxidation Ditch 2 was constructed in 2001. Oxidation Ditch 3 was constructed in 2019. There are a number of condition related issues for each oxidation ditch, including:

- Oxidation Ditch 1
  - Control building roof is original to 1976 and should be replaced.
  - Surface aerator is original to 1976 and is at the end of its useful life.
  - Piping and valves are original to 1976 and are at the end of their useful life.
  - Existing surface aerators are brush rotor type and have exceeded their useful life. During summer months, aerator is unable to maintain a DO in the basins.
  - Surface aerator runs at constant speed. Replacing constant speed starters with variable speed will allow for dissolved oxygen control in the basins.
  - Electrical, controls, and instrumentation were installed in 2001 and near the end of useful life. Include automatic controls to allow for adjustment of aerator speed based on DO measurement in basin.
  - Control building is original to 1976. Exterior brick requires repair. HVAC equipment and controls are at the end of their useful life.
- Oxidation Ditch 2
  - Surface aerator runs at constant speed. Replacing constant speed starters with variable speed will allow for dissolved oxygen control in the basins.
  - Existing surface aerators are brush rotor type and have exceeded their useful life. During summer months, aerator is unable to maintain a DO in the basins.
  - Electrical, controls, and instrumentation were installed in 2001 and near the end of useful life. Include automatic controls to allow for adjustment of aerator speed based on DO measurement in basin.

The Secondary Clarifiers and associated structures were constructed in 2001 and have a number of condition related issues including:

- Fiberglass Reinforced Plastic (FRP) covers are original to 2001 and leak. Doors freeze shut during winter months. Exhaust fans have exceeded useful life. Covers, doors, dormers, lighting, and HVAC equipment should be replaced.
- Existing clarifier mechanism and access bridges are original to 2001 and have reached the end of their useful life. Replace clarifier mechanisms and access bridges in each clarifier.
- Slide gates at influent splitter structure are original to 2001 and have reached the end of their useful life. Replace slide gates at influent splitter structure.
- Telescopic control valves for sludge draw-off are difficult to control. Alternative method for sludge removal which can be operated per tank should be considered.
- Electrical, controls, and instrumentation were installed in 2001 and near the end of useful life. Include level indicators to monitor sludge blanket in each basin.
- Blast and recoat existing clarifier launderers and top of sidewalls.

The Chemical Feed Building was constructed in 1976 and relocated in 1995 and has a number of condition related issues including:

- Existing structure is a wood timber walled structure covered in gypsum board.
- Current chemical feed pumps are oversized for coagulant demand and unable to turn down for cost effective phosphorus control.
- Current chemical feed pumps discharge into a common chemical feed header. Piping does not allow for even flow of coagulant to oxidation ditches.
- Existing chemical feed is limited to oxidation ditch effluent boxes. Consider addition of alternative coagulant feed locations at oxidation ditches influent structures and secondary clarifier influent splitter structures.

- Electrical, controls, and instrumentation were installed in 2001 and near the end of useful life. Include level indicator for chemical fill in bulk chemical storage tanks.

Selector Basin

The facility operates a two-stage selector basin. Return activated sludge is introduced to the head of the basin. Influent may be introduced at either the head of the first cell, the head of the second cell, or at the end of the basin. Cells 1 and 2 are separated by a timber baffle wall. Each cell has a cover-mounted, dual-impeller mixing system. The selector basin was constructed in 2001. The effluent box of the selector basin also serves as a splitter structure, diving flow between the oxidation ditch treatment trains.

The selector basin has a side water depth of approximately 12'-0" and a total volume of 106,000 gallons (53,000 gallons per cell). The baffle wall is constructed from 1-3/4" thick redwood baffle board and is original to the 2001 construction.

Selector basin sizing depends on the type of treatment being performed. A two-stage anaerobic/aerobic system (AO) facilitates basin biological phosphorus removal. Assuming a typical hydraulic retention time (HRT) between 0.5 and 1.0 hours for the anaerobic cell of the selector tank (Metcalf and Eddy, fourth edition). The determination includes consideration for a return activated sludge recirculation rate of 150% of average influent flow capacity at all flow conditions.

The following summarizes total HRT for both stages at different design flows at current flow demand:
- Calendar Day, Average: 1.8 hours per cell.
- Average Wet Weather: 1.5 hours per cell.
- Peak Hourly Wet Weather: 0.6 hours per cell.

The following summarizes total HRT for both stages at different design flows at current flow demand:
- Calendar Day, Average: 0.9 hours per cell.
- Average Wet Weather: 0.8 hours per cell.
- Peak Hourly Wet Weather: 0.3 hours per cell.

Selector basin size should be reconsidered with each secondary treatment alternative technology evaluated. Suitability for AO operation in conjunction with activated sludge oxidation ditches indicates there may be sufficient capacity available, though the selector tanks are very near operational capacity at the anticipated flow demand.

Suitability of the influent wastewater characteristics can also be considered for use of the selector basin as part of an AO process. A first approximation of the suitability for a waste stream to be used for biological phosphorus removal is the $cBOD_5$:TP ratio, with a minimum $cBOD_5$:TP ratio of 20:1 (WEF Manual of Practice No. 8) necessary to produce an effluent TP of 1 mg/L. This consideration would still assume the use of coagulant for finished effluent.

The following summarizes $cBOD_5$:TP ratio for different design loads at current load demand:
- Calendar Day, Average: 46
- Maximum Month as Day Average: 49
- Calendar Day, Maximum: 69

The following summarizes $cBOD_5$:TP ratio for different design loads at anticipated load demand:
- Calendar Day, Average: 53
- Maximum Month as Day Average: 56
- Calendar Day, Maximum: 77

The $cBOD_5$:TP ratio under current and anticipated load conditions indicates the selector basins may perform well when used as part of an AO treatment process.

Oxidation Ditch

The facility operates three oxidation ditches, ditch 1 constructed in 1976, ditch 2 constructed in 2001, and ditch 3 constructed in 2019. Each oxidation ditch is approximately 350,000 gallons with a side water depth between 9.60’ and 10.80’ depending on the elevation of the adjustable effluent weir. 10 States Standards for Wastewater Facilities (2014 Edition) provide design recommendation for oxidation ditch biological treatment processes.

The activated sludge treatment process, which consists of the selector basins, oxidation ditches, secondary clarifiers, and chemical phosphorus removal was intended to treat for total phosphorus biologically with coagulant for polishing. At the current organic loading rates, biological phosphorus treatment is not achievable due to the current flow and load demand to the facility.

Oxidation ditches follow design recommendations for extended aeration systems. 10 States Standards recommends aeration tank organic loading for $cBOD_5$ at 15 lbs of $cBOD_5$ / 1,000 cuft / day. The organic loading capacity for each oxidation ditch is then approximately 700 lbs of $cBOD_5$ per day.

The three oxidation ditches are sufficient to meet current calendar day average $cBOD_5$ load demands, however the basins do not provide sufficient recommended volume at current maximum month as day average and calendar day maximum load demands.

Oxidation ditches operate as extended aeration processes with HRTs typically between 10 and 30 hours. 24 hours is a commonly used design condition as indicated by WEF Manual of Practice 8 (fourth edition). The oxidation ditches are sufficiently sized for anticipated HRT given a typical return activated sludge recirculation rate of 150% design average flow at both current and anticipated future flow demands.

MPCA reliability for wastewater treatment facilities operating activated sludge processes recommends that there here must be a sufficient number of units of a size such that, with the largest unit out of service, the remaining units will have a design load capacity of at least 50% of the total design loading to that unit operation. For current load demand, the oxidation system meets the reliability requirements. The oxidation system does not meet reliability requirements at anticipated future load demand.

Secondary Sedimentation

The facility has three 34-foot diameter center-feed secondary clarifiers. Each clarifier is fed from an influent splitters structure. The splitter structure has an influent box which combines effluent from the oxidation ditches, and a separate rectangular weir to split flow between the secondary clarifiers. Waste scum is removed by gravity to the waste sludge holding tank.

The RAS/WAS pumping station controls sludge withdrawal using three telescopic valves, one for each secondary clarifier. Operation staff have reported significant issues with use of telescopic valves to induce sludge draw-off from the secondary clarifier tanks. The valve control does not allow for the ability to vary withdrawal rates from the tanks or easily adjust and monitor withdrawal rates. Sludge is pumped using three submersible pumps and sent to the administration building. A modulating valve and flow meter separate a portion of the sludge to waste to the waste sludge holding tank. The remainder returns to the selector basin.

The clarifiers are covered with fiberglass enclosures and aluminum access bridges. The splitter structure is covered by open aluminum grating. The RAS/WAS pumping station has a concrete cover with aluminum equipment hatches.

Each secondary clarifier is:

- 34”-0” diameter
- 12’-0” side water depth
- 81,500 gallons
- 900 square foot surface area
- 94’-0” weir length

The splitter, clarifiers, and RAS/WAS pumping structures were constructed in 2001.

10 States Standard for Wastewater Facilities (2014 Edition) recommendations are followed by the MPCA for when evaluating secondary clarifiers for treatment capacity. The following are critical design characteristics:

- Dimensions
- Surface Overflow Rates
- Peak Solids Loading Rates
- Weir Loading Rates

The recommended minimum side water depth for secondary clarification is 12’-0”, which is the side water depth of the existing tanks.

MPCA reliability for wastewater treatment facilities operating secondary clarifier processes recommends that there here must be a sufficient number of units of a size such that, with the largest unit out of service, the remaining units will have a design load capacity of at least 50% of the total design loading to that unit operation.

The surface overflow rate for secondary clarification tanks with chemical addition to mixed liquor for phosphorus removal is 900 gpd per square foot. Surface overflow rate is designed at the peak hourly wet weather flow, based only on influent flow. At current flow demand, the surface overflow rate is approximately 800 gpd per square foot will all units operating and 600 gpd per square foot with one unit out of service and 50% of influent and recirculation flow. At the anticipated flow demand, the surface overflow rate is approximately 1,600 gpd per square foot will all units operating and 1,200 gpd per square foot with one unit out of service and 50% of influent and recirculation flow. The secondary clarifiers are at surface overflow design capacity under current flow and load demands but are insufficient at anticipated flow and load demand.

The peak solids loading rate for secondary clarification tanks with chemical addition to mixed liquor for phosphorus removal is 35 lbs per day per square foot. Peak solids loading rate is designed at calendar day maximum flow plus maximum recirculation and the design mixed liquor suspended solids (MLSS). Typical MLSS for extended aeration oxidation ditches is between 3,000 mg/L and 5,000 mg/L. Capacity is evaluated at the maximum MLSS concentration of 5,000 mg/L. At current flow and load demand, the peak solids loading rate is approximately 35 lbs per day per square foot will all units operating and 26 lbs per day per square foot with one unit out of service and 50% of influent and recirculation flow and load. At anticipated flow and load demand, the peak solids loading rate is approximately 68 lbs per day per square foot will all units operating and 51 lbs per day per square foot with one unit out of service and 50% of influent and recirculation flow and load. The secondary clarifiers are at peak solids loading capacity under current flow and load demands and are insufficient at anticipated flow and load demand.

The weir loading rate for secondary clarification tanks with a plant capacity greater than 1.0 MGD is 30,000 gpd per linear foot. Weir loading rate is designed at peak hourly wet weather flow, based only on influent flow. At current demand, the weir loading rate is approximately 6,900 gpd per linear foot will all units operating and 5,200 gpd per linear foot with one unit out of service and 50% of influent flow demand. At anticipated demand, the weir loading rate is approximately 14,000 gpd per linear foot will all units operating and 10,500 gpd per linear foot with one unit out of service and 50% of influent flow

demand. The secondary clarifiers have remaining weir loading capacity under current flow and load demands and are sufficient at anticipated flow and load demand.

Chemical Phosphorus Removal

Bulk chemical storage and feed equipment are located in the chemical building. The chemical building contains three double-walled bulk chemical storage tanks and four chemical feed pumps, The chemical feed pumps are oversized and unable to provide sufficient turndown for efficient total phosphorus control. As noted, the chemical feed pumps discharge to a common distribution header which makes control of coagulant feed to a given dose location difficult. The City current utilizes ferric chloride for chemical phosphorus precipitation.

It is recommended that jar testing be conducted to determine an appropriate daily amount of coagulant consumption required for phosphorus removal. Typical iron requirements for municipal wastewater are 15 to 30 mg/L as iron (45 to 90 mg/L as ferric chloride) to reduce phosphorus by 85 to 90% (WEF Manual of Practice 8 (Fourth edition). Depending on operation of the facility, chemical phosphorus precipitation may be the primary mode of phosphorus removal (current operation), supplementing biological phosphorus removal, or as backup to biological phosphorus removal.

At current calendar day average flow and total phosphorus load, it is estimated that 540 pounds of ferric is consumed daily, which corresponds to 56 gallons of solution based on the referenced guidance and assuming 40% ferric chloride solution at 90% removal. Two to four weeks of chemical storage is commonly provided, depending on the availability of bulk delivery. Between 800 and 1,600 gallons of storage would be anticipated at current flow demands.

Summary

The following summarizes the review for secondary treatment at the future anticipated flow and load demands:

- Selector basin is likely undersized for future flow demands.
- Oxidation ditches are undersized for current and anticipated load demand.
- Secondary sedimentation is undersized for anticipated flow and load demand.
- Existing chemical feed pumps and piping would be replaced for process control.
- Additional chemical feed alternate dose locations to secondary clarifier splitter structure.
- Condition related improvements as noted.

Finishing and Discharge

The finishing and discharge at Big Lake consists of the following treatment processes:

- Ultraviolet Disinfection
- Effluent Flow Measurement
- Outfall

Effluent from the secondary clarifiers flows to the administration building. A disinfection bypass is provided via piping and control valve. When disinfecting, flow enters an influent splitter box and is split between two channels for Ultraviolet (UV) disinfection. Disinfected effluent combines in an effluent box. The effluent box has an effluent control weir with ultrasonic level indicator which is used to report plant effluent flow.

Effluent flow from the disinfection effluent box flows through a series of three manhole structures prior to discharge to the Mississippi River via outfall pipe.

Condition-Related Issues

The modified portion of the Administration Building used for disinfection was constructed in 1976 and modified in 2001. It has a number of condition related issues including:

- The roof is original to 1976 and requires replacement.
- Interior and exterior architectural coatings are original to 1976 and should be replaced.
- Repair of exterior CMU walls is required to provide water-tight seal for joint cracks.
- Existing hydronic piping and equipment is failing and requires replacement.
- Raw sludge piping running through the administrative building requires clean air exchanges to avoid hazardous classification of the building space. Separate or re-route raw sludge piping from remainder of administrative building.
- Automatic controls including programmable logic controllers (PLCs) with human machine interface (HMI) displays for remote control and monitoring. Current controls cannot modulate lamp intensity.
- Interior and exterior architectural coatings are original to 1976 and should be replaced.
- Egress occupancy requirements are likely exceeded from lower level.

Disinfection

The current disinfection system consists of four banks of ultraviolet (UV) disinfection banks, arranged in two parallel trains. The system was installed in 2001. The disinfection influent piping has a manual bypass which allows for isolation of channels for maintenance and bypassing of the system while disinfection is not required. The current system is installed in a converted rectangular clarifier and located in the lower level of the administration building.

Each disinfection channel is 1’-9” wide and designed for the existing PHWW capacity of 2.204 MGD. The rated capacity is not sufficient for the anticipated future flow demand requirements. The operating staff have indicated UV disinfection is the preferred disinfection method. MPCA guidance for UV disinfection requires:

- Minimum of two treatment trains.
- Trains shall be redundant at AWW flow demand.
- Both trains operating shall meet PHWW flow demand.

Operation staff have noted that maintenance and operation of the existing system in the converted rectangular clarifier is difficult due to the location and clearance of equipment. The system also introduces humidity and filter flies into the remaining portions of the administration building.

Effluent Flow Measurement

Effluent flow measurement is accomplished via ultrasonic level indicator placed above a sharp crested weir. Top elevation of the weir is 912.00’ and is set by an adjustable 1/2-inch aluminum weir plate. The weir length is 2’-0”. At existing PIWW flow, the anticipated water level above the weir would be 8-inches. At the anticipated PIWW flow demand, the anticipated water level above the weir would be 12.75-inches.

Plant operating staff have noted that the existing system:

- Is unable to measure current peak flow events.
- Is difficult to maintain as the measurement devise is located in a converted underground structure.

Outfall

Finished plant effluent is conveyed to a gravity outfall pipe via three manhole structures. The outfall pipe is 16-inch pipe. The flow capacity of the pipe is approximately 5,550 gpm (8.0 MGD), which is sufficient for the anticipated flow demand.

Summary

The following summarizes the review for finishing and discharge at the future anticipated flow and load demands:

- Replace ultraviolet disinfection system with an appropriately sized disinfection system.
- Relocate disinfection to a stand alone building to better control work environment and conditions. Relocation to reduce the required amount of conditioning equipment and allow for proper maintenance and operation of equipment.
- Replace effluent measurement with reliable, and accessible system.
- Condition related improvements as noted.

SOLID TREATMENT CAPACITY REVIEW

Solids treatment includes waste activated sludge and waste scum from the secondary clarifiers. The facility is capable of producing either liquid biosolids, dewatered biosolids, or dried biosolids. Typically, dewatered biosolids are produced and landfilled for disposal. The following sections will review each liquid treatment process in greater detail for suitability to meet the anticipated future flow and load capacity.

Biosolids Stabilization

The biosolids stabilization at Big Lake consists of the following treatment processes:

- Waste Sludge Storage
- Aerobic Digestion
- Liquid Biosolids Storage

Waste activated sludge is stored in one of two waste sludge holding tanks. Stored solids flow to an effluent structure where it is combined with waste scum from secondary clarification and pumped to the Sludge Control Building. The waste sludge storage is mixed by diffused aeration. The waste sludge storage tank contains a supernatant wetwell which can be used to collect supernatant from the waste sludge holding tank, as well as supernatant which flows by gravity from liquid biosolid storage.

The Sludge Control Building contains treatment equipment for aerobic digestion and liquid biosolids storage. Waste sludge from waste sludge storage is pumped to the aerobic digester. The aerobic digester is mixed and aerated through diffused aeration. The aerobic digester also has the ability to be heated, though the system is not operated.

Stabilized biosolids overflow by gravity from the aerobic digester to liquid biosolids storage. The liquid biosolids storage has a decant tree to remove supernatant to the supernatant wetwell at waste sludge storage. The liquid biosolids storage is also mixed by diffused aeration system with blowers in the Sludge Control Building and off-gas from the off gas compressor as part of the drying equipment in the Biosolids Processing Building. Liquid biosolids loadout is possible via a quick companion flange at the Sludge Control Building.

For normal operation, liquid biosolids are pumped via transfer pump from the liquid biosolids storage tank to the Biosolids Processing Building.

Condition-Related Issues

The waste sludge storage was constructed in 1976 and modified in 1995 to include a duplex submersible type wetwell for transfer of waste sludge to the aerobic digesters. The waste sludge storage has a number of condition related issues including:

- Roof of blower room is original to 1976 and should be replaced.
- Interior and exterior architectural coatings are original to 1976 and should be replaced.
- Repair of exterior CMU walls is required to provide water-tight seal for joint cracks.

- Existing fiberglass covers are at end of serviceable life.
- Mixing blowers are located in Administration Building and area at the end of serviceable life.
- Coarse bubble differs are at the end of serviceable life.
- Electrical, controls, and instrumentation were installed in 1995 and near the end of useful life. Include level indictors for each storage cell.
- Existing floating decanter is not serviceable preventing thickening in holding tank. Rectangular tanks are not ideal for gravity thickening.
- Submersible sludge transfer pumps are at the end of serviceable life.
- Submersible supernatant transfer pumps are at the end of serviceable life.
- There is local demand to receiving of sludge from other communities. Operating staff would like the ability to receive solids directly to holding tank for feed to aerobic digesters.

The Sludge Control Building was constructed in 1995 and has a number of condition related issues including:

- Roof of control building is original to 1995 and should be replaced.
- Roof of aerobic digester is original to 1995 and should be replaced.
- Interior and exterior architectural coatings are original to 1995 and should be replaced.
- Minor concrete repair is likely required on interior walls of aerobic digester.
- HVAC equipment is original to 1995 and should be replaced.
- Cut-in sump for new drain/transfer sludge pump to aerobic digester.
- Cut-in sump for new drain/transfer sludge pump to liquid sludge storage.
- Electrical, controls, and instrumentation were installed in 1995 and near the end of useful life. Include level indictors for each treatment tank. Include ORP and DO instrumentation for aerobic digester.
- Blowers are original to 1995 and should be replaced.
- Coarse bubble diffused aeration equipment is aerobic digester and biosolids storage tank are original to 1995 and should be replaced.
- Boiler and recirculation pumps for heating aerobic digester are not used and at serviceable life. Equipment should be removed.
- Current biosolids storage is not covered to maintain water temperature during winter months.
- Exterior personnel doors need replacement.

Waste Sludge Storage

The waste sludge storage tank has a design capacity of 76,000 gallons. The holding tank was originally constructed as part of the 1976 improvements project and has been modified over the years. The holding tank consists of two holding cells which are mixed via diffused air, an effluent box which acts as a submersible type wetwell and drywell valve structure, and a supernatant submersible type wetwell which receives supernatant from both the waste sludge holding tank and the biosolids storage tank.

The sludge holding tank can be decanted from to reduce the required volume in the aerobic digester, however the piping and valves no longer function.

Generally, 10 States Standard for Wastewater Treatment Facilities (2014 edition) provides the following recommendations for thickening of undigested sludge:

> The use of gravity thickening tanks for unstabilized sludges is not recommended because of problems due to septicity unless provisions are made for adequate control of process operational problems and odors at the gravity thickener and any following unit processes. Particular attention should be given to the pumping and piping of the concentrated sludge and possible onset of anaerobic conditions.

Diffused aerated mixing is provided for the storage tank, however mixing or recirculation should be considered for the transfer wetwells for the aerobic digester and supernatant.

As the waste sludge storage tank does not currently operate as a thickener, thickening of waste sludge is not considered when evaluating current treatment capacity of the solid stabilization equipment. Unthickened and at current flow and load demand, the waste sludge storage tank provides the following storage times:

- 36 hours at calendar day average flows and loads,
- 12 hors at maximum month as day flows and loads,

Unthickened and at anticipated flow and load demand, the waste sludge storage tank provides the following storage times:

- 18 hours at calendar day average flows and loads
- 5 hours at maximum month as day flows and loads.

Overflow rate is a measurement of the volume of sludge being sent to a gravity thickener and the surface area of the thickener. It is assumed that a single cell will be wasted to at a time. The waste sludge storage tank overflow rate is:

- 20 cubic feet per square foot day at calendar day average flows and loads, and
- 31 cubic feet per square foot day at maximum month as day flows and loads.

At the anticipated flow and load demand, the overflow rate is:

- 41 cubic feet per square foot day at calendar day average flows and loads, and
- 65 cubic feet per square foot day at maximum month as day flows and loads.

Typical guidance is for 33 cubic feet per square foot day.

The waste sludge storage tank is likely not suitable for rehabilitation as a gravity thickener, but may be effective at a small process holding, break, or receiving tank.

Aerobic Digestion

The aerobic digester consists of a single aerated tank which is 54’-8” by 35’-6” and a side water depth of 16’-0” at overflow elevation. The total storage capacity is 233,000 gallons. The aerobic digester was constructed in 1995. A later improvements project in 2012 modified the aeration system to include off-gas from the Biosolids Processing Building.

Stabilized biosolids overflow by gravity from the aerobic digester to the liquid biosolid storage tank. The liquid biosolid storage tank is not operated as a secondary aerobic digester. The aerobic digester has the ability to be heated via boiler and heat exchanger, though the system is not operated. Operations staff would prefer to remove the current heating equipment. There is currently no way to completely drain the aerobic digester. Operations staff would like to improve the tank by having a method to drain the tank for maintenance that does not require the manual installation of a trash pump for the remaining few feet of biosolids. The aerobic digester has a flat tank bottom.

The aerobic digester is mixed using two blowers which supply air to a common head header with the liquid biosolids storage tank. The header divides into two 8-inch laterals in the aerobic digester. Each lateral consists of 22 diffuser assemblies.

Reliability recommendation by 10 States Standard for Wastewater Treatment Facilities (2014 edition) suggests that multiple digestion units capable of independent operation are desirable and shall be provided in all plants where the design average flow exceeds 100,000 gallons per day. All plants not having multiple units shall provide alternate sludge handling and disposal methods.

Current liquid sludge loadout is limited to the liquid biosolids storage tank. Alternate sludge loadout may be included as a method of draining the aerobic digester or as part of the receiving connection for outside haulers at the waste sludge holding tank.

10 States Standard for Wastewater Facilities (2014 Edition) recommendations are followed by the MPCA for when evaluating aerobic digesters for treatment capacity. The following are critical design characteristics:

- Treatment volume requirements
- Mixing and air requirements
- Supernatant, scum, and grease removal

Additional design guidance for aerobic digestion is provided by Water Environment Federation (WEF) Manual of Practice Number 8 (MOP8) and Wastewater Engineering by Metcalf and Eddy.

A minimum 60 days of solids retention time (SRT) at 59 degrees Fahrenheit (15 degrees Celsius) for aerobic stabilization of biosolids is required by the United States Environmental Protection Agency (USEPA) 40 Code of Federal Regulations (CFR) Part 503 Biosolids Rule if solids are to be liquid land applied. 10 States Standards for Wastewater Treatment (2014 Edition) requires 27 days SRT at 59 degrees Fahrenheit for stabilization and disposal. The City's current method of disposal is landfilling of cake dewatered solids. At current calendar day average flow and load demand, the 233,000-gallon aerobic digester provides approximately 36 days of SRT. At anticipated flow and load demand, there is approximately 17.5 days SRT provided by the digester. The aerobic digester is at capacity at current flow and load demand, and exceed capacity for anticipated flow and load demand if solids are to be disposed of via landfill. Digester capacity is exceeded at both current and anticipated flow and load conditions if biosolids are to be land applied.

Air demand for aerobic digesters should be sufficient to maintain between 1 mg/L and 2 mg/L residual dissolved oxygen. A minimum amount of aeration is required for mixing in order to maintain suspension of solids during treatment. 10 States Standards for Wastewater Treatment Facilities (2014 Edition) recommends a minimum mixing air supply of 30 cfm per 1,000 square feet of tank. For Big Lake this corresponds to 6,900 scfm of mixing air.

Supernatant, scum, and grease are removed in a separate biosolids storage tank. Scum and grease from the aerobic digester tank, where excessive, would be removed via overflow pipe.

Liquid Biosolids Storage

The liquid biosolids storage tank is an open-topped, 76'-0" diameter, roughly circular storage tank with a design capacity of 482,000 gallons. The maximum side water depth is 13'-8" with a 2'-0" center cone. The storage tank includes a supernatant decant tree to remove decant and thickened stabilized biosolids. The biosolids storage was constructed in 1995. A later improvements project in 2012 constructed the sludge transfer pumps to convey sludge from biosolids storage to the biosolids processing building.

The liquid biosolids storage is mixed using two blowers which supply air to a common head header within the aerobic digester. The 10-inch header feed 12 lateral legs in the biosolids storage tank. The laterals are 3-inch PVC pipes feeding diffuser assemblies.

There is currently no way to completely drain the liquid biosolids storage tank. Operations staff would like to improve the tank by having a method to drain the tank for maintenance that does not require the manual installation of a trash pump for the remaining few feet of biosolids. The liquid biosolids storage tank has a cone-shaped tank bottom.

10 States Standard for Wastewater Facilities (2014 Edition) recommendations are followed by the MPCA for when evaluating aerobic digesters for treatment capacity. The following are critical design characteristics:

- Storage volume requirements
- Mixing and air requirements
- Supernatant, scum, and grease removal

All facilities are required to provide a minimum of 120 days of anticipated sludge storage for the location of the Big Lake Wastewater Treatment Facility. Additional storage requirements based on population equivalent do not apply as on-site dewatering facilities are available for use.

Both current and future flow and load demand exceed the minimum 120 days of storage is recommended, however solids are typically dewatered to either cake or dried cake for disposal. Additionally, biosolids are disposed of by landfilling, which does not have weather, seasonal, or crop limitations associated with land application.

An additional 150,000 gallons of liquid sludge storage capacity is available in the batch and alternative batch tanks at the biosolids processing building.

Supernatant is removed through a manual decant tree with five decant elevation, each 2'-0" apart. Scum and grease, where excessive, would either be removed via decant pipe or overflow pipes.

Summary

The following summarizes the review for biosolids stabilization at the future anticipated flow and load demands:

- Aerobic digester capacity is likely exceeded at anticipated flow and load demand.
- Liquid biosolids storage capacity requires weekly dewatering at future flow and load demand.
- Condition related improvements as noted.

Biosolids Dewatering

Biosolids dewatering at the Big Lake facility occurs in the Biosolids Processing Building. The Biosolids Processing Building was constructed in 2012 and provide shift-operated dewatering of biosolids from stabilized liquid biosolids to Class A biosolids.

The biosolids dewatering at Big Lake consists of the following treatment processes:

- Biosolids Thickening
- Thickened Cake Biosolids Loadout
- Biosolids Drying
- Dried Cake Biosolids Loadout

Liquid sludge is pumped via transfer pump from Biosolids Storage to the Biosolids Processing Building. Transferred liquid biosolids is stored in one of two biosolids batch tanks at the Biosolids Processing Building. The primary batch tank has a 100,000 gallons of storage capacity and is the batch tank used for normal operation. An alternative batch tank provides an addition 50,000 gallons of storage capacity. The Biosolids batch tanks are mixed via coarse bubble diffused aeration. Each biosolids batch tank mat be pumped into using alternate connection points for hauled liquid biosolids.

Centrifuge feed pumps feed liquid biosolids to centrifuges for thickening. Centrate from the centrifuges in introduced to preliminary treated effluent ahead of the Selector Basin. Each centrifuge is sized to dewater 167 gpm of liquid biosolids. The calculated current liquid biosolids generation rate is 22 gallons per day at current calendar day average flow and load demand and 42 gallons per day at anticipated flow and load demand.

Thickened cake is transferred to a storage bunker in the Biosolids Processing Building. The dewatering centrifuges typically produce between 20% and 25% total solids with the addition of a liquid polymer thickening aid.

Dry feed pumps pump thickened biosolids to the dryer. The dryer conveys dried biosolids to either the biosolids storage silo adjacent to the Biosolids Processing Building, or an alternate loadout directly to a

receiving truck. Thickened biosolids may also be sent to an alternate loadout, bypassing drying. The biosolids dryer is sized to process up to 7,846 wet lbs per hour of dewatered cake from the centrifuges.

Typical operation is to loadout and landfill cake biosolids rather than dry due to operation and maintenance cost of the drying equipment and capacity issues for liquid treatment related to the large volume of return water from the drying process.

The current storage facilities are indented for dried biosolids, so there is effectively no cake biosolids storage provided other than a relatively small transfer bunker intended to feed the drying equipment. It is recommended that 180 days of cake biosolids storage be provided. Functionally, cake biosolids will air and freeze dry to approximately 40 to 50% total solids while being stored. For the purpose of design, it is assumed storage will be for 20% totals solids, which is the conservative minimum observed during centrifuge operation. At design conditions and 20% solids the storage requirement is approximate 3,600 cubic yards. A cake biosolids storage facility is required with a design depth of 8 feet, width of 60 feet, and overall length of 200 feet.

It is anticipated that there is sufficient capacity with shift operation to meet anticipated load demand for dewatering and drying of biosolids.

Condition-Related Issues

The Biosolids Processing Building was constructed in 2012 and has a number of condition related issues including:

- The air conditioning unit for the electrical room has exceeded its useful service life and requires replacement.
- Radiant heat boiler controls are not reliable and should be replaced.
- Plant PLC panel is no longer serviceable and should be replaced.
- Centrifuge liquid sludge feed pumps are approaching the end of serviceable life.
- Centrifuges are near major overhaul. It is anticipated that the PLC panels for the centrifuges will be recommended for replacement at this time. The VFD drive for centrifuge #1 should be replaced.
- Central odor control system requires media replacement. Location of media tank obstructs service of process equipment and should be relocated.
- There is no chemical eyewash and shower for the polymer chemical feed equipment.
- There is no shower for staff in the lavatory.
- There is no storage for dewatered cake.
- Alternate cake loadout should be improved to reduce spillage of cake between load out. Currently the loadout is just a horizontal plain end pipe.

Summary

The following summarizes the review for biosolids dewatering at the future anticipated flow and load demands:

- Condition related improvements as noted.

OTHER CONSIDERATIONS

Other considerations at the facility include those capital improvements which serve the community but are not directly part of the wastewater treatment process. These considerations contribute to flow and load at the facility and are included in the capacity review considerations for both solids and liquids processes.

Administration

The facility has a multi-use administration building which houses the:

- Office space,

- Laboratory and testing equipment,
- Effluent total phosphorus online monitor,
- Waste sludge storage blower room (considered previously as part of Biosolids Stabilization),
- Ultraviolet disinfection (considered previously as part of Finishing and Discharge),
- RAS/WAS control valve and flow meter (considered previously as part of Secondary Treatment), and
- Effluent measurement (considered previously as part of Finishing and Discharge).

The administration and control building was constructed in 1976 and modified during the 2001 and 2019 projects. Open-top process tanks introduces humidity and filter flies to the otherwise administrative workspace which both impact environment control equipment, process control equipment, and administrative equipment in the building.

Condition-Related Issues

The Administration Building was constructed in 1976 and has a number of condition related issues including:

- The roof is original to 1976 and requires replacement.
- Existing conditioning system consists of a boiler original to 1976 and an air conditioning unit which does not operate. The HVAC system should be replaced with a forced air and central conditioning system for the administration building, separate from process rooms.
- Raw sludge piping running through the administrative building requires clean air exchanges to avoid hazardous classification of the building space. Separate or re-route raw sludge piping from remainder of administrative building.
- Automatic controls including programmable logic controllers (PLCs) with human machine interface (HMI) displays for remote control and monitoring should come back to the administration building supervisory control and data acquisition (SCADA) system for the entire facility. System should include a data logging historian, remote controls, and monitoring for all treatment processes.
- Existing in-plant sanitary waste wetwell, pump, controls, and piping are past serviceable life. Replace with new in-plant suction lift station with top-mounted fiberglass valve and pump enclosure.
- The existing lavatory and shower facilities house process monitoring equipment and are non-functional.
- Interior and exterior architectural coatings are original to 1976 and should be replaced.
- Repair of exterior CMU walls is required to provide water-tight seal for joint cracks.

Vactor Receiving

The facility currently operates a Vactor receiving station for septage haulers at the facility. The current station is small, precast concrete receiving structure near the preliminary treatment building. The current structure:

- Is located in a difficult to access location for inexperienced drivers,
- Does not allow for metering a septage to the head of the treatment facility,
- Does not measure volume of septage received, and
- Does not facilitate site security and requires a plant operator to facilitate access to the station.

The current vactor receiving station does not meet the growing demand for septage treatment services in the community. The septage receiving, site access, and operation of the receiving station should be addressed as part of the capacity improvements at the facility.

Utilities

Backup Power

The wastewater treatment site has a 100-kW backup generator installed in the administration building. The generator is insufficiently sized to power then entire treatment facility during utility outages. The generator is original to the 1976 improvements project and is at the end of its useful life.

Site Lighting

Site lighting is original to the 2001 improvements project on the south site of the project site. Site lighting through the facility requirements improvements and replacement.

Communications

Currently buildings on the north site of the site (Biosolids Processing Building and Preliminary Treatment Building) have fiber communications. The buildings on the south side of the site does not. Fiber communications should be run to all treatment buildings to allow for centralized control, monitoring, and alarms by plant SCADA from Administration Building.
Lift stations in collection system communicate via radio to plant control and monitoring system.

Hardscape

Asphalt pavement on south side of site is original to 2001 improvements project and is new the end of useful life. Asphalt pavement should be replaced throughout site due to age and related construction activities.

Summary

The following summarizes the review for other considerations at the future anticipated flow and load demands:

- Relocate UV disinfection to separate, purpose-built structure.
- Relocate RAS/WAS piping and controls to separate structure.
- Relocate septage receiving, increase accessibility, capacity, and include the ability to meter and measure flows.
- Add card access and motorized gate with security camera to main drive of facility. Provide capability of issuing access cards to septage haulers.
- Replace backup generator with appropriately size unit.
- Run new fiber communications to all treatment building and equipment.
- Condition related improvements as noted.

A summary of the recommended improvements for facilities can be found in attachment 5 of this memorandum.

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Attachments:
Attachment 1: Liquid Treatment Flow and Load Memorandum
Attachment 2: Solids Treatment Flow and Load Memorandum
Attachment 3: Condition Assessment Survey
Attachment 4: Preliminary Effluent Limit Request Electronic Response Letter Dated Nov. 2, 2022
Attachment 5: Summary of Recommendations

c: Eric Miller, SEH Inc.
Colin Marcusen, SEH Inc.

Attachment 1

Liquid Treatment Flow and Load Memorandum

Building a Better World for All of Us®

MEMORANDUM

TO: Equipment Suppliers and Manufacturers

FROM: Eric Miller

DATE: April 6, 2023

RE: Big Lake Wastewater Treatment Facilities Plan Flow and Load Conditions
SEH No. BIGLK 167307 14.00

The purpose of the memorandum is to serve as a reference for preparation of a preliminary proposal package to be referenced in the Big Lake Wastewater Treatment Facilities Plan being prepared by SEH Inc. on behalf of the City of Big Lake. Flow and load conditions referenced may change between preliminary design as part of the facilities plan and final design for construction. Anticipated construction for this project is during summer 2024.

As part of the preliminary proposal package, please include:

- Budgetary proposal.
- General description of space requirement for major equipment, a non-site-specific general arrangement drawing, or similar drawing from equipment proposed elsewhere.
- Identify specific utility, piping, or ancillary process requirements associated with the proposed equipment (ie electrical, wash water, drains, plant air, etc.).

Please refer to Tables 1 and 2 below for the anticipated flow and load demand to the facility at startup (existing) and design capacity (anticipated).

Table 1: Flow Demand Design Parameters

Parameter	Current Flow Demand [3]	Anticipated Flow Demand [3]
Average Dry Weather (ADW) Flow, mgd	0.699	1.366
Calendar Average Day (ADF) Flow, mgd	0.721	1.446
Average Wet Weather (AWW) Flow, mgd	0.838	1.682
Calendar Day Maximum Flow, mgd	1.208	2.475
Peak Hourly Wet Weather (PHWW) Flow, mgs	2.204	4.467
Peak Instantaneous Wet Weather (PIWW) Flow, mgd	2.204	4.467
Return Activated Sludge Flow, Minimum, mgd [1]	0.361	0.723
Return Activated Sludge Flow, Maximum, mgd [2]	1.082	2.169

Notes:
1. Corresponds to 50% of calendar average day influent flow demand.
2. Corresponds to 150% of calendar average day influent flow demand.
3. Does not include flow as a result of supernatant, decant, centrate, or drier water.

Table 2: Load Demand Design Parameters

Parameter	Current Load Demand [1]	Anticipated Load Demand [1]
Calendar Day, Average $cBOD_5$, ppd	2,141	4,621
Maximum Month as Day Average $cBOD_5$, ppd	3,679	7,773
Calendar Day, Maximum $cBOD_5$, ppd	7,386	14,988
Calendar Day, Average TSS, ppd	**2,963**	**5,465**
Maximum Month as Day Average TSS, ppd	6,702	12,227
Calendar Day, Maximum TSS, ppd	11,202	19,984
Calendar Day, Average TP, ppd	**47**	**87**
Maximum Month as Day Average TP, ppd	75	138
Calendar Day, Maximum TP, ppd	107	195
Calendar Day, Average TKN, ppd	**358**	**652**
Maximum Month as Day Average TKN, ppd	496	894
Calendar Day, Maximum TKN, ppd	496	894

Notes:
1. Does not include load as a result of recirculation, supernatant, decant, centrate, or drier water.

ejm

c: Jessica Hedin, SEH Inc.

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Attachment 2

Solids Treatment Flow and Load Memorandum

Building a Better World for All of Us®

MEMORANDUM

TO: Equipment Suppliers and Manufacturers

FROM: Eric Miller

DATE: April 6, 2023

RE: Big Lake Wastewater Treatment Facilities Plan Flow and Load Conditions
SEH No. BIGLK 167307 14.00

The purpose of the memorandum is to serve as a reference for preparation of a preliminary proposal package to be referenced in the Big Lake Wastewater Treatment Facilities Plan being prepared by SEH Inc. on behalf of the City of Big Lake. Flow and load conditions referenced may change between preliminary design as part of the facilities plan and final design for construction. Anticipated construction for this project is during summer 2024.

As part of the preliminary proposal package, please include:

- Budgetary proposal.
- General description of space requirement for major equipment, a non-site-specific general arrangement drawing, or similar drawing from equipment proposed elsewhere.
- Identify specific utility, piping, or ancillary process requirements associated with the proposed equipment (ie electrical, wash water, drains, plant air, etc.).

Please refer to Table 1 below for the anticipated flow and load demand to the facility at startup (existing) and design capacity (anticipated).

Table 1: Flow and Load Demand Design Parameters

Parameter	Current Flow Demand [3]	Anticipated Flow Demand [3]
Calendar Average Day (ADF) Flow, mgd	0.721	1.446
Average Wet Weather (AWW) Flow, mgd	0.838	1.682
Peak Hourly Wet Weather (PHWW) Flow, mgd	2.204	4.467
Waste Activated Sludge Flow, Average, mgd [1]	0.048	0.099
Waste Activated Sludge Flow, Maximum, mgd [1]	0.156	0.314
Waste Activated Sludge Flow, Average, mgd [2]	0.027	0.055
Waste Activated Sludge Flow, Maximum, mgd [2]	0.085	0.170
Waste Activated Sludge Flow, Average, mgd [3]	0.015	0.029
Waste Activated Sludge Flow, Maximum, mgd [3]	0.044	0.086
Liquid Biosolids Flow, Average, mgd [2]	0.031	0.060
Liquid Biosolids Flow, Average, mgd [3]	0.021	0.040

Notes:
1. Assumes 0.85% total solids by weight and 2,400 gpd unthickened scum and scum carrier water.
2. Assumes 1.50% total solids by weight and 2,400 gpd unthickened scum and scum carrier water.
3. Assumes 3.00% total solids by weight and 2,400 gpd unthickened scum and scum carrier water.

ejm

c: Jessica Hedin, SEH Inc.

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Attachment 3

Condition Assessment Survey

Project: Big Lake Wastewater Treatment Facilities Plan
SEH Proj. No.: BIGLK 167307
Project Manager: Jessica Hedin
Title: Condition Assessment

Condition Score Legend	
1	Very good
2	Minor defects
3	Maintenance required
4	Requires renewal
5	Unserviceable

Risk Score Legend	
1	High-Impact
2	Medium-Impact
3	Low-Impact

Preliminary Treatment (01)	Condition Score	Risk Score	Notes
Building			
Structural Concrete	2	2	Channel concrete and vortex grit appear to be in good condition, the hollow core planks on ceiling have been sagging since construction in 2011. The City has a support member installed to hold up the sagging ceiling. Recommend structural engineer visual inspection and assesment before assuming the structures can be reused.
Roof / Cover	1	3	Roof in good condition.
Mechanical Equipment	4	2	Two electric unit heaters have failed in screening room due to harsh environments. MAU provides heat for this space and the EUHs are no longer operational. A/C replacement is required. MAU maintenance required.
Plumbing and Piping	4	2	All plumbing (W1, W2 and SAN) needs to be replaced in the building with corrosion resistant materials such as PVC. There are a lot of hose bibs provided currently throughout the building, less bibs have been requested by the Operations staff because of maintenance concerns with more valves and staff do not ever use all of the available hose connections.
Electrical Equipment	2	1	City is requesting to consolidate plant PLC HMIs in each building for use of tablets. Rockwell system requested, City is working with Total Control as a system integrator. The PLC for Lakeside Raptor Screen 1 is still installed in the electricla room, this will need to be removed to make room for Huber PLC with replacement perforated plate fine screen to be installed. Electrical equipment in the Preliminary Treatment Building appeared to be in fair condition and is relatively new, installed in 2011.
Controls / SCADA	4	1	Upgrade plant PLC with tablet interface, no HMIs requested as a lot of these HMIs around the plant have had connectivity issues. Total Control is aware of this issue and can be named as the system integrator for next improvements project.
Coatings	4	3	All existing piping requires new coatings, wall coatings appear to be in fair condition but may need touchups. No coatings observed in the channels or vortex grit chamber. Coatings on grit classifier need touchup if the cyclone is not replaced during the next improvements project.
NFPA Code Compliance	2	3	Separate electrical room provided, appears to meet NFPA code. Possibly further investigation to confirm code requirements of Preliminary Treatment Buildings.
Building Code Complaince (ingress/egress)	1	3	No concerns from staff
Doors and Windows	4	3	All existing doors are coated steel doors and have corroded. Replace with either FRP or aluminum doors, aluminum preferred. Some of the doors have swollen such that they cannot be easily opened and closed.
Fine Screen Equipment			
Fine screens	4	2	2011 Lakeside Raptor screen no longer has the ability to run washwater. Operations staff need to hand spray down the screen which reduces efficiency and requires more of the staff's time to maintain the equipment. One of the two original screens have been replaced with Huber RPPS perforated plate fine screen, the second screen should be replaced to match this screen.
Wash water Booster Pumps and Pressure Tank	4	3	The pressure tank is residential grade and has failed previously. This tank needs to be replaced with industrial grade pressure tank. Booster pumps appear to be in good condition, however the capacity needs to be evaluated when a second perforated plate fine screen is installed and will require high pressure washwater for operation. The City has mentioned that at this high pressure, a lot of W1 city water is used for screen washing. The City would like to investigate installing a plant effluent water loop to provide alternative water source for washwater in the Preliminary Treatment Building and elsewhere around the facility.
vortex grit removal	3	2	Installed in 2011, the Operators mentioned that the vortex grit removal system runs well. Maintenance may be required on the drive unit itself, however there have not been any known issues with the vortex grit system drive to date.
Grit Removal Equipment			
grit pump	4	1	One grit pump is installed, Operations staff requested installing a second grit pump for redundancy. Recently the grit pump required replacement and there was no backup pump to operate during the time needed to obtain a new grit pump. The replacement grit pump is in good operating condition, but a redundant pump is requested to be installed.
grit classifier	2	2	Installed in 2011, the grit classifier is in fair condition. Surface corrosion has been observed and a replacement cyclone may be required to extend the service life of the equipment.
Flow Control Equipment			
Parshall flume and instrumentation	2	2	Installed in 2011, the flume and instrumentation are in good working condition. The instrumentation is likely near its useful life.
Slide gates / stop logs	2	2	There are stop logs for isolating channels, screens are pivoted out of the channel for maintenance.
Automatic Sampler	2	2	Influent sampler appears to be in fair condition, installed in 2011. May want to consider replacing when the sampler hits useful life.

Project: Big Lake Wastewater Treatment Facilities Plan
SEH Proj. No.: BIGLK 167307
Project Manager: Jessica Hedin
Title: Condition Assessment

Condition Score Legend		Risk Score Legend	
1	Very good	1	High-Impact
2	Minor defects	2	Medium-Impact
3	Maintenance required	3	Low-Impact
4	Requires renewal		
5	Unserviceable		

Selector Basin (02)	Condition Score	Risk Score	Notes
Building			
Structural Concrete	2	2	Concrete appears to be in fair condition, the selector tank was added in 2001. Concrete cover appears to have minor defects.
Roof / Cover	N/A	N/A	Uncovered.
Mechanical Equipment	N/A	N/A	There is no mechanical equipment installed in the anaerobic selector tank.
Plumbing and Piping	4	2	Piping original to structure.
Electrical Equipment	4	2	Installed in 2001, the electrical equipment has reached its useful life.
Controls / SCADA	4	2	Mixers run continuously, new controls will likely be required with new mixers being installed.
Coatings	N/A	N/A	Unable to observe the condition and/or presence of coatings due to concrete cover
NFPA Code Compliance	N/A	N/A	Unoccupied, no instrumentation.
Building Code Complaince (ingress/egress)	N/A	N/A	Unoccupied.
Doors and Windows	N/A	N/A	No windows or doors.
Selector Tank Equipment			
Mixers	4	2	Installed in 2001, the current mixers have reached their useful life and ragging issues have been observed. Replace with non-clogging style submersible mixers as a part of the next improvements project.
Gates	3	2	Installed in 2001, the gates have reached their useful life and replacement should be considered to extend the useful life of this process another 20 years.
Baffle wall	2	3	Unable to observe the condition of the baffle wall due to concrete cover
Instrumentation	4	2	There is no instrumentation in this tank, consider adding ORP probes for process control purposes to improve biological phosphorus removal operations.

Oxidation Ditches (03)	Condition Score	Risk Score	Notes
Building			
Structural Concrete	2	3	Building appears to have minor defects and is quite old. Improvements to the building HVAC and doors should be considered during the next improvements project.
Roof / Cover	4	3	Control building roof original to tanks. Tanks uncovered.
Mechanical equipment	4	3	Mechanical equipment in the old building above Oxidation Ditch 1 aeration equipment likely needs to be replaced due to age.
Plumbing and Piping	4	2	Piping and valves original to structure.
Electrical equipment	4	2	Oxidation Ditch 1 and 2 aeration equipment electrical needs to be replace with VFD for improved aeration control based on DO control.
Controls / SCADA	4	2	Oxidation Ditch controls for 1 and 2 need to be replaced, DO control improvements can be made for more efficient use of aeration energy.
Coatings	N/A	N/A	No coatings observed in the oxidation ditches.
NFPA Code Compliance	N/A	N/A	Was not entered for consideration.
Building Code Complaince (ingress/egress)	N/A	N/A	Was not entered for consideration.
Doors and Windows	N/A	N/A	Was not entered for consideration.
Aeration Tank Equipment			
Structural Concrete	2	1	Oxidation Ditch 1 and 2 are old, but the concrete appears to be in fair condition for reuse of these structures long term. Recommend structural engineer visual inspection and assesment before assuming the structures can be reused.
Aeration equipment	4	1	Existing equipment is brush rotor style surface aeration, Oxidation Ditch 1 and 2 aeration equipment has reached or exceeded useful life and is in need of replacement. During summer months and times of high influent loading, the current aeration equipment in Oxidation Ditch 1 and 2 cannot maintain a DO concentration of 2 mg/L.
Instrumentation	4	3	1 DO probe currently installed per basin, Operations staff would like 1 DO probe tied to the operation of each brush rotor aeration equipment for improved DO control.

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Project Manager: Jessica Hedin
Title: Condition Assessment

Condition Score Legend		Risk Score Legend	
1	Very good	1	High-Impact
2	Minor defects	2	Medium-Impact
3	Maintenance required	3	Low-Impact
4	Requires renewal		
5	Unserviceable		

Secondary Clarifiers (04)	Condition Score	Risk Score	Notes
Building			
Structural Concrete	2	2	Installed in 2001. Recommend structural engineer visual inspection and assesment before assuming the structures can be reused.
Roof / Cover	4	3	Existing covers are FRP and leak. Doors freeze in the winter. Consider replacement.
Mechanical Equipment	4	3	Fans appear to be in poor condition on covers.
Plumbing and Piping	3	1	The telescoping valves appear to be in fair condition, the operation of telescoping valves to control RAS and WAS is not ideal for Operations staff. Consider designing a new building in between new final clarifiers with dedicated RAS and WAS pumps for improved control of return and wasted solids. Telescoping valve configuration may be reused if existing final clarifiers are used for flow equalization to return post equalized flow back to the anaerobic selector area.
Electrical Equipment	4	2	Installed in 2001, electrical gear is nearing useful life.
Controls / SCADA	4	2	Sludge blanket monitoring equipment requested by Operations staff.
Coatings	4	3	New coatings required for effluent launders at a minimum.
NFPA Code Compliance	2	3	Existing equipment appears to be rated for Class 1 Division 1.
Building Code Complaince (ingress/egress)	1	3	No issues observed
Doors and Windows	5	3	Doors damaged and require replacement.
Secondary Clarifier Equipment			
Bridges	4	1	I-beams are badly corroded inside final clarifiers when taken out of service for maintenance August 2022.
Mechanisms	4	1	Installed in 2001, the clarifier mechanisms have reached their useful life.
Effluent weir and launders	2	1	Effluent weirs and launders appear to be in okay condition, however difficult to see all around the final clarifiers from the bridge. Consider small repairs needed if the effluent weirs and launders will be reused for flow equalization.
Slide Gates	4	2	Installed in 2001 the slide gates for isolating clarifiers have reached useful life. Consider replacing during the next improvements project.
Influent Structure Equipment			
Structural Concrete	2	2	Influent splitter structure appears to be in fair condition. Recommend structural engineer visual inspection and assesment before assuming the structures can be reused.

Chemical Feed Building (05)	Condition Score	Risk Score	Notes
Building			
Structural Concrete	3	3	Existing garage is residential grade, consider upgrading overhead door to protect chemical storage tanks. Staff are worried about the overall condition of the building.
Roof / Cover	1	3	Asphalt shingle roof, relatively new. Could be replaced with standing seam steel for 20 year design life.
Mechanical equipment	3	3	Aging equipment may need upgraded to last another 20 years.
Plumbing and Piping	3	2	Piping and valving is complicated, separate line to each oxidation ditch is provided currently, staff requested an additional dose point to the influent splitter structure. This is where they would prefer to dose coagulant in the future opposed to each oxidation ditch individually. Staff agreed that keeping the existing piping and valves in place for operational flexibility makes sense.
Electrical equipment	2	2	All electrical in this building appears to be fed from a lighting panel, 120V. May be approaching useful life.
Controls / SCADA	2	2	Would like automated dosing in SCADA system, currently the dose needs to be adjusted at the peristaltic pumps within the chemical storage building.
Coatings	2	3	Architectural caotings appear to be in good condition.
NFPA Code Compliance	N/A	N/A	No issues observed.
Building Code Complaince (ingress/egress)	N/A	N/A	No issues observed.
Doors and Windows	2	3	Hollow-metal steel door installed in residnetnial grade exterior finish. No drip edge over door.
Chemical Feed Equipment			
Metering pumps	4	1	Existing metering pumps are oversized (on the order of 100 gph capacity where 5 gph dose is desired), the pumps are all the way turned down.
Instrumentation	3	2	Generally there is not a lot of instrumentation in the chemical storage building, perhaps addition of radar level instrumentation in chemical storage tanks would be helpful for monitoring chemical volume at any given time.
Chemical Feed Points	4	2	Requested to add a dose point to the oxidation ditch influent splitter box.

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Condition Score Legend	
1	Very good
2	Minor defects
3	Maintenance required
4	Requires renewal
5	Unserviceable

Risk Score Legend	
1	High-Impact
2	Medium-Impact
3	Low-Impact

Administration and Disinfection Building (06)	Condition Score	Risk Score	Notes
Administration Building Portion			
Structural Concrete	3	3	Restrooms and shower improvements, drinking fountain requested, coatings improvements, general upgrades to last another 20 years. New microscope requested in Lab.
Roof / Cover	4	3	All buildings on south end of plan need roof replacement.
Mechanical Equipment	4	3	A/C unit needs to be replaced. Boiler can be replaced with forced air system.
Plumbing and Piping	4	2	Original to building. Hydronic piping failing.
Electrical Equipment	4	3	Aging equipment needs replacing.
Controls / SCADA	4	1	New SCADA workstation required.
Coatings	4	3	Architectural coatings should be replaced.
NFPA Code Compliance	5	A	Sludge piping pumped through disinfection portion which is connected to entirey or building.
Building Code Complaince (ingress/egress)	N/A	N/A	None observed in administrative portion
Doors and Windows	4	3	Original hollow-metal doors to building. No windows.
UV Disinfection Building Portion			
Structural Concrete	2	2	Concrete appears to be in fair condition, the existing UV structures were repurposed from final clarifiers and chlorine contact tank connected to Admin Building. Owner would like new UV building with better access.
Roof / Cover	4	3	All buildings on south end of plan need roof replacement.
Mechanical Equipment	4	2	Ventilation improvements likely required, potentially for NFPA code.
Plumbing and Piping	4	2	Original to building. Hydronic piping failing.
Electrical Equipment	3	2	There is no available room for electrical gear expansion in the Admin Building where UV system is also installed. Equipment has been updated over previous projects, further investigation required if electrical upgrades would be required for a new UV system.
Controls / SCADA	4	2	Controls need to be updated with new UV system, existing controls are unable to modulate lamp intensity due to issues with effluent flow meter.
Coatings	4	3	Room coatings could use replacement
NFPA Code Compliance	5	1	Sludge piping pumped through disinfection portion which is connected to entirey or building.
Building Code Complaince (ingress/egress)	5	1	Likely egress issues with lower level from UV equipment.
Doors and Windows	4	3	Original hollow-metal doors to building. No windows. Would like to convert UV room to garage with man-door and overhead door.
UV Disinfection Equipment			
UV Equipment	4	1	Current UV system is no longer supported by Trojan and is approaching useful life.
Instrumentation	4	2	Effluent flow meter needs to be replaced.
Flow Control Equipment			
Effluent Flow Meter	4	1	Does not read properly. Located in valt adjacent to UV channel and difficult to access/maintain.
Automatic Sampler	4	2	Sampler itself is in fair condition, however the controls need to be updated.

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2	Minor defects	2	Medium-Impact
3	Maintenance required	3	Low-Impact
4	Requires renewal		
5	Unserviceable		

Waste Sludge Holding Tank (07)	Condition Score	Risk Score	Notes
Building			
Structural Concrete	3	2	Existing tanks are old but seem to be in fair condition. These tanks are roughly 70,000 gal and could be used for future biosolids hauling tank from other communities. If this is the case, City would like to allow for easy dumping. Look at SRT of digester to see if thickening is required.
Roof / Cover	4	3	Fiberglass cover is aging and in need of replacement.
Mechanical Equipment	N/A	N/A	Not mechanical equipment.
Plumbing and Piping	4	2	Original to building.
Electrical equipment	3	2	Electrical equipment is aging and may need replacement.
Controls / SCADA	N/A	N/A	No controls
Coatings	N/A	N/A	No coatings
NFPA Code Compliance	N/A	N/A	Not occupiable.
Building Code Compliance (ingress/egress)	N/A	N/A	Not occupiable.
Doors and Windows	N/A	N/A	No windows or doors.
Thickening Equipment			
Diffusers/ mixers	4	2	Aging equipment, need to be replaced.
Instrumentation	4	3	New level instrumentation requested for monitoring tank contents. Currently only a high level float switch installed.
Blowers	3	2	Blowers are located in the Admin Building, appear to be in fair condition but it is not known by staff if all three blowers are in operating condition. Only one blower is operated periodically in Hand to mix tank contents.
Decanter	5	3	Decanter not serviceable, currently tied up so it does not fall into the tank. No need to decant from this tank, as any thicker solids does not help centrifuge dewatering equipment performance. If digester SRT is low for projected flows, a new decanter may be required to thicken WAS prior to digestion.
Pumps	4	2	2 pumps are aging and need to be replaced.

Biosolids Control Building (08)	Condition Score	Risk Score	Notes
Building			
Structural Concrete	4	1	Staff have concerns about the concrete walls of the aerobic digester tank structural integrity with respect to the cover/roof, and no longer go up on the roof for Operator safety reasons. Recommend structural engineer visual inspection and assesment before assuming the structures can be reused.
Roof / Cover	4	1	Staff have concerns about the roof of the aerobic digester tank structural integrity, and no longer go up on the roof for Operator safety reasons. Recommend structural engineer visual inspection and assesment before assuming the structures can be reused.
Mechanical equipment	3	2	Mechanical equipment appeared to be aging and may need maintenance or replacement to last another 20 years.
Plumbing and Piping	2	2	Piping appears to be in fair condition. City would like to add to suction line in order to pump down tank contents completely, currently there is a few feet of solids left at the bottom of the tank that needs to be pumped out with a trash pump. All valves in the digester building are aging and will likely need to be replaced to extend the
Electrical equipment	4	2	Aging electrical equipment will likely need to be replaced to extend the useful life of this process for another 20 years.
Controls / SCADA	4	2	Aging controls will likely need to be updated if blowers and pumps are replaced.
Coatings	3	2	No known coatings in the aerobic digester. Room coatings may need touched up, piping coatings appeared to be in fair condition with touchup required.
NFPA Code Compliance	N/A	N/A	No issues observed.
Building Code Complaince (ingress/egress)	N/A	N/A	No issues observed.
Doors and Windows	4	3	Original hollow-metal doors. No windows.
Aerobic Digester Equipment			
Diffusers	4	2	Diffusers are aging and likely need replacement
Blowers	3	2	Blowers appear to be in fair condition, however are aging and will likely need maintenance or replacement to extend the useful life of this process another 20 years. The capacity of the blowers will also need to be reviewed.
Pumps	3	2	Pumps appear to be aging but in fair condition, either maintenance or replacement would be recommended to extend the useful life of this process another 20 years.
Instrumentation	4	2	Aging instrumentation will need to be replaced, level, pH, ORP and DO controls would be ideal for process control purposes.

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1	Very good	1	High-Impact
2	Minor defects	2	Medium-Impact
3	Maintenance required	3	Low-Impact
4	Requires renewal		
5	Unserviceable		

Biosolids Holding Tank (09)	Condition Score	Risk Score	Notes
Building			
Structural Concrete	2	2	Concrete appeared to be in better condition than the aerobic digester, this tank was installed in 1996 and may need some repairs.
Roof / Cover	4	3	There is currently no cover, staff would like to install a cover over this tank to maintain process water temperature in the cold months.
Mechanical equipment	N/A	N/A	No mechanical equipment inside storage tank
Plumbing and Piping	2	2	Piping appears to be in fair condition. City would like to add to suction line in order to pump down tank contents completely, currently there is a few feet of solids left at the bottom of the tank that needs to be pumped out with a trash pump. Insulation of aeration piping may need replaced. All valves in the digester building are aging and will likely need to be replaced to extend the useful life of this process another 20 years.
Electrical equipment	4	2	Aging electrical equipment will likely need to be replaced to extend the useful life of this process for another 20 years.
Controls / SCADA	4	2	There are not much for controls in this process, updated controls for process control would be preferred.
Coatings	N/A	N/A	No known coatings in the solids holding tank
NFPA Code Compliance	N/A	N/A	Not occupiable.
Building Code Complaince (ingress/egress)	N/A	N/A	Not occupiable.
Doors and Windows	N/A	N/A	No windows or doors.
Biosolids Holding Tank Equipment			
Diffusers	4	2	Diffusers are aging and likely need replacement
Blowers	3	2	Blowers appear to be in fair condition, however are aging and will likely need maintenance or replacement to extend the useful life of this process another 20 years. The capacity of the blowers will also need to be reviewed.
Pumps	3	2	Pumps appear to be aging but in fair condition, either maintenance or replacement would be recommended to extend the useful life of this process another 20 years.

Biosolids Processing Building (10)	Condition Score	Risk Score	Notes
Building			
Structural Concrete	2	2	Fair condition
Roof / Cover	1	3	Roof in good condition.
Mechanical equipment	4	2	Most of the mechanical equipment is in fair condition, A/C unit needs to be replaced. Maintenance required on Boiler for in-floor heating, Honeywell control is not reliable.
Plumbing and Piping	1	3	Piping and valves in good condition.
Electrical equipment	5	2	Plant PLC not serviceable. See above for electrical equipment associated by process equipment.
Controls / SCADA	1	3	SCADA and controls new to building Would like to standardize rest of plant around these controls.
Coatings	2	3	Coatings appear to be in fair condition
NFPA Code Compliance	N/A	N/A	No issues observed.
Building Code Complaince (ingress/egress)	N/A	N/A	No issues observed.
Doors and Windows	2	3	Hollow-metal exterior doors to be replaced. No windows.
Dewatering Equipment			
Building components	2	2	Fair condition
Biosolids batch tanks x 2	3	2	150,000 gal batch tanks appear to be in fair condition - maintenance is required of pumps.
Dewatering centrifuge x 2	4	2	Alfa Laval is scheduled to do maintenance on major components Summer 2022. PLC may need to be replaced for each centrifuge. VFD #1 needs to be replaced. Feed pumps, polymer feed need to be upgraded for easier control of dose to centrifuges. Achieve 20-25% solids.
Drying Equipment			
Conveyors	2	2	Need a deflector plate at top of vertical conveyor at a minimum, possibly look for alternatives. Staff are constantly having issues with this vertical conveyor.
Biosolids hopper/bunker to feed dryer	2	2	This hopper's progressive cavity pumps can also loadout to dump truck outdoors for dewatered sludge hauling without use of dryer. This system seems a bit messy and could be improved. Heat tracing and insulation provided on this loadout pipe outside the building.
Komline Sanderson solids drying system	2	2	Used quarterly for exercising equipment. Rotate equipment monthly. Use 130,000 gal of water each use, which causes issues with the final clarifier hydraulic capacity. Runs for 10 hours. Honeywell boiler controller needs to be reset often and is not reliable. Offgas cooling system has had issues.

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3	Maintenance required	3	Low-Impact
4	Requires renewal		
5	Unserviceable		

General Site	Condition Score	Risk Score	Notes
Odor Control Equipment			
Carbon adsorber odor control system	3	2	Appears to be in fair condition but likely needs media replacement. This equipment is in the way of accessing other equipment with large vehicles, it is in the middle of the floor plan.
Loadout Equipment			
Biosolids storage silo with dust collection	3	2	Minor air pressure power valve issues. Retractable extension cord with bucket system used may need maintenance.
Loadout System	2	2	Need to use dryer silo for using the loadout system, separate loadout provided for dewatered solids (not dried) needs improvements as it is a messy process. There was a pile of biosolids on the ground when on site. Dump truck is used for dewatered solids to landfill for cheaper O&M costs than running the dryer system.
Progressive Cavity Pumps	3	2	Can rotary lobe pumps be used instead of PC. 24% solids with polymer being pumped to batch tanks.
Site Improvements			
Generator	2	1	Staff have been told that the generator will not run all equipment in future. New generator may be required on south end of facility with improvements project.
Lighting	4	3	Upgrade site lighting needed consisting of new poles and fixtures.
Pavement	4	3	New pavement needed through main drive and on south end of facility, north end pavement appears to be in fair condition.
Stormwater	1	3	No stormwater issues known on site.
Electrical	3	2	Lighting upgrades needed, electrical between buildings on south end of facility may need to be upgraded.
Front Gate	4	3	New automated front gate requested - swing gate with key card access for plant staff tied back to City Hall system and key pad with multiple codes for haulers to keep track of time stamped comings and goings.
Septage receiving	4	3	Would like a way to measure flow being discharged.
Surveylance System	4	3	Requested for site security, especially with septic haulers. Camera at front gate and septage receiving.
Coordination and Utilities			
Integrator	N/A	N/A	Total Control - Craig is the main contact for Big Lake
Utilities (water, nat. gas,)			Add plant effluent water loop connected to buildings with washwater and 2 inch site hydrants requested for washdown. New effluent flow meter required.
Fiberoptic / cable / phone	3	3	Fiber between buildings on north end of site, but not in south end. Phone used for dialer.
Radio communications / telemetry	2	3	Cellular coms from lift stations

Attachment 4

Preliminary Effluent Limit Request Response Letter

RE: Preliminary Effluent Limits for the Proposed Big Lake Discharge
NPDES/SDS Permit MN0041076-SD001

Mr. Wolohan:

This electronic-letter is in response to your request for preliminary effluent limits for an expansion of the City of Big Lake wastewater treatment plant (WWTP). It summarizes the preliminary effluent limits for the WWTP proposed expansion. The preliminary limits are draft values. Effluent limits only become final after the National Pollutant Discharge Elimination System (NPDES) permit has undergone a complete review, been public noticed, the public's comments considered and either our Commissioner or a delegated representative signs the permit.

Please be aware that receiving the preliminary effluent limits in the table below does not mean that your proposed expansion/new facility has been approved. As part of the permitting process, your project must comply with antidegradation requirements (see the Antidegradation Requirement section below for important details). You must demonstrate that there is no way to avoid water quality degradation and that the chosen project alternative is the least degrading prudent and feasible alternative. In many cases, the least degrading prudent and feasible alternative may not be your preferred option or the option(s) discussed in this letter. (7050.0280, subp. 2).

Scenario descriptions

The City of Big Lake requested preliminary effluent limits for one scenario at their Big Lake WWTF discharge:

	Average Wet Weather Design (MGD)	Average Dry Weather Design (MGD)	Discharge Type
Existing Facility	0.958	0.746	Continuous
Scenario #1	2.206	1.413	Continuous

The receiving water will remain the Mississippi River. This section of the Mississippi River is classified as a 1C, 2Bdg, 3,4,5,6 river and is also designated as a restricted outstanding resource value water.

The 7Q10 flow rate of this reach of the Mississippi River is 1074 cfs and this 7Q10 flow rate represents a dilution ratio of 1746:1 at the expanded flow rate.

Table 1: Limits Table

	Existing Discharge		Scenario 1	
AWWDF (MGD)	0.958		2.206	
ADWDF (MGD)	0.746		1.413	
River flow- 7q10	1074		1074	
Dilution Ratio	2685		1746	
Antideg review needed?	No		Yes	
Environmental review needed?	No		No	
Frozen Mass Limits Possible?			Yes	
$cBOD_5$-Ammonia Linkage Eligible?	NA		No	
POLLUTANT / PARAMETER	Conc.	Mass	Conc.	Mass
$cBOD_5$, mg/L (kg/day)	25	34.3	25	34.3[1]
TSS, mg/L (kg/day)	30	41.2	30	41.2[1]
Fecal Coliform Organisms, orgs/100 mL	200 (Apr-Oct)	---	200 (Jan-Dec)	---
Ammonia-N (June 1 - September 30)	---	---	---	---
Ammonia-N (October 1 - November 30)	---	---	---	---
Ammonia-N (December 1 - March 31)	---	---	---	---
Ammonia-N (April 1 - May 31)	---	---	---	---
Dissolved Oxygen, mg/L	---	---	---	---
pH (Standard Unit)	6.0 - 9.0	---	6.0 - 9.0	---
Mercury[3]	---	---	---	---
Phosphorus, mg/L	---		1.0	
Phosphorus, kg/yr (12 month rolling avg)	---	1,160	---	1,160
Chloride, mg/L as Mo. Avg. (kg/day)	---	---	---	---

1. Mass limits associated with previous permit 0.84 MGD AWWDF frozen mass limits.
2. The disinfection limits would be required all year to ensure protection of the ORVW and ensure protection of water at the metro drinking water intakes.
3. Mercury limits and antidegradation analysis of mercury loading would not be required if frozen TSS mass limits are accepted.

Impaired Waters

There are numerous waters impaired for a variety of pollutants ranging from PFAS to mercury and nutrients. Not all of these impairments are relevant for any of the proposed scenarios. The impaired waters of primary importance for effluent limit setting are nutrients, TSS and fecal coliform and all three of these parameters have wasteload allocations in approved TMDLS. It would be very difficult and time intensive to officially modify these TMDLs for Big Lake to receive a larger wasteload allocation.

Phosphorus Details

The current facility has a 1,160 kg/yr 12-month moving total mass limit. The proposed facility has an average wet weather design flow (AWWDF) of 2.206 mgd (Table 2). The new facility will have an annual 1.0 mg/L concentration limit regardless of design flow (Minnesota Rule 7053.0255 subpart 3) because the AWWDF is greater than 1.0 MGD. The Mississippi River and Lake Pepin TMDL established an annual wasteload allocation of 1,160 kg/yr for the Big Lake WWTF (MPCA and Limnotech 2021). The annual mass limit for the proposed expansion is 1,160 kg/yr. As flows at the Big Lake WWTF increase, the facility will have to achieve well below 1.0 mg/L to comply with the 1,160 kg/yr annual mass limit.

Table 2. Total phosphorus (TP) effluent concentrations to achieve Lake Pepin based mass allocation of 1,160 kg/yr at proposed average wet weather design flows (AWWDF) and average dry weather design flows (ADWDF).

Design	flow (mgd)	TP mg/L	TP kg/d	kg/yr
Current AWWDF	0.958	0.8765	3.18	1,160
Current ADWDF	0.746	1.00	2.82	1,031
Proposed AWWDF 1	2.206	0.3805	3.18	1,160
Proposed ADWDF 1	1.413	0.594	3.18	1,160

The proposed expansion will continue to be to the Mississippi River. Kaufenberg (2017) found that the Lake Pepin based limits were sufficient to protect the Mississippi River reaches within the Mississippi River – St. Cloud Watershed. An antidegradation review for phosphorus is not needed since no additional mass of phosphorus is authorized from the proposed expansion.

Class 3 and 4 Water Quality Standards

In 2020 the MPCA submitted a rulemaking proposal to make changes to the existing class 3 and 4 water quality standards. On July 13th, 2021 these rules became effective in state law. The new draft class 3 and 4 standards now have translators effective (Class 3 & Class 4A) in rule that the MPCA must use to determine whether a discharger requires an effluent limit to protect the class 3 and 4 beneficial uses. These translators turn the protective narrative goals of the class 3 and 4A designated uses into enforceable numeric effluent limits. The MPCA does not expect that Big Lake will need a new limit because of these translators, but the MPCA must document that the translators were used upon issuing the permit.

Monitoring requirements

All municipal NPDES permit holders need to monitor for pH, TSS, CBOD5, and DO, fecal coliform. In addition, this permittee will have to monitor the following parameters at the frequencies specified in the table below. The WET testing and priority pollutant scans are required because the facility would become a Major facility (AWWDF > 1MGD).

Table 3 Additional required monitoring beyond standard monitoring

Analyte	Units	Options 1-3 Mechanical Frequency & Influent/Effluent
Mercury, Total	ng/L	4X per year I/E
Mercury, Dissolved	ng/L	4X per year I/E
TSS (grab w/Mercury)	mg/L	4X per year I/E
Ammonia nitrogen, Total	mg/L	4X per year E
Kjeldahl nitrogen, Total	mg/L	4X per year I/E
Nitrate/nitrite nitrogen	mg/L	4X per year I/E
TDS	mg/L	2X per year E
Sulfate	mg/L	2X per year E
Chloride	mg/L	---
Sodium, Calcium & Magnesium	mg/L, umhos/cm	---
Acute Wet Testing	NA	1X per Year
Priority Pollutant Scan	NA	3X per 5 yr cycle

Regulatory Certainty

In response to listening session comments, a voluntary option — part of the Governor's Community Water Infrastructure bonding investment package — would provide up to 20 years of regulatory certainty for wastewater treatment facilities that are willing to accept phosphorus and nitrogen effluent limits and design, construct, and fully operate a biological nutrient removal (BNR) treatment system[1],[2]. BNR systems remove both phosphorous and nitrogen, and are considered the best available technology for wastewater treatment. Indeed, BNR is the only known cost-effective wastewater removal technology for nitrate.

Once the BNR system is in place, the facility would not be required to comply with any new phosphorous or nitrogen limits, beyond those in their discharge permit, for the estimated useful life of the new BNR system. The proposal is linked to a bonding request for water infrastructure grants, and is intended to incentivize facility upgrades to BNR systems.

Communities that volunteer to participate by installing and operating BNR systems would no longer have to speculate what future nitrogen water quality standards might mean for them. Rather than needing to upgrade to meet phosphorus limits now and potentially upgrade again to meet nitrogen limits in five or ten years, communities that install a BNR system would comprehensively address all nutrients for up to 20 years and obtain regulatory certainty. Over time, communities could also save money by reducing both energy usage and the purchase of chemicals for phosphorus removal. Water quality in Minnesota lakes and rivers would also benefit from more treatment plants converting to the best available technology. Notably, we could get a jump on reducing nitrogen in state waters, years ahead of when we can institute a new nitrogen standard. And because Minnesota is home to the headwaters of the Mississippi River, the Great Lakes, and the Red River of the North, the impact of reducing phosphorus and nitrogen in the state will be felt in all our downstream waters, including the Hudson Bay, the Gulf of Mexico, and all the Great Lakes.

[1] Minnesota Statute 115.426

[2] Fact sheet on regulatory certainty

Antidegradation Assessments and Capped Mass Limits

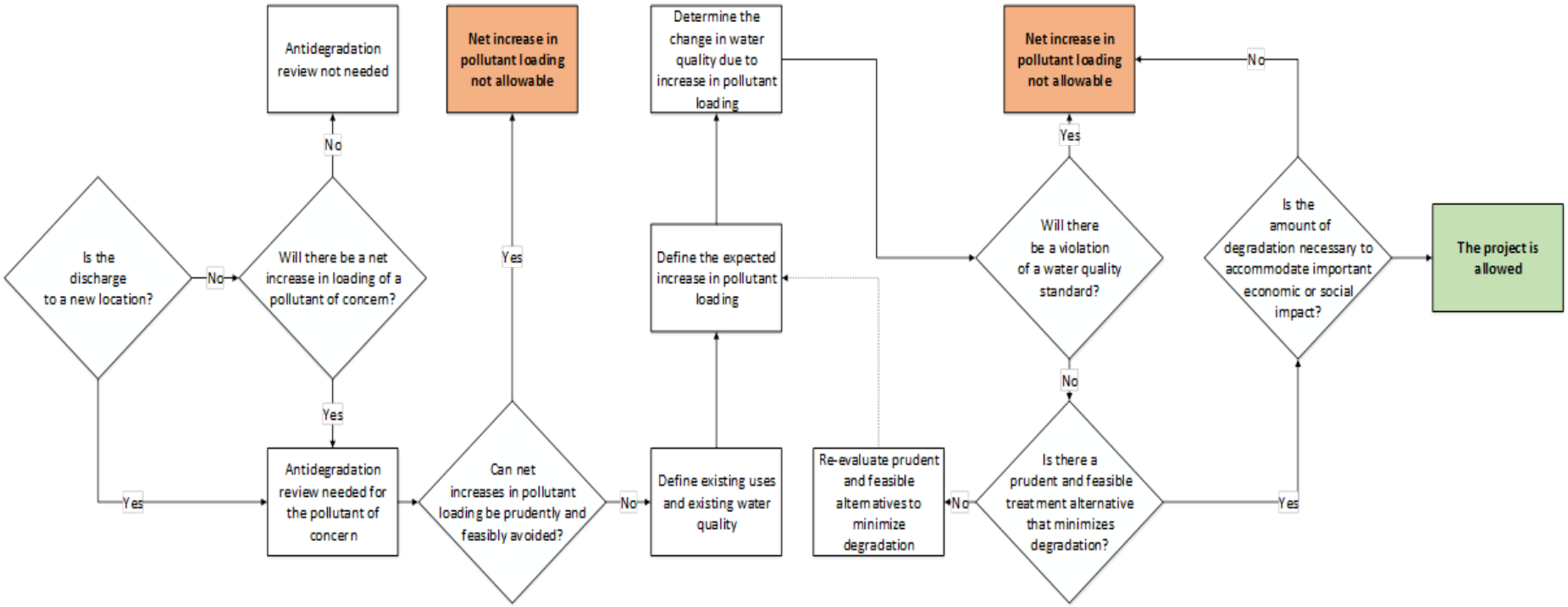
Antidegradation is one of the fundamental protections in the Clean Water Act, and all newly issued or re-issued wastewater permits must comply with both state and federal antidegradation Rules. The goal of antidegradation is to preserve waters of high quality and to ensure that they are not degraded unless balanced by important economic or social development. See Minn. R. 7050.0250 to 7050.0335. The antidegradation assessment process may result in more restrictive effluent limits.

For wastewater permitting, antidegradation concerns are triggered when a new discharge is proposed or when an existing discharger is proposing to increase the loading of any parameter of concern in its discharge. An antidegradation assessment is a substantial evaluation that must consider all beneficial uses of the receiving water, potential economic impacts, all possible treatment options and the potential environmental degradation for every pollutant that triggers the need for an antidegradation assessment. The applicant (permittee) must demonstrate that the chosen project alternative cannot be avoided and is the least degrading prudent and feasible alternative. The permittee must also examine the socioeconomic impacts of the project as compared to the environmental changes in water quality. The environmental degradation must be offset by the socioeconomic benefit. A flowchart summary of the antidegradation assessment process required by state rules (Minn. R. 7050.0280) can be seen below.

New and expanded NPDES permits that result in net increases in pollutant loading to surface waters are required to undergo an antidegradation review (Minn. R. 7050.0280). When applied to a proposed activity that is not regulated by an existing control document (i.e. permit), any loading or other causes of degradation resulting from the proposed activity constitute a net increase (7050.0255 Subp. 26). In this situation, the proposed new treatment system constitutes a net increase in loading; and therefore, an antidegradation review must be completed and approved in order for the effluent limitations to be final for the selected option.

The permittee must submit the antidegradation assessment to the Minnesota Pollution Control Agency (MPCA). MPCA staff will review the assessment to determine if it satisfies state and federal rules. The MPCA has recently developed a guidance document for developing antidegradation assessments that you may find helpful.

Antidegradation assessments frequently require permittees to perform additional water quality monitoring to ensure that appropriate water quality evaluations are performed. The water quality monitoring required for an antidegradation assessment is permit-specific and is intended to fill gaps in existing water quality knowledge. Filling these water quality gaps could require additional monitoring of the discharge, receiving waters upstream and downstream of the discharger or significant industrial users permitted by the discharger.



Summary of the antidegradation assessment process required by Minn. R. 7050.0280

Completing an antidegradation assessment can require a significant amount of time, data and writing effort. It is reasonable to expect at least six to twelve months of effort to complete an antidegradation assessment. The permittee is expected to complete the antidegradation assessment, but the MPCA must approve it as a part of permit documents. The MPCA is responsible for defending the assessment during public comment and in any future legal proceedings. Antidegradation assessments are frequently legally contested, and as such, the MPCA will only approve an assessment of high quality that complies with state and federal antidegradation rules. MPCA staff may provide assistance to the permittee with the antidegradation process.

Because of the workload associated with completing an antidegradation assessment, most permittees looking to expand their permitted flow rates choose to accept "frozen mass limits". "Frozen mass limits" represent the full authorized load in the previous permit for the pollutants of interest. If the permittee is willing to accept "frozen mass limits" while also expanding their flow rates, then the receiving water would receive no net increase in authorized loading because of the expansion, and an antidegradation assessment would not be needed for that parameter. In this scenario, permitted concentration limits would stay the same as in the last permit issuance, however "effective" concentration limits would be lower in order to comply with voluntary mass limits. If the permittee voluntarily accepts frozen mass limits for the pollutants of concern, they will have satisfied antidegradation rules for that parameter, and they will not need to submit an antidegradation assessment for that parameter.

It must be noted that the receiving water for Big Lake is a restricted outstanding resource value water and the requirements in Minn. R. 7050.0265 subp. 6 are applicable (see statute below).

> **Subp. 6.** Protecting restricted outstanding resource value waters.
>
> The commissioner shall restrict a proposed activity in order to preserve the existing water quality as necessary to maintain and protect the exceptional characteristics for which the restricted outstanding resource value waters identified under part 7050.0335, subparts 1 and 2, were designated.

This statute requires the MPCA to restrict loading to ORVW waters to a higher degree than for non-ORVW waters. The functional result of this statute to Big Lake is that it would be difficult to justify expanding the frozen mass limits for any parameter and Big Lake would be wise to consider accepting frozen mass limits as they are found in the current permit.

Chloride is the only pollutant of concern that must be addressed in an antidegradation review that doesn't currently have a limit in the permit. Big Lake will not receive a chloride limit in the current or future permit, but because of the expansion there will be a net increase in chloride loading. An antidegradation review must address this net increase in loading of chloride and demonstrate that the exceptional characteristics of the Mississippi River will be maintained. It would be prudent to collect at least five chloride samples in Big Lake's effluent to characterize Big Lake's current chloride loading and fulfill the requirements in Minn. R. 7050.0265 with regards to calculating changes in receiving water quality because of the expansion. The MPCA can provide surface water quality data that would help with this calculation and has attached the Otsego West antidegradation assessment that contains a similar calculation for reference.

Environmental Review

An Environmental Assessment Worksheet (EAW) is likely to be required for the expanded facility. This is because for the expansion the flow rate would increase by both 200,000 GPD and by >50% (Minn. R. 4410.4300 subp. 18b). Please contact current MPCA Environmental Review (ER) Wastewater Liaison (Kim Grosenheider) with questions on MPCA ER interpretation. More information can be found in Minn. R. 4410.4300 or at https://www.eqb.state.mn.us/content/mandatory-environmental-review-categories-legislative-assessment-report. A full environmental review is not likely to be needed.

According to the *Preliminary Effluent Limit Review Request* document, the building of a new continuous WWTP will not impact wetlands. If building of the WWTP were to result in the physical alteration of a wetland, then wetland mitigation sequencing in compliance with Minn. R. 7050. 0186 would be required.

References

Kaufenberg, L. 2017. Total phosphorus effluent limit review: Upper Subwatershed of the Mississippi River – St. Cloud Watershed. MPCA St. Paul 17 pp.

If you have any questions, comments or concerns, please contact me at 651-757-2665 or email me at *Scott.Kyser@state.mn.us*

Sincerely,

Scott Kyser, PE
Minnesota Pollution Control Agency
Environmental Analysis and Outcomes Division

Attachment 5

Summary of Capacity and Condition Recommendations

Building a Better World for All of Us®

MEMORANDUM

TO: Dan Childs

FROM: Jessica Hedin, PE (Lic. MN 41639)

DATE: March 24, 2023

RE: Big Lake Wastewater Treatment Facilities Plan, Summary of Capacity and Condition Recommendations
SEH No. BIGLK 167301 14.00

The following memorandum is a summary of capacity and condition related recommendations based upon the evaluation details in the "Big Lake Wastewater Treatment Facilities Plan, Capacity and Condition Evaluation" memorandum.

Refer to Attachment 1 for a process flow diagram for the facility.

CONVEYANCE

Old Main Lift Station

- Demolish existing abandoned old main lift station structure.

Main Lift Station

- Interior process piping, equipment, and architectural coatings.
- Automatic controls including programmable logic controllers (PLCs) with human machine interface (HMI) displays for remote control and monitoring.
- Capacity Review
  - 20 HP submersible pumps are likely insufficient.
  - 43 HP high flow submersible pumps are likely insufficient.
  - 8-inch forcemain will likely be undersized based on high flow pump operation.
  - 12-inch high flow forcemain may be reused for regular flow.
  - A new forcemain will likely need to be furnished to economically meet wastewater flow demand. A phasing approach is recommended to meet minimum flow velocity at startup of new equipment.

PRELIMINARY TREATMENT

Preliminary Treatment Building

- Replace influent screens with system suitable for recommended secondary treatment alternative.
- Add redundant grit pump.
- Replace grit classify and washer cyclone.
- Electric unit heaters.
- Makeup air unit.
- Plumbing piping, fittings, hangers, and accessories.
- Interior process piping, equipment, and architectural coatings.
- Automatic controls including programmable logic controllers (PLCs) with human machine interface (HMI) displays for remote control and monitoring.
- Automatic sampler.

- Influent flow measurement instrumentation.
- Exterior personnel and overhead doors.

SECONDARY TREATMENT

Selector Basin

- Minor concrete repair on concrete cover.
- Process piping and flow control gates were installed in 2001 and near the end of useful life.
- Electrical, controls, and instrumentation were installed in 2001 and near the end of useful life.
- Add instrumentation to monitor oxidation reduction potential (ORP) for process control.
- Mixers operate continuously. Remote controls and communication to SCADA would allow for process monitoring and the potential for a more efficient operating scheme.
- Current mixers were installed in 2001 and experience ragging issues. Mixers are new end of useful life. Replace mixers with non-ragging type mixers.

Oxidation Ditch 1

- Control building roof is original to 1976 and should be replaced.
- Surface aerator is original to 1976 and is at the end of its useful life.
- Piping and valves are original to 1976 and are at the end of their useful life.
- Existing surface aerators are brush rotor type and have exceeded their useful life. During summer months, aerator is unable to maintain a DO in the basins of 2 mg/L.
- Surface aerator runs at constant speed. Replacing constant speed starters with variable speed will allow for dissolved oxygen control in the basins.
- Electrical, controls, and instrumentation were installed in 2001 and near the end of useful life. Include automatic controls to allow for adjustment of aerator speed based on DO measurement in basin.
- Control building is original to 1976. Exterior brick requires repair. HVAC equipment and controls are at the end of their useful life.

Oxidation Ditch 2

- Surface aerator runs at constant speed. Replacing constant speed starters with variable speed will allow for dissolved oxygen control in the basins.
- Existing surface aerators are brush rotor type and have exceeded their useful life. During summer months, aerator is unable to maintain a DO in the basins of 2 mg/L.
- Electrical, controls, and instrumentation were installed in 2001 and near the end of useful life. Include automatic controls to allow for adjustment of aerator speed based on DO measurement in basin.

Secondary Clarifiers

- Fiberglass Reinforced Plastic (FRP) covers are original to 2001 and leak. Doors freeze shut during winter months. Exhaust fans have exceeded useful life. Covers, doors, dormers, lighting, and HVAC equipment should be replaced.
- Existing clarifier mechanism and access bridges are original to 2001 and have reached the end of their useful life. Replace clarifier mechanisms and access bridges in each clarifier.
- Slide gates at influent splitter structure are original to 2001 and have reached the end of their useful life. Replace slide gates at influent splitter structure.
- Telescopic control valves for sludge draw-off are difficult to control. Alternative method for sludge removal which can be operated per tank should be considered.
- Electrical, controls, and instrumentation were installed in 2001 and near the end of useful life. Include level indicators to monitor sludge blanket in each basin.
- Blast and recoat existing clarifier launderers and top of sidewalls.

Chemical Feed

- Existing structure is a wood timber walled structure covered in gypsum board. Not suitable for wet work environments.
- Current chemical feed pumps are oversized for coagulant demand and unable to turn down for cost effective phosphorus control.
- Current chemical feed pumps discharge into a common chemical feed header. Piping does not allow for even flow of coagulant to oxidation ditches.
- Existing chemical feed is limited to oxidation ditch effluent boxes. Consider addition of alternative coagulant feed locations at oxidation ditches influent structures and secondary clarifier influent splitter structure.
- Electrical, controls, and instrumentation were installed in 2001 and near the end of useful life. Include level indicator for chemical fill in bulk chemical storage tanks.

Capacity Review

- The selector basin is likely undersized for future flow demands.
- The oxidation ditches are undersized for current and anticipated load demand.
- The secondary clarifiers are undersized for anticipated flow and load demand.
- Existing chemical feed pumps and piping would be replaced for process control. Additional chemical feed alternate dose locations provided at secondary clarifier splitter structure in addition to oxidation ditch effluent boxes.

FINISHING AND DISCHARGE

Administration Building (Disinfection Portion)

- The roof is original to 1976 and requires replacement.
- Interior and exterior architectural coatings are original to 1976 and should be replaced.
- Repair of exterior CMU walls is required to provide water-tight seal for joint cracks.
- Existing hydronic piping and equipment is failing and requires replacement.
- Raw sludge piping running through the administrative building requires clean air exchanges to avoid hazardous classification of the building space. Separate or re-route raw sludge piping from remainder of administrative building.
- Automatic controls including programmable logic controllers (PLCs) with human machine interface (HMI) displays for remote control and monitoring. Current controls cannot modulate lamp intensity.
- Interior and exterior architectural coatings are original to 1976 and should be replaced.
- Egress occupancy requirements are likely exceeded from lower level.

Capacity Review

- Replace ultraviolet disinfection system with an appropriately sized disinfection system.
- Relocate disinfection to a standalone building to better control work environment and conditions. Relocation to reduce the required amount of conditioning equipment and allow for proper maintenance and operation of equipment.
- Replace effluent measurement with reliable, and accessible system.

BIOSOLIDS STABILIZATION

Waste Sludge Storage

- Roof of blower room is original to 1976 and should be replaced.
- Interior and exterior architectural coatings are original to 1976 and should be replaced.
- Repair of exterior CMU walls is required to provide water-tight seal for joint cracks.
- Existing fiberglass covers are at end of serviceable life.
- Mixing blowers are located in Administration Building and area at the end of serviceable life.

- Coarse bubble differs are at the end of serviceable life.
- Electrical, controls, and instrumentation were installed in 1995 and near the end of useful life. Include level indictors for each storage cell.
- Existing floating decanter is not serviceable preventing thickening in holding tank. Rectangular tanks are not ideal for gravity thickening.
- Submersible sludge transfer pumps are at the end of serviceable life.
- Submersible supernatant transfer pumps are at the end of serviceable life.
- There is local demand to receiving of sludge from other communities. Operating staff would like the ability to receive solids directly to holding tank for feed to aerobic digesters.

Sludge Control Building

- Roof of control building is original to 1995 and should be replaced.
- Roof of aerobic digester is original to 1995 and should be replaced.
- Interior and exterior architectural coatings are original to 1995 and should be replaced.
- Minor concrete repair is likely required on interior walls of aerobic digester.
- HVAC equipment is original to 1995 and should be replaced.
- Evaluate options to fully draw-down contents of aerobic digester and biosolids storage. Currently a few feet remain in tank with requirements manually installing trash pump.
- Electrical, controls, and instrumentation were installed in 1995 and near the end of useful life. Include level indictors for each treatment tank. Include ORP and DO instrumentation for aerobic digester.
- Blowers are original to 1995 and should be replaced.
- Coarse bubble diffused aeration equipment is aerobic digester and biosolids storage tank are original to 1995 and should be replaced.
- Boiler and recirculation pumps for heating aerobic digester are not used and at serviceable life. Equipment should be removed.
- Current biosolids storage is not covered to maintain water temperature during winter months.
- Exterior personnel doors need replacement.

Capacity Review

- Aerobic digester capacity is likely exceeded at anticipated flow and load demand.
- Liquid biosolids storage capacity requires weekly dewatering at future flow and load demand.

BIOSOLIDS DEWATERING

Biosolids Conditioning Building

- The air conditioning unit for the electrical room has exceeded its useful service life and requires replacement.
- Radiant heat boiler controls are not reliable and should be replaced.
- Plant PLC panel is no longer serviceable and should be replaced.
- Centrifuge liquid sludge feed pumps are approaching the end of serviceable life.
- Centrifuges are near major overhaul. It is anticipated that the PLC panels for the centrifuges will be recommended for replacement at this time. The VFD drive for centrifuge #1 should be replaced.
- Central odor control system requires media replacement. Location of media tank obstructs service of process equipment and should be relocated.
- Provide provisions for cake biosolids storage in addition to the dried biosolids silo.
- Alternate cake loadout should be improved to reduce spillage of cake between load out. Currently the loadout is just a horizontal plain end pipe.

OTHER CONSIDERATIONS

Administration Building

- The roof is original to 1976 and requires replacement.

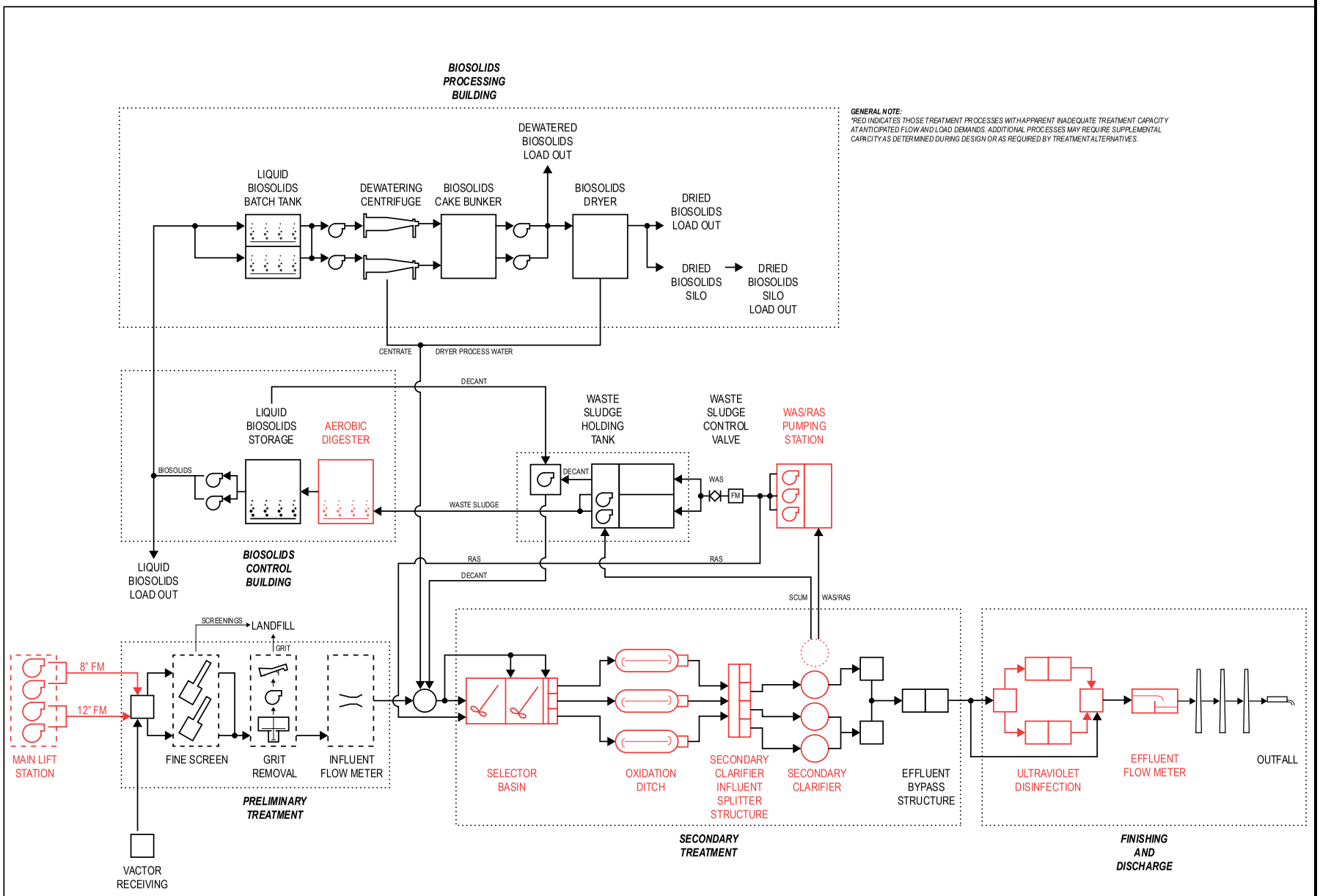
- Existing conditioning system consists of a boiler original to 1976 and an air conditioning unit which does not operate. The HVAC system should be replaced with a forced air and central conditioning system for the administration building, separate from process rooms.
- Raw sludge piping running through the administrative building requires clean air exchanges to avoid hazardous classification of the building space. Separate or re-route raw sludge piping from remainder of administrative building.
- Automatic controls including programmable logic controllers (PLCs) with human machine interface (HMI) displays for remote control and monitoring should come back to the administration building supervisory control and data acquisition (SCADA) system for the entire facility. System should include a data logging historian, remote controls, and monitoring for all treatment processes.
- The existing lavatory and shower facilities house process monitoring equipment and are non-functional.
- Interior and exterior architectural coatings are original to 1976 and should be replaced.
- Repair of exterior CMU walls is required to provide water-tight seal for joint cracks.

Summary

- Relocate UV disinfection to separate, purpose-built structure.
- Relocate RAS/WAS piping and controls to separate structure.
- Relocate septage receiving, increase accessibility, capacity, and include the ability to meter and measure flows.
- Add card access and motorized gate with security camera to main drive of facility. Provide capability of issuing access cards to septage haulers.
- Replace backup generator with appropriately size unit.
- Run new fiber communications to all treatment building and equipment.

ejm
Attachments:
Attachment 1: Process Flow Diagram for the Big Lake Wastewater Treatment Facility.

c: Eric Miller, SEH Inc.
Colin Marcusen, SEH Inc.



NOT FOR CONSTRUCTION

Project Owner
City of Big Lake
160 Lake Street N
Big Lake, MN 55309

BIG LAKE, MINNESOTA
WASTEWATER TREATMENT FACILITIES PLAN
18999 County Road 14 NW
Big Lake, Minnesota 55309

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SEH Project BIGLK 167107
Checked By
Drawn By

Project Status DRAFT
Issue Date DATE

REVISION SCHEDULE

REV. #	DESCRIPTION	DATE

EXISTING FACILITIES PROCESS FLOW DIAGRAM

1

2/1/2022 9:04:54 AM

C-3 – Facilities Plan Treatment Alternatives

Building a Better World for All of Us®

MEMORANDUM

TO: Dan Childs

FROM: Jessica Hedin, PE (Lic. MN 41639)

DATE: May 10, 2023

RE: Big Lake Wastewater Treatment Facilities Plan, Treatment Alternatives
SEH No. BIGLK 167307 14.00

The purpose of this memorandum is to evaluate the treatment alternatives to meet the anticipated design year flow and load demand at the Big Lake Wastewater Treatment Facility (WWTF). Each structure, equipment, or treatment process considered for condition, age, or capacity replacement or rehabilitation at the wastewater treatment facility was considered.

SUMMARY OF THE MAJOR PROCESS-CENTRIC RECOMMENDATIONS

Liquid Treatment Processes:

- Conveyance:
  - Demolish abandoned-in-place old main lift station.
  - Increase design capacity of main lift station.
  - Add additional forcemain to preliminary treatment.
- Preliminary Treatment:
  - Replace influent fine screening and compacting equipment.
  - Replace grit classifying and washing cyclone and add redundant grit pump.
- Secondary Treatment:
  - Replace existing selector basin mixers and baffle.
  - Expand selector basin hydraulic capacity for biological phosphorus removal.
  - Expand secondary treatment organic capacity:
    - Alternative 1 – Additional extended aeration oxidation ditches, brush aerated.
    - Alternative 2 – Modification of existing oxidation ditches for IFAS.
    - Alternative 3 – Modifications of existing oxidation ditches for MOB.
  - Expand secondary clarifier hydraulic and solids capacity:
    - Alternative 1 – Rehabilitation and expansion of existing secondary clarifiers.
    - Alternative 2 – Conversion of existing for a different process and construction of new secondary clarifiers.
  - Replace existing waste and return activated sludge pumps and structure at a proposed Disinfection and Pumping Building.
  - Replace existing coagulant feed equipment.
    - Alternative 1 – Rehabilitate existing chemical storage building.
    - Alternative 2 – Relocate to new Disinfection and Pumping Building.
- Finishing and Discharge:
  - Replace existing ultraviolet disinfection equipment and relocate to new Disinfection and Pumping Building.
  - Replace existing effluent flow measurement and relocate to new Disinfection and Pumping Building.

Solid Treatment Processes:

- Biosolids Stabilization:
  - Provide waste sludge and scum thickening prior to aerobic digestion:
    - Alternative 1 – Gravity thickening.
    - Alternative 2 – Dissolved air floatation thickening.
  - Expand solids treatment capacity of existing aerobic digester, replace existing aeration equipment and diffusers with selected mixing and aeration alternative:
    - Alternative 1 – Rehabilitate primary cell 1, convert liquid biosolids storage to secondary cell 1.
    - Alternative 2 – Rehabilitate primary cell 1, construct primary cell 2, convert liquid biosolids storage to secondary cell 1.
  - Evaluate mixing and aeration alternatives for Waste Sludge Holding Tank, Aerobic Digester, and Liquid Biosolids Storage:
    - Alternative 1 – Diffused aeration and mixing.
    - Alternative 2 – Diffused aeration, compressed aerated mixing.
    - Alternative 3 – Jet aeration and mixing.
  - Centralized sludge and biosolids low-pressure aeration at Biosolids Control Building.
  - Convert existing Waste Sludge Storage Tank to sludge receiving station.
  - Cover liquid sludge storage.
- Biosolids Dewatering:
  - Replace centrifuge controls and drives.
  - Replace centrifuge feed pumps.
  - Relocate odor control equipment.
  - Furnish emergency eyewash and lavatory shower.
  - Replace vertical shaftless screw conveyor.
  - Provide permanent gate and controls for dewatered biosolids loadout.

Other Considerations

- Administration Building
  - Replace HVAC with forced air.
  - Demolish equipment from lower level, fill lower level, convert upper level of process room to maintenance garage.
  - New PLC and SCADA system.
  - Replace backup generator with sufficiently sized unit in all-weather enclosure.
- Site
  - New fiber communications.
  - Replace site lighting.
  - Replace site asphalt.
  - Replace site stormwater system as needed.
  - Replace and relocate septage receiving.
  - Replace front gate with motor-operated gate, card scanner, and camera.
- Disinfection and Pumping Building
  - Construct new multi-purpose process building on south side of site for:
    - Ultraviolet disinfection equipment (lower level)
    - Effluent flow measurement (lower level)
    - WAS and RAS pumping (lower level)
    - Other process specific pumping requirements based on alternatives (lower level)
    - Chemical storage and feed (upper level, as applicable to alternatives)
    - Electrical equipment and south site generator (upper level)

ALTERNATIVE EVALUATION

Improvement considered are identified based on the associated treatment process and generally categorized as liquid treatment processes and solids treatment processes. Where appropriate, alternatives are identified and considered. Improvements recommended based on age, condition, or where alternative consideration are not applicable present the recommended improvements and associate Preliminary Engineer's Opinion of Probable Costs.

LIQUID TREATMENT ALTERNATIVES

Refer to Attachment 1 for process schematics for proposed liquid treatment alternatives.

Conveyance

Conveyance consists of the following processes:

- Main Lift Station, and
- Influent Forcemain.

Old Main Lift Station

The old main lift station which was replaced by the current main lift station is abandoned-in-place. The existing old main lift station is recommended for demolition. Its removal would eliminate the existing facilities, which are degrading and pose a concern for safety.

Main Lift Station:

Alternatives for the main lift station building consist of replacement due to condition. Alternatives for the main lift station pumps are capacity related. The recommended improvements align with the future capacity for replacement of existing pumps as indicated in the Record Drawings for the Main Lift Station. Additional work may be required if the proposed high-flow pumps, lifting system, controls or other equipment require additional room for operation and maintenance than what is planned in the current main lift station building.

Summary of Recommended Improvements:

Condition-Based Replacement:

- Replace electrical service, generator, transfer switch for larger pumps.
- Replace existing controls with new PLC, radio transmitter to WWTF.
- Replace jib crane.
- Interior coatings for piping, equipment, and architecture.
- Replace existing high-flow pumps in-kind or new to serve as low-flow pumps.
- Coarse bubble aerator and regenerative blower to reduce ragging and grease accumulation.

Capacity-Based Replacement:

- Replace existing low-flow pumps with new high-flow pumps.

Note that the replacement of the submersible pumps may deviate pending flow and head determination as part of design.

Influent Forcemain

The recommended improvements align with the future capacity for an additional high flow forcemain as indicated in the Record Drawings for the Main Lift Station. Additional work may be required if the proposed high flow forcemain piping, pumps, or other equipment require additional room for operation and maintenance than what is planned in the current main lift station building.

Summary of Recommended Improvements:

Condition-Based Replacement:

- Replace isolation valve, relief valve, piping, and accessories as existing air relief structures for existing forcemains.

Capacity-Based Replacement:

- New 16-inch DIP piping in valve building with magnetic flow meter.
- New 18-inch HDPE DR9 forcemain for WWTF. Interconnect with 12-inch for future or high-flow.

Note that the forcemain size and quantity of relief structures may deviate pending flow and alignment determination as part of design.

Preliminary Engineer's Opinion of Probable Costs

Refer to Table 1 for a summary of the anticipated Preliminary Engineer's Opinion of Probable Costs associated with the recommended improvements. These costs reflect the opinion of probable costs at the time of preparation of this report. Probable costs are likely to change between preparation of the facility plan and bidding of improvements.

Table 1: Preliminary Engineer's Opinion of Probable Costs for Conveyance Improvements

Description	Opinion of Probable Cost
Electrical and Controls	$187,000
Jib Crane	$13,000
Process Equipment	$395,000
Forcemain and Relief Structures	$1,357,000
Restoration and Coatings	$90,000
Selective Demolition	$3,000
Old Main Lift Station Demolition	$80,000
Subtotal for Construction [1]	$2,301,000
Contingency [2]	$691,000
Engineering and Design [3]	$415,000
Legal, Fiscal, and Administrative [4]	$24,000
Total for Project	$3,431,000

General Notes:

- Preliminary Engineer's Opinion of Probable Costs does not include costs associated with right-of-way and permitting for forcemain alignment.
- Assumes one direction drill crossing for County Road 14.
- Assumes no structural modifications are required at Main Lift Station for installation of new pumps and forcemain.

Notes:

1. Includes 5.0% construction contingency, 3.0% mobilization, bonding, and insurance, 0.1% permitting as part of Construction Costs.
2. Includes 30% contingency of preliminary anticipated capital improvements costs as Design Contingency.
3. Includes 18% of preliminary anticipated capital improvements costs for Engineering, Design, and Field Services.
4. Includes 1% of preliminary anticipated capital improvements costs for Legal, Fiscal, and Administrative.

Preliminary Treatment

Preliminary Treatment consists of the following processes:

- Preliminary Treatment Building,
- Fine Screening,
- Grit Removal, and
- Influent Flow Measurement.

Preliminary Treatment Building

Alternatives for the preliminary treatment building consist of replacement due to condition. Major process treatment units will be considered separately.

Summary of Recommended Improvements:

Condition-Based Replacement:

- Replace (2) existing Class I Division 1 Group D rated electric unit heaters in screening room with roof mounted unit, ductwork, and roof repair.
- Replace existing natural gas, direct fire Make-up Air Unit.
- Replace existing potable water plumbing piping, fittings, valves, insulation, hose bibs, and hydrants in screening room.
- Interior piping, equipment, and architectural coatings.
- Replace existing controls with new PLC.
- Replace (3) existing 36" wide exterior hollow metal doors with new aluminum doors.
- Replace (1) existing 8' wide x 10' tall exterior overhead door with new aluminum overhead door. Replace overhead door operator with new Class I Division 1 Group D rated operator and local controls. No safety eyes, open/close are spring opening pushbuttons.
- Replace existing refrigerated automatic influent sampler.

Note that the replacement of the HVAC may deviate pending occupancy review and room classification determination as part of design.

Fine Screening

Alternatives for fine screening consist of replacement due to condition of existing equipment. Facility currently operates drum-type automatic fine screens. Screen opening of current and proposed screens is 6 mm, which is suitable for secondary treatment alternatives.

Summary of Recommended Improvements:

Condition-Based Replacement:

- Replace existing fine screening and compaction equipment and controls with new 6mm drum screens. Furnish with wash nozzles suitable for plant effluent. Discharge to roll-off container.

Grit Removal

Alternatives for grit removal consist of replacement due to condition of existing equipment. The facility has recently replaced the existing grit pump and was without grit removal due to difficulty sourcing a replacement pump. A standby pump would allow for reliable process operation.

Summary of Recommended Improvements:

Condition-Based Replacement:

- Replace grit classifier and washer cyclone.
- Add second standby grit pump, replace suction and discharge piping as needed.
- Replace existing grit pump suction and discharge valves (4-inch flanged ductile).

Influent Flow Measurement

Alternatives for influent flow measurement consist of replacement due to condition of existing equipment.

Summary of Recommended Improvements:

Condition-Based Replacement:

- Replace existing flow measurement instrument.
- Add recirculation submersible pump after flow measurement to a sample chamber on wall in screen room opposite automatic sampler.
- Add online pH meter after flow measurement.

Preliminary Engineer's Opinion of Probable Costs

Refer to Table 2 on the following page for a summary of the anticipated Preliminary Engineer's Opinion of Probable Costs associated with the recommended improvements. These costs reflect the opinion of

probable costs at the time of preparation of this report. Probable costs are likely to change between preparation of the facility plan and bidding of improvements.

Table 2: Preliminary Engineer's Opinion of Probable Costs for Preliminary Treatment Improvements

Description	Opinion of Probable Cost
Electrical and Controls	$163,000
Mechanical and HVAC Equipment and Controls	$265,000
Plumbing Piping and Accessories	$30,000
Coatings	$67,000
Architectural Doors	$25,000
Automatic Sampler, Piping, and Recirculation Pump	$25,000
Fine Screening and Compacting Equipment and Controls	$659,000
Grit Cyclone, Pump, Piping, and Controls	$49,000
Influent Flow Measurement Instrumentation and Controls	$3,000
Selective Demolition	$6,000
Subtotal for Construction [1]	$1,398,000
Contingency [2]	$420,000
Engineering and Design [3]	$252,000
Legal, Fiscal, and Administrative [4]	$14,000
Total for Project	$2,084,000

Notes:
1. Includes 5.0% construction contingency, 3.0% mobilization, bonding, and insurance, 0.1% permitting as part of Construction Costs.
2. Includes 30% contingency of preliminary anticipated capital improvements costs as Design Contingency.
3. Includes 18% of preliminary anticipated capital improvements costs for Engineering, Design, and Field Services.
4. Includes 1% of preliminary anticipated capital improvements costs for Legal, Fiscal, and Administrative.

Secondary Treatment

The design intent for the wastewater treatment facility is for biological phosphorus removal. Current flow and load demands do not allow for biological phosphorus removal due to insufficient treatment capacity in the secondary treatment process. Benefits to the facility for biological phosphorus removal include:

- Reduced solids production as compared to chemical precipitation.
- Reduced operating costs associated with purchase of coagulant.
- Conducive to existing aerobic digestion, reducing risk of rerelease of phosphorus.
- Reduced environmental impact reducing the requirement for production, transportation, and discharge of coagulant by the facility.

Secondary Treatment consists of the following processes:

- Selector Basin,
- Biological Treatment,
- Secondary Clarifiers, and
- Chemical Phosphorus Removal.

Selector Basin

The selector basin does not provide the recommended hydraulic retention time at the anticipated flow demand. Increasing the treatment volume through either additional cells or through an additional treatment train will allow for greater range of operational control.

Parameters for the existing selector basin are:

- Quantity: 1 tank, 2 cells separated by baffle (may be 1 anaerobic/1anoxic, 2 anoxic, or 2 anaerobic).
- Mixing: Mechanical, static impeller.
- Length: 27'-0", each cell.
- Width: 22'-0", each cell
- Side Water Depth: 13'-0".
- Total Volume: 57,750 gallons, each cell.

Summary of Recommended Improvements:

Condition-Based Replacement:

- Replace (2) existing mechanical mixers with submersible mixers.
- Provide ORP instrumentation for enhanced process control.
- Replace existing redwood baffle wall.
- Apply interior coatings from 1 foot below normal water elevation to top of sidewall and undersize of concrete cover slab.
- Replace isolation slide gate.

Capacity-Based Replacement:

- Refer to Biological Treatment Alternatives for selector basin improvements.

Biological Treatment

Several alternatives are considered for biological treatment with biological phosphorus removal. Consideration for alternatives includes the potential for nitrogen effluent limits. The parameters for the existing biological treatment are:

- Quantity: (3) oxidation ditches.
- Mixing: (2) brush aerators, per ditch.
- Run: 258'-0" total run (100'-0" each channel, 29'-0" each radius), per ditch.
- Width: 18'-0" each channel, 18'-6" each radius.
- Side Water Depth: 10'-9", maximum.
- Total Volume: 368,500 gallons, each ditch.

ALTERNATIVES CONSIDERED:

ALTERNATIVE 1 – EXPANSION OF EXISTING OXIDATION DITCHES (EXTENDED AERATION)

There is insufficient organic capacity at the anticipated load demand for the existing oxidation ditches. This alternative would add additional tankage for additional oxidations ditches to meet future load demand. When possible, future oxidation ditches will be sized and configured similar to existing tankage for ease of operation.

The existing oxidation ditches provide a combined organic treatment capacity of 2,250 pounds of $cBOD_5$ per day. The anticipated calendar day average $cBOD_5$ load demand exceeds the current capacity by approximately 2,350 pounds of $cBOD_5$ per day. The addition of three additional oxidation ditches, each approximately 375,000 gallons would provide sufficient organic load capacity at a design organic load of 15 pounds of $cBOD_5$ per day per 1,000 cuft of tank volume. Typical hydraulic retention time for an oxidation ditch ranges from 8 to 30 hours. At anticipated the Average Wet Weather (Maximum Month as Day Average) flow, the HRT, with all six trains operating, would be 33 hours.

The current splitter structure as part of the selector basin can split flow between the three existing oxidation ditches. As part of this alternative, an additional upstream splitter structure would divide flow between the existing selector basin and a second, additional, selector basin. From there, the additional selector basin would be identical to the existing and split flow to the three additional oxidation ditches. Interconnected piping between the selector basin splitter structure would allow flow from either selector tank to any oxidation ditch, though hydraulics will influence the split.

A return activated sludge splitter structure would also be added to facilitate even splitting of RAS between the two selector basin treatment trains regardless of secondary clarifier operation scheme. The splitter structure also allows for observation and sampling of RAS prior to mixing with influent.

Condition-Based Replacement:

- Replace Oxidation Ditch 1 and 2 aerator building roof with fully adhered EPDM.
- Repair Oxidation Ditch 1 and 2 aerator building exterior CMU.
- Replace Oxidation Ditch 1 and 2 aerator building interior architectural coatings.
- Replace Oxidation Ditch 1 and 2 aerator building exterior coatings.
- Replace Oxidation Ditch 1 and 2 aerator building brush aerator with new system, including VFD which can adjust speed based on DO measurement in basin.
- Add dissolved oxygen online analyzer to Oxidation Ditch 1, 2, and 3.
- Replace Oxidation Ditch 1 and 2 aerator building (1) existing 36” wide and (1) 60” wide double-leaf exterior hollow metal doors with new aluminum doors.
- Provide condition related improvements to existing selector basin, refer to selector basin portion of this memorandum.

Capacity-Based Replacement:

- Construct three additional oxidation ditches similar in size, configuration, and capacity as existing ditches.
- Construct new additional selector basin similar in size, configuration, and capacity as existing basin.
- Construct new RAS splitter structure.
- Construct new selector basin influent splitter structure.

Note that the aerator motor and selector basin mixer horsepower may deviate pending biological treatment aeration requirement determination as part of design.

ALTERNATIVE 2 – CONVERSION TO INTEGRATED FIXED FILM ACTIVATED SLUDGE (IFAS)

This alternative would introduce IFAS mobile biofilm media for growth of biofilm into an aeration basin within the existing oxidation ditches. The mobile biofilm media supports a very high concentration of attached biomass; and maintains excellent mass transfer conditions. The neutrally buoyant biofilm media within the bioreactor tank provide a stable base for growth of a diverse community of microorganisms. Every biofilm media has a very high surface-to-volume ratio, allowing for a high concentration of biological growth to thrive within the internally protected areas.

The media is retained in a separate aeration basin constructed in the existing oxidation ditches by submerged static screens. Effluent is allowed to flow from the IFAS aeration basin into the remainder of the converted oxidation ditch through a cast-in-place concrete diver wall. Separate fine-bubble aeration diffuser grids installed in the oxidation ditches will facilitate step aeration. The modifications convert the oxidation ditch to a flow-through, completely mixed process tank rather than a recirculating, plug flow process tank.

For this alternative, the splitter structure for the existing selector tank is sufficient as additional activated sludge tanks are not required. The selector tank would be rehabilitated with new mixing equipment, baffle wall, and instrumentation. A third selector cell is still recommended. RAS is returned from the secondary clarifiers to the front of the selector basins. WAS is wasted from the secondary clarifier to the aerobic digesters.

The self-regulating nature of biofilm adjusts to variations in process load. As the contaminant load increases, the microbial population in the biofilm increases enabling additional treatment capacity. Likewise, during low loading conditions, the population self-adjusts and decreases.

Fixed film processes are resistant to toxic contaminants as the inner layer of biofilm is protected. In the case of a toxic shock, the outer layer of dead bacteria will be removed by normal detachment mechanisms present in the bioreactor while the inner layer will provide a seed for microbial growth and enabling the system to continue meeting the contaminant load.

Combination of suspended growth and fixed film processes enhances the treatment reaction such that the volume necessary to conduct certain level of treatment is significantly lower than those required by activated sludge alone. As a result, a given volume of reactor can handle significantly larger flow and load by addition of media, without the need to add any new tank volume, and associated capital expense.

The alternative requires conversion of existing oxidation ditches into IFAS process tanks. The third basin may either remain in place for future expansion or be removed, however; it is assumed to remain in place for flexibility of expansion in the future.

It is assumed at this time that influent wastewater characteristics are appropriate for effective biological phosphorus removal such that a supplemental carbon source is not required to meet the anticipated total phosphorus effluent limits. Additionally, it is assumed that the speciation of phosphorus can be removed via the mechanisms of biological phosphorus removal and tertiary treatment for filtration is not required. Coagulant feed is provided for polishing and sized for chemical precipitation. A preliminary design phase is recommended for detailed modeling for the treatment process and determination of additional processes which may be required to meet effluent water quality parameters.

Condition-Based Replacement:

- Remove oxidation ditch 1 and the associated aerator building.
- Remove oxidation ditch 2 and 3 brush motor enclosures.
- Provide condition related improvements to existing selector basin, refer to selector basin portion of this memorandum.

Capacity-Based Replacement:

- Construction of baffle walls and installation of retention screens to create separate IFAS aeration basin and step aeration basin within existing oxidation ditch 2 and 3.
- Fine-bubble diffused aeration equipment installed in each oxidation ditch.
- Blowers, controls, and piping for each converted oxidation ditch.
- Construction of a blower building for aeration blowers.

ALTERNATIVE 3 – CONVERSION TO MOBILE ORGANIC BIOFILM (MOB) ACTIVATED SLUDGE

This alternative would introduce MOB mobile fixed-film media to the existing oxidation ditches. The alternative is intended to address stringent nutrient removal requirements, improve secondary sludge settleability, and intensify secondary treatment process capacities to address existing activated sludge footprint. The media is 100% plant-derived hybrid technology that combines the advantages of integrated fixed-film activated sludge (IFAS) and aerobic granular sludge (AGS). The process utilizes a renewable plant material as a medium for biofilm growth. The ballasted media core provides a backbone for the establishment of organically ballasted granular sludge. The biomedia acts as an adsorptive ballast, which provides a high degree of stability that enhances the granular sludge process.

The media would recirculate within the oxidation ditch and secondary clarifier. Media granules are fully mobile and free to circulate throughout wastewater treatment plant's secondary treatment processes. A 500-micron drum screen on the WAS line would separate media from WAS. The separated media would be returned with RAS to the front of the selector basins. Screened WAS would be transferred to the aerobic digester.

For this alternative, the splitter structure for the existing selector tank is sufficient as additional activated sludge tanks are not required. The selector tank would be rehabilitated with new mixing equipment, baffle wall, and instrumentation. A third selector cell is still recommended.

WAS screen equipment and screened WAS pumps will be located in the Disinfection and Pumping Building with WAS and RAS pumping. It is assumed that additional storage will be required for the screened WAS and WAS screenings. The existing secondary clarifier tank may be converted and utilized for storage with the addition of mixing equipment. Final determination of suitability for existing tanks to be reused will be included as part of design.

For the purpose of the facility plan evaluation, the current surface aerators would be replaced with a more efficient fine-bubble aeration system. The MOB process is suitably aerated through surface aerators, though the age, condition, and efficiency of the current equipment would benefit from replacement. Blowers may also be furnished in weather-proof enclosures which negate the need for a blower building, however for ease of operation and maintenance a blower building is included in the evaluation.

It is assumed at this time that influent wastewater characteristics permit are appropriate for biological phosphorus removal such that a supplemental carbon is not required to meet the anticipated total phosphorus effluent limits. Additionally, it is assumed that the speciation of phosphorus can be removed via the mechanisms of biological phosphorus removal and tertiary treatment for filtration is not required. Coagulant feed is provided for polishing and sized for chemical precipitation. A preliminary design phase is recommended for detailed modeling of the treatment process and determination of additional processes which may be required to meet effluent water quality parameters.

Condition-Based Replacement:

- Remove oxidation ditch 1 aerator building.
- Remove oxidation ditch 2 and 3 brush motor enclosures.
- Provide condition related improvements to existing selector basin, refer to selector basin portion of this memorandum.

Capacity-Based Replacement:

- Introduction of mobile fixed-film media at 1.25% fill.
- Installation of WAS drum screen,
- Screened WAS pumps.
- Screened WAS media pumps.
- Fine-bubble diffused aeration equipment installed in each oxidation ditch.
- Blowers, controls, and piping for each converted oxidation ditch.
- Construction of a blower building for aeration blowers.

NON-ECONOMIC CONSIDERATIONS

Non-economic factors weight heavily in the comparison between alternatives for biological treatment. All alternatives are technically possible however the following pros and cons associated with Alternative 3 are substantive:

- Pro
  - Alternative can utilize either 2 or 3 existing oxidation ditches depending on the desired percent media fill.
  - Additional treatment capacity can be added by increasing percent media fill.
  - Does not require static retention screens.
  - Provide ballasted settling in secondary clarifier, improving settleability.
  - May use surface aerators or diffused air for aeration.
  - Replacement media is added yearly rather than all at once.

- Con
  - Media is proprietary to manufacturer.
  - Requires WAS screening and additional pumping for recirculation.
  - Requires blower building and blowers.

Refer to Table 3 for the preliminary Engineer's opinion of probable costs associated with each alternative considered.

Table 3: Preliminary Engineer's Opinion of Probable Costs for Biological Treatment Alternatives

Alternative	Description	Opinion of Probable Cost [1, 2, 3, 4]
Alternative 1:	Expansion of Existing Oxidation Ditches	$9,407,000
	Second Selector Basin Train	$1,734,000
	Total	**$11,141,000**
Alternative 2:	Conversion to Integrated Fixed Film Activated Sludge	$7,458,000
	Selector Basin Expansion	$1,103,000
	Total	**$8,561,000**
Alternative 3: [5]	Conversion to Mobile Organic Biofilm Activated Sludge	$6,181,000
	Selector Basin Expansion	$1,103,000
	Total	**$7,284,000**

Notes:
1. Includes 5.0% construction contingency, 3.0% mobilization, bonding, and insurance, 0.1% permitting as part of Construction Costs.
2. Includes 30% contingency of preliminary anticipated capital improvements costs as Design Contingency.
3. Includes 18% of preliminary anticipated capital improvements costs for Engineering, Design, and Field Services.
4. Includes 1% of preliminary anticipated capital improvements costs for Legal, Fiscal, and Administrative.
5. Alternative requires replacement of secondary clarifier tanks and reuse for WAS pumping.

The recommended alternative is Alternative 3. The alternative provides process intensification without the need for additional basins at the lowest anticipated capital cost. The alternative provides the advantages of ballasted settling for secondary clarification and can have additional media added at a later date to increase the organic capacity of the treatment process.

The recommended alternative meets the anticipated flow and load demands with the following advantages:

- The technology may be installed in either two or three existing oxidation ditches; however, this estimate assumes all three basins are converted to provide flexibility for future expansion. The preliminary opinion of probable cost reflects three existing tanks being converted. This allows for either continued operation of the existing oxidation ditches with equipment in place for future expansion projects or limiting of capital and operation costs and installation of equipment in two of the three existing oxidation ditches.
- The alternative adds the benefit of ballasted settling to the secondary sedimentation process, which given the relatively low total phosphorus effluent limit requirements will benefit the facility by increasing sludge settleability and solids capture rate.
- With considerations for other alternatives considered, the additional pumping required by screening of waste activated sludge can be combined with other processes. This eliminates the needs for dedicated pumping as a result of the additional screening step.
- Alternative 2 and 3 both utilize fine-bubble diffused aeration and blowers for the same converted tankage. During preliminary design, decoupling for separate mixing and aeration may be evaluated to further increase energy efficiency.

Secondary Clarifier

Influent Splitter Structure:

The secondary clarifier splitter structure is setup for combining oxidation ditch effluent from the three existing oxidation ditches and splitting that flow between three existing secondary clarifier tanks. There are facilities for splitting flow to a future fourth secondary clarifier. Considerations for the influent splitter structure will be discussed as part of the secondary clarifier alternatives due to the need to split flow evenly between the process tanks.

Capacity-Based Replacement:

- Refer to Secondary Clarifier Alternatives for selector basin improvements.

Basins:

Two alternatives were developed for providing sufficient treatment capacity to meet anticipated flow and load demands. The secondary clarifiers are solids limited, meaning the solids loading to the treatment process will drive the recommended alternatives.

ALTERNATIVES CONSIDERED:

ALTERNATIVE 1 – REHABILITATION AND EXPANSION OF EXISTING SECONDARY CLARIFIERS

For this alternative the existing secondary clarifier tanks would be rehabilitated. This would include:

- Replacement of the (3) existing 34’-0” suction arm clarifier mechanisms.
- Replacement of the (3) existing clarifier bridges.
- Replacement of the (3) existing fiberglass clarifier domes with aluminum domes, doors, and HVAC equipment.
- Coatings from 1 foot below normal water elevation across top of tank wall, including all of the concrete launderer.

Additional capacity will be provided by additional secondary clarifiers, similar to those currently installed. This is to allow for ease of operation without having imbalanced flow to differently sized clarifier tanks.

The maximum allowable peak solids loading rate as recommended by 10 States Standards for Wastewater Facilities (2014 Edition) is 35 lbs per day per sqft. To achieve this loading rate, two additional secondary clarifier tanks with a weir diameter of 34’-0” and interior tank diameter of 39’-6” would need to be constructed.

Condition-Based Replacement:

- Secondary clarifier mechanism, bridge, domes, doors, HVAC, and coatings as noted above.
- Expand the existing influent splitter structure for capacity to split flow between five secondary clarifiers.
- Coagulant chemical feed location at weir for each secondary clarifier.

Capacity-Based Replacement:

- (2) additional secondary clarifier tanks, identical to existing.
- (2) suction arm clarifier mechanisms.
- (2) aluminum dome covers, doors, and HVAC equipment.
- Coatings from 1 foot below normal water elevation across top of tank wall, including all of the concrete launderer.
- Scum, drain, influent, effluent, and sludge yard piping to and from new secondary clarifier tanks.
- Add ultrasonic sludge level transducers with wipers to each tank for monitoring sludge blanket depth.

ALTERNATIVE 2 – NEW SECONDARY CLARIFIERS

For this alternative the existing secondary clarifier tanks would be rehabilitated. This would include:

- Conversion of the existing three secondary clarifiers holding or other process tanks as noted in treatment alternatives.
- Removal of the existing clarifier mechanisms, domes, doors, and HVAC equipment, unless noted otherwise in treatment alternatives.

All required capacity, including the additional capacity needed, will be provided by two new clarifier mechanisms with a 60'-0" weir diameter. This is to allow for ease of operation while taking advantage of scale and volume efficiency of round tanks. Construction of the new clarifiers can be done with the facility operating and allows for conversion of the existing tankage to supplement the current, limited waste sludge storage capacity.

The maximum allowable peak solids loading rate as recommended by 10 States Standards for Wastewater Facilities (2014 Edition) is 35 lbs per day per sqft. To achieve this loading rate, two secondary clarifier tanks with weir diameter of 60'-0" and interior tank diameter of 65'-0" would be constructed.

Condition-Based Replacement:

- Conversion of the existing three secondary clarifiers as noted above.
- Replace existing influent splitter structure for capacity to split flow between two secondary clarifiers.
- Coagulant chemical feed location at weir for each secondary clarifier.

Capacity-Based Replacement:

- (2) additional secondary clarifier tanks.
- (2) suction arm clarifier mechanisms.
- (2) dome covers, doors, and HVAC equipment.
- Coatings from 1 foot below normal water elevation across top of tank wall, including all of the concrete launderer.
- Scum, drain, influent, effluent, and sludge yard piping to and from new secondary clarifier tanks.
- Add ultrasonic sludge level transducers with wipers to each tank for monitoring sludge blanket depth.

Refer to Table 4 on the following page for the preliminary Engineer's opinion of probable costs associated with each alternative considered.

Table 4: Preliminary Engineer's Opinion of Probable Costs for Secondary Clarification Alternatives

Description	Opinion of Probable Cost [1, 2, 3, 4, 5]
Alternative 1: Rehabilitation and Expansion of Existing Secondary Clarifiers	$17,475,000
Alternative 2: Conversion of Existing and Construction of New Secondary Clarifiers	$7,222,000

Notes:

1. Includes 5.0% construction contingency, 3.0% mobilization, bonding, and insurance, 0.1% permitting as part of Construction Costs.
2. Includes 30% contingency of preliminary anticipated capital improvements costs as Design Contingency.
3. Includes 18% of preliminary anticipated capital improvements costs for Engineering, Design, and Field Services.
4. Includes 1% of preliminary anticipated capital improvements costs for Legal, Fiscal, and Administrative.
5. Costs associated with modifications to the existing clarifier tanks are included as part of other alternatives. Cost includes demolition of existing equipment and covers.

It is recommended to proceed with alternative 2. The purpose-built clarifiers allow for mechanisms designed to operate with thicker mixed liquor and sludge blankets resulting from process intensification from either secondary treatment Alternatives 2 or 3. New basins will allow for a sludge draw-off sump and piping dedicated for each tank. The reduced number of operating basis will also simplify process operation.

The recommended alternative meets the anticipated flow and load demands with the following advantages:

- Increases treatment capacity to meet anticipated flow and load demand.
- Provide purpose-built facilities with dedicated sludge return and wasting pumps.
- Allows for secondary sedimentation tanks to be tailored to higher-efficiency solids removal equipment with considerations for the recommended biological treatment alternative.

WAS/RAS Pumping Station:

Existing WAS/RAS Pumping Station improvements include replacement of the structure to meet future flow demands and modify operation to allow for additional process control related to:

- Independent pumping for RAS from each clarifier tank.
- Independent pumping for WAS from each clarifier tank.

New WAS/RAS Pumping Equipment will be relocated to a proposed Disinfection and Pumping Building which will provide:

- Sufficient space for separate RAS and WAS pumps for each clarifier tank.
- Safe egress access for operation and maintenance.
- Relocated WAS controls from Administration Building.
- Flow-paced pump controls.

Summary of Recommended Improvements:

Condition-Based Replacement:

- Replace existing pumps and controls for WAS/RAS submersible pumps.
- Remove existing WAS/RAS structure.
- Provide new PLC and controls for pump operation.

Capacity-Based Replacement:

- Provide sufficient hydraulic capacity of WAS pumps for future flow demand.
- Provide sufficient hydraulic capacity of RAS pumps for future flow demand.
- Provide instrumentation and controls for reliable operation of RAS and WAS pumps.

Chemical Phosphorus Removal

Recommended improvements to the chemical phosphorus removal equipment are intended to:

- Provide additional operation flexibility by providing additional coagulant dose locations.
- Improvement process efficiency by providing chemical feed pumps with sufficient turndown for coagulant demand.
- Address health and safety for bulk chemical storage.

The secondary treatment process is anticipated to operate for biological phosphorus removal with coagulant feed equipment in place for polishing and backup. The capacity of coagulant feed equipment is intended to be sufficient for a facility operating as a chemical precipitation for phosphorus removal but allow for turn-down to meet anticipated operating conditions. Jar testing for anticipated coagulant consumption rates at the total phosphorus effluent limit is recommended. The following recommendation assume 90 mg/L ferric chloride demand.

Summary of Recommended Improvements:

Condition-Based Replacement:

- Existing coagulant feed pumps are obsolete.
- Existing coagulant bulk storage tanks lack sufficient fill indicators for measurement and overfill. Furnish instrumentation and controls to record and report chemical tank levels.
- Existing chemical storage building lacks appropriate ventilation and sprinkling for storage of hazardous materials.
- Existing chemical feed header is a combined discharge, unable to reliably dose coagulant evenly to existing chemical feed locations.

Capacity-Based Replacement:

- Furnish dedicated coagulant feed pump for each secondary clarifier, with the ability to dose to either the oxidation ditch effluent box or influent clarifier splitter structure.
- Additional chemical feed locations recommended at secondary clarifier influent splitter structure to provide additional operation flexibility.
- Additional chemical storage where needed.

ALTERNATIVES CONSIDERED:

ALTERNATIVE 1 – REHABILITATION OF EXISTING CHEMICAL STORAGE BUILDING

This alternative reuses the existing chemical storage building, tanks, and piping where possible while providing new equipment and piping as noted.

Condition-Based Replacement:

- Replace existing chemical feed pumps. The quantity of pumps will be sufficient for one dedicated pump for each biological treatment tank or secondary clarifier tank, whichever quantity is greater.
- Replace existing chemical feed common header with dedicated piping to ensure even distribution of coagulant to dose locations.
- Replace chemical feed tubing to existing coagulant feed locations at biological treatment tanks.
- Replace intake and exhaust HVAC equipment.
- Extend water main, add sprinkler riser, sprinkler control panel, and sprinkler system to chemical storage building.

Capacity-Based Replacement:

- Provide new secondary containment, pull boxes, and primary carrier tubing for coagulant feed to additional biological treatment tanks as necessary and all secondary clarifier influent splitter box feed locations.

ALTERNATIVE 2 – RELOCATION TO DISINFECTION AND PUMPING BUILDING

This alternative relocates the chemical storage to the proposed Disinfection and Pumping Building. The proposed location will reduce the length of yard coagulant piping required to feed locations and allow for occupancy and building improvements to be incorporated into a new concrete structure.

Condition-Based Replacement:

- Replace existing chemical feed pumps. The quantity of pumps will be sufficient for one dedicated pump for each biological treatment tank or secondary clarifier tank, whichever quantity is greater.
- New dedicated chemical feed piping to ensure even distribution of coagulant to dose locations.
- Provide new secondary containment, pull boxes, and primary carrier tubing for coagulant feed to all biological treatment feed locations.
- New intake and exhaust HVAC equipment.
- Extend water main, add sprinkler riser, sprinkler control panel, and sprinkler system. Include floor drains and sump.

Capacity-Based Replacement:

- Provide new secondary containment, pull boxes, and primary carrier tubing for coagulant feed to additional biological treatment tanks as necessary and all secondary clarifier influent splitter box feed locations.

Refer to Table 5 for the preliminary Engineer's opinion of probable costs associated with each alternative considered.

Table 5: Preliminary Engineer's Opinion of Probable Costs for Chemical Phosphorus Removal Alternatives

Description	Opinion of Probable Cost [1, 2, 3, 4]
Alternative 1: Rehabilitation of Existing Chemical Storage Building	$219,000
Alternative 2: Replacement of Disinfection and Effluent Metering Equipment	$472,000

General Notes:

- The cost comparison is for replacement of chemical feed equipment and piping to the existing treatment facilities to establish an equal comparison.
- Costs include the additional feed location at the secondary clarifier splitter structural. Actual preliminary costs may change if additional tankage is recommended by other alternatives.
- Cost for Alternative 2 does not include additional building costs as it is assumed to fit within the proposed upper-level floor plan of the Disinfection and Pumping Building.

Notes:

1. Includes 5.0% construction contingency, 3.0% mobilization, bonding, and insurance, 0.1% permitting as part of Construction Costs.
2. Includes 30% contingency of preliminary anticipated capital improvements costs as Design Contingency.
3. Includes 18% of preliminary anticipated capital improvements costs for Engineering, Design, and Field Services.
4. Includes 1% of preliminary anticipated capital improvements costs for Legal, Fiscal, and Administrative.

It is recommended to proceed with Alternative 2. The alternative provides an industrial-grade, durable, and safe facility which has been designed and constructed for hazardous material storage. The existing chemical building has been relocated and rehabilitated in at least two major expansion projects and is nearing the useful service lift for a timber structure.

The recommended alternative meets the anticipated flow and load demands with the following advantages:

- The alternative provides the lowest capital cost for improvements while reusing existing facilities.
- Removes hazardous chemical storage from proposed Disinfection and Pumping Building.
- Allows for coagulant feed to remain in place during construction.

Preliminary Engineer's Opinion of Probable Costs

Refer to Table 6 on the following page for a summary of the anticipated Preliminary Engineer's Opinion of Probable Costs associated with the recommended improvements. These costs reflect the opinion of probable costs at the time of preparation of this report. Probable costs are likely to change between preparation of the facility plan and bidding of improvements.

Table 6: Preliminary Engineer's Opinion of Probable Costs for Secondary Treatment Improvements

Description	Opinion of Probable Cost
Selector Basin Improvements	$739,000
Biological Treatment Alternative 3	$4,147,000
Secondary Clarifier Alternative 2	$4,846,000
Chemical Phosphorus Removal Alternative 1	$417,000
Subtotal for Construction [1]	$9,878,000
Contingency [2]	$2,965,000
Engineering and Design [3]	$1,781,000
Legal, Fiscal, and Administrative [4]	$101,000
Total for Project	$14,725,000

General Notes:
- Refer to individual treatment sections for additional information and discussion for alternatives considered and associated Preliminary Engineer's Opinion of Probable Costs.

Notes:
1. Includes 5.0% construction contingency, 3.0% mobilization, bonding, and insurance, 0.1% permitting as part of Construction Costs.
2. Includes 30% contingency of preliminary anticipated capital improvements costs as Design Contingency.
3. Includes 18% of preliminary anticipated capital improvements costs for Engineering, Design, and Field Services.
4. Includes 1% of preliminary anticipated capital improvements costs for Legal, Fiscal, and Administrative.

Finishing and Disinfection

Finishing and Disinfection consists of the following processes:
- Ultraviolet Disinfection,
- Effluent Flow Measurement, and
- Outfall.

Ultraviolet Disinfection

The location of the existing ultraviolet disinfection system structure is in a repurposed rectangular secondary clarifier basin. The location poses the following issues for operation:
- Inadequate egress.
- Insufficient space for sufficient expansion of equipment banks in current channels.
- Obsolete controls.
- Limited space for operation and maintenance of existing equipment.

Existing ultraviolet disinfection system controls are obsolete. Though planned space is noted for addition banks, it is insufficient for anticipated flow demand. Modulation of lamp intensity is not currently feasible due to issues with effluent flow measurement.

Summary of Recommended Improvements:

<u>Condition-Based Replacement:</u>
- Replace existing PLC and Controls.
- Relocate and/or separate from raw sludge piping and to provide adequate egress.
- Provide ability to modulated lamp intensity by either influent or effluent flow measurement.

<u>Condition-Based Replacement (included with Other Considerations):</u>
- Demolish and infill lower level of process room in Administration Building.
- Pour at-grade floor with trench drain and flammable waste interceptor for maintenance garage. Remove exterior wall for overhead garage door.
- Replace interior architectural coatings.

- Repair exterior CMU wall grout joints.
- Replace roof.

Capacity-Based Replacement:

- Remove and relocate disinfection equipment to new adequately sized structure. Furnish new ultraviolet disinfection system, channel, control weirs and controls.
- Davit hoist and base for lamp bank removal.
- Sufficient rolling storage racks for removal and storage outside of channel of all lamp racks.

Effluent Flow Measurement

Existing effluent flow measurement does not have the ability to measure current peak instantaneous flow events. Instrumentation also is not able to be used to operate ultraviolet disinfection equipment.

Summary of Recommended Improvements:

Capacity-Based Replacement:

- Remove and relocate effluent flow measurement equipment to new adequately sized structure.

Outfall

No condition or capacity related improvements are required for the Outfall.

Preliminary Engineer's Opinion of Probable Costs

Costs associated with recommended finishing and disinfection improvements are included as part of administration building and disinfection and pumping building improvements. Both facilities are described in further detail in the Other Considerations section of this memorandum. Refer to that section for Preliminary Engineer's Opinion of Probable Costs at each building.

SOLID TREATMENT ALTERNATIVES

Refer to Attachment 2 for process schematics for proposed solid treatment alternatives.

Biosolids Stabilization

Biosolids stabilization consists of the following processes:

- Biosolids Control Building,
- Considerations
- Waste Sludge and Scum Thickening
- Aerated Digestion
- Liquid Biosolids Storage
- Solids and Biosolids Mixing
- Waste Sludge Storage

Biosolids Control Building

Alternatives for the Biosolids Control Building are divided into improvements for the control building gallery space, the aerobic digester, and liquid biosolids storage. The Biosolids Control Building has several recommended improvements to address the age and condition of the building in additional to those pertaining to treatment processes.

Summary of Recommended Improvements:

Condition-Based Replacement:

- Replace roof with fully adhered EPDM.
- Replace interior architectural coatings.
- Replace exterior architectural coatings.
- Replace exhaust/supply HVAC equipment and gas-fired unit heaters.
- Replace electrical service equipment, motor control centers, and PLC.
- Remove unused boiler and recirculation pumps from aerobic digester.

- Replace (2) existing 36” wide and (1) 72” wide double-leaf exterior hollow metal doors with new aluminum doors.

Note that the replacement of the HVAC may deviate pending occupancy review and room classification determination as part of design.

Considerations

The current aerobic digester stabilizes unthickened sludge due to failure of the decant mechanism in the waste sludge storage tank. The current primary aerobic digester cell is at treatment capacity and unable to produce biosolids compliant to EPA 503 requirements for land application. The City retains permitted application site for land application and would prefer to resume land application of biosolids rather than landfilling. The current primary digester cell volume is insufficient for stabilization of biosolids for EPA 503 compliance, even when thickening is considered. Functionally, aerobic digestion is limited to a maximum solids concentration around 4.0% total solids. The facility does not operate anaerobic digestion and the existing flat-bottom tank is not suitable for conversion. Expansion of aerobic digestion will then consist of a combination of additional aerobic digester tankage and thickening.

Challenges to this approach include:

- Aerobic digestion is recommended to not exceed 4.0% total solids. The total air demand increases significantly at higher solids concentrations due to a reduced oxygen transfer efficiency.
- 10 States Standards for Wastewater Facilities recommended guidance for providing a minimum of two aerobic digester cells for facilities above 100,000 gallons per day of flow demand.
- Dewatering centrifuge performance is best when liquid feed sludge is below 2.0% total solids.
- A single aerobic digester limits the application of fine-bubble diffusers due to the need to access the aeration grid for maintenance. Fine-bubble diffusers would allow for more efficient oxygen transfer, lower air volume demand, and reduced blower operation and maintenance as compared to coarse bubble diffusers.
- The degree of thickening and method of stabilization may be explored in greater detail during design.

To address these concerns, it is recommended that the liquid biosolids storage have equipment installed for operation as a secondary aerobic digestion cells. A second aerobic digester cell could be constructed parallel to the existing digester providing redundancy and additional treatment volume. The additional volume would allow for:

- Reduction in thickening required for waste sludge and scum being fed to the aerobic digesters which:
  - Reduced the oxygen demand and power consumption of blowers.
  - Reduces the chemical consumption which may be a required for thickening.
  - Recused the energy demand for mixing of the aerobic digesters.
- Allow for process redundancy which:
  - Allows for installation of fine-bubble diffusers which reduced the oxygen demand and power consumption of blowers.
  - Provides operation flexibility for equipment repair and replacement.
  - Meets redundancy recommendation of 10 States Standards.

A gallery would be installed between the primary aerobic tanks to eliminate a hydrophilic water stop in the corners of the new digester cell and provide access for piping and equipment to the tanks. The existing gallery would be utilized for large equipment, shared between aerobic digester cells and storage tanks. The existing primary aerobic digestion cell would be modified to include a suction sump for transfer and draining of the tank. Typical operation would be designed for parallel operation of the primary aerobic digesters and series operations of the primary aerobic digesters to a common secondary aerobic digester.

With a second primary aerobic digester cell, the total primary treatment volume will be approximately 61,500 cuft. Conversion of the liquid biosolids storage as a secondary aerobic digester would provide a

total treatment volume of approximately 126,000 cuft. At this volume, the anticipated solids load demand would require thickening to 1.6% total solids to attain 60 days of solids retention time. Without the second primary treatment cell, the total storage volume would be approximately 95,000 cuft. The anticipated solids load demand would require thickening to 2.2% total solids to attain 60 days of solids retention time.

Waste Sludge and Scum Thickening

Two considerations for reuse of existing tanks were evaluated for thickening:

- Reuse of an existing secondary clarifier tank.
- Reuse of the existing waste sludge storage tank.

ALTERNATIVES CONSIDERED:

ALTERNATIVE 1 – DISSOLVED AIR FLOATATION THICKENING

An existing secondary clarifier tank is oversized for conversion to a circular dissolved air floatation (DAF) thickener, and the existing waste sludge storage is appropriately sized, however in poor condition, and difficult to modify as a dissolved air floatation thickener (DAFT). A nominal 12'-0" diameter circular tank would be constructed on site for the DAFT. The existing secondary clarifier tanks may be reused as waste sludge holding to equalize scum and waste activated sludge being fed to the DAFT, and as underflow holding prior to being pumped ahead of secondary treatment.

DAFT thickening and would include:

- DAFT mechanism, weirs, and floatable box.
- Rehabilitation or construction of a DAFT feed tank for scum and WAS with mixers and flat aluminum cover.
- Rehabilitation or construction of a DAFT underflow tank for underflow with mixers and flat aluminum cover.
- Construction of a new DAFT cast-in-place concrete tank with aluminum dome cover, bridge, lighting, and ventilation.
- Air compressor, saturation tank, recirculation pumps, DAFT feed pumps, underflow pumps and controls.
- Thickened sludge transfer pumps from gravity thickener tank.
- Polymer blending and feed equipment.

Opportunities:

- The underflow holding tank may be combined with storage decant and Administration Building sanitary drains to eliminate the submersible wetwells at the Waste Sludge Holding Tank.
- Air compressor, saturation tank, recirculation pumps, DAF feed pumps, underflow pumps and controls may be located in the proposed Disinfection and Pumping Building.
- Can thicken total solids as needed by digester alternatives.
- Repurposes existing secondary clarifier tanks if not used as part of other alternatives.
- Mixing may be combined with sludge and biosolids mixing equipment from the Biosolids Control Building.
- Does not require plant effluent for dilution water to prevent septic conditions and odor.

ALTERNATIVE 2 – GRAVITY THICKENING

Conversion of a secondary clarifier tank for gravity thickening is feasible. The existing waste sludge storage is appropriately sized, however in poor condition and require the continued use of a floating decanter. The anticipated maximum performance for gravity thickening of extended aeration secondary solids is 2-3% total solids at a solid loading rate of 5-8 pounds per square foot per day. Gravity thickening does require plant effluent recirculation to prevent septic conditions and odor in the thickener.

Conversion of an existing clarifier tank to a gravity thickener would include:

- Gravity thickener mechanism.
- Modifications to existing suction-arm clarifier structure to a hopper-bottom gravity thickener.
- Replacement dome cover, bridge, lighting, and ventilation.
- Rehabilitation or construction of a tank for clarified effluent with submersible mixers and flat aluminum cover.
- Construction of a tank for scum with submersible mixers and flat aluminum cover.
- Thickened sludge transfer pumps from gravity thickener tank.
- Plant effluent pumps for dilution water.
- Oxidizing chemical feed system for odor and septicity control to dilution water.

Operation of the gravity thickener requires dilution water, which is estimated to be approximately 100 gpm (0.14 MGD) at startup and reducing to 60 gpm (0.08 MGD) as sludge production increases at anticipated flow and load demand. Clarified effluent would flow to a replacement supernatant wetwell and be pumped to the manhole prior to the selector basins.

Opportunities:

- The clarified effluent holding tank may be combined with storage decant and Administration Building sanitary drains to eliminate the submersible wetwells at the Waste Sludge Holding Tank.
- Plant effluent pumps, feed pumps, clarified effluent pumps, scum pumps, and controls may be located in the proposed Disinfection and Pumping Building.
- Mixing may be combined with sludge and biosolids mixing equipment from the Biosolids Control Building.

NON-ECONOMIC CONSIDERATIONS

Non-economic factors weigh heavily in the comparison between alternatives for thickening of waste activated sludge and scum. Both alternatives are technically possible however the following pros and cons associated with Alternative 1 are substantive:

- Pro
  - Smaller footprint as the second aerobic digester cell is not needed. Less mechanism, less dome cover.
  - Only alternative which can reliably meet a variety of totals solids operating conditions with low operator time monitoring requirements.
  - Does not require a separate scum wetwell.
  - Plant effluent water required to prevent septic conditions is not necessary.
  - Significantly more operator control over process performance.
- Con
  - Additional compressor, saturation tank, and recirculation pump.
  - Polymer feed equipment is recommended.

Aerobic Digestion

As noted, the current single aerated digester cell is at treatment capacity. Thickening is not feasible due to the age and condition of the floating decanter in the waste sludge storage tank.

A second aerobic digester cell may be provided. A two-cell configuration will allow for parrel, series, or batch operation of the aerobic digesters. In either one or two cells, a cut-in suction sump will be added to the existing aerobic digester cell and included in the proposed cell for transfer and draining.

Conversion of the existing liquid biosolid storage for secondary aerobic digestion is also recommended. At startup conditions the secondary aerobic digester is not likely required, however as load demand increases to design conditions the additional treatment volume will be necessary.

Summary of Recommended Improvements to Existing Aerobic Digester:

Condition-Based Replacement:

- Replace Roof with fully adhered EPDM.
- Cut-in suction sump for new transfer and drain pumps to existing aerobic digester.

ALTERNATIVES CONSIDERED:

ALTERNATIVE 1 – REHABILITATE PRIMARY CELL 1, CONVERT LIQUID BIOSOLIDS STORAGE TO SECONDARY CELL 1

This alternative would focus on rehabilitation of the existing primary aerobic digestion cell. EPA 503 compliant digestion suitable for land application requires 60 days of SRT in the aerobic digester. To achieve this SRT with one cell, waste sludge would need to be thickened prior to digester to at least 2.2% total solids at design year flow and load demand.

The alternative would require conversion of the existing liquid biosolid storage for secondary aerobic digestion.

There are several operational challenges which will also need to be addressed by the facility staff. They include:

- Dewatering centrifuge performance is best when liquid feed sludge is below 2.0% total solids.
- Use of coarse-bubble diffusers due to limited accessibility.
- Greater aeration demand for mixing and oxygen transfer due to higher total solids content and diffuser type.

Condition-Based Replacement:

- Replace and construction aeration and mixing system (refer to Sludge and Biosolids Mixing section of this memorandum).
- Replace blowers and controls in gallery of Biosolids Control Building.
- Add common header instrumentation and controls to monitor and control air discharge to system.

Capacity-Based Replacement:

- Convert liquid biosolid storage to a secondary aerobic digester.
- Add dissolved oxygen instrumentation to primary and secondary aerobic digester cells.

ALTERNATIVE 2 – REHABILITATE PRIMARY CELL 1, CONSTRUCT PRIMARY CELL 2, CONVERT LIQUID BIOSOLIDS STORAGE TO SECONDARY CELL 1

This alternative would rehabilitate the existing primary aerobic digestion cell, as well as construct an identical second primary digestion cell adjacent to the existing cell. A 12’-0” gallery would be sited between the treatment cells for piping, valve, and controls between the tanks.

It is assumed the alternative would utilize the existing gallery for equipment and controls used to operate of the aerobic digester cells. Additional gallery space may be needed for equipment as determined during design. Piping would allow for either parallel, series, or batch operation of the digestion cells.

With a second primary aerobic digester cell, the total treatment volume will be 126,000 cuft. At this volume, the anticipated solids load demand would require thickening to 1.6% total solids to attain 60 days of solids retention time at the anticipate future load demand.

The alternative would require conversion of the existing liquid biosolid storage for secondary aerobic digestion.

Condition-Based Replacement:

- Replace and construction aeration and mixing system (refer to Sludge and Biosolids Mixing section of this memorandum).
- Replace blowers and controls in gallery of Biosolids Control Building.
- Add common header instrumentation and controls to monitor and control air discharge to system.

Capacity-Based Replacement:

- Convert liquid biosolid storage to a secondary aerobic digester.
- Add dissolved oxygen instrumentation to primary and secondary aerobic digester cells.
- Construct primary aerobic digester cell 2 adjacent to existing primary aerobic digester cell 1.
- Construct piping and valve gallery between digester tanks.
- Additional piping for series, parallel, or batch operation of primary aerobic digester cells.

NON-ECONOMIC CONSIDERATIONS

Non-economic factors weigh heavily in the comparison between alternatives for aerobic digestion. Both alternatives are technically possible however the following pros and cons associated with Alternative 1 are substantive:

- Pro
  - Lower capital cost associated with less structure and for a single primary aerobic digester.
- Con
  - Centrifuge performance decreases significantly above 2.0% total solids.
  - Oxygen transfer efficiency is reduced by the increased solids requirement, increasing blower capacity and energy requirements.
  - Coarse bubble diffusion recommended due to limited accessibility to tank for maintenance, increasing blower capacity and energy requirements.
  - Greater mixing energy requirement for higher solids content.
  - No process redundancy and less operation flexibility with a single aerobic digester.

Liquid Biosolids Storage

The biosolids sludge storage provides temporary storage prior to dewatering and alternative liquid biosolids loadout if needed. The exiting liquid biosolids storage tank has a decant tree for thickening and is uncovered, resulting in freezing which impacts the staff's ability to thicken and transfer biosolids for dewatering. Alternatives considered are condition-based to address operational challenges with the existing tank.

It is recommended that the liquid sludge storage tank be converted to a secondary aerobic digester to meet the volume requirements in lieu of additional primary aerobic digester cells above those noted in the aerobic digester alternatives. Under startup conditions, the secondary aerobic digester will likely not be used to limit the pH reduction due to nitrification.

Summary of Recommended Improvements:

Condition-Based Replacement:

- Cover and vent for existing tank.
- Cut-in suction sump for new transfer and drain pumps.
- Replace mixing system (refer to Sludge and Biosolids Mixing section of this memorandum).

Capacity-Based Replacement:

- Construction aeration system (refer to Sludge and Biosolids Mixing section of this memorandum).

Sludge and Biosolids Mixing

Sludge and biosolids process tanks with mixing systems which had condition related improvements include:

- Aerobic Digester.
- Liquid Biosolids Storage Tank.
- Waste Sludge Storage Tank.
- Waste Sludge and Scum Storage Tank (as applicable to alternatives)

The proximity of the treatment process allows for implementation of a common mixing system. Use of similar technologies will also reduce the number of spare parts required on site and allow for more commonly applied specialized knowledge for operation, maintenance, and troubleshooting by the facility operators. The three processes currently have air-based mixing and the facility staff or knowledgeable and comfortable with its application. Consideration is given to the mixing alternatives as they interact with aeration in the aerobic digester. The aeration and mixing technology evaluation for the aerobic digester will inform the aerated mixing alternative for liquid biosolids storage and waste sludge storage tanks.

Oxygen transfer efficiency is largely driven by the total solids content is the tank being aerated. For this reason, it is important to understand that the air flow requirements increase dramatically as the design solids concentration increases. A comparison is then appropriate when consider additional tank at a lower concentration as compared to a single tank at a higher solid concentration. Regardless of the aeration technology, oxygen transfer is essentially negligible above 4.0% total solids.

It is assumed the alternatives would utilize the existing gallery for equipment and controls used to operate of the aeration and mixing equipment. Additional gallery space may be needed for equipment as determined during design.

AERATION AND MIXING ALTERNATIVES CONSIDERED:

ALTERNATIVE 1 –DIFFUSED AERATION AND MIXING

For this alternative coarse bubble diffused air would be utilized for both aeration and mixing. Coarse bubble aeration has the advantage of not requiring access to the diffuser grid for period maintenance at the cost of oxygen transfer efficiency. A single coarse bubble diffused aeration grid with aerators would be installed near the bottom of process tanks. A common discharge air header from blowers located in the Solids Control Building would supply air to maintain a preset discharge air header pressure. Electrically modulated valves would allow air to each process tank for mixing and aeration. Typically, the volume of air required for mixing exceeds the air requirement for aerobic digestion resulting in additional air demand for operation.

Condition-Based Replacement:

- Remove existing blowers in Administration Building.
- Replace existing blowers Biosolids Control Building.
- Create common discharge header for all process tanking being mixed and aerated.
- Replace existing primary aerobic digester cell 1 diffused aeration and mixing grid.
- Add new primary aerobic digester cell 2 diffused aeration and mixing grid, as applicable.
- Replace existing liquid biosolids storage diffused aeration and mixing grid.
- Replace existing waste sludge storage diffused aeration and mixing grid.

Capacity-Based Replacement:

- Provide new instrumentation and modulated control valves for aeration system.
- Provide new aeration header between Biosolids Control Building and Waste Sludge Storage Tank.

ALTERNATIVE 2 – DIFFUSED AERATION, COMPRESSED AERATED MIXING

For this alternative the primary aerobic digester(s) and liquid biosolids storage would have two distinct aeration grids installed:

- One grid, used for providing dissolved oxygen would consist of diffusers. If a single primary aerobic digester is installed, it is recommended the grid utilize coarse-bubble diffusers as access for maintenance of the diffusers is not required. If two primary aerobic digesters are installed, it is recommended the grid utilize fine-bubble diffusers for an increase in oxygen transfer efficiency and reduced aeration requirements.
- The second would have a compressed air mixing system consisting of a control valve assembly and mixing heads which are used to create much larger aeration bubbles that are more effective at mixing, but ineffective at oxygen transfer. The compressed air mixing system only utilized one valve at a time for mixing, reducing the over air flow requirements.

Separate compressors would supply air for the compressed air mixing system, and conventional rotary lobe blowers would provide air from fine-bubble aeration. The compressed air mixing controls, as part of a Manufacturer PLC package, allow for periodic mixing. Only one mixing valve is opened at a time reducing the volume of air required at any given time. The compressed air mixing uses separate compressors from aeration blowers. A common compressed air discharge air header from compressors and a surge tank would supply air for mixing. The aerobic digester cells would utilize a common header from blowers located in the Solids Control Building for aeration.

Condition-Based Replacement:

- Replace existing blowers in Administration Building and Biosolids Control Building to meet aeration demand of common discharge header.
- Replace existing primary aerobic digester cell 1 diffused aeration grid and construct new compressed air mixing grid.
- Add new primary aerobic digester cell 2 diffused aeration grid and construct new compressed air mixing grid, as applicable.
- Add new existing liquid sludge storage diffused aeration grid and construct new compressed air mixing grid.
- Add new existing waste sludge storage compressed air mixing grid.

Capacity-Based Replacement:

- Provide new instrumentation, manufacturer PLC, and modulated control valves for aeration system.
- Provide new manufacturer PLC, and modulated control valves for compressed air mixing system.
- Provide new aeration header between Biosolids Control Building and process tanks.

ALTERNATIVE 3 – JET AERATION AND MIXING

This alternative provides separate mechanisms for aeration and mixing of the aerobic digester. A liquid and aeration common header feed a set of jet mixing nozzles along the process tank. While mixing, only the recirculation pumps would operate to draw solids from the process tank and through the jet mixing nozzles. For aeration, air is introduced into the mixing nozzles and sheered into smaller bubbles which have an oxygen transfer efficiency between fine and coarse bubble. Storage tanks would have only the jet mixing system installed. Separate mixing pumps would be required for each process tank to prevent mixing of digested and undigested solids.

Condition-Based Replacement:

- Replace existing blowers in Administration Building and Biosolids Control Building.
- Replace existing primary aerobic digester cell 1 diffused aeration grid with:
  - (1) duty and (1) standby mixing recirculation pump,
  - (1) jet mixing lateral and jet diffusers, and
  - (1) aeration header to jet diffusers.
- Construct new primary aerobic digester cell 2, as applicable:
  - (1) duty and (1) standby mixing recirculation pump,
  - (1) jet mixing lateral and jet diffusers, and
  - (1) aeration header to jet diffusers.
- Replace existing liquid biosolids storage diffused aeration grid with:
  - (1) duty and (1) standby mixing recirculation pump,
  - (1) jet mixing lateral and jet diffusers, and
  - (1) aeration header to jet diffusers.
- Replace existing waste sludge storage diffused aeration grid with:
  - (1) duty and (1) standby mixing recirculation pump, and
  - (1) jet mixing lateral and jet diffusers.

Capacity-Based Replacement:

- Provide new instrumentation and modulated control valves for aeration system.

Waste Sludge Storage

Convert waste sludge storage basin to a sludge receiving facility for discharge to aerobic digesters. Replace aerated mixing equipment and blowers. Centralize aeration for mixing from Biosolids Control Building using common header and yard piping. As applicable, existing blower room may be suitable for jet mixing pumps, however the location does not provide for flooded-suction installation. Furnish level control instrumentation for tanks. Replace submersible sludge transfer pumps to aerobic digester.

Summary of Recommended Improvements:

Condition-Based Replacement:

- Add quick coupling piping to pump into storage tank from sludge hauling truck.
- Replace existing submersible sludge transfer pumps with drywell-mounted pumps in Disinfection and Pumping Building.
- Relocate aeration blowers to Biosolids Control Building, install new yard aeration piping.
- Replace mixing system in sludge storage tank (refer to Sludge and Biosolids Mixing section of this memorandum).

Preliminary Engineer's Opinion of Probable Costs

Refer to Table 7 on the following page for the preliminary Engineer's opinion of probable costs associated with each alternative considered. Costs presented in Table 7 include Aerated Digester and Thickening Alternatives, Liquid Sludge Storage recommended improvements, and Sludge and Biosolids Mixing Alternatives.

Table 7: Preliminary Engineer's Opinion of Probable Costs for Sludge and Biosolids Mixing Alternatives

Mixing Alternative	Digestion Alternative	Opinion of Probable Cost [1, 2, 3, 4]	
		Gravity Thickening	DAF Thickening
Alternative 1: Diffused Aeration and Mixing	Alternative 1: One Primary Cell	$6,296,000	$6,257,000
	Alternative 2: Two Primary Cells	$8,520,000	$8,481,000
Alternative 2: Diffused Aeration, Compressed Aerated Mixing	Alternative 1: One Primary Cell	$8,570,000	$8,531,000
	Alternative 2: Two Primary Cells	$10,372,000	$10,333,000
Alternative 3: Jet Aeration and Mixing [5]	Alternative 1: One Primary Cell	$10,068,000	$10,029,000
	Alternative 2: Two Primary Cells	$13,767,000	$13,728,000

Notes:
1. Includes 5.0% construction contingency, 3.0% mobilization, bonding, and insurance, 0.1% permitting as part of Construction Costs.
2. Includes 30% contingency of preliminary anticipated capital improvements costs as Design Contingency.
3. Includes 18% of preliminary anticipated capital improvements costs for Engineering, Design, and Field Services.
4. Includes 1% of preliminary anticipated capital improvements costs for Legal, Fiscal, and Administrative.
5. Cost alternatives do not include additional building required for ancillary equipment.

In addition to the capital costs for equipment, it is likely that alternative 3 would require an additional pumping building on site for installation of the jet mixing recirculation pumps. Having the largest capital cost without consideration of additional building required for installation, results in alternative 3 not being considered further.

Table 8 on the following page summarizes the anticipated operation and maintenance associated with mixing alternatives 1 and 2. Note that the compressed aerated mixing alternative allows for decoupling of aeration and mixing resulting in reduced operational requirements for the blowers, electrical consumption, and wear. Alternative 2 does not include, but would be applicable for, Green Project Reserve funding (GPR) due to the increase in process operation efficiency. Both alternatives would be applicable to biosolids related funding through the Clean Water State Revolving Funds (CWSRF).

Table 8: Preliminary Engineer's Opinion of Net Present Value for Sludge and Biosolids Mixing Alternatives

Mixing Alternative	Digestion Alternative	Thickening Alternative	Opinion of Yearly OM	Opinion of 20-yr NPV [1,2,3,4]
Alternative 1: Diffused Aeration and Mixing	One Cell	DAF	$202,403	$9,269,000
		Gravity	$199,801	$9,269,000
	Two Cells	DAF	$215,306	$11,685,000
		Gravity	$154,586	$10,820,000
Alternative 2: Diffused Aeration, Compressed Aerated Mixing	One Cell	DAF	$111,581	$10,192,000
		Gravity	$108,980	$10,192,000
	Two Cells	DAF	$122,244	$12,152,000
		Gravity	$114,194	$12,071,000

General Notes:
- OM: Operation and Maintenance, presented as one year cost. Costs are for May 2023.
- NPV: Net Present Value given the assumptions noted below.
- DAF: Dissolved Air Flotation.
- Includes capital costs described in Table 7.

Notes:
1. Estimated labor hours per year based on *The Northeast Guide for Estimating Staffing at Publicly and Privately Owned Wastewater Treatment Plants*.
2. Assumes operator total compensation labor rate of $35.00 per hour. Represents year one O&M rate.
3. Cost per year assumes an electrical utility rate of $0.0773 per kWhr.
4. 20 year period at 3.0% annual rate.

The recommended alternative is Alternative 2 using two primary aerobic digestion cells and DAF thickening. The alternative provides the greatest degree of process control. The DAF thickening is much less operator intensive and reliable, with a greater degree of control over the finished solids concentration. The additional aerobic digester cell meets reliability recommendation and provides for future capacity of the facility. Decoupling mixing and aeration allows for the ability to meet mixing requirements without the risk of souring the digester, resulting in labor intensive foam removal.

The recommended alternative meets the anticipated flow and load demands with the following advantages:

Aeration and Mixing:
- Diffused aeration and compressed aerated mixing provides the lowest operation and maintenance costs of the proposed mixing alternatives.
- Diffused aeration and compressed aerated mixing is the middle capital costs of the proposed mixing alternatives.
- The reduction in aeration equipment better fits the existing Biosolids Control Building gallery space.
- Allows the ability to mix without aerating to control nitrification, thereby reducing the risk of low pH, foaming, and digester upset.

Though not the lowest capital cost alternative for aerobic digestion, a two cell digester:
- Allows for one cell to be removed from service for maintenance of fine-bubble aeration equipment, as well as other maintenance activities.
- Meets the redundancy recommendations of 10 States Standards.

Thickening:

- Capital cost and operation and maintenance of the processes is equivalent whether thickening by DAFT for gravity thickener.
- DAFT thickening provides operation flexibility which can be various operating conditions between startup and design capacity treatment conditions.
- DAFT thickening does not require significant plant effluent recirculation, reducing the additional capital an O&M costs associated with a large recirculation stream being returned through secondary treatment.

Refer to Table 9 for a summary of the anticipated Preliminary Engineer's Opinion of Probable Costs associated with the recommended improvements. These costs reflect the opinion of probable costs at the time of preparation of this report. Probable costs are likely to change between preparation of the facility plan and bidding of improvements.

Table 9: Preliminary Engineer's Opinion of Probable Costs for Biosolids Stabilization Improvements

Description	Opinion of Probable Cost
Biosolids Control Building Architectural Improvements	$128,000
Biosolids Control Building HVAC Improvements	$214,000
Biosolids Control Building Electrical Improvements	$77,000
DAF Thickening and Clarifier Modifications	$1,717,000
Aerobic Digester Tank Cell 1 Modifications	$202,000
Aerobic Digester Tank Cell 2 and Gallery	$1,233,000
Liquid Sludge Storage Tank Cover	$534,000
Liquid Sludge Storage Tank Modifications	$20,000
Waste Sludge Storage Tank Modifications	$196,000
Diffused Aeration and Compressed Aerated Mixing	$2,484,000
Subtotal for Construction [1]	$7,150,000
Contingency [2]	$2,148,000
Engineering and Design [3]	$1,288,000
Legal, Fiscal, and Administrative [4]	$73,000
Total for Project	$10,659,000

Notes:
1. Includes 5.0% construction contingency, 3.0% mobilization, bonding, and insurance, 0.1% permitting as part of Construction Costs.
2. Includes 30% contingency of preliminary anticipated capital improvements costs as Design Contingency.
3. Includes 18% of preliminary anticipated capital improvements costs for Engineering, Design, and Field Services.
4. Includes 1% of preliminary anticipated capital improvements costs for Legal, Fiscal, and Administrative.

Biosolids Dewatering

Biosolids dewatering consists of the following processes:

- Biosolids Processing Building,
- Dewatering Equipment, and
- Drying Equipment.

Biosolids Processing Building

The Biosolids Processing Building is anticipated to have sufficient capacity; however, several existing conditions and condition-related improvements have been identified.

Summary of Recommended Improvements:

Condition-Based Replacement:

- Replace electrical room air conditioning unit.
- Replace radiant heat boiler controls.
- Replace existing PLC panel.
- Add emergency eyewash and shower near liquid polymer feed equipment in dryer room.
- Add corner shower to existing lavatory (remove floor and connect to floor drain sanitary pipe, new vent through roof).
- Relocate existing activated carbon odor control skid outside and re-route existing fiberglass duct to new location. Replace media. Provide media access. Assumes replacement of exhaust fan in enclosure are required due to relocation.

Dewatering Equipment

The dewatering centrifuge are near major maintenance overhaul and have a few electrical-related improvements which have been identified.

The existing dewatering cake loadout was designed as an alternate loadout. The dewatered cake loadout is operated as the primary loadout and additional controls would reduce operator maintenance time as a result of cake biosolids spilling during loadout.

Cake biosolids would be discharged and conveyed to a cake storage building. The building would consist of a concrete pad with channel drain. The building would have 8-foot push walls and be 60-feet by 200-feet. The approximate storage volume for design would be 3,600 cubic yards. The concrete storage would be covered using a pre-engineered steel frame and 28 oz PVC fabric roof system. The roofing system would include ice breaker cleats and the steel frame system would be galvanized.

Summary of Recommended Improvements:

Condition-Based Replacement:

- Replace both dewatering centrifuge progressive cavity-type feed pumps.
- Replace existing dewatering centrifuge PLC in PLC control panel.
- Replace dewatering centrifuge #1 main drive variable frequency drive (VFD).
- Water heater for polymer dilution and carrier water.
- Current dewatered cake shaftless screw convey vertical section plugs with solids. Replace conveyor with horizontal-vertical-horizontal cleated belt conveyor.
- Provide cake biosolids storage in addition to dried biosolids silo.
- Add slide gate and controls to dewatered cake loadout.

Drying Equipment

No condition or capacity related improvements are required for the Drying Equipment.

Preliminary Engineer's Opinion of Probable Costs

Refer to Table 10 on the following page for a summary of the anticipated Preliminary Engineer's Opinion of Probable Costs associated with the recommended improvements. These costs reflect the opinion of probable costs at the time of preparation of this report. Probable costs are likely to change between preparation of the facility plan and bidding of improvements.

Table 10: Preliminary Engineer's Opinion of Probable Costs for Biosolids Dewatering Improvements

Description	Opinion of Probable Cost
Biosolids Processing Building HVAC Improvements	$40,000
Biosolids Processing Building Electrical Improvements	$62,000
Biosolids Processing Building Plumbing Improvements	$16,000
Biosolids Processing Building Odor Control Relocation	$40,000
Dewatering Centrifuge Feed Pumps, PLC, Drive, and Polymer Feed	$132,000
Dewatered Cake Biosolids Loadout Slide Gate	$41,000
Dewatered Cake Biosolids Storage	$744,000
Subtotal for Construction [1]	$1,165,000
Contingency [2]	$350,000
Engineering and Design [3]	$210,000
Legal, Fiscal, and Administrative [4]	$12,000
Total for Project	$1,737,000

Notes:
1. Includes 5.0% construction contingency, 3.0% mobilization, bonding, and insurance, 0.1% permitting as part of Construction Costs.
2. Includes 30% contingency of preliminary anticipated capital improvements costs as Design Contingency.
3. Includes 18% of preliminary anticipated capital improvements costs for Engineering, Design, and Field Services.
4. Includes 1% of preliminary anticipated capital improvements costs for Legal, Fiscal, and Administrative.

OTHER CONSIDERATIONS

Other considerations have been broken down for review into the following processes:
- Administrative Building,
- Site Improvements, and
- Disinfection and Pumping Building.

Administration Building

Existing Administration Building is a combined process and administrative structure. Recommended improvements separate process and administrative elements for occupancy and fire rating requirements. Most recommendations are condition-based and related to the age of the building. The facility backup generator is located in the administration building and is recommended for replacements as it is insufficient to operate existing or anticipated facilities.

Summary of Recommended Improvements:

Condition-Based Replacement:
- Demolish and infill lower level of process room in Administration Building.
- Pour at-grade floor with trench drain and flammable waste interceptor for:
  - Maintenance garage,
  - Functional bathroom group, and
  - Separate shower facilities.
- Destratification exhaust fans and gas detection equipment.
- Remove exterior wall for overhead garage door.
- Replace Roof with fully adhered EPDM.
- Repair exterior CMU.
- Replace interior architectural coatings.
- Replace exterior architectural coatings.
- Remove existing boiler, replace with forced air furnace, and air conditioning.

- New PLC and SCADA system.
- Remove and route sanitary drain to intermediate plant lift station.
- Replace (6) existing 36” wide and (1) 72” wide double-leaf exterior hollow metal doors with new aluminum doors.

Note that the replacement of the HVAC may deviate pending occupancy review and room classification determination as part of design.

Capacity-Based Replacement:

- Replace backup generator with sufficiently sized unit in all-weather enclosure (see Site for this item).

Site Improvements

Existing facility communications, controls and monitoring equipment is not facility wide. New equipment and existing equipment are recommended to be connected to new facility-wide PLC control and SCADA supervisory system. Construction related traffic, excavation, and age of existing facilities contribute to replacement of existing site hardscape and lighting.

The existing septage receiving station is small, difficult to meter and supervise, and difficult to access for an average over-sized vehicle. Improvements to the gate, monitoring, access, and septage receiving structure are recommended to address these issues.

The current backup generator is undersized for the existing facility and located in the administrative building. A new generator has been located at the Biosolids Processing Building but does not include backup power for the Biosolids Control Building. It is assumed the existing generator at the Biosolids Processing Building is sufficient for the services currently supported. A new generator would be constructed for the Biosolids Control Building and Disinfection and Pumping Building. It is recommended that the generator be relocated to outside of the building in an all-weather enclosure as a cost-effective replacement of the existing system. The initial estimate assumed a 750-kW generator is required. Actual size will be verified during design.

Summary of Recommended Improvements:

Condition-Based Replacement:

- New fiber communications.
- Generator with sufficiently sized unit in all-weather enclosure.
- Replace site lighting.
- Replace site asphalt.
- Replace site stormwater system as needed.
- Replace and relocate septage receiving.
- Replace front gate with motor-operated gate, card scanner (software by City), and camera (software by City).

Note that the replacement of the site generator may deviate pending electrical load determination as part of design.

Disinfection and Pumping Building

As part of other improvements to address age and capacity issues, it is recommended a new multi-purpose disinfection and pumping building be located on site. A new multi-purpose building will allow for construction of new process critical facilities to be constructed while the existing facility remains in service. Critical processes intended to be relocated to this building are:

- RAS and WAS Pumping,
- Thickener Sludge Pumping (as applicable to solids alternatives),
- Recirculation Pumping (as applicable to solids alternatives),
- Plant Effluent Pumping (as applicable to solids alternatives),
- Decant Pumping (as applicable to solids alternatives),
- Ultraviolet Disinfection,
- Effluent Flow Measurement,
- Electrical Equipment, Emergency Backup Generator, and Services for:
    - Selector Basins,
    - Biological Treatment,
    - Secondary Clarification,
    - Chemical Feed,
    - Waste Sludge Storage,
    - Waste Sludge Thickening,
    - Biosolids Control Building, and
    - Administration Building.

The building will consist of a lower level to provide a drywell for submerged suction pumping from secondary clarifiers and gravity flow of facility effluent for disinfection. The lower-level requirements create and upper-level building space with can be suitable for electrical equipment, pump retrieval, and maintenance. The recommended alternative assumes a separate blower building as applicable for the biological treatment alternatives. During design, integration of the blower equipment to the disinfection and pumping building may be evaluated. Additional space may also be identified as necessary based on the final building layout during design. Refer to individual equipment sections discussed above for equipment costs. Facilities and utilities associated with the Disinfection and Pumping Building are presented below.

Preliminary Engineer's Opinion of Probable Costs

Refer to Table 11 on the following page for a summary of the anticipated Preliminary Engineer's Opinion of Probable Costs associated with the recommended improvements. These costs reflect the opinion of probable costs at the time of preparation of this report. Probable costs are likely to change between preparation of the facility plan and bidding of improvements.

Table 11: Preliminary Engineer's Opinion of Probable Costs for Other Improvements

Description	Opinion of Probable Cost
Administrative Building Electrical and Controls	$105,000
Administrative Building HVAC Improvements	$63,000
Administrative Building Process Room Conversion	$97,000
Administrative Building Architectural Improvements	$176,000
Administrative Building Sanitary Service	$20,000
Site Grading and Restoration	$32,000
Site Water, Process, and Sanitary Piping and Utilities	$274,000
Site Electrical Improvements	$470,000
Site Paving and Hardscape	$418,000
Site Septage Receiving Improvements	$194,000
Disinfection and Pumping Building	$2,714,000
Subtotal for Construction [1]	$4,743,000
Contingency [2]	$1,424,000
Engineering and Design [3]	$855,000
Legal, Fiscal, and Administrative [4]	$50,000
Total for Project	$7,072,000

General Notes:

- Opinion of Probable Cost does not include capital coast for process equipment. Process equipment capital costs are included in the process alternatives considered in each applicable section. Refer to individual sections for further discussion.
- Costs are associated with improvements are based on the recommended treatment alternatives.
- Site improvement costs do not include a stormwater retention pond. A retention pond, or expanded retention pond, may be required as determined during preparation of the SWPPP.

Notes:

1. Includes 5.0% construction contingency, 3.0% mobilization, bonding, and insurance, 0.1% permitting as part of Construction Costs.
2. Includes 30% contingency of preliminary anticipated capital improvements costs as Design Contingency.
3. Includes 18% of preliminary anticipated capital improvements costs for Engineering, Design, and Field Services.
4. Includes 1% of preliminary anticipated capital improvements costs for Legal, Fiscal, and Administrative.

Table 12 on the following page summarizes the preliminary Engineer's opinion of capital costs associated with recommended improvements.

Refer to Attachment 3 for a preliminary layout of proposed facilities associated with the recommended improvements.

Table 12: Preliminary Engineer's Opinion of Probable Costs for Recommended Improvements

Description	Opinion of Probable Cost
Main Lift Station and Forcemain [1]	$2,301,000
Preliminary Treatment [1]	$1,398,000
Selector Basin, Biological Alternative 3 [1]	$739,000
Biological Alternative 3 [1]	$4,147,000
Secondary Sedimentation Alternative 2 [1]	$4,846,000
Chemical Phosphorus Removal Alternative 2 [1]	$316,000
Disinfection and Pumping Building [1]	$2,714,000
Sludge and Biosolids Mixing Alternative 2 [1]	$2,484,000
Waste Sludge and Scum Thickening Alternative 2 [1]	$1,861,000
Waste Sludge Storage Conversion [1]	$217,000
Biosolids Control Building and Aerobic Digestion Alternative 2 [1]	$2,588,000
Biosolids Conditioning Building and Dewatering [1]	$1,165,000
Administration Building [1]	$526,000
Site Improvements [1]	$1,503,000
Subtotal for Construction	$26,805,000
Contingency [2]	$8,049,000
Engineering and Design [3]	$4,831,000
Legal, Fiscal, and Administrative [4]	$276,000
Total for Project	$39,961,000

Notes:
1. Includes 5.0% construction contingency, 3.0% mobilization, bonding, and insurance, 0.1% permitting as part of Construction Costs.
2. Includes 30% contingency of preliminary anticipated capital improvements costs as Design Contingency.
3. Includes 18% of preliminary anticipated capital improvements costs for Engineering, Design, and Field Services.
4. Includes 1% of preliminary anticipated capital improvements costs for Legal, Fiscal, and Administrative.

ejm

Attachments:
- Attachment 1: Liquid Treatment Alternatives
- Attachment 2: Solid Treatment Alternatives
- Attachment 3: Preliminary Layout of Recommended Improvements

c: Eric Miller, SEH Inc.
Colin Marcusen, SEH Inc.

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Attachment 1

Liquid Treatment Alternatives

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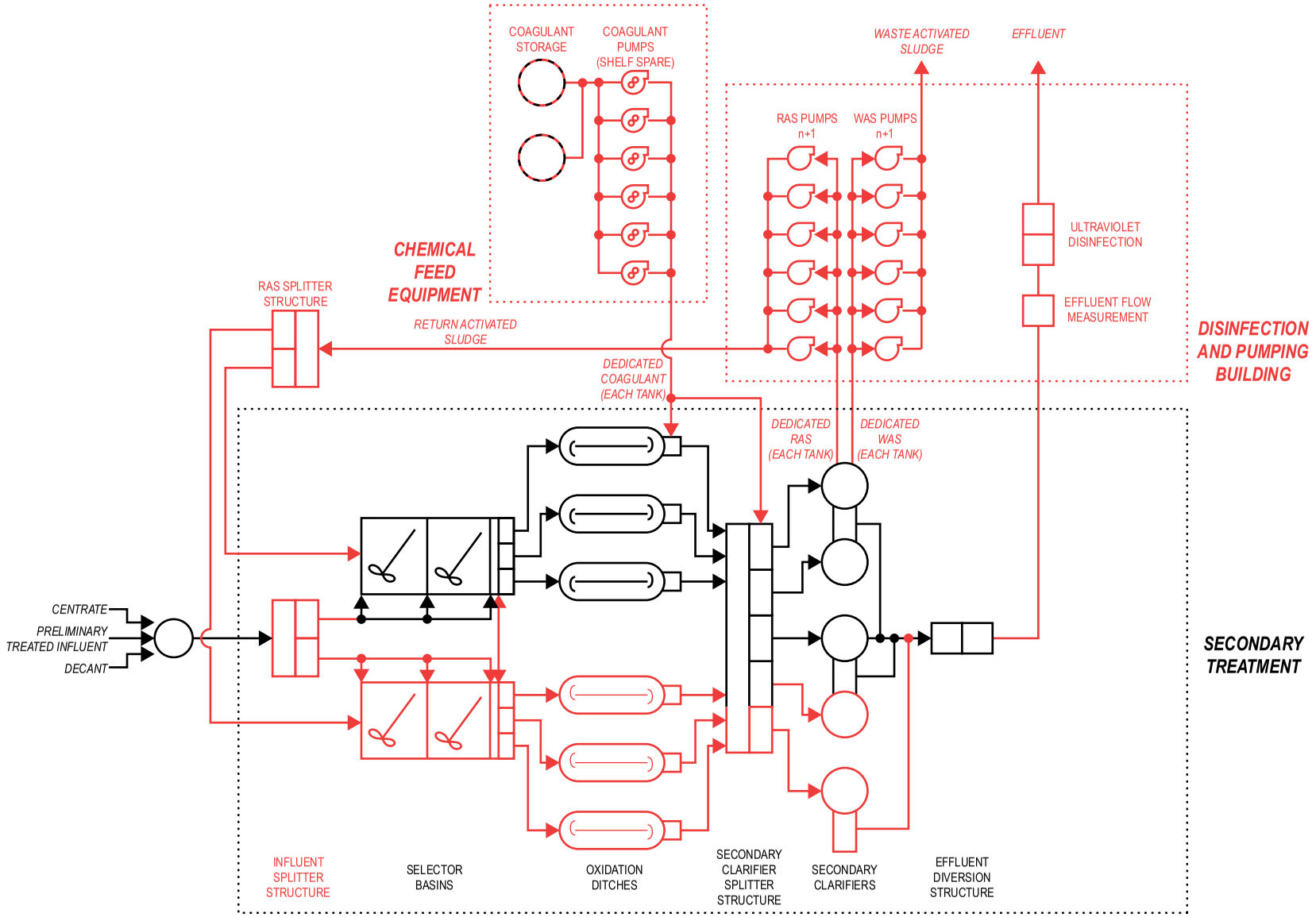

BIOLOGICAL TREATMENT ALTERNATIVE 1
SECONDARY TREATMENT ALTERNATIVE 1

01

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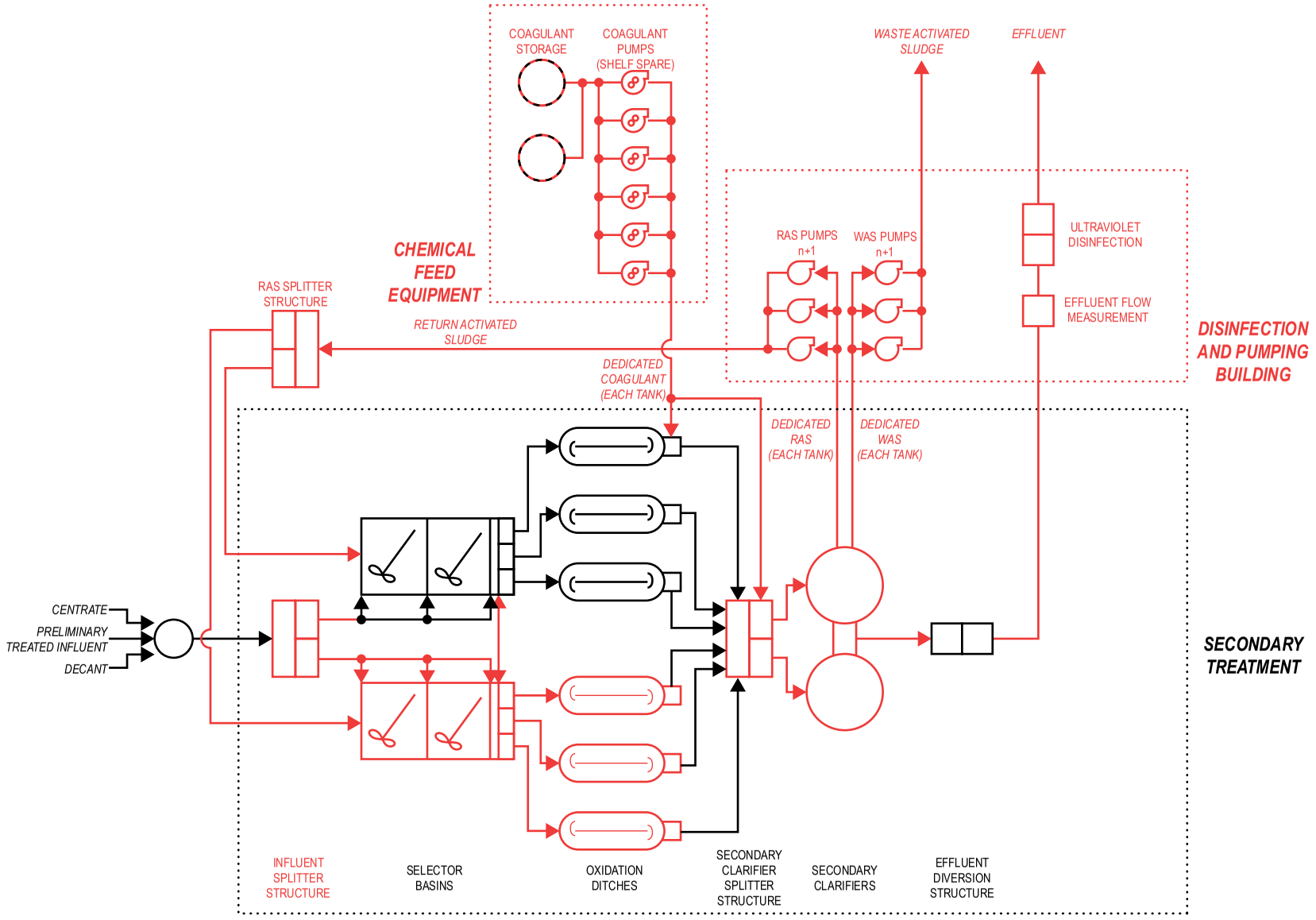

BIOLOGICAL TREATMENT ALTERNATIVE 1
SECONDARY TREATMENT ALTERNATIVE 2

02

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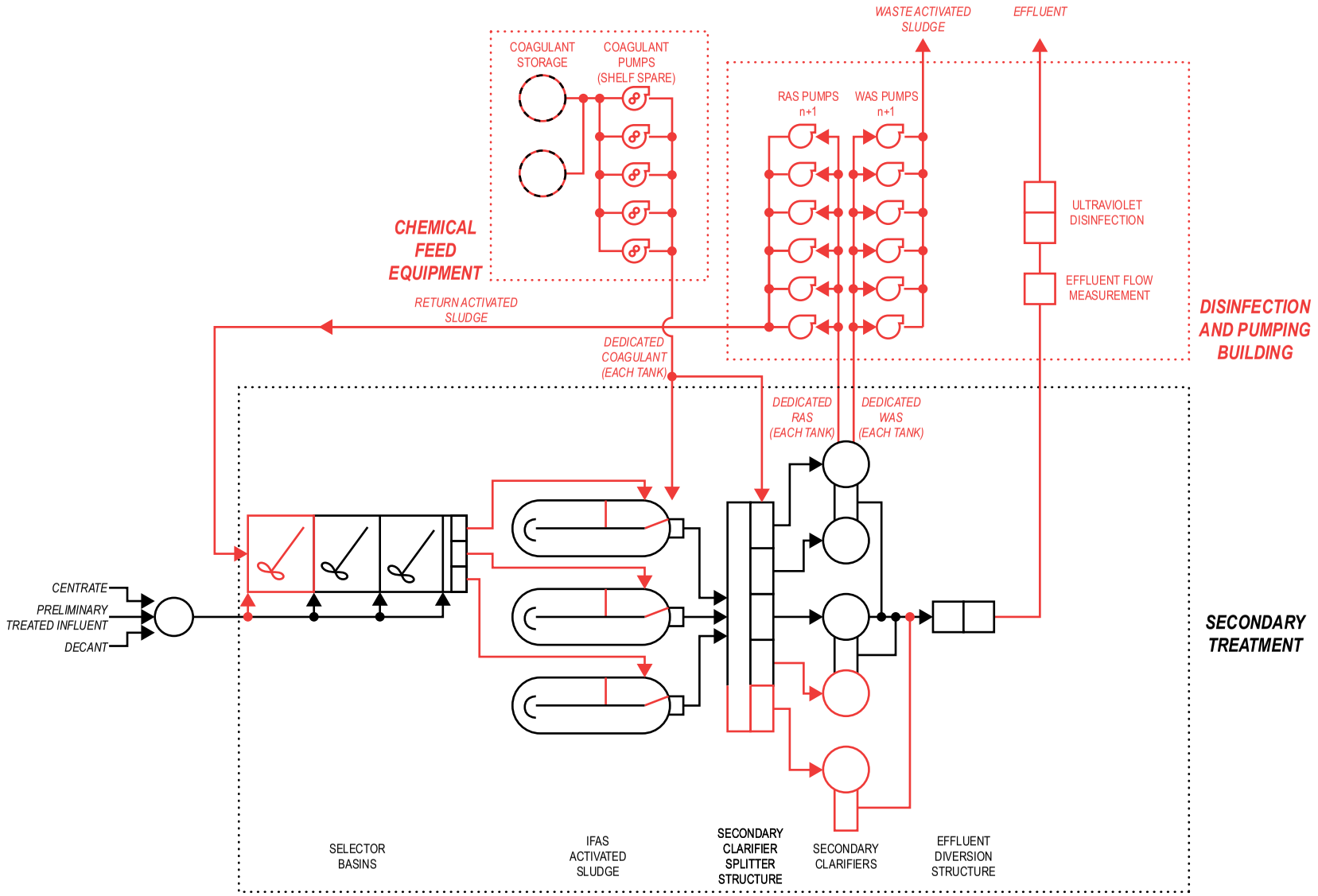

BIOLOGICAL TREATMENT ALTERNATIVE 2
SECONDARY TREATMENT ALTERNATIVE 1

03

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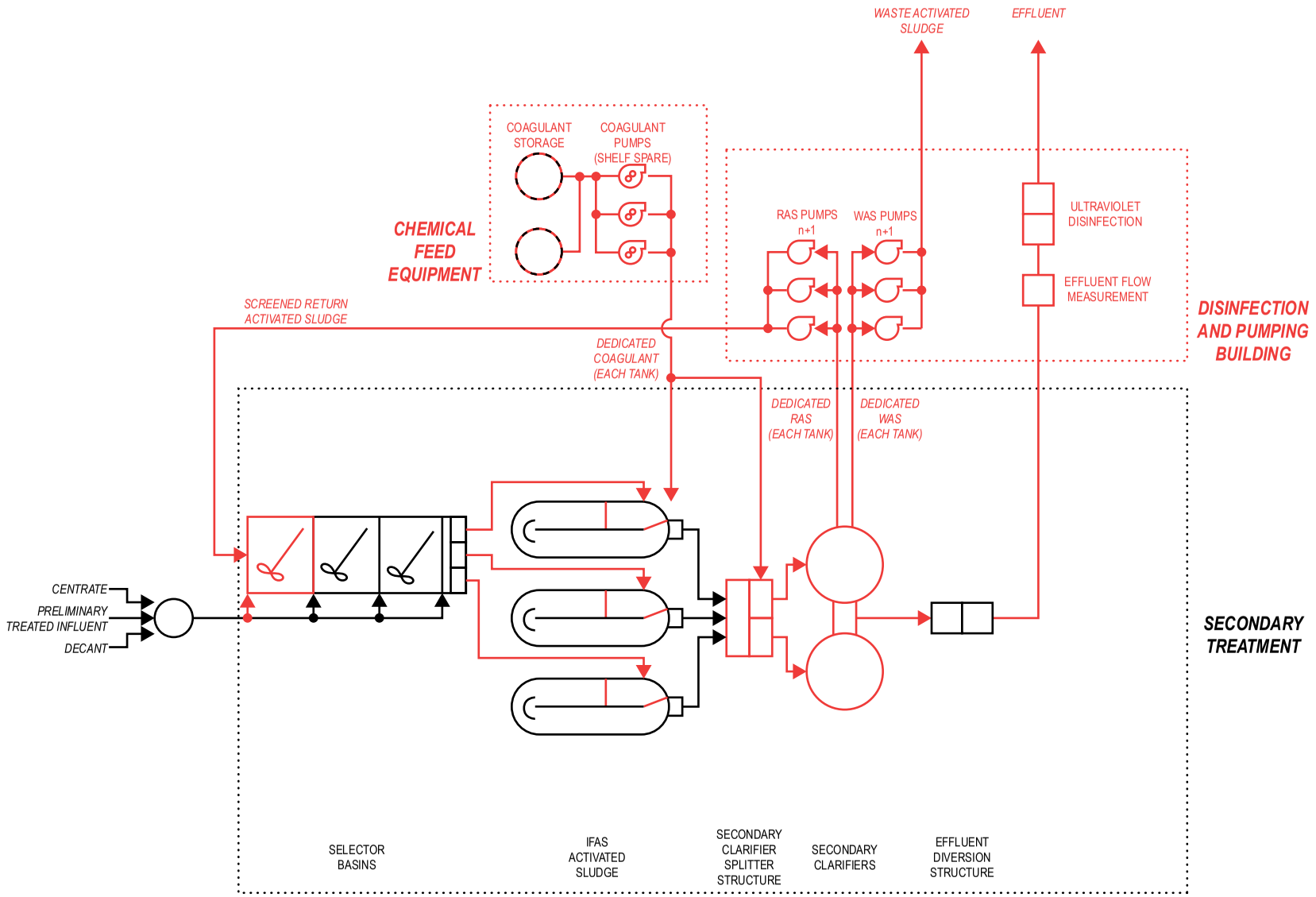

BIOLOGICAL TREATMENT ALTERNATIVE 2
SECONDARY TREATMENT ALTERNATIVE 2

04

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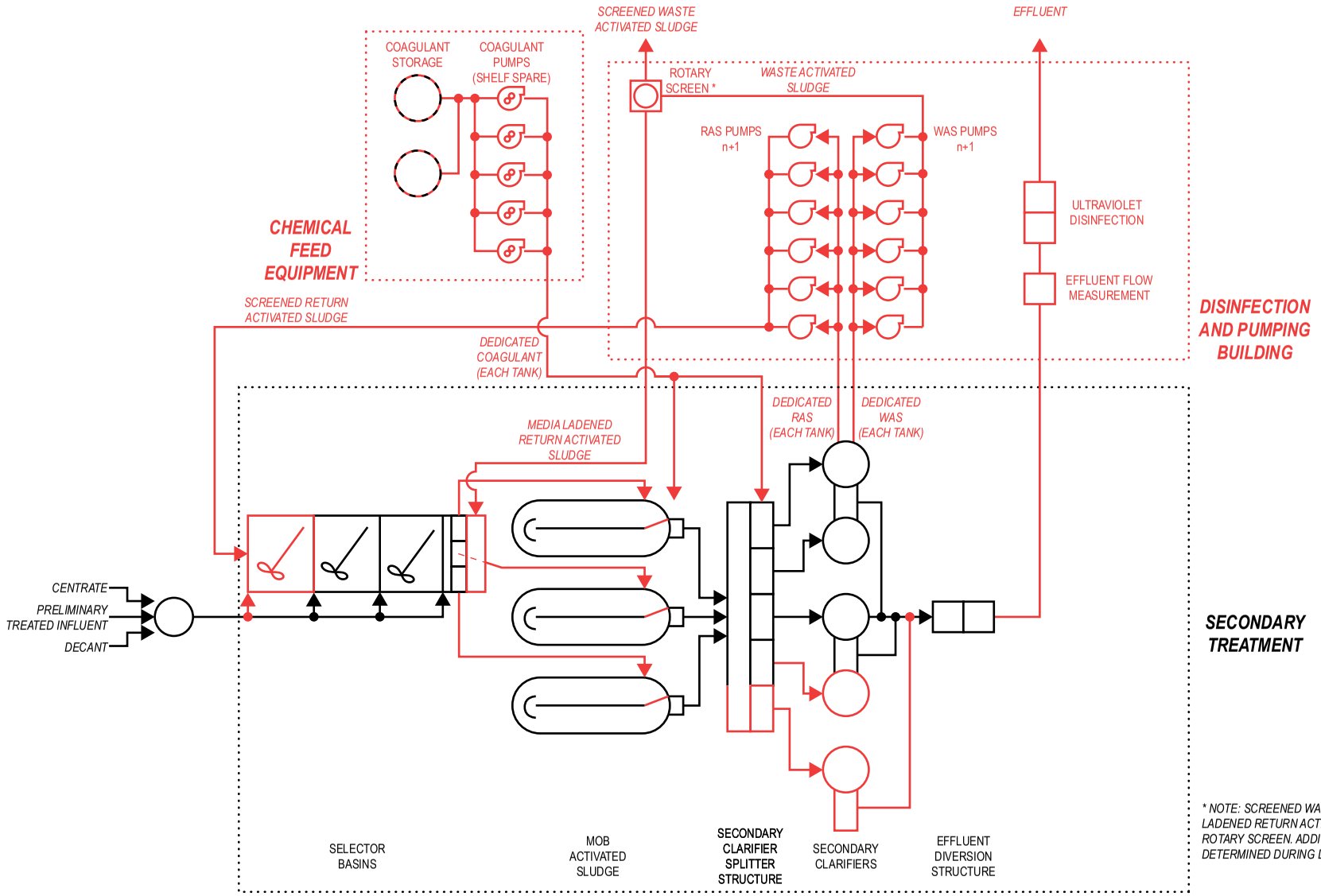

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BIOLOGICAL TREATMENT ALTERNATIVE 3
SECONDARY TREATMENT ALTERNATIVE 1

05

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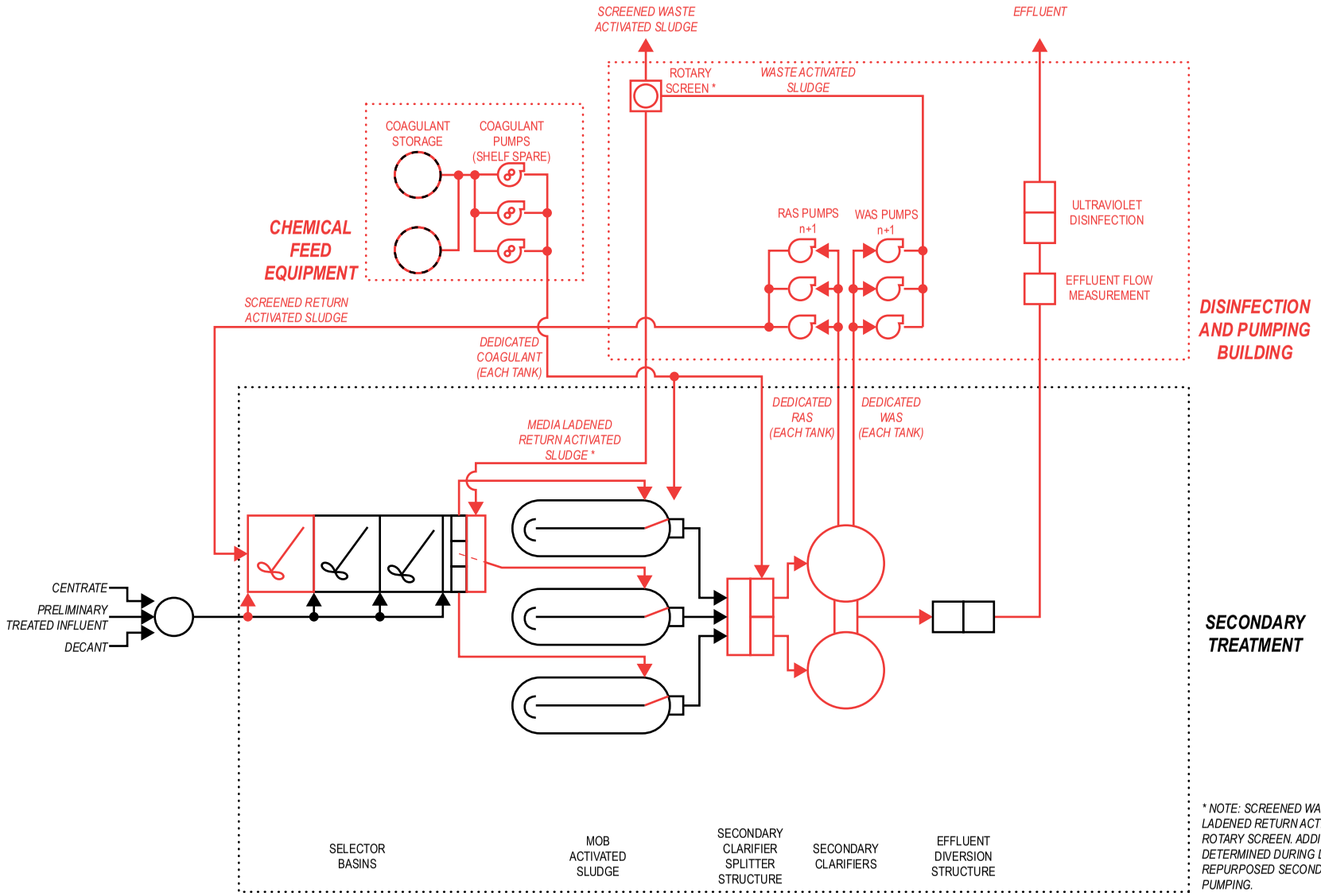

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BIOLOGICAL TREATMENT ALTERNATIVE 3
SECONDARY TREATMENT ALTERNATIVE 2

06

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Attachment 2

Solids Treatment Alternatives

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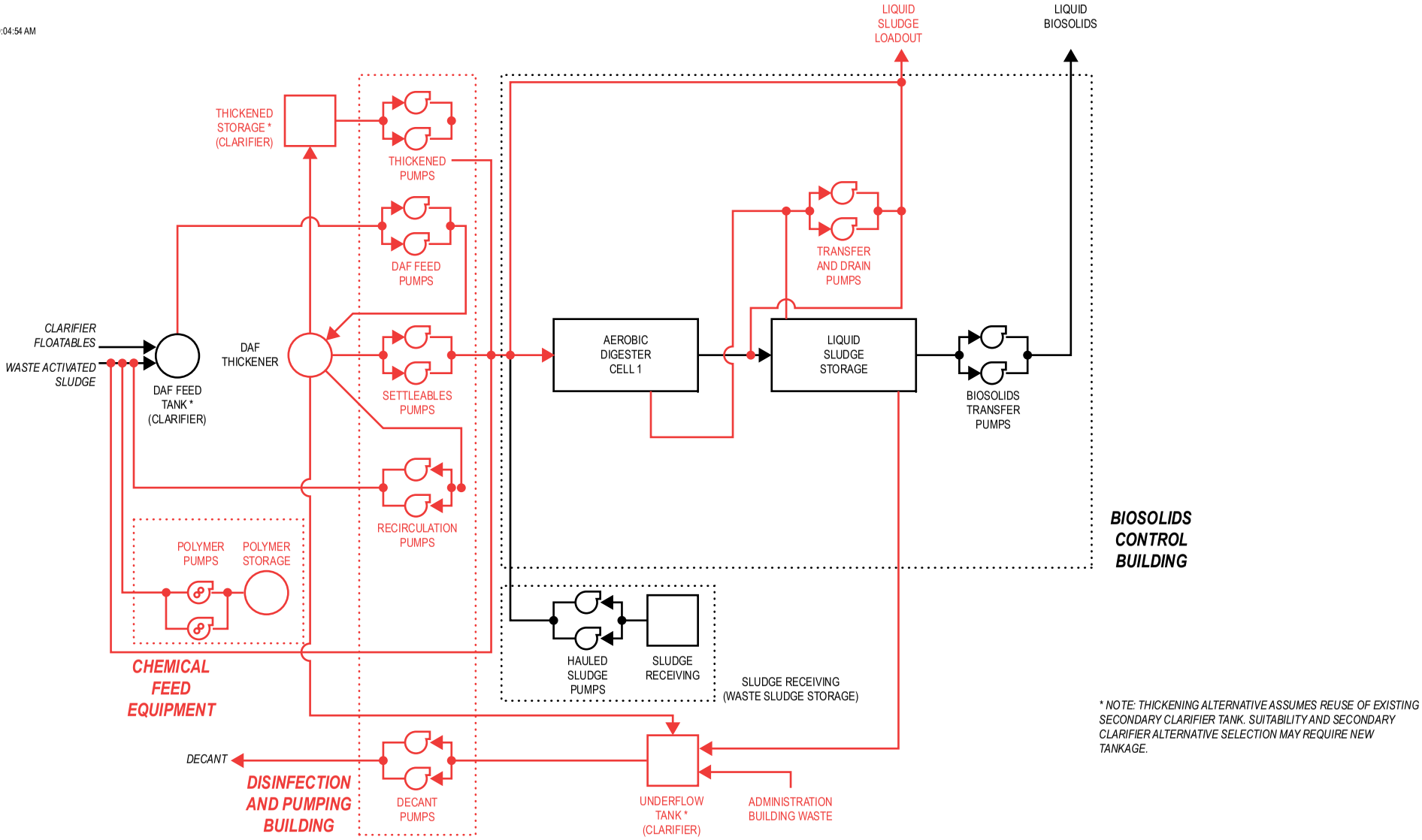

** NOTE: THICKENING ALTERNATIVE ASSUMES REUSE OF EXISTING SECONDARY CLARIFIER TANK. SUITABILITY AND SECONDARY CLARIFIER ALTERNATIVE SELECTION MAY REQUIRE NEW TANKAGE.*

AEROBIC DIGESTION
ALTERNATIVE 1
MIXING ALTERNATIVES
1 AND 2

01

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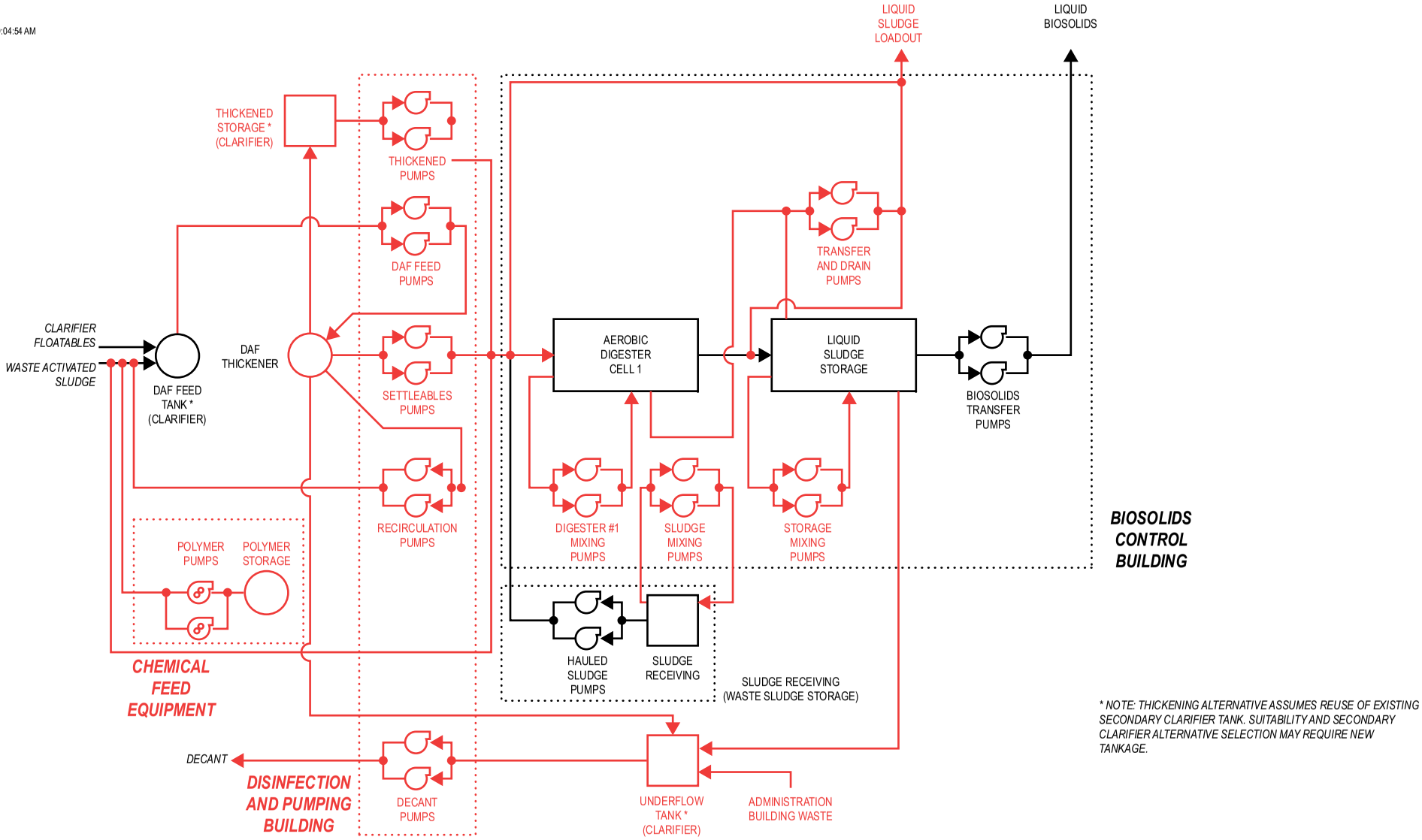

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AEROBIC DIGESTION
ALTERNATIVE 1
MIXING ALTERNATIVE 3

02

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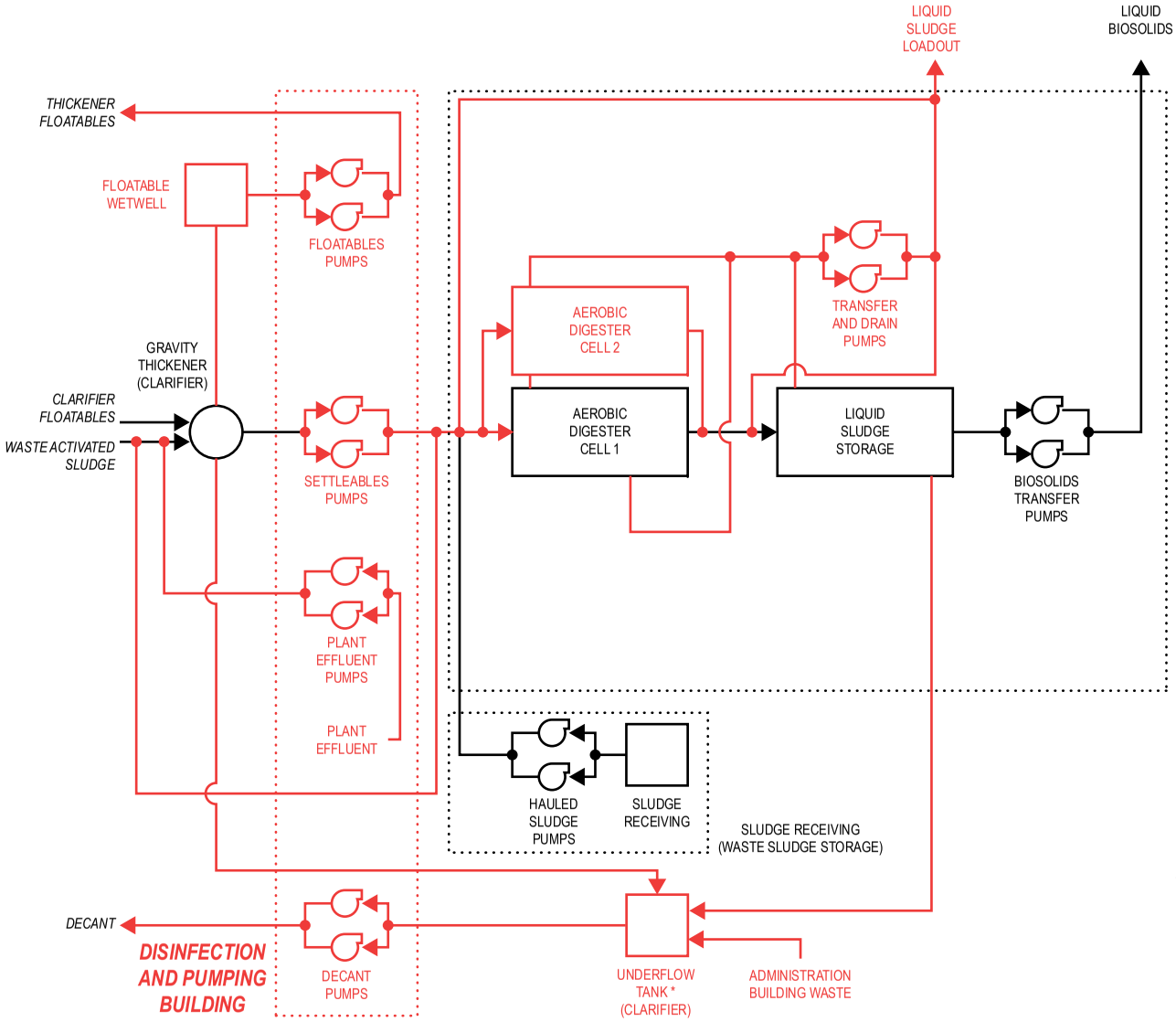

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AEROBIC DIGESTION ALTERNATIVE 2 MIXING ALTERNATIVES 1 AND 2

03

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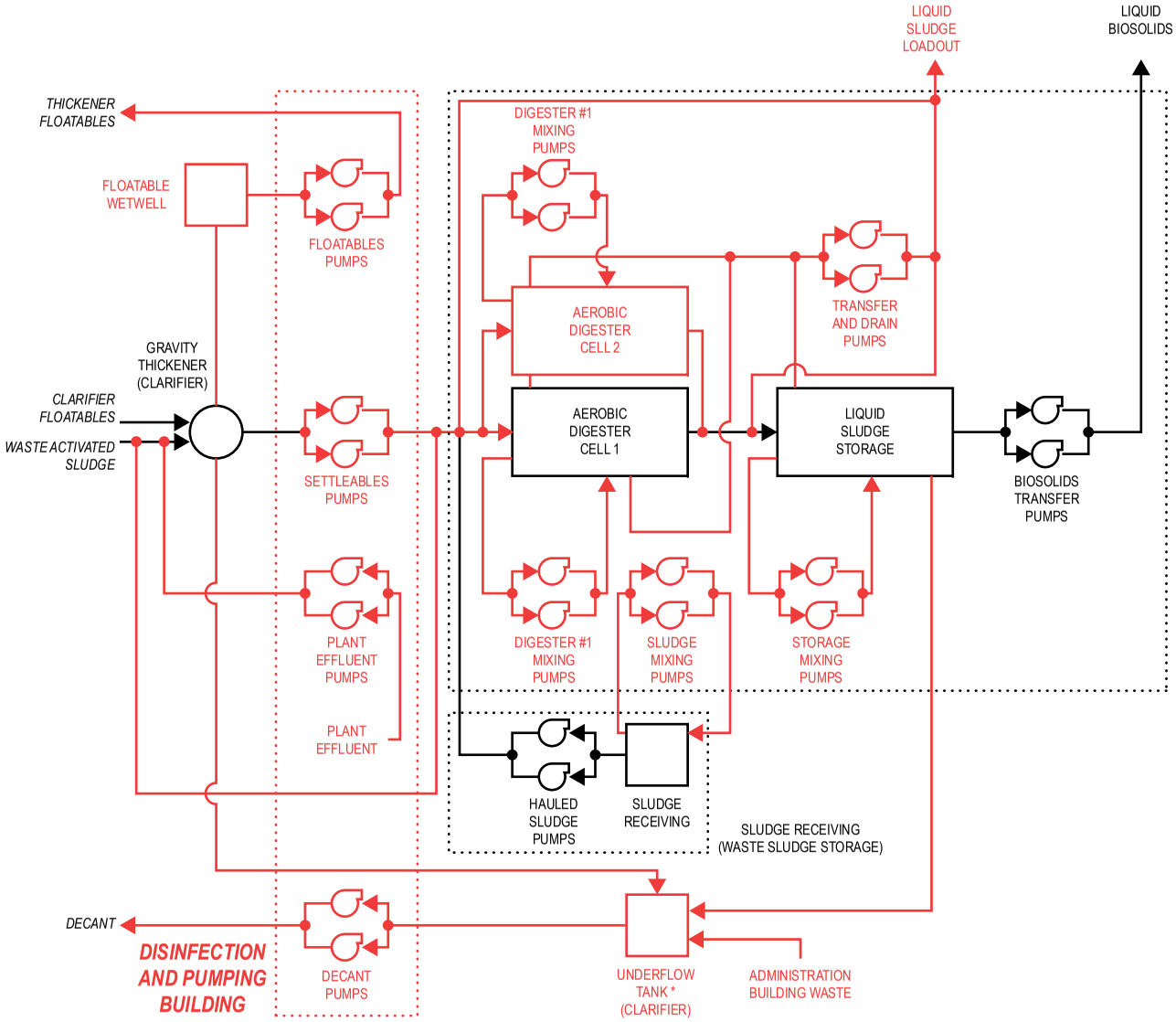

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AEROBIC DIGESTION
ALTERNATIVE 2
MIXING ALTERNATIVE 3

04

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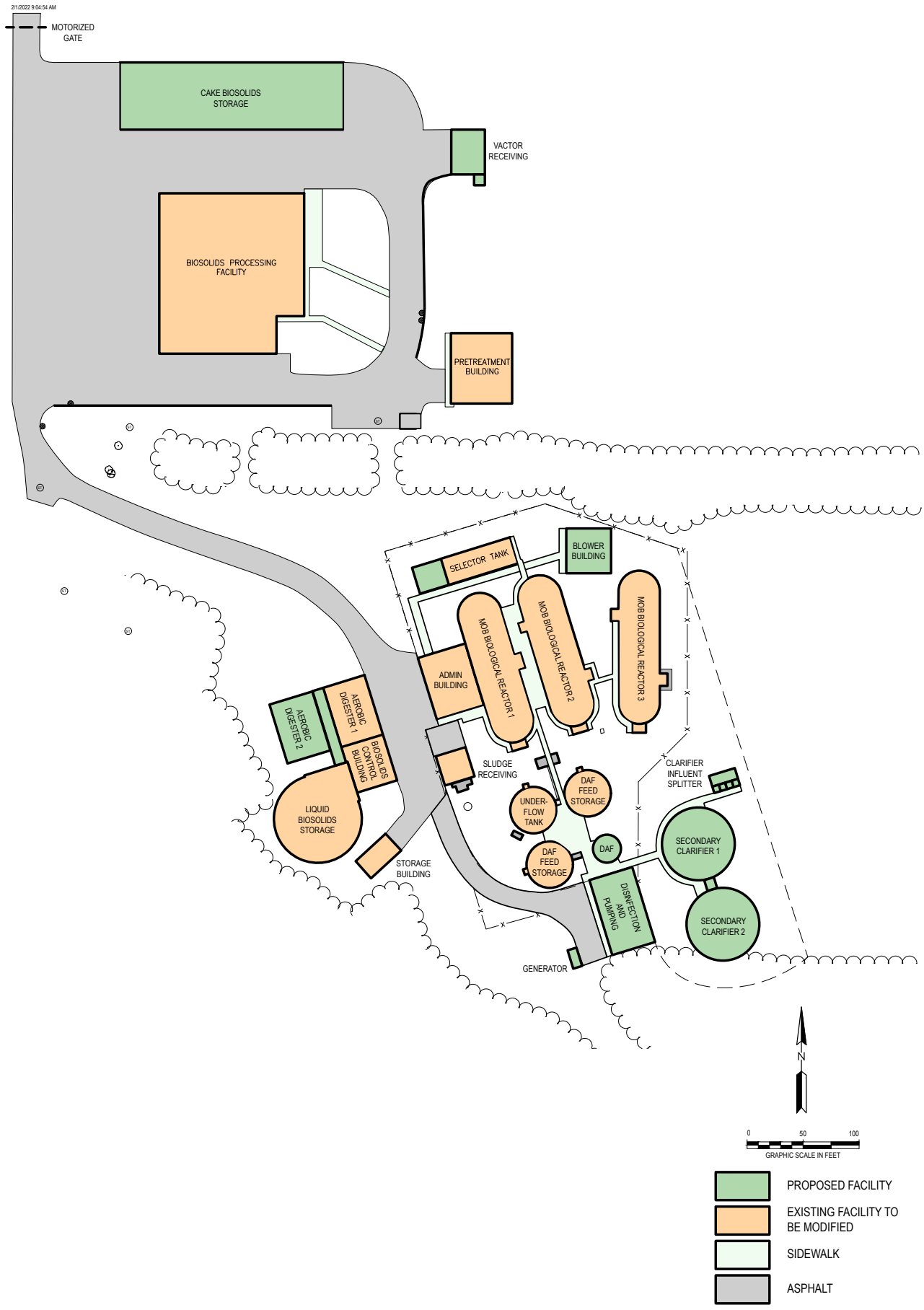
Attachment 3

Preliminary Layout of Recommended Improvements



RECOMMENDED IMPROVEMENTS FOR WASTEWATER TREATMENT FACILITIES

2C

REVISION SCHEDULE

REV #	DESCRIPTION	DATE

Project Status: DRAFT

Issue Date:

SEH Project

Submitted By:

Drawn By:

BIGLK 167207

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Engineer/Owner:
SEH / City of Big Lake
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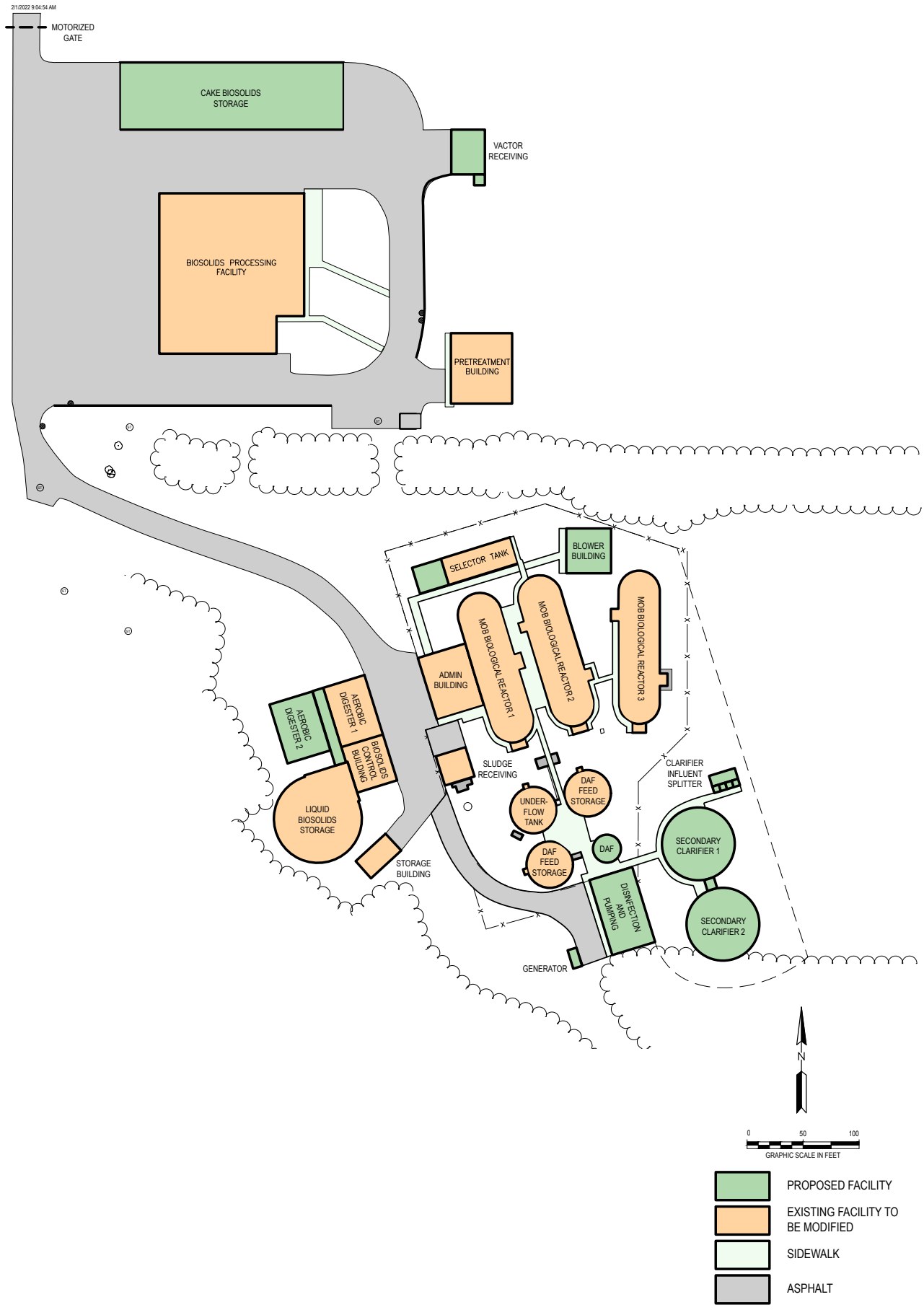
C-4 – Preliminary Site Plan of the Recommended Alternative



RECOMMENDED IMPROVEMENTS FOR WASTEWATER TREATMENT FACILITIES

2C

REVISION SCHEDULE

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BIGLK 167207

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BIG LAKE, MINNESOTA

WASTEWATER TREATMENT FACILITIES PLAN

18999 County Road 14 NW
Big Lake, Minnesota 55309

Engineer/Owner:
SEH / City of Big Lake
160 Lake Street N
Big Lake, MN 55309

NOT FOR CONSTRUCTION

SEH

Appendix D

Minnesota Pollution Control Agency Documentation

D-1 – Flow and Load Determination Guidance
D-2 – CWRF Cost and Effectiveness Certification
D-3 – WRF B3 2030 Exemption Certification

D-1 – Flow and Load Determination Guidance

Design flow and loading determination guidelines for wastewater treatment plants

Introduction

Determination of design flow and loadings is one of the most important items when planning a new or expanded wastewater treatment facility. Sound engineering judgement along with these minimum guidelines will determine the hydraulic and pollutant load capacity required by the proposed facility to meet all permitted limits.

All influent sources must be accounted for when completing design flow and loading determination including residential, seasonal, institutional, commercial, industrial, inflow, infiltration, any recycle streams, and any other unique aspect of flow and pollutant contributions. During the treatment facility design process, possible impacts of design flows and loadings on each upstream and downstream unit process should be considered.

Definitions

Existing flow data for critical low and peak wet weather events are used to estimate the following flow conditions critical to the design of wastewater treatment plants.

Term	Definition
ADW	**Average dry weather** flow is the daily average flow when the groundwater is at or near normal and a runoff condition is not occurring.
AWW	**Average wet weather** or peak month flow is the daily average flow for the wettest 30 consecutive days for mechanical plants or for the wettest 180 consecutive days for controlled discharge pond systems. The 180 consecutive days for pond systems should be based on either the storage period from approximately November 15 through May 15 or the storage period from approximately May 15 through November 15.
PHWW	**Peak hourly wet weather** **Existing collection system:** flow is the peak flow during the peak hour of the day at a time when the groundwater is high and a five-year one-hour storm event is occurring. To determine this five-year one-hour storm event for a specific location, please refer to Map Number 1. **New collection system:** 2.5 or higher multiplier or AWW for residential, commercial + peak hourly industrial. (Ten States Standards Figure 1, Chapter 10)
PIWW	**Peak instantaneous wet weather** **Existing collection system:** flow is the peak instantaneous flow during the day at a time when the ground water is high and a twenty-five year one-hour storm event is occurring. To determine the twenty-five year one-hour storm event for a specific location, please refer to Map Number 2. **New collection system:** 2.5 or higher multiplier or AWW for residential, commercial + peak hourly industrial. (Ten States Standards Figure 1, Chapter 10)

Minimum design requirements

Table 1 contains a summary of the minimum recommended flow and loading conditions for only a select group of processes. Specific design parameter details for individual treatment process units shall be in accordance with **Ten States Standards.**

Where the Minnesota Pollution Control Agency (MPCA) determines that the above design flow considerations will not provide adequate protection to the receiving waters, facility capacity in excess of peak instantaneous wet weather and/or organic loading calculation may be required.

Table 1: Design conditions summary.

Item	Design
Collection system	Must be capable of transporting all flow to the treatment facility without bypassing.
Lift station	Must be capable of transporting all flow to the treatment facility without bypassing.
Flow equalization basin	If PHWW/ADW > 3, or if PHWW/AWW > 3, flow equalization must be considered. If equalization is not provided, a discussion of how the facility will handle the transition in flow must be included. See flow equalization section of this document.
Facility piping and pumping	PIWW
Preliminary treatment unit (screens, grit removal, influent filters, etc.)	PIWW
Clarifiers (surface settling rate and weir loading rate)	PHWW + recirculation flow see "Ten States Standards"
Disinfection (detention time)	PHWW see (Ten States Standards)
Organic loading	Minimum BOD of 0.17 #pcd plus commercial, industrial, and other non-residential flow Minimum TSS of 0.20 #pcd plus commercial, industrial, and other non-residential flow

Design flows

Actual flow data should be used to determine design flow when possible. At a minimum, 100 gallons per capita per day should be used. Include the following information with design flow calculations.

- Data used and data excluded. At least 5-years of facility flow records should be evaluated. Extreme wet or dry weather events may be excluded where appropriate. Map 1 and 2 can be used to analyze wet weather events to determine if an event exceeds the rainfall event for design purposes.
- Water use information, particularly during dry weather flow periods.
- Total and per capita pollutant loadings during a range of flow events.
- Reliability of flow monitoring equipment, pump station performance and methods used to estimate flow reductions or contributions from inflow and infiltration.

Discussion of a method to use when existing flow data is and is not available is included below.

New treatment system and new collection system (no existing flow data)

Use Table 2 for flow calculations. Table 3 should be used to determine the design loadings for a new or upgraded wastewater treatment plant. Table 2 and 3 can also be found electronically in Excel format here: https://www.pca.state.mn.us/sites/default/files/wq-wwtp5-20a.xlsx

For mechanical plants, if the industrial flow varies during the day or week, the design flow should be based on the average flow on the peak day during the period when the industry or industries are operating. This condition is called "rated flow." For example, if the industry discharges 10,000 gallons over eight of the twenty-four hours, the rated flow is 30,000 gallons per day. For controlled discharge pond systems, if the industrial flow varies during the day or week, the average design flow may be based on a weekly average.

The MPCA may approve of an alternative flow design with appropriate justification. For determining the design of the collection system (including design flow), refer to Chapter 30 of Ten State Standards).

Some form of permit "control language" may be included for wastewater treatment facilities if the per capita design flow is less than what is recommended in this document. For this situation, it may become a permit violation when the permitted design flow is reached. Violation of the permitted flow could result in "no more connections" being allowed to the system, or the requirement for submittal of a report that examines the flow in comparison to the number of connections and the number of people using the system. The permittee could also be required to plan, design, and build additional treatment units upon reaching the design capacity.

Existing treatment systems and collection system (existing flow data)

For a mechanical plant, the attached Table 2 should also be used to determine the peak hourly wet weather flow, the peak instantaneous wet weather flow, the average dry weather flow, and the average wet weather flow.

Part A of Table 2 and Figure 1 are used to determine the peak hourly wet weather flow. The measured flow should be plotted for a twenty-four hour period when **groundwater is at or near normal and a runoff condition is not occurring** (Curve X on Figure 1). This should include flows data from overflows, bypasses, and emergency pumping events. The ground water elevation in relation to the sewer elevation should be noted. The present peak hourly dry weather flow is indicated by point (1) on Figure 1, and row 1 in Table 2.

The measured flow should be plotted for a twenty-four hour period when **groundwater is high and a runoff condition is not occurring** (Curve Y). This should include overflow, bypasses, and emergency pumping. The ground water elevation in relation to the sewer elevation should be noted. Point (2) on Figure 1 and row 2 in Table 2 is the peak hourly flow during a high groundwater period when a runoff condition is not occurring. The peak flow at point (2) minus the present peak hourly dry weather flow at point (1) is the peak hourly infiltration.

The measured flow should be plotted for a twenty-four hour period when the **groundwater is high and a runoff condition is occurring** (Curve Z). This should include flow data from overflows, bypasses, and emergency pumping events. The amount of rainfall and its duration should be plotted on the same graph. The peak inflow is represented by the greatest distance between Curve Y and Curve Z. The present hourly flow at the point of greatest distance between Curve Y and Z [point (5) on Figure 1 and row 5 in Table 2] minus the present hourly flow during high ground water at the same time of day on Curve Y [point (6) on Figure 1 and row 6 in Table 2] is the peak hourly inflow.

It may be necessary to adjust the measured flow based on a relationship between the data attained during a major storm event and the five-year one-hour designed storm event. Items (10) and (13) in Table 2 are determined through a cost effectiveness evaluation. The gallons per capita per day (gpcd) contribution for population increase in item (15), (25), (33), and (41) should all be 100 gpcd.

Part B of Table 2 determines the peak instantaneous wet weather flow. The present peak hourly inflow adjusted for a five-year one-hour rainfall event [see part A row (8)] is subtracted from the peak hourly wet weather flow [see part A row (19)]. To this number, add the present peak hourly inflow adjusted for a twenty-five year one-hour storm event. The resulting number is the peak instantaneous wet weather flow.

Part C of Table 2 determines the average dry weather flow. The present average dry weather flow (24) is the average flow received over a twenty-four hour period when the ground water is at or near normal and a runoff condition is not occurring. If the industrial flow varies during the day or week, the present average dry weather flow should be based on the average flow of the peak day during the period when the industry or industries are operating (rated flow). This also applies to the average flow from industrial increases.

Part D of Table 2 determines the thirty-day average wet weather design flow. The average infiltration and inflow after rehabilitation (where rehabilitation is cost effective) is the wettest thirty-day average. The amount of infiltration after rehabilitation averaged over the thirty wettest days should be the same or nearly the same as the peak infiltration after rehabilitation. This is due to the fact that the ground water could stay high for a fairly extended period of time. The amount of inflow after rehabilitation averaged over the thirty wettest days depends on the type of sources, their location, the amount of rainfall that affects the source, etc.

Part E of Table 2 correlates all related information that can impact the degree of accuracy of the determination of design flows. It is recommended that a minimum of six months of accurate data be recorded. Data associated with the critical peak wet weather flow events for a sustained wet weather period are essential for accurate estimation of design flows. Critical peak wet weather flow events typically occur in the spring (March-June) and must include the condition of high ground water with inflow.

Controlled discharge pond systems with existing sanitary sewer systems

The peak hourly wet weather and the peak instantaneous wet weather design flows to a pond system with an existing sanitary sewer system are arrived at in the same manner as in Parts A and B of the previous section. If the present industrial flow varies during the day or week, the present average dry weather flow (24) and (30) may be based on a weekly average. When computing the average wet weather flow, the average infiltration after rehabilitation (31), and the average inflow after rehabilitation (32) are averages over the wettest 180 consecutive days.

Flow equalization

This section applies to all treatment facilities except pond systems.

If the ratios described below are three or more, flow equalization should be considered. If flow equalization is not employed, an explanation must be provided describing how the facility will handle the transition from these average design flows to peak hourly wet weather design flow.

A. During a period of high ground water for that area and system, calculate the ratio of peak hourly wet weather design flow to average wet weather design flow [which is (19) divided by (37)]

B. During a normal ground water period, calculate the ratio of the peak hourly design flow during the five-year one-hour storm event [(1)+(14)+(15)+(17)+(18)] to the average dry weather design flow (29).

Infiltration and inflow

Infiltration and inflow (I/I) is a part of every collection system and must be taken into account in the determination of an appropriate design flow.

Inflow means water other than wastewater that enters a sewer system directly from sources such as roof leaders, foundation drains, yard drains, manhole covers, cross connections between storm sewers and sanitary sewers, catch basins, storm water runoff and other drainage structures.

Infiltration means water other than wastewater that enters the sewer system from the ground through defective pipe, pipe joints, and manholes.

Excessive infiltration means the quantity of flow that is more than 120 gpcd (domestic base flow and infiltration).

Excessive inflow means the quantity of flow during storm events that results in chronic operational problems related to hydraulic overloading of the treatment system or that results in a total flow of more than 275 gpcd (domestic and industrial base flow plus infiltration and inflow). Chronic operational problems may include surcharging, backups, bypasses, and overflows.

Bypasses/overflows and releases

Determining the design flow is one of the most challenging parts of the design process. It is not cost effective to design a system that can capture and treat flows from every extreme event, however, bypasses, overflows and releases of any kind are prohibited by permit and rules.

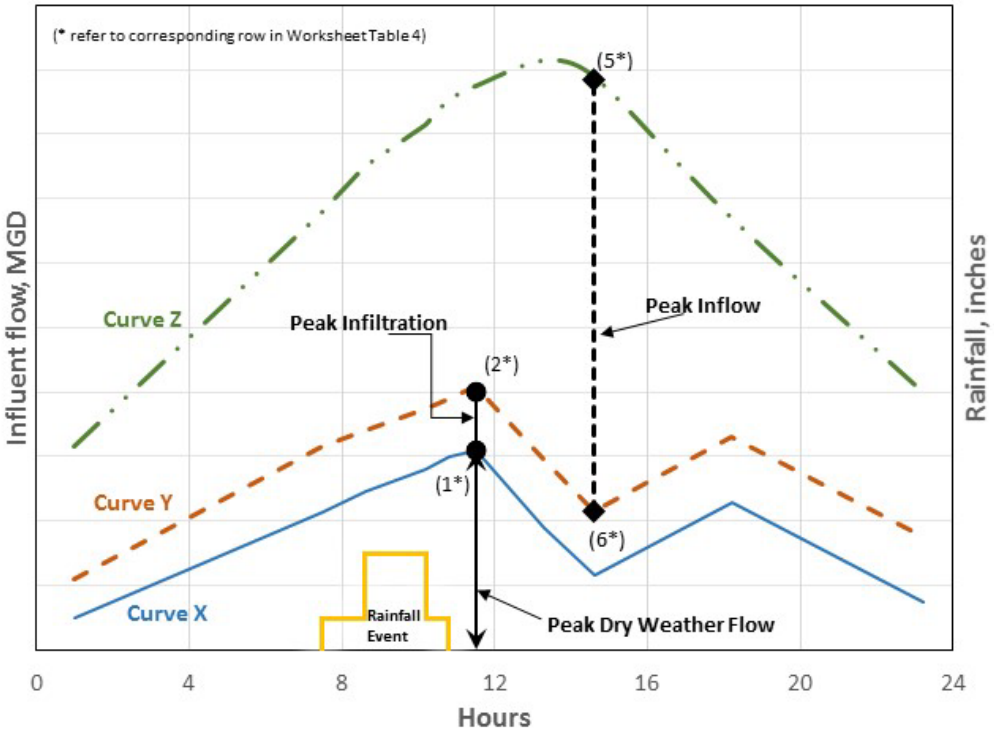
For more information

Please contact the engineer assigned to the project or district. If the engineer is unknown, contact the Customer Assistance Center.

MPCA 651-296-6300

Toll-free 800-657-3864

Figure 1: Determination of peak hourly flows before adjustment for storm event.



- Curve X: 24 hour flow with NORMAL groundwater conditions and no runoff
- Curve Y: 24 hour flow with HIGH groundwater conditions and no runoff
- Curve Z: 24 hour flow with HIGH groundwater conditions and runoff

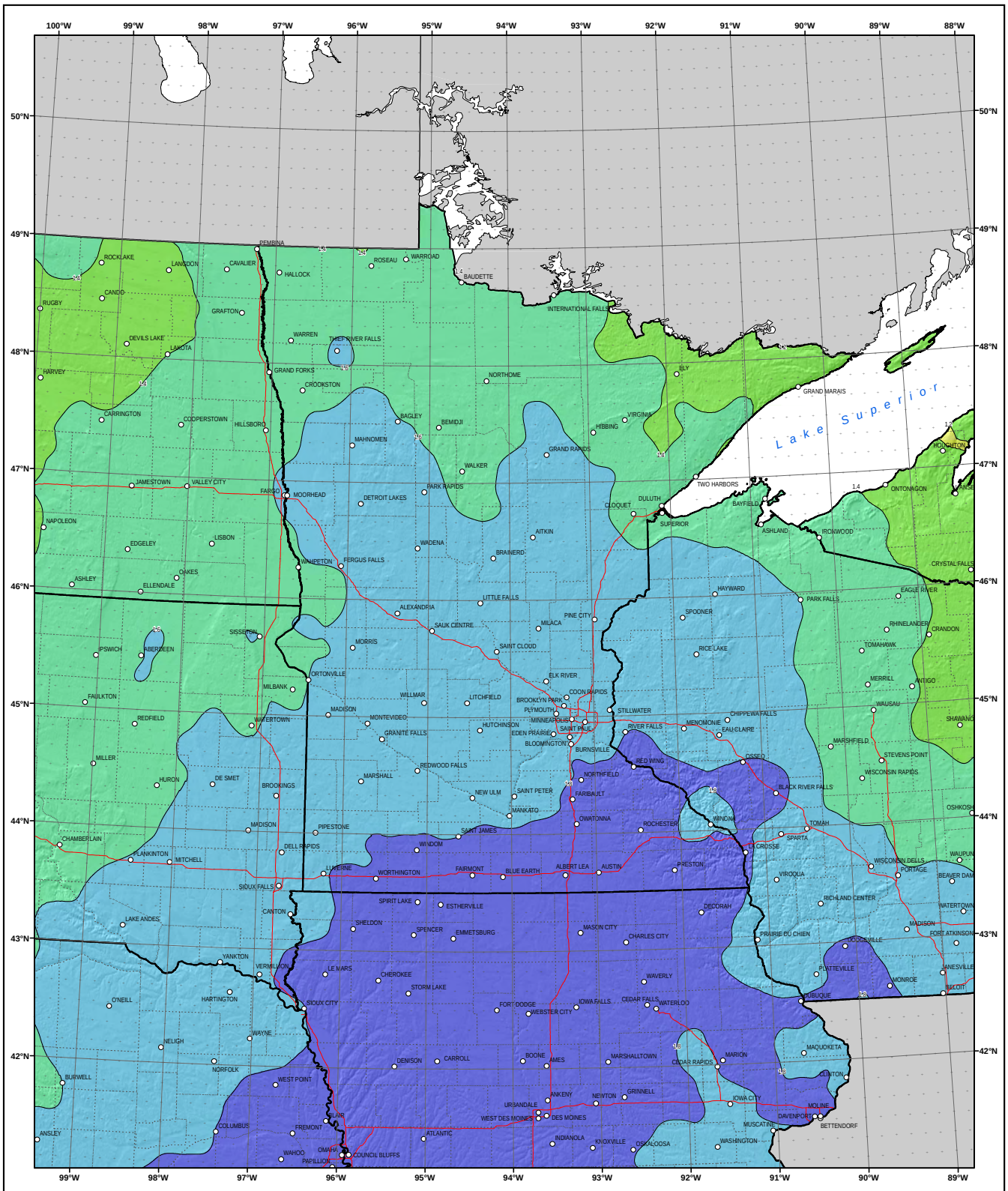
All of these flows should include any bypassing, overflows or bypass pumping.

For more detail see discussion in previous pages.

Note: All flow measurements taken at treatment plant with adjustments for bypasses, overflows and emergency pumping. Groundwater elevation in relation to sewers should be stated for several points in the sewer system. Dates of flow measurements should be stated.

Design Flow and Loading Determination Guidelines for Wastewater Treatment Plants (Table 2 and 3): https://www.pca.state.mn.us/sites/default/files/wq-wwtp5-20a.xlsx

Map 1 and Map 2 are taken from the NOAA website. An interactive site specific map can also be used. Found here: https://hdsc.nws.noaa.gov/hdsc/pfds/pfds_map_cont.html?bkmrk=mn



NOAA Atlas 14, Volume 8, Version 2
Midwestern States

MINNESOTA

Isopluvials of 5-year 60-minute precipitation in inches

SCALE 1:2,250,000

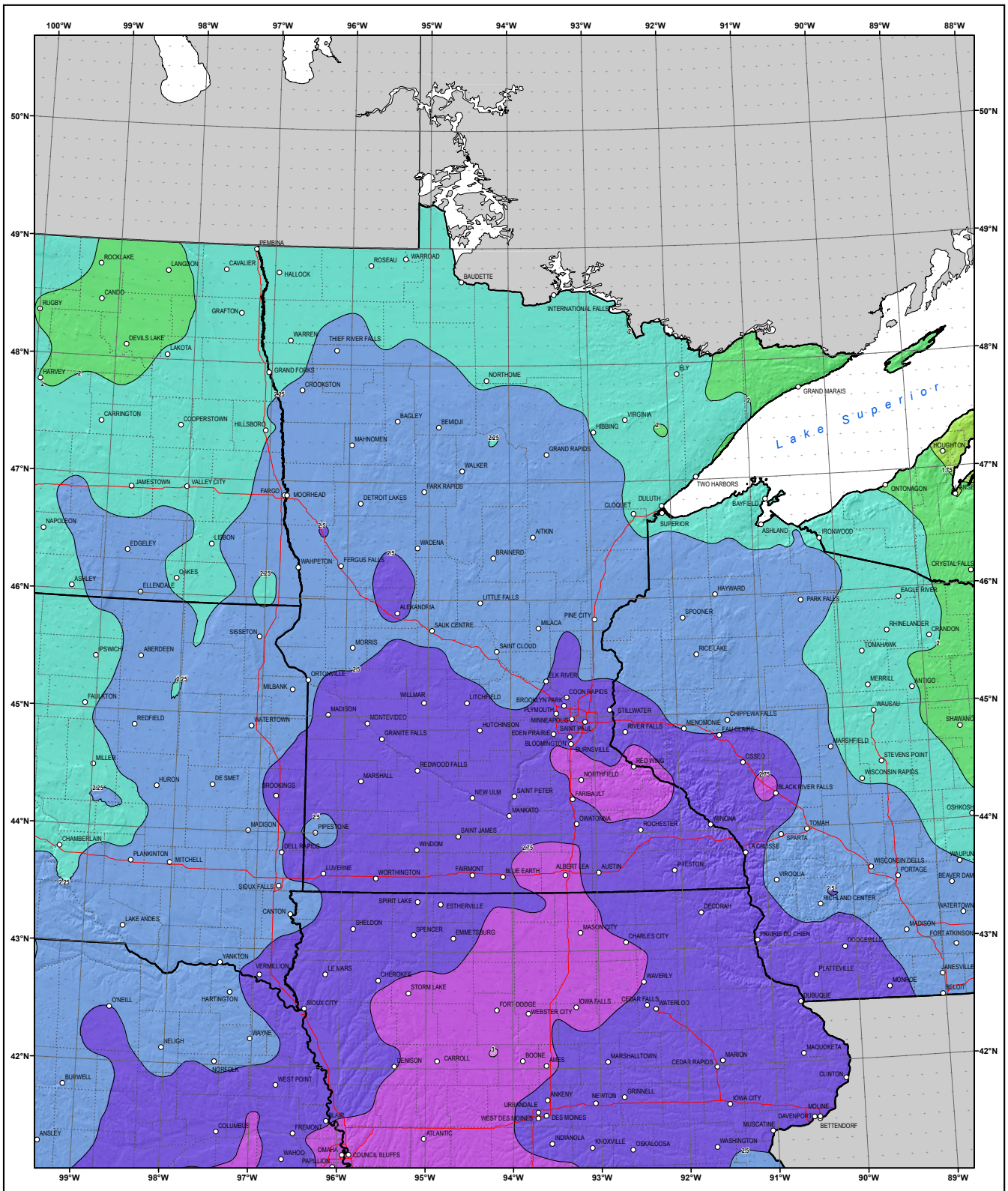
0.47 - 0.60 | 1.01 - 1.20 | 1.61 - 1.80 | 2.21 - 2.40
0.61 - 0.80 | 1.21 - 1.40 | 1.81 - 2.00 | 2.41 - 2.45
0.81 - 1.00 | 1.41 - 1.60 | 2.01 - 2.20

Legend based on entire Volume 8 project area.

Prepared by U.S. DEPARTMENT OF COMMERCE
NATIONAL OCEANIC AND ATMOSPHERIC ADMINISTRATION
NATIONAL WEATHER SERVICE
OFFICE OF HYDROLOGIC DEVELOPMENT
HYDROMETEOROLOGICAL DESIGN STUDIES CENTER
April 2013

0 5 10 20 30 Miles
0 10 20 40 60 Kilometers

Projection: Lambert Conformal Conic; Datum NAD83; Standard Parallels: 44°N and 48°N; Central Meridian 94.5°W.



NOAA Atlas 14, Volume 8, Version 2
Midwestern States

MINNESOTA

Isopluvials of 25-year 60-minute precipitation in inches

SCALE 1:2,250,000

0.74 - 0.75 | 1.26 - 1.50 | 2.01 - 2.25 | 2.76 - 3.00
0.76 - 1.00 | 1.51 - 1.75 | 2.26 - 2.50 | 3.01 - 3.25
1.01 - 1.25 | 1.76 - 2.00 | 2.51 - 2.75 | 3.26 - 3.33

Legend based on entire Volume 8 project area.

Prepared by U.S. DEPARTMENT OF COMMERCE
NATIONAL OCEANIC AND ATMOSPHERIC ADMINISTRATION
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HYDROMETEOROLOGICAL DESIGN STUDIES CENTER
April 2013

0 5 10 20 30 Miles
0 10 20 40 60 Kilometers

Projection: Lambert Conformal Conic; Datum NAD83; Standard Parallels: 44°N and 48°N; Central Meridian 94.5°W.

D-2 – CWRF Cost and Effectiveness Certification

MINNESOTA POLLUTION CONTROL AGENCY
520 Lafayette Road North
St. Paul, MN 55155-4194

CWRF cost and effectiveness certification form

Clean Water Revolving Fund (CWRF) Program

Federal Water Pollution Control Act Section 602(b)(13)
and Minn. R. 7077.0272, subp. 2.D. or 7077.0277, subp. 2.C.

Instructions: The project representative must check boxes 1), 2), and either Z) or ZZ) below, and the form must be signed by both the Project Representative and the Professional Engineer for the project.

☒ 1) The municipality has studied and evaluated the cost and effectiveness of the processes, materials, techniques, and technologies for carrying out the proposed project or activity for which the assistance is sought under the Clean Water Revolving Fund (Minn. Stat. § 446.07); and

☒ 2) The municipality has selected, to the maximum extent practicable, a project or activity that maximizes the potential for efficient water use, reuse, recapture, conservation, and energy conservation[Z&ZZ], taking into account:

a) The cost of constructing the project or activity.
b) The cost of operating and maintaining the project or activity over the life of the project or activity.
c) The cost of replacing the project or activity.

☒ Z) If this project exempt from Building, Benchmarks, and Beyond (B3) provisions of the Sustainable Building (SB) 2030 Guidelines (B3 SB 2030) Wastewater Treatment Plants (WWTP) Review (attach a completed *B3 SB 2030 exemption form*).

☐ ZZ) If this project not exempt from B3 SB 2030 WWTP Review.

Project information

Municipality name: City of Big Lake

Project number: _____

Certification

We certify that the project has completed requirements (1 and 2, and either Z or ZZ) as checked above.

Project Representative

Print name: Dan Childs

Signature: _____

Date (mm/dd/yyyy): _____

Professional Engineer

Print name: Jessica Hedin, PE (Lic. MN)

Signature: _____

Date (mm/dd/yyyy): _____

Footnote: If ZZ) is checked, the Professional Engineer has submitted a Facilities Plan to the B3 SB 2030 WWTP Review and will consider the Review water and energy conservation recommendations.

MINNESOTA POLLUTION CONTROL AGENCY
520 Lafayette Road North
St. Paul, MN 55155-4194

CWRF cost and effectiveness checklist

Clean Water Revolving Fund (CWRF) Program

Instructions: This checklist must be used with the Minnesota Pollution Control Agency (MPCA) *Minnesota Clean Water Revolving Fund (CWRF) cost and effectiveness guidance* document dated March 2018. The guidance document assists the consulting engineer in completing the cost and effectiveness analysis required by the Federal Water Pollution Control Act (FWPCA) Section 602(b)(13). The cost and effectiveness analysis for a project must be further documented in the project Facilities Plan. This checklist is also an attachment to the MPCA *Facilities Plan submittal checklist.*

Project information

Project name: Big Lake Wastewater Treatment Facilities Plan Date submitted (mm/dd/yyyy): _____

City: City of Big Lake

City's authorized representative: Dan Childs

Consulting engineer: Jessica Hedin, PE (Lic. MN)

Cost analysis items

Cost analysis items to be completed for all CWRF wastewater projects.

Section		Yes	No
II.	Does the project owner have an Asset Management system in place? Where is the Asset Management system documented in the Facilities Plan: *Section 6.1.1 of the Facilities Plan Report*	☒	☐
IVA.	Did the Facilities Plan address Energy Conservation Opportunities? Where is the Energy Conservation discussion documented in the Facilities Plan: *Section 6.1.2 of the Facilities Plan Report*	☒	☐
IVB.	Did the Facilities Plan address Renewable Energy Opportunities? Where is the Renewable Energy discussion documented in the Facilities Plan: *Section 6.1.2.1 of the Facilities Plan Report*	☒	☐
IV.C.i.	Has the Facilities Plan analyzed Water Reuse options? Where is the Water Reuse options analysis documented in the Facilities Plan: *Section 6.1.3 of the Facilities Plan Report*	☒	☐
IV.C.ii.	Has the Facilities Plan analyzed installation of Water Efficient Devices? Where is the use of Water Efficient Devices analysis documented in the Facilities Plan: *Section 6.1.3.1 of the Facilities Plan Report*	☒	☐
IV.C.iii.	Has the Facilities Plan analyzed installation of new Water Meters or replacement of existing Water Meters? Where is the installation of new or replacement Water Meters analysis documented in the Facilities Plan: *Section 6.1.3 of the Facilities Plan Report*	☒	☐
IV.C.iv.	Has the Facilities Plan considered or completed Water Audits and/or Conservation Plan? Where is the discussion of Water Audits and/or Conservation Plan documented in the Facilities Plan: *Section 6.1.3.2 of the Facilities Plan Report*	☒	☐
IV.D.	Did the Facilities Plan for the project complete a Buildings, Benchmark, and Beyond (B3) Sustainable Building (SB) Wastewater Treatment Plant (WWTP) or B3 SB 2030 *WWTP exemption form*? Where is the B3 SB 2030 *WWTP exemption form* documented in the Facilities Plan: *Section 6.1.4 of the Facilities Plan Report. Checklist is included in Appendix D-3.*	☒	☐

Nonmonetary analysis items **Applicable**: **Yes** ☒ **No** ☐

Nonmonetary analysis items to be completed for all new wastewater treatment facilities with design average wet weather (AWW) flow of greater than 100,000 gallons per day, or significant upgrades meaning work on three or more major treatment units for any wastewater treatment facilities with a design AWW flow of greater than 1 million gallons per day.

Section		Yes	No
V.A.i.	Does the Facilities Plan analyze the project sustainability and climate resilience? Where is the discussion on project sustainability and climate resilience documented in the Facilities Plan: *Section 6.2.1 of the Facilities Plan Report.*	☒	☐
V.A.ii.	Does the Facilities Plan analyze how a project addresses Water Quality objectives? Where is the discussion on how the project addresses Water Quality objectives documented in the Facilities Plan: *Section 2.2 of the Facilities Plan Report*	☒	☐
V.A.iii.	During the project planning process, did the owner consider project alternatives, such as consolidation or regionalization with another or other service area? Where is the discussion on how the project addresses possible consolidation or regionalization documented in the Facilities Plan: *Section 6.2.2 of the Facilities Plan Report.*	☒	☐
V.B.i.	Is the project location and physical aspects discussed in the Facilities Plan? Where is the discussion on the project location and physical aspects located in the Facilities Plan: *Section 4 of the Facilities Plan Report. Section 5 of the Facilities Plan. C-2 Facilities Plan Capacity and Condition Evaluation. C-3 Facilities Plan Treatment Alternatives.*	☒	☐
V.B.ii.	Is the project reliability discussed in the Facilities Plan? Where is the discussion on the project reliability located in the Facilities Plan: *Section 6.2.3 of the Facilities Plan Report.*	☒	☐
V.B.iii.	Is the project feasibility and operability discussed in the Facilities Plan? Where is the discussion on the project feasibility and operability located in the Facilities Plan: *Section 4 of the Facilities Plan Report. Sectioon 5 of the Facilities Plan. C-2 Facilities Plan Capacity and Condition Evaluation. C-3 Facilities Plan Treatment Alternatives.*	☒	☐
V.C.i.	Are possible water conservation practices, water reuse and/or water recapture opportunities discussed in the Facilities Plan? Where is the discussion on the project water conservation practices, water reuse, and/or water recapture opportunities located in the Facilities Plan: *Section 6.1.3 of the Facilities Plan Report*	☒	☐
V.C.ii.	Are possible energy conservation practices discussed in the Facilities Plan? Where are the possible energy conservation practices discussed in the Facilities Plan: *Section 6.1.2 of the Facilities Plan Report*	☒	☐
V.C.iii.	Are possible opportunities to recover and recycle or reuse other resources discussed in the Facilities Plan? Where are possible opportunities to recover and recycle or reuse other resources options discussed in the Facilities Plan: *Section 6.1.3 of the Facilities Plan Report*	☒	☐
V.C.iv.	Are possible opportunities to use green infrastructure components within the project discussed in the Facilities Plan? Where are possible opportunities to use green infrastructure components within the project discussed in the Facilities Plan: *Section 6.2.4 of the Facilities Plan Report.*	☒	☐

Section		Yes	No
V.C.v.	Are possible other environmental impacts of the project discussed in the Facilities Plan? Where are the possible other environmental impacts of the project discussed in the Facilities Plan: *Section 1.2 of the Facilities Plan Report. Appendix B-1 Environmental Information Worksheet.*	☒	☐
V.D.i.	Are possible considerations which may be part of a local trend or demographics affecting the need or demand for a project discussed in the Facilities Plan? Where are the possible considerations which may be part of a local trend or demographics affecting the need or demand for a project discussed in the Facilities Plan: *Section 3.4 of the Facilities Plan Report. C-1 Facilities Plan Anticipated Flow and Load Review.*	☒	☐
V.D.ii.	Are possible considerations which may be part of a local trend or demographics affecting the need or demand for a project discussed in the Facilities Plan? Where are the possible considerations which may be part of a local trend or demographics affecting the need or demand for a project discussed in the Facilities Plan: *Section 3.4 of the Facilities Plan Report. C-1 Facilities Plan Anticipated Flow and Load Review.*	☒	☐
V.D.iii.	Are there possible environmental justice issues which may be considered for the project discussed in the Facilities Plan? Where are the possible environmental justice issues which may be considered for the project discussed in the Facilities Plan: *Section 6.2.5 of the Facilities Plan Report.*	☒	☐
V.D.iv.	Are there possible acceptability or affordability issues which may be considered for the project discussed in the Facilities Plan? Where are the possible acceptability or affordability issues which may be considered for the project discussed in the Facilities Plan: *Section 6.2.6 of the Facilities Plan Report.*	☒	☐

Integrating cost and effectiveness analysis **Applicable: Yes ☒ No ☐**

Integrating cost and effectiveness analysis to be completed for all new wastewater treatment facilities with design AWW flow of greater than 100,000 gallons per day, or significant upgrades meaning work on three or more major treatment units for any wastewater treatment facilities with a design AWW flow of greater than 1 million gallons per day.

Section		Yes	No
VI.	Has an integrated cost and effectiveness analysis of the cost factors and the other/nonmonetary factors for a project been completed in the Facilities Plan? Where is the integrated cost and effectiveness analysis of the cost factors and the other/nonmonetary factors for a project discussed/located in the Facilities Plan? Section 6.3 of the Facilities Plan Report.	☒	☐

D-3 – WRF B3 2030 Exemption Certification

MINNESOTA POLLUTION CONTROL AGENCY
520 Lafayette Road North
St. Paul, MN 55155-4194

CWRF B3 SB 2030 exemption form

Clean Water Revolving Fund (CWRF) Program
Wastewater Projects

(Minn. Stat. § 216B.241, sub. 1-10 and 16B, sub. 1-4)

Doc Type: Wastewater Point Source

Instructions: If at least one of the "**Yes**" statements is checked, the project is considered to have completed these requirements and is not required to submit additional information to meet the Building, Benchmarks, and Beyond (B3) provisions of the Sustainable Building (SB) 2030 Guidelines (B3 SB 2030). **Sign and send the completed form electronically to the Minnesota Pollution Control Agency (MPCA) review engineer.**

If the answer to **all of the statements is** "**No", sign and send the completed form electronically to the MPCA review engineer.** Once the Facilities Plan receives preliminary approval [Minn. R. 7077.0272], submit it to B3 SB 2030 Wastewater Treatment Plant (WWTP) Review at sb2030@b3mn.org. More information is available at https://www.b3mn.org/2030energystandard/.

Project information

Project name: Big Lake Wastewater Treatment Facilities Plan

Project Description: Suitability for Future Effluent Water Quality Requirements in Accordance with the NPDES/SDS Permit.

MPCA review engineer: Vinod Sathyaseelan MPCA project number:

Exempt criteria	Yes	No
1. The project is limited to environmental study.	☐	☒
2. The project is limited to planning and design.	☐	☒
3. The project is for emergency/disaster relief and/or protection.	☐	☒
4. The project is limited to minor modifications to an existing treatment facility.	☐	☒
5. The project is limited to modifications within a new or an existing building less than 10,000 square feet.	☒	☐
6. The project is limited to a new or existing collection system including lift stations.	☐	☒
7. The project is limited to pond system.	☐	☒
8. The project is limited to installation of a backup power generator.	☐	☒
9. The project is limited to a stormwater project.	☐	☒

If a "Yes" box is checked for any of criteria 1- 9 above, the project is exempt. If none of the "Yes" boxes are checked, the project is not exempt. Please provide a brief description of the project and complete the Certification Statement below.

The facilities plan reuses existing facilities with the anticipated addition of two occupieable equipmetn and control buildings, one approximately 4,200 sqft and the other approximately 2,700 sqft. The existing facilities do not exceed 10,000 sqft.

Certification statement

I certify that the information provided on this form is complete and accurate and that this project:

☒ Meets the exempt criteria established by the Minnesota Pollution Control Agency.

☐ Does not meet the exempt criteria. A preliminary approved Facilities Plan will be sent to the B3 SB 2030 WWTP Review at sb2030@b3mn.org, and the Review water and energy conservation recommendations will be considered.

Project Representative or Professional Engineer

Print name: Jessica Hedin, PE (Lic. MN)

Organization: SEH Inc.

Email address: jhedin@sehinc.com

Signature:

Date (mm/dd/yyyy):

Appendix E

Municipal Planning and Documentation

E-1 – Daily Monitoring Reports (DMRs)
E-2 – 2018 Comprehensive Growth Plan
E-3 – Ordinance for Sanitary Sewer
E-4 – Significant Industrial User Agreements

E-1 – Daily Monitoring Reports (DMRs)

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MEMORANDUM

TO: Dan Childs

FROM: Jessica Hedin, PE (Lic. MN 41639)

DATE: March 25, 2023

RE: Big Lake Wastewater Treatment Facilities Plan, Summary of Monthly Flow and Load Demand
SEH No. BIGLK 167307 14.00

The following memorandum is a summary of the reported influent and effluent water quality samples summarized as monthly flow and load demand. Sampling information was provided by the City of Big Lake and serves as the basis of flow and load determination as described in the memorandum "Big Lake Wastewater Treatment Facilities Plan, Anticipated Flow and Load Demand" memorandum.

Refer to the tables on the following sheets for a monthly summary of the sampling information provided.

Table 1 – Summary of Monthly Average Flow and Load Demand as Reported by Big Lake, 2017

Month	Influent Monitoring Parameters							Effluent Monitoring Parameters					
	Total Flow	$cBOD_5$	TSS	Total P as P	$NO^-_2 + NO^-_3$ as N	TKN	TN as N	$cBOD_5$	TSS	Total P as P	$NO^-_2 + NO^-_3$ as N	TKN	TN as N
	(MGD)	(mg/L)	(mg/L)	(mg/L)	(mg/L)	(mg/L)	(mg/L)	(mg/L)	(mg/L)	(mg/L)	(mg/L)	(mg/L)	(mg/L)
January	0.681	283	42	6.5	ND	ND	ND	6.8	8.6	0.5	ND	ND	ND
February	0.662	315	25	5.6	ND	ND	ND	3.5	9.0	0.4	ND	ND	ND
March	0.640	348	17	6.0	ND	ND	ND	2.8	7.2	0.4	ND	ND	ND
April	0.656	319	36	6.3	ND	ND	ND	5.0	9.6	0.6	14.0	28.0	24.3
May	0.731	299	17	7.3	ND	ND	ND	2.6	6.5	0.5	ND	ND	ND
June	0.772	385	33	8.5	ND	ND	ND	4.4	9.8	0.8	ND	ND	ND
July	0.755	418	16	8.1	ND	ND	ND	2.5	7.0	0.7	ND	ND	ND
August	0.767	345	22	8.9	ND	ND	ND	3.0	7.1	0.8	ND	ND	ND
September	0.779	469	19	10.7	ND	ND	ND	2.8	5.9	0.7	23.8	3.5	1.3
October	0.806	455	19	9.8	ND	ND	ND	2.5	10.9	0.9	ND	ND	ND
November	0.760	327	21	7.8	ND	ND	ND	2.9	7.3	0.7	18.9	ND	ND
December	0.728	469	21	8.6	ND	ND	ND	3.0	6.6	0.8	ND	ND	ND
Average	0.728	369	24	7.8	ND	ND	ND	3.5	8.0	0.7	18.9	15.7	**12.8**
Minimum	0.640	283	16	5.6	ND	ND	ND	2.5	5.9	0.4	14.0	3.5	**1.3**
Maximum	0.806	469	42	10.7	ND	ND	ND	6.8	10.9	0.9	23.8	28.0	**24.3**

Notes:
$cBOD_5$: 5-day carbonaceous biochemical oxygen demand.
TSS: Total suspended solids.
TP: Total Phosphorus.
TKN: Total Kjeldahl Nitrogen.
1. ND: No data collected for parameter during reporting period.

Table 2 – Summary of Monthly Average Flow and Load Demand as Reported by Big Lake, 2018

Month	Influent Monitoring Parameters							Effluent Monitoring Parameters					
	Total Flow	$cBOD_5$	TSS	Total P as P	$NO^-_2 + NO^-_3$ as N	TKN	TN as N	$cBOD_5$	TSS	Total P as P	$NO^-_2 + NO^-_3$ as N	TKN	TN as N
	(MGD)	(mg/L)	(mg/L)	(mg/L)	(mg/L)	(mg/L)	(mg/L)	(mg/L)	(mg/L)	(mg/L)	(mg/L)	(mg/L)	(mg/L)
January	0.702	420	33	7.7	ND	ND	ND	5.5	9.8	0.8	ND	ND	ND
February	0.750	454	38	7.5	ND	ND	ND	5.9	12.5	0.7	ND	ND	ND
March	0.703	313	37	7.3	ND	ND	ND	5.3	7.0	0.7	ND	ND	ND
April	0.669	321	30	7.1	ND	ND	ND	5.3	10.0	0.7	0.6	32.8	31.2
May	0.727	327	40	9.2	ND	ND	ND	5.6	10.9	0.7	ND	ND	ND
June	0.718	472	16	9.0	0.05	87	25	2.4	6.8	0.7	21.9	2.7	ND
July	0.733	423	16	8.5	ND	ND	ND	2.4	5.2	0.8	ND	ND	ND
August	0.723	302	13	8.2	ND	ND	ND	2.0	6.0	0.8	ND	ND	ND
September	0.736	299	14	8.6	0.05	53	25	1.9	4.3	0.8	22.6	1.9	0.3
October	0.715	595	17	8.7	ND	ND	ND	2.4	5.1	0.8	ND	ND	ND
November	0.702	527	41	8.6	ND	ND	ND	6.7	9.0	0.7	ND	ND	ND
December	0.601	529	18	9.1	0.05	73	36	3.3	9.5	0.6	22.2	13.7	9.6
Average	**0.706**	**415**	**26**	**8.3**	**0.05**	**71**	**28**	**4.1**	**8.0**	**0.7**	**16.8**	**12.8**	**13.7**
Minimum	**0.601**	**299**	**13**	**7.1**	**0.05**	**53**	**25**	**1.9**	**4.3**	**0.6**	**0.6**	**1.9**	**0.3**
Maximum	**0.750**	**595**	**41**	**9.2**	**0.05**	**87**	**36**	**6.7**	**12.5**	**0.8**	**22.6**	**32.8**	**31.2**

Notes:
$cBOD_5$: 5-day carbonaceous biochemical oxygen demand.
TSS: Total suspended solids.
TP: Total Phosphorus.
TKN: Total Kjeldahl Nitrogen.
1. ND: No data collected for parameter during reporting period.

Table 3 – Summary of Monthly Average Flow and Load Demand as Reported by Big Lake, 2019

Month	Influent Monitoring Parameters							Effluent Monitoring Parameters					
	Total Flow	$cBOD_5$	TSS	Total P as P	$NO^-_2 + NO^-_3$ as N	TKN	TN as N	$cBOD_5$	TSS	Total P as P	$NO^-_2 + NO^-_3$ as N	TKN	TN as N
	(MGD)	(mg/L)	(mg/L)	(mg/L)	(mg/L)	(mg/L)	(mg/L)	(mg/L)	(mg/L)	(mg/L)	(mg/L)	(mg/L)	(mg/L)
January	0.652	475	26	8.8	ND	ND	ND	4.3	9.5	0.5	ND	ND	ND
February	0.672	452	25	7.9	ND	ND	ND	3.7	8.1	0.4	ND	ND	ND
March	0.717	436	30	7.3	ND	ND	ND	4.4	8.0	0.4	18.8	9.7	7.1
April	0.670	494	24	7.2	ND	ND	ND	3.9	8.3	0.6	ND	ND	ND
May	0.738	466	20	7.5	ND	ND	ND	3.0	6.9	0.5	ND	ND	ND
June	0.787	359	27	7.5	0.09	54	21	4.1	7.3	0.6	18.8	2.3	ND
July	0.795	272	13	5.7	ND	ND	ND	2.0	3.6	0.5	ND	ND	ND
August	0.771	246	11	7.2	ND	ND	ND	1.7	5.1	0.7	ND	ND	ND
September	0.777	299	11	7.2	0.05	56	26	1.7	5.0	0.5	24.0	2.2	0.2
October	0.831	312	15	7.3	ND	ND	ND	2.0	4.7	0.5	ND	ND	ND
November	0.783	261	15	5.6	ND	ND	ND	2.5	6.9	0.4	ND	ND	ND
December	0.764	295	35	6.5	0.05	48	30	3.2	9.4	0.4	27.6	2.8	ND
Average	**0.746**	**364**	**21**	**7.2**	**0.06**	**53**	**26**	**3.1**	**6.9**	**0.5**	**22.3**	**4.2**	**3.7**
Minimum	**0.652**	**246**	**11**	**5.6**	**0.05**	**48**	**21**	**1.7**	**3.6**	**0.4**	**18.8**	**2.2**	**0.2**
Maximum	**0.831**	**494**	**35**	**8.8**	**0.09**	**56**	**30**	**4.4**	**9.5**	**0.7**	**27.6**	**9.7**	**7.1**

Notes:
$cBOD_5$: 5-day carbonaceous biochemical oxygen demand.
TSS: Total suspended solids.
TP: Total Phosphorus.
TKN: Total Kjeldahl Nitrogen.
1. ND: No data collected for parameter during reporting period.

Table 4 – Summary of Monthly Average Flow and Load Demand as Reported by Big Lake, 2020

Month	Influent Monitoring Parameters							Effluent Monitoring Parameters					
	Total Flow	$cBOD_5$	TSS	Total P as P	$NO^-_2 + NO^-_3$ as N	TKN	TN as N	$cBOD_5$	TSS	Total P as P	$NO^-_2 + NO^-_3$ as N	TKN	TN as N
	(MGD)	(mg/L)	(mg/L)	(mg/L)	(mg/L)	(mg/L)	(mg/L)	(mg/L)	(mg/L)	(mg/L)	(mg/L)	(mg/L)	(mg/L)
January	0.775	259	92	5.8	ND	ND	ND	15.0	19.1	1.1	ND	ND	ND
February	0.749	290	65	6.6	ND	ND	ND	10.2	19.4	0.8	ND	ND	ND
March	0.726	263	41	7.3	ND	ND	ND	6.6	9.7	0.5	0.3	36.6	32.1
April	0.700	229	39	7.5	ND	ND	ND	6.4	9.9	0.4	ND	ND	ND
May	0.694	265	12	7.0	ND	ND	ND	2.0	4.3	0.3	ND	ND	ND
June	0.718	255	12	8.1	0.05	57	32	2.0	3.8	0.4	27.4	4.3	ND
July	0.746	330	13	8.6	ND	ND	ND	2.1	4.6	0.4	ND	ND	ND
August	0.752	317	13	8.3	ND	ND	ND	1.9	5.0	0.4	ND	ND	ND
September	0.724	301	20	7.9	0.13	42	23	3.0	9.2	0.4	22.0	1.4	0.2
October	0.698	283	13	7.9	ND	ND	ND	2.2	6.4	0.3	ND	ND	ND
November	0.727	266	9	8.0	ND	ND	ND	1.7	3.9	0.1	ND	ND	ND
December	0.659	270	11	8.0	0.28	60	34	2.0	5.6	0.2	31.9	1.8	ND
Average	**0.722**	**277**	**28**	**7.6**	**0.15**	**53**	**30**	**4.6**	**8.4**	**0.4**	**20.4**	**11.0**	**16.2**
Minimum	**0.659**	**229**	**9**	**5.8**	**0.05**	**42**	**23**	**1.7**	**3.8**	**0.1**	**0.3**	**1.4**	**0.2**
Maximum	**0.775**	**330**	**92**	**8.6**	**0.28**	**60**	**34**	**15.0**	**19.4**	**1.1**	**31.9**	**36.6**	**32.1**

Notes:
$cBOD_5$: 5-day carbonaceous biochemical oxygen demand.
TSS: Total suspended solids.
TP: Total Phosphorus.
TKN: Total Kjeldahl Nitrogen.
1. ND: No data collected for parameter during reporting period.

Table 4 – Summary of Monthly Average Flow and Load Demand as Reported by Big Lake, 2021

Month	Influent Monitoring Parameters							Effluent Monitoring Parameters					
	Total Flow	$cBOD_5$	TSS	Total P as P	$NO^-_2 + NO^-_3$ as N	TKN	TN as N	$cBOD_5$	TSS	Total P as P	$NO^-_2 + NO^-_3$ as N	TKN	TN as N
	(MGD)	(mg/L)	(mg/L)	(mg/L)	(mg/L)	(mg/L)	(mg/L)	(mg/L)	(mg/L)	(mg/L)	(mg/L)	(mg/L)	(mg/L)
January	0.661	360	17	8.2	ND	ND	ND	2.8	4.1	0.2	ND	ND	ND
February	0.732	327	25	7.3	ND	ND	ND	3.7	9.1	0.2	ND	ND	ND
March	0.645	413	16	7.0	ND	ND	ND	2.5	5.8	0.2	24.1	1.7	0.1
April	0.621	387	9	7.4	ND	ND	ND	1.6	3.6	0.4	ND	ND	ND
May	0.645	365	13	7.0	ND	ND	ND	2.2	4.5	0.5	ND	ND	ND
June	0.718	364	8	7.1	0.05	61	33	1.3	4.0	0.5	30.8	1.7	ND
July	0.738	324	7	7.6	ND	ND	ND	1.1	2.2	0.6	ND	ND	ND
August	0.733	310	6	8.1	ND	ND	ND	1.1	3.6	0.6	ND	ND	ND
September	0.728	335	9	6.4	0.05	67	41	1.5	4.4	0.5	39.4	2.0	0.3
October	0.683	289	7	7.1	ND	ND	ND	1.2	4.6	0.4	ND	ND	ND
November	0.719	283	11	7.5	ND	ND	ND	2.0	3.3	0.2	ND	ND	ND
December	0.761	283	7	7.1	0.18	53	23	1.2	2.3	0.1	22.2	0.7	ND
Average	**0.699**	**337**	**11**	**7.3**	**0.09**	**60**	**32**	**1.9**	**4.3**	**0.4**	**29.1**	**1.5**	**0.2**
Minimum	**0.621**	**283**	**6**	**6.4**	**0.05**	**53**	**23**	**1.1**	**2.2**	**0.1**	**22.2**	**0.7**	**0.1**
Maximum	**0.761**	**413**	**25**	**8.2**	**0.18**	**67**	**41**	**3.7**	**9.1**	**0.6**	**39.4**	**2.0**	**0.3**

Notes:
$cBOD_5$: 5-day carbonaceous biochemical oxygen demand.
TSS: Total suspended solids.
TP: Total Phosphorus.
TKN: Total Kjeldahl Nitrogen.
1. ND: No data collected for parameter during reporting period.

Table 5 – Summary of Monthly Average Flow and Load Demand as Reported by Big Lake, 2022

Month	Influent Monitoring Parameters							Effluent Monitoring Parameters					
	Total Flow	$cBOD_5$	TSS	Total P as P	$NO^-_2 + NO^-_3$ as N	TKN	TN as N	$cBOD_5$	TSS	Total P as P	$NO^-_2 + NO^-_3$ as N	TKN	TN as N
	(MGD)	(mg/L)	(mg/L)	(mg/L)	(mg/L)	(mg/L)	(mg/L)	(mg/L)	(mg/L)	(mg/L)	(mg/L)	(mg/L)	(mg/L)
January	0.858	268	13	7.0	ND	ND	ND	2.1	3.1	0.1	ND	ND	ND
February	0.813	348	20	7.0	ND	ND	ND	6.0	5.0	0.1	ND	ND	ND
March													
April													
May													
June													
July													
August													
September													
October													
November													
December													
Average	**0.836**	**308**	**17**	**7.0**	**ND**	**ND**	**ND**	**4.1**	**4.1**	**0.1**	**ND**	**ND**	**ND**
Minimum	**0.813**	**268**	**13**	**7.0**	**ND**	**ND**	**ND**	**2.1**	**3.1**	**0.1**	**ND**	**ND**	**ND**
Maximum	**0.858**	**348**	**20**	**7.0**	**ND**	**ND**	**ND**	**6.0**	**5.0**	**0.1**	**ND**	**ND**	**ND**

Notes:
$cBOD_5$: 5-day carbonaceous biochemical oxygen demand.
TSS: Total suspended solids.
TP: Total Phosphorus.
TKN: Total Kjeldahl Nitrogen.
1. ND: No data collected for parameter during reporting period.

ejm

c: Eric Miller, SEH Inc.
Colin Marcusen, SEH Inc.

x:\ae\b\biglk\167307\4-prelim-dsgn-rpts\tech memos\facilities plan anticipated flow and load review\20230325 attachment 2 big lake wastewater treatment facilities plan, summary of monthly flow and load demand.docx

E-2 – 2018 Comprehensive Growth Plan

City of Big Lake
Comprehensive Plan
2018

City of Big Lake Comprehensive Plan

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Raeanne Danielowski , Mayor
Dick Backlund
Seth Hansen
Duane Langsdorf
Mike Wallen

City Planning Commission
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City Staff
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Layne Otteson, City Engineer
Mike Goebel, Public Works Director
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Adopted 2018

City of Big Lake Comprehensive Plan

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Demographic Assessment

This chapter presents a profile of the people who make up the Big Lake community and identifies major demographic trends that may affect city planning over the next 20 years. Included are population and housing, race and ethnicity, age, household composition, income and employment.

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Major Demographic Issues

The following are the major demographic issues identified through the analysis of conditions. Issues are questions to be discussed, debated and resolved during the planning process in light of other issues. The subsequent analysis of conditions has been prepared to help readers understand why these are issues and why they should be considered.

1. **Household Income and Employment:** What, if anything, should the City do to promote the growth of living-wage jobs, help raise average incomes and reduce the rate of unemployment or under-employment among Big Lake residents, particularly households with children?

2. **Age Structure:** What should the City do to attract and retain more people in the 35 to 64 year-old age group, those in their prime earning years who are looking for move-up housing?

3. **Regional and City Growth:** What additional steps should the City take, if any, to attempt to capture a portion of the projected population growth in the region?

4. **Household Size and Housing Choices:** How should the Land Use Plan respond to the shrinking average size of households and the increased demand for multiple-family housing?

5. **Growing Diversity:** What, if anything, should the community do to successfully accommodate an expected increase in population diversity?

   By 2040, the Seven County Metro Area is forecast to be 40 percent "people of color." Big Lake will likely experience some of that change.

Major Demographic Findings

The following are the major demographic finding and trends that should be considered in the update of the *Comprehensive Plan*.

- Big Lake grew rapidly from the mid-90s through the mid 2000s but has slowed since that time.
- The Minnesota Demographer issued a revised population forecast for Sherburne County in mid-2017. That forecast showed an increase in the county's 2040 population of approximately 10 percent over the 2015 estimate instead of the 40 percent increase forecast in 2014.
- The population in 2015 was approximately 10,285. It is forecast to grow by approximately 2,850 to 13,100 people by year 2040.
- The number of households in 2015 was approximately 3,660. It is forecast to grow by 1,115 to 4,775 by year 2040.
- Big Lake Township has experienced considerable residential growth. The township has increased by 5,910 people since 1970 to approximately 7,618 in year 2015. The rate of growth in the township has slowed since year 2000 compared to the three preceding decades.
- It is assumed that Big Lake will grow slightly faster than Sherburne County during the next 25 years.
- Approximately 1,115 additional households are forecast in Big Lake between 2015 and 2040. This would be an average of 45 households per year. This estimate should be checked every five years using local data and forecasts by the Minnesota Demographer. Please refer to the Land Use and Development Assessment for an estimate of how this household growth may translate into demand for land development.
- The rate of growth in households exceeds the rate of growth in population because the average household size is declining slightly.

There were an estimated 3,660 households in the city in 2015. Of those:

- 74 percent were families
- 60 percent included married couples
- 43 percent had children in the home
- 9 percent were headed by a woman
- 6 percent were headed by a woman and had children at home
- 8 percent were headed by someone 65 years of age or older.
- The average household size was 3.05 people; the average family size 3.5

Demographic Characteristics

Population

The City of Big Lake has been one of the fastest-growing counties in Minnesota. Its location along US Highway 10 between the Twin Cities metropolitan area and the City of St. Cloud has made it an attractive location for business and housing. Big Lake competes regionally with Elk River, Becker, Monticello, and to a lesser extent, Albertville, for population and jobs. Other competition comes from growth in unincorporated locations in the Highway 10 corridor, including Big Lake Township. The bridge over the Mississippi River at Minnesota Highway 25 provides access by I-94 on the south side of the river.

As with Sherburne County, the Big Lake population grew rapidly between the years 1990 and 2010, but the 2015 count reached "only" 10,285. The 2008 recession and the many associated housing mortgage foreclosures in the city and the county were a setback to growth. The County's population is forecast by the Minnesota Demographer to slow substantially out to 2040.

It is assumed that the City's rate of growth will continue to slightly exceed that of the County. Supporting that trend are its highway access, public utilities, rail service and developable land.

Table 2-1: City and County Population

Year	Sherburne County	Ratio of City to County	City of Big Lake	Change per Decade	City Rate of Change
1970	18,344	0.07	1,215		
1980	29,908	0.07	2,210	995	82%
1990	41,945	0.07	3,113	903	41%
2000	64,417	0.09	6,063	2,950	95%
2010	88,499	0.11	10,060	3,997	66%
2015	91,705	0.11	10,285		
2020	94,258	0.12	11,311	1,251	10%
2030	98,248	0.13	12,281	970	9%
2040	101,005	0.13	13,131	850	7%

Sources: US Census; Minnesota Demographer counties forecast

Forecast of ratio by Weber Community Planning

Figure 2-1
City Population, 1970 – 2040

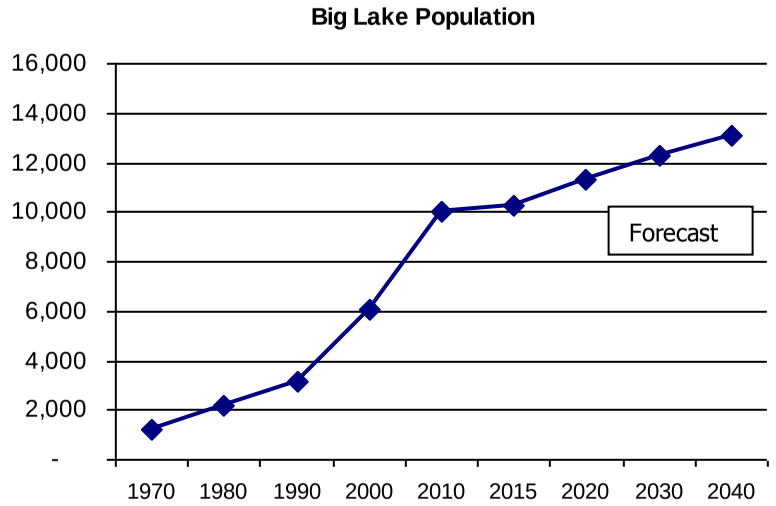
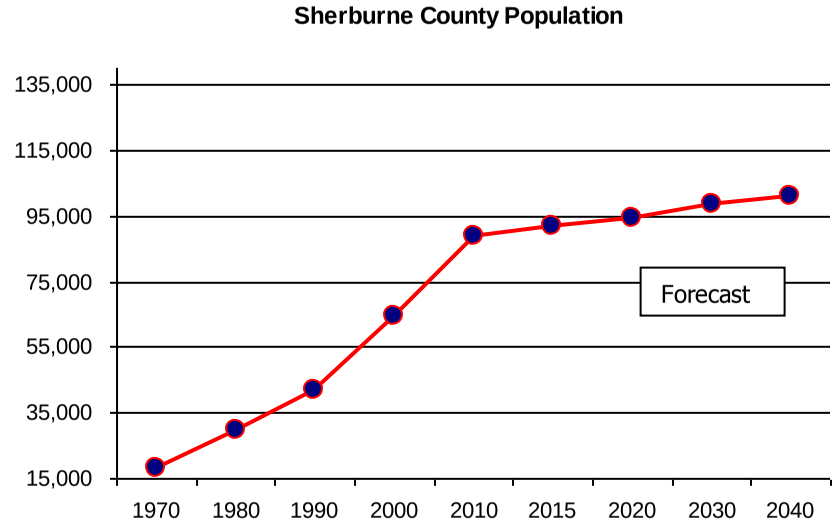


Figure 2-2
County Population, 1970 – 2040



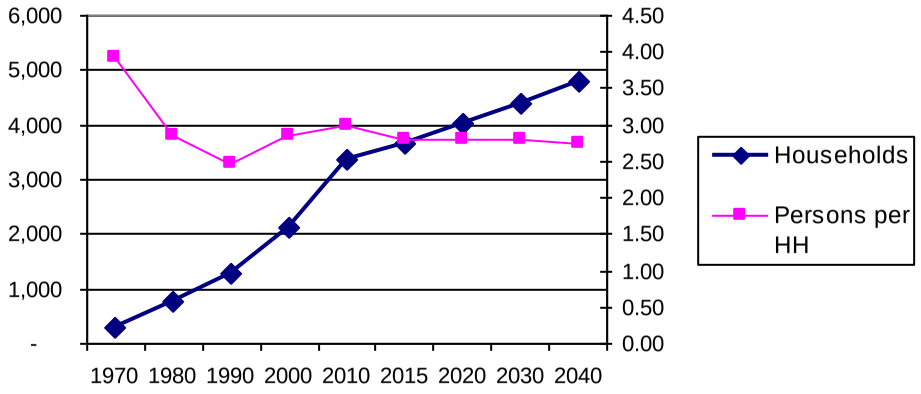
Households

The number of households in the City of Big Lake during prior years was obtained from the US Census. The forecast of households is based on the forecast of population shown in Table 2-1 divided by a forecast of persons per household. The rate of change for the number of persons per household was based on the trend forecast for Sherburne County by the Minnesota Demographer. As the percentage of attached housing units increases in the city, a trend observed in other small, growing towns, the average household size will decrease.

Table 2-2
Big Lake Households and Persons per Household, 1970 to 2040

Year	Big Lake Population	Persons per H'hold	Big Lake Households	Change per Decade	Rate Per Decade
1970	1,215	3.92	310		
1980	2,210	2.86	774	464	150%
1990	3,113	2.46	1,264	490	63%
2000	6,063	2.86	2,117	853	67%
2010	10,060	2.98	3,377	1,260	60%
2015	10,285	2.81	3,660		
2020	11,311	2.80	4,040	663	20%
2030	12,281	2.80	4,386	346	9%
2040	13,131	2.75	4,775	389	9%

Source: US Census; Weber Community Planning.



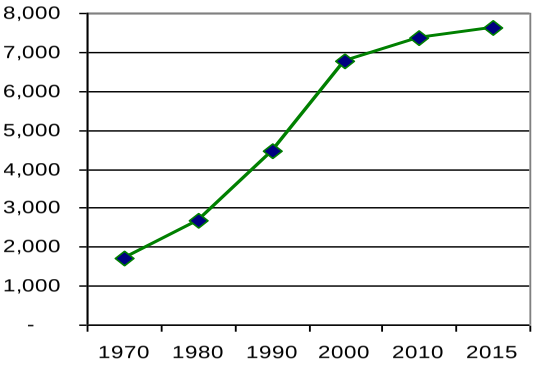
Growth in Big Lake Township

The City is surrounded by Big Lake Township, whose population grew most rapidly in-between years 1980 to 2000 but has slowed since then. Still, the population of the Township is three-quarters as big as that of the City, with Township residents living almost entirely in single-family detached houses on large lots with individual wastewater systems and wells.

Table 2-3
Big Lake Township Population

Year	Population	Numeric Change by Decade	Rate of Change by Decade
1970	1,708		
1980	2,679	971	57%
1990	4,452	1,773	66%
2000	6,785	2,333	52%
2010	7,386	601	9%
2015	7,618	232	

Figure 2-3
Big Lake Township Population



Households and Families

There were an estimated 3,369 households in the city in 2015. Of those:

- 74 percent were families
- 60 percent included married couples
- 43 percent had children in the home
- 9 percent were headed by a woman
- 6 percent were headed by a woman and had children at home
- 8 percent were headed by someone 65 years of age or older.
- The average household size was 3.05 people; the average family size 3.5

The number of households fell slightly from year 2000 to 2015 even as the population rose slightly. This indicates a slight increase in housing vacancy (likely temporary as a hang-over from the recession) and a rising average number of people per household.

Average Household Size

The average number of people in a household across the city (and state) has been declining for many years, and that trend is forecast to continue, mirroring statewide and national trends. This has implications for the type and size of housing units to be built. In general, families are having fewer children and more people are choosing to live independently.

Age of the Population

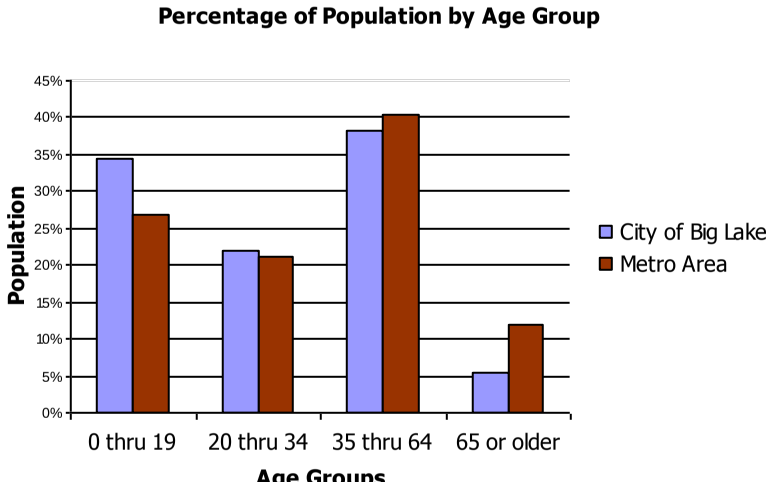
Compared to the Seven County Metropolitan Area, Big Lake has a higher percentage of children and a lower percentage of seniors. The City and the Metro Area populations are quite close in their proportions in the 20 through 34 and the 35 through 64 age groups.

The median ages of Big Lake and the Metro Area were 31.5 and 36.6, respectively.

Source: American Community Survey, US Department of the Census, 2015.

Table 2-5
Population by Age Group

	Percentages	
Age Group	**City**	**Metro Area**
0 thru 19	35%	27%
20 thru 34	22%	21%
35 thru 64	38%	40%
65 or older	5%	12%
	100%	100%



Occupation and Industry

The labor force populations of Big Lake and Sherburne County are quite similar in their occupations and industrial employment. However, compared to the Metropolitan Area, Big Lake is lower in management but higher is transportation and production occupations. Compared to the Metro Area, Big Lake is slightly higher in manufacturing and retail trade but slightly lower in professional, scientific, education and health care.

Table 2-6: Occupation and Industry, by Percentage

	Big Lake	County	Metro
Management	28	34	43
Service	17	16	16
Sales and office	23	23	24
Construction; natural resources	8	11	6
Transportation; production	23	16	11
Industry			
Manufacturing	16	15	14
Retail trade	15	12	11
Professional; scientific	10	8	12
Education; health care	21	22	23

Source: American Community Survey

Table 2-7: Travel Mode and Place of Work, by Percentage

Means of Transporation to Work	Percent
Car, truck, or van	94
Drove alone	82
Carpooled	12
Public transportation (excluding taxicab)	2
Walked	1
Bicycle	0
Taxicab, motorcycle, or other	0.3
Worked at home	3
Place of Work	
Worked in county of residence	21
Worked outside county of residence	79

Other Demographic Comparisons

Table 2-8
Other Demographic Characteristics

	Big Lake Is in Comparison to:	
Characteristic / Big Lake	**Sherburne Co.**	**Twin Cities Metro**
Families as a % of h'holds / 74 %	3 percent lower	9 percent higher
Married couples, % of h'holds / 60 %	3 percent lower	9 percent higher
Children in the home / 43 %	4 percent higher	11 percent higher
H'hold headed by a woman / 9 %	0.5 percent higher	1 percent lower
H'hold headed by 65+ person / 8 %	1 percent higher	2 percent lower
Average h'hold size / 3.06	0.15 person larger	0.5 person larger
Median age / 31.5 years	4 years younger	5 years younger
Children as a % of total / 38 %	3 percent higher	7 percent higher
High school graduate / 27 %	1 percent higher	5 percent higher
Bachelor's degree / 16 %	3 percent lower	9 percent lower
Native born US / 94 %	3 percent lower	4 percent higher
Language other than English / 9 %	4 percent higher	4 percent lower
Unemployment rate / 4.8 %	0.4 percent lower	1 percent lower
Mean travel time to work / 33 min.	I minute longer	8 minutes longer
Median household income	$12,000 lower	$6,000 lower
Median family income	$17,000 lower	$19,000 lower
Median earning per worker	$4,000 lower	$5,000 lower
White race / 94 %	1 percent higher	14 percent higher
Hispanic ethnicity / 9 %	7 percent higher	4 percent higher
Cash public assistance / 6 %	4 percent higher	3 percent higher
Families, income < poverty / 7 %	2 percent higher	1 percent higher

Source: American Community Survey of the US Department of the Census.
Numbers rounded for understanding and to reflect the range of error in the source data.

Land Use and Development Assessment

This chapter describes the major trends and forces related to land use, development and growth management in and around the City of Big Lake.

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A portion of the original Big Lake commercial center

Major Land Use and Development Issues

The following are the major issues in the topic of land use and development identified through the analysis of conditions. Issues are questions to be discussed, debated and resolved during the planning process in light of other issues. The subsequent analysis of conditions has been prepared to help readers understand why these are issues and why they should be considered.

1. **Protecting the Ability of the City to Grow Outward:** Will the County and Big Lake Township continue to cooperate with the City to protect the City's ability to growth outward in an efficient and economic fashion?

   The County zoning on the perimeter of the City is Urban Reserve, Agriculture or General Rural. The General Rural district allows problematic 2.5 acre lots. However, the Township and County recognize the need to protect the City's ability to grow outward. Consequently, the County land use plan guides the area between the City and the Elk River as "Urban Reserve Residential." See Figure 4-2 on page 4-6.

2. **Annexation of Town Peninsulas:** What should be done, if anything, to encourage land owners in the several Township "peninsulas" to petition for annexation of their land to the City?

   These linear patterns of lands in the Township are the result of successful annexation petitions that have enlarged the City in an irregular pattern. It would be efficient to eventually consolidate those locations into the City through petitions by the owners.

3. **Fringe Development Pattern:** What should be the pattern of land use on the City's perimeter?

   Should there be a large industrial area in the southwest in the vicinity of County Highway 17 as shown on the Big Lake Township Comprehensive Plan map, Figure 4-3? Should there be corridor of commercial development along Highway 25 between Big Lake and Monticello. and along Highway 10 to the west, as shown in the 1999 plan (Figure 4-1)?

4. **Favored Locations for Perimeter Growth:** What are the most efficient and beneficial locations for perimeter growth?

   Should the City forever remain south of the Elk River? Should the lakes to the northwest be regarded as the limit to growth in that direction? Should the City fill in the land up to the Elk River? Should the City actively discourage, through planning, zoning and capital improvements, the expansion of the urban area into the farm fields to the south in favor of long-term preservation of that area for farming?

5. **Locations for Multiple-Family Housing:** What are the best types of locations for multiple-family housing?

   Multiple-family housing is sometimes relegated to the least attractive locations in some cities. However, to take advantage of that increasingly popular housing form, some cities integrate various types of attached housing into neighborhoods of detached housing. Extra care is sometimes needed in housing design to make this successful, but the results are often a more interesting and sustainable city.

6. **Types of New Housing:** Should the plan try to guide development toward or away from certain types of housing or let the market make that decision?

   Some Cities steer the market by narrowly zoning locations for limited types of housing. Other Cities have broader and more inclusive zoning districts and let market forces prevail.

7. **Appearance of New Multiple-Family Housing:** Should the City adopt design guidelines, or regulations, that help make attached housing more compatible with detached (single-family) housing?

   Some people have expressed a concern that some of the attached housing built in Big Lake in recent years is either unattractive or not sufficiently compatible with the appearance of detached (single-family) housing. Some cities have adopted design guidelines or requirements for attached housing to help it emulate the single-family house. Of special concern is the appearance of "garage-forward" townhouses.

8. **New Neighborhood Design:** Should the City require that new residential areas be designed with many of the features of the older neighborhoods such as sidewalks, street trees, a mixture of housing types, narrow streets, short front setbacks and garages set back further than the façade of the house? Should there be regulations to soften the appearance of garage doors?

   The City can guide the design of new neighborhoods through its zoning and subdivision ordinances. The visual appearance and function of the residential pattern will affect long-term property values and quality of life. Some planners advocate narrower streets, use of sidewalks and street trees, interconnected streets, and reduced visual effects from garage doors.

9. **Downtown:** To what degree should the City promote and assist redevelopment that conforms with the recommendations of the downtown design guidelines for retail, offices, housing and mixed-use buildings? What should be the next major step forward for the downtown?

   Those design guidelines are summarized on page 4-13. There are obstacles to creating a "city center" in Big Lake, including Highway 10, the railroad tracks and existing development.

10. **Waterfront Greenways:** Should the City acquire land for a linear public park and trail plus protected open space along the Elk River?

    The idea of a linear park and walking-biking trail along the river has great appeal and has been promoted in prior plans. Nearly all of the land along the Elk River is privately owned. Some of it has been divided into residential parcels and developed. For it were to be most useful, it would run from Becker to Elk River, thus probably requiring some County leadership and money. At a minimum, natural protection of the floodplain forest and habitat would seem to be wise.

11. **Economic Development, Jobs and Income:** What land use, zoning and development policy changes, if any, should be made to help promote economic development in Big Lake?

    This should be guided by market opportunities and preferences, which will be summarized in the Economic Development chapter of this comprehensive plan.
    Should the City plan a location for the coordinated development of industry and offices?

12. **Commercial Growth:** How much land should be planned and zoned for retail business development? Should multiple-family housing be allowed in certain commercially-zoned locations?

    An insufficient amount of land zoned for retail business may lead to the loss of potential tax base and excessive driving to shops. On the other hand, over-zoning for business, a common occurrence, would cause land to be underutilized or stand vacant. Should certain Downtown locations be redeveloped as apartments?

13. **General Redevelopment:** How proactive should the City be in encouraging redevelopment?

    In some key locations, redevelopment occurs only with the involvement of a public agency, as site acquisition and preparation is very expensive. It is a matter of public policy as to the level of risk that the City or its Economic Development Authority are willing to take to effect changes in critical locations.

14. **Lakefront Land Ownership and Use:** Can or should public access to the lakes be improved?

    Most locations along the edges of Mitchell and Big Lakes are privately owned, even where there is a public street along the lake. Consequently, there is very little public access to the lakes except at the City parks.

15. **Role of the Plan:** How strong should the Comprehensive Plan be in setting City policy, ordinances and budgeting?

    Ideally, the comprehensive plan should be the central decision-making reference document for all departments of the City and for elected and appointed officials, leading to coordinated decisions supporting common goals.

A typical Big Lake residential street scene

Prior Plans

Big Lake Comprehensive Plan, 1999; updated 2009

It is useful to look back at prior plans because some continuity in policy is beneficial and also to realize that changes in course are sometimes advisable as the community navigates the swirl of events.

The preceding *Big Lake Comprehensive Plan* was adopted in 1999, during a period of robust growth across the county but before the acceleration and crash of the 2000s. The land use plan map was amended in 2009. Some of identified issues are still facing the community, some of its recommendations have been accomplished and other worthy objectives simply need updating.

1999 Issues: Here are a few of the major planning issue subjects of 1999: :

- How to protect the City's **fringe growth** potential?
- How to achieve orderly, **compact** growth that is fiscally sustainable?
- How to **compete** with unsewered, rural locations for development?
- How to approve **annexation** petitions while minimizing conflict?
- Which **directions** should the City plan to grow?
- How to address the trend of the city becoming very **linear**?
- How to **coordinate** the sanitary sewer system and land development?
- How to **diversify housing** type and cost?
- How to protect **water quality** in lakes and streams?
- How to improve the quality of the **aging housing** stock?
- How to build a compact, identifiable and viable **"city center"**?
- How to attract **industries** that provide well-paying jobs and a good image?
- How to improve **street** continuity?
- How to deal with the negative effects of **Highway 10**?
- How to grow according to a **plan**? Should the City and Township **merge**? Should they continue to share some facilities and finances?

Major 1999 Planning Initiatives: In response to those and other identified planning issues, the plan offered these and other recommendations:

- Build a US Highway 10 **bypass** route south of the present urban area; line it with businesses. This idea is now dead, and the associated land use plan map, shown below, is infeasible.
- Map and adopt a small municipal **Urban Expansion Area** into which sewered housing growth would be guided and limited
- Plan for continued semi-rural, **unsewered housing** south of the Elk River
- Plan for **industry** along Highway 10 to the east and west
- Plan for businesses along **Highway 25**, starting at the Mississippi River and moving north
- Limit **mid- or high-density housing** to a few locations near the commercial center or next to the schools campus
- Create a public-private "**greenway**" along the Elk River in the Township
- Expect a **Northstar** station near Lake Street. (Was built near CR 4)
- Continue to protect **wetlands** and **floodplains**

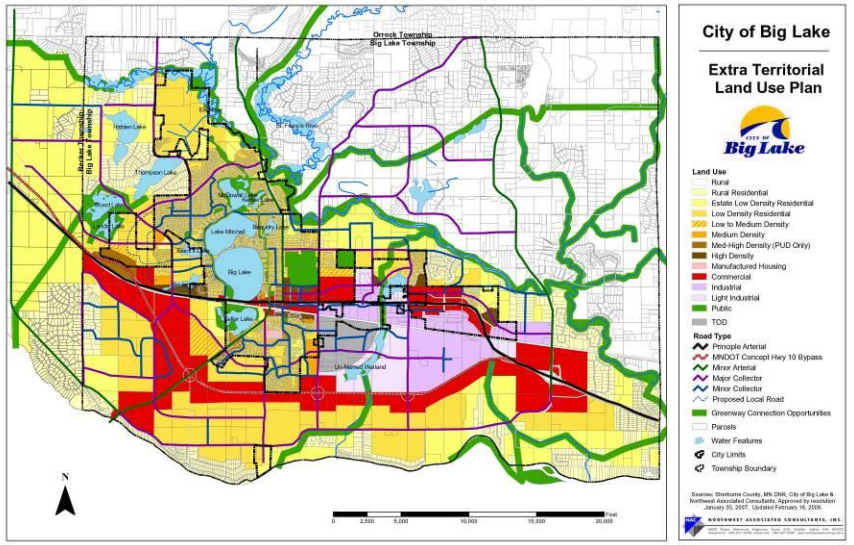


Figure 4-1: Big Lake Land Use Plan Map, 2009

Big Lake Township Land Use Plan

Sherburne County updated its county-wide land use plan in 2010. The Big Lake Township portion of that plan, illustrated by Figure 4-2, calls for:

- Urban Reserve north and west of the city up to the Elk River and near the Northstar commuter rail station; this implies urban, sewered development in locations either under an Orderly Annexation Agreement or identified by the Town Board as likely to be annexed by 2030 (red on the map)
- Agriculture south of the city (green)
- Industry (purple):
  - Around the intersection of Highway 10 and County Highway 15
  - Along US Highway 10 west of the city
  - Along County Highway 17
  - Along State Highway 25
- Semi-rural, large-lot housing north of the Elk River (gray on the map)
- Housing with nature conservancy along the Mississippi River (blue)

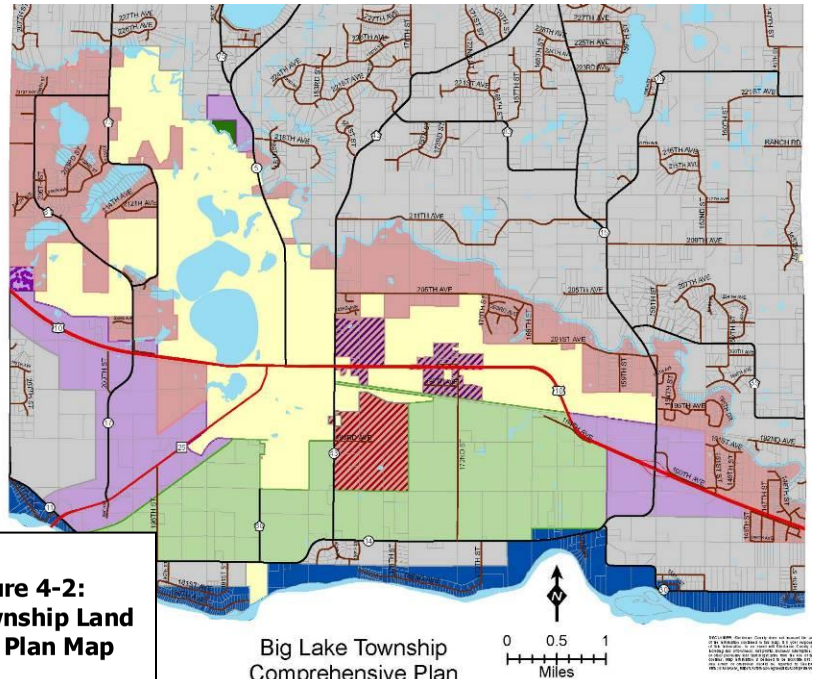


Figure 4-2: Township Land Use Plan Map

Big Lake Township Zoning Map

Sherburne County administers zoning for Big Lake Township, as it does for eight other townships. Note that some locations have not been rezoned to conform to the Land Use Plan map. The Agriculture zoning district should prevent semi-rural lots that are difficult to resubdivide and serve with City utilities. However, the General Rural district poses a potential problem.

Table 4-1: Big Lake Township Zoning Districts

District	Allowed Uses	Minimum Lot Size
Agricultural	Farms; houses	5 acres if "wooded"; otherwise, 1 house per 40 acres
General Rural	Farms; houses	2.5 acres
Industrial	Farms; houses	30,000 square feet
Commercial	Farms; houses	22,500 square feet
Urban Expansion	Farms; houses	City dimensions
Recreational River	Houses	22,500 square feet

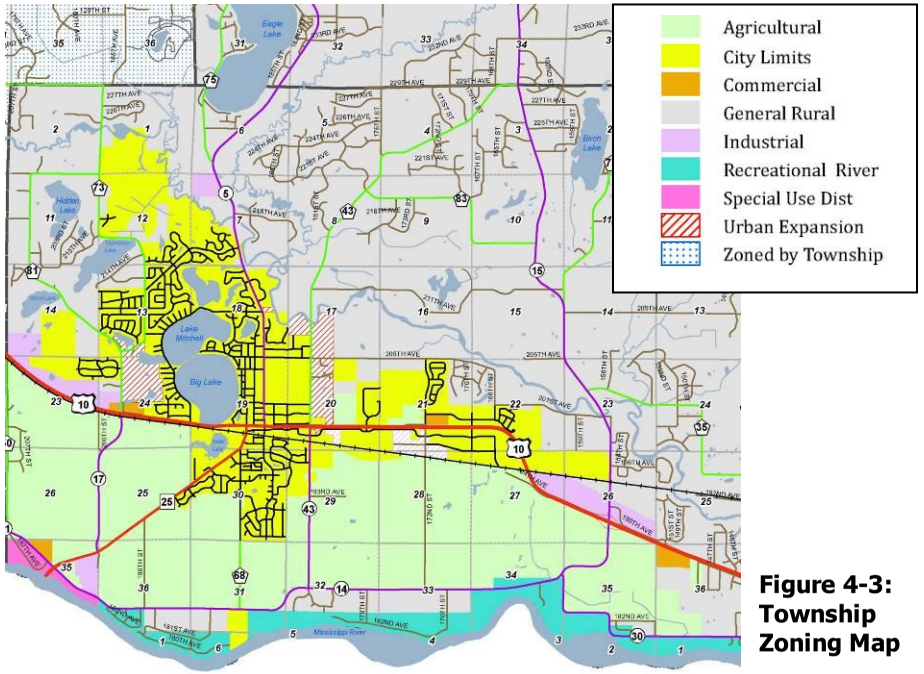


Figure 4-3: Township Zoning Map

Existing Pattern of Land Use

The pattern of land use as of 2016 is illustrated by Figure 4-11, below.

Many Eras Represented

Being an old community, Big Lake has a variety of development styles that reflect many eras:

- The remnants of the Lake Street commercial center near the railroad tracks and now-gone station
- The early lake cabins, now mostly remodeled or replaced
- A scattering of traditional houses with Victorian or American four-square designs and front porches
- Small post-War housing
- Houses from the 1960s through the present with increasing degrees of garage-forward design
- Auto-oriented commercial buildings ranging from early gasoline stations to more recent linear centers and "big boxes"
- The magnificent former high school building
- A small but growing number of townhouse or apartment designs.

Observations and Forces

These are observations about the pattern of land use:

- **East-West Pattern:** The City has become stretched along Highway 10, which is inefficient for utility and road services, and diminishes the city's sense of place or center
- **Infill Opportunities:** There are many opportunities for infill development along the eastern Highway 10 corridor between Glenwood Avenue (205th Street) and the railroad tracks
- **Railroad Divider:** The Burlington Northern - Santa Fe Railroad tracks are a major community divider, and the frequent freight trains are a major nuisance
- **Northwest:** Thompson Lake and the adjacent large-lot, unsewered housing are a barrier to municipal expansion on the northwest side
- **North and Northeast:** The Elk River would seem to be a logical northeastern limit to municipal growth as it would be costly to bridge; further northeast are extensive tracts of semi-rural, unsewered residential subdivisions that would work against annexation and serviced development
- **Northeast:** Land between the Elk River and Glenwood Avenue has natural features that are conducive to attracting better-quality housing development; this location remains largely unaffected by prior residential plats that would be difficult or impossible to resubdivide and serve
- **South:** Land to the southwest, south and southeast of the present urban area is easily developable because it is flat, sandy, unencumbered by prior development, and easily served by sanitary sewer, which drains south toward the treatment plant near the river; however, the flat and treeless landscape offers little natural amenity for housing, meaning that developers would be wise to create interest through design and improvements
- **Northstar Vicinity:** The vicinity of the Northstar commuter rail station may eventually become a location of intensive and varied housing but it remains to be seen how long that will require and what effect the train service will play. See below for a further description of the plan for the station area.
- **Business Locations:** Retail and industrial locations are strongly oriented to the east along Highway 10; there are three industrial locations along Highway 10 west and none along Highway 25; this may be the result of the historic trend and a business desire to separate from the Monticello commercial
- **Shared Business Parks:** The City shares with the Township ownership of one industrial park and one mixed retail-industrial area along Highway 10 east

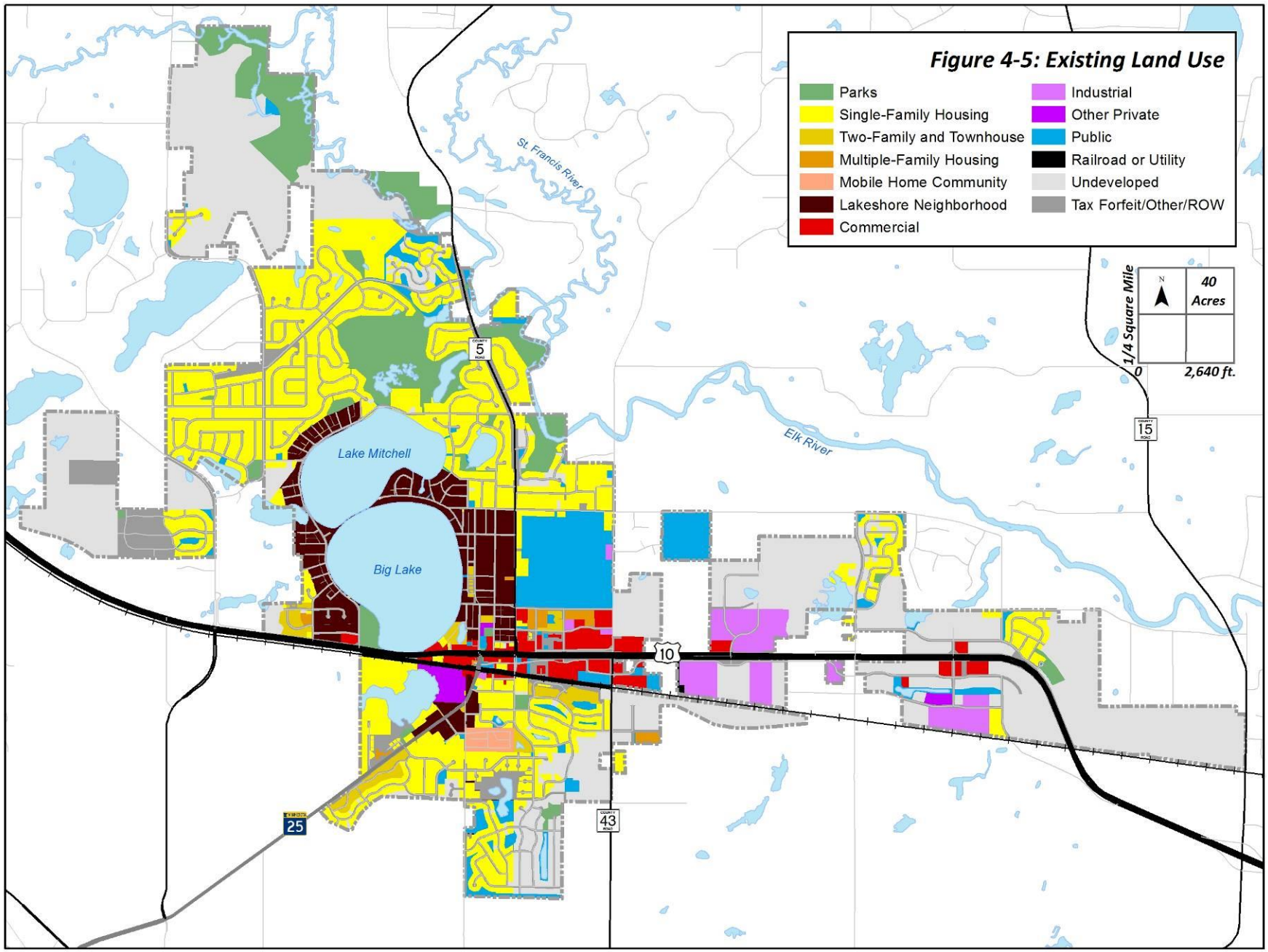


Figure 4-5: Existing Land Use
Parks
Single-Family Housing
Two-Family and Townhouse
Multiple-Family Housing
Mobile Home Community
Lakeshore Neighborhood
Commercial
Industrial
Other Private
Public
Railroad or Utility
Undeveloped
Tax Forfeit/Other/ROW
St. Francis River
Elk River
Lake Mitchell
Big Lake
1/4 Square Mile
40 Acres
0
2,640 ft.
5
15
10
25
43

- **Lakeshore Neighborhoods:** The lake cabins and older housing near Big and Mitchell Lakes form a distinct and interesting portion of the community that links it to its 19th Century roots; refer to the description of early settlement in Chapter 10, Introduction and Summary
- **Industrial Proposal:** It is significant that the Township land use plan map shows a large industrial area along County Highway 17 southwest of the city; in that vicinity there was a development proposal in the early discussion and study stage in 2017 to build a major distribution center of several hundred acres served by railroad and trucks; the Highway 25 Coalition was conducting a traffic study on that subject; see below for further description
- **Housing Diversity:** There seems to be a need to diversify the housing stock in terms of type and tenure (own vs. rent); approximately 83 percent of the housing in Big Lake is single-family detached; approximately 86 percent is owner-occupied; there are many "starter" homes and fewer move-up or luxury homes compared to the county or the metro area
- **Housing Infill:** There are approximately 240 unbuilt housing lots that have been platted and in some cases served with streets and utilities; see the subsequent section titled, Acreage Needed to Accommodate Growth, for further detail
- **School Campus:** Two public elementary schools, one middle and one high school are clustered in the northeast quadrant near County Road 43
- **Wetlands and Floodplains:** Wetlands and floodplains are confined mostly to the Elk River corridor; some high groundwater levels are also found there; other locations tend to be sandy and well-drained
- **Greenway Potential:** The natural features along the Elk River provide an opportunity to possibly create a band of undeveloped or open land along it banks of some width; this corridor may be owned privately and publicly; it could include a public "trail" for walking and bicycling if ownership and easements allowed; it would certainly help with natural protection and wildlife movement; because it is entirely outside the City at this time and cross-county connections would be desired, the County would need to be involved, probably in a leadership role
- **Fringe Growth Protection:** Safeguarding the ability of the City to grow in a compact and cost-efficient manner is probably its greatest planning challenge; creating housing lots immediately outside the City in the range of 2 to 5 acres could erect a barrier to future resubdivision and service with City utilities.

  Fortunately, the County-Township land use plan designates as Urban Reserve the gap between the City and the Elk River, and guides as Agriculture large tracts to the south of the City; this protection will save the public money, provide development opportunities and reduce the loss of prime farm land Unfortunately, the County's zoning does not fully align with the land use plan and many areas guided for urban reserve continue to be zoned general rural. Additionally, the urban reserve district allows some types of development that may be undesirable such as small lot housing with well and septic systems and different street design than what is required by the City.

Current Zoning

The Big Lake zoning ordinance is summarized below and the zoning map is shown on the next page. Observations about the ordinance:

- Housing types in the Mid and High-Density zones should be allocated differently
- The R-5 district, for the old cottage areas, is a useful idea
- Shoreland standards are conveniently shown in each residential district
- Downtown Overlay is a good attempt to create an identifiable center
- Several houses north and south of "downtown" (e.g., near Pleasant Avenue) became non-conforming, and thus limited for expansion, because they were zoned R-3.
- Other districts are typical for a small town

Table 4-1

Big Lake Zoning Districts

	Major Types of Land Uses Allowed		
District	**Permitted**	**Conditional**	**Minimum Lot Sizes**
Future Development / Agriculture	Detached houses; farming	Home occupations; solar farms; others	5 acres
R-1E Single-Family Estate	Detached houses	Day care, schools, home occupations	100 ft wide 15,000 sf area
R-1 Single-Family Housing	Detached houses	Day care, schools, home occupations	85 ft wide 12,000 sf area
R-2 Medium Density Housing	One- and two-family houses	Seniors' housing Planned-unit development (PUD)	80 ft wide 10,000 sf area
R-3 High-Density Housing	Two-family, townhouse and apartment buildings	Certain businesses in a planned-unit project, long-term care, PUD	Density transition to R-1 required.
R-4 Manufactured housing	Mobile homes	Day care, home occupations	20 ft separation
R-5 Residential Redevelop't Purpose: To promote re-use of old cabin lots	Detached houses	Two-family or townhouse buildings	20 ft from local street; Shoreland setbacks from water; 35 % impervious surface limit; Existing lot or 10 to 12,000 sf; Townhouses: not on lakeshore and 25 % open
B-1 Business Campus	Offices, personal services	Extended stay hotels, accessory retail or manufacturing	100 ft wide 1 acre area
B-2 Community Business	Retail or service businesses, offices	Retail, service, office, civic, cultural and entertainment uses, R-C mixed-use, conference centers, convenience stores, brew pubs, day care, motels, long-term care, auto repair, theatres	100 ft wide 20,000 sf area 35 ft tall
B-3 General Business District	Retail or service businesses that draw from the region	Same as B-2 plus breweries, hospitals, auto sales, PUD, manufacturing, shopping centers, transit stations	100 ft wide; 20,000 sf area; 30 ft front setback; > 35 ft tall by permit
I-1 Industrial Park	Manufacturing, warehousing, accessory offices, gyms, auto repair or sales	Animal hospitals, distribution centers, hospitals, offices, PUD, accessory retail	150 ft wide; 40,000 sf area; 50 % building coverage; 40 ft front setback. Screening requirements.
I-2 General Industrial	Same as I-1 plus processing raw materials; industries needing isolation	Same as I-1 plus radio antennas, shooting range, incineration	100 ft wide; 40,000 sf area; 50 % building coverage; 40 ft front setback. Screening requirements.
I-3 Isolated Industrial	Same as I-3; industries needing strict isolation or special protection	Same as I-2 plus satellite dishes, oil storage, outdoor storage, freight terminals, trash disposal	Same as I-2. Screening requirements.
Downtown Design Overlay	Adopts the 2008 design manual. Coordinates themes for site design, architecture, parking, pedestrian and bicycle access, environment, and utilities for all properties in the City within the DD, Downtown Design Overlay District. Approximate boundaries: Lake to County Road 43 and Eagle Lake Road to Pleasant Avenue. Includes voluntary guidelines and mandatory standards. Includes an easterly transition zone where standards are merely guidelines.		
Shoreland Overlay	Requires larger lots and protects environmental and scenic values within 300 feet of Elk River and 1,000 feet of eight lakes.		
Floodplain Overlay	Requires larger lots and reduced coverage. Restricts land uses. Requires flood-proofing or elevation. Based on state model.		
Mississippi River	Regulates lot size and setbacks. Protect environmental and scenic values along Mississippi River. State requirement.		

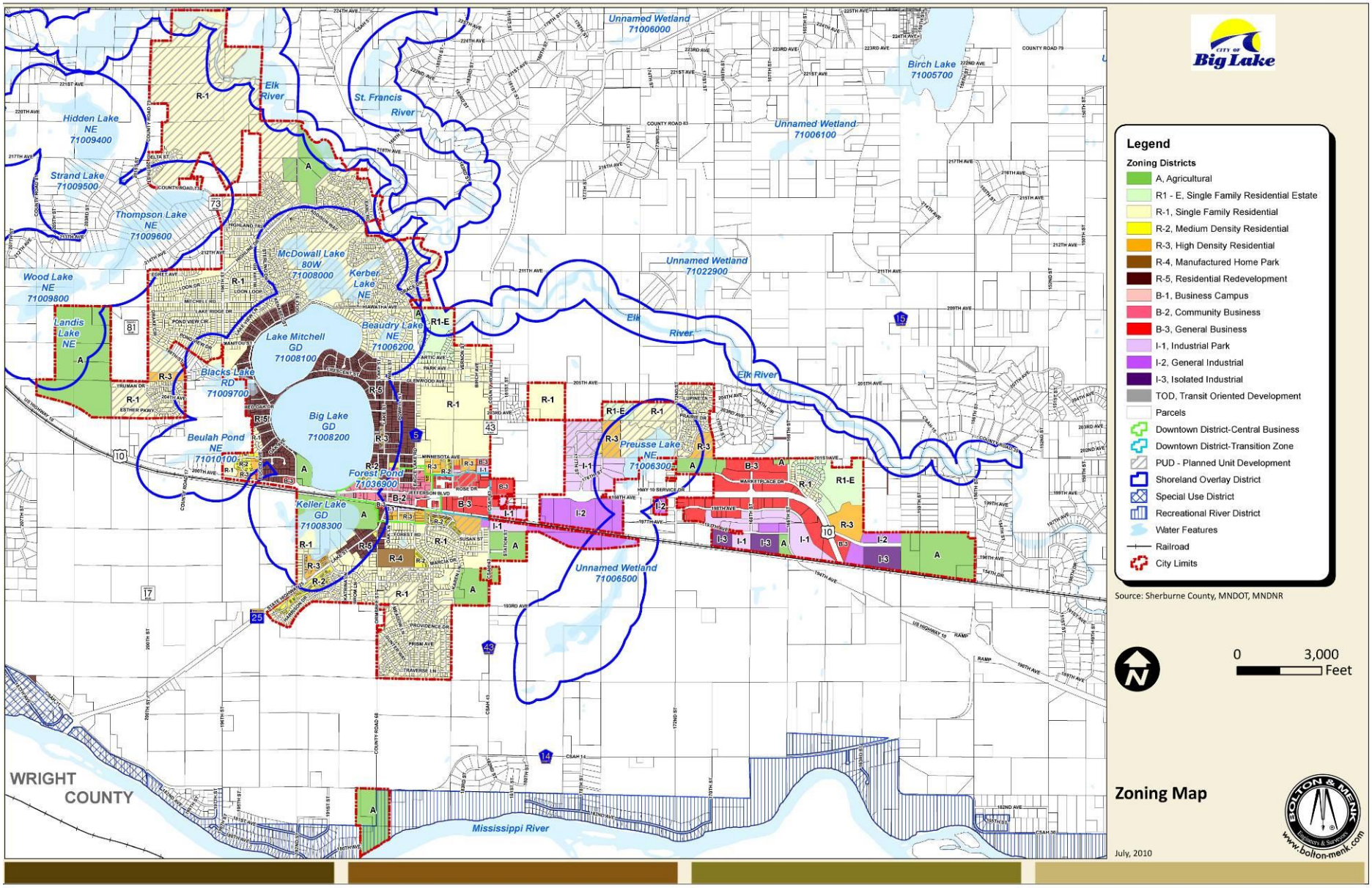


Figure 4-5: Big Lake Zoning Map, 2016

Plan for the Vicinity of the Northstar Station

Prior to the opening of the Northstar commuter rail service and Big Lake station in 2009, the City prepared and adopted guidance for land development and urban design near the station. Included were a design guidelines manual, an illustrative development map (Figure 4- 5) and a zoning ordinance.

Generally, the plan calls for an intensive, mixed and walkable pattern of development aimed at supporting train ridership and taking advantage of the improved regional access. Three zones near the station, each about ¼ mile wide, were conceived. Closest to the station were to be offices and retail or service businesses catering to the transit riders. Next would be large apartment buildings, mixed commercial and residential buildings, and restaurants. The third zone would allow B-1 Business Campus zoning district uses, which were mainly offices and manufacturing.

The Zoning ordinance for the transit area also prescribed maximum parking ratios, maximum building setbacks, minimum lot coverage, minimum building heights, and standards for streetscape, building facades and signs.

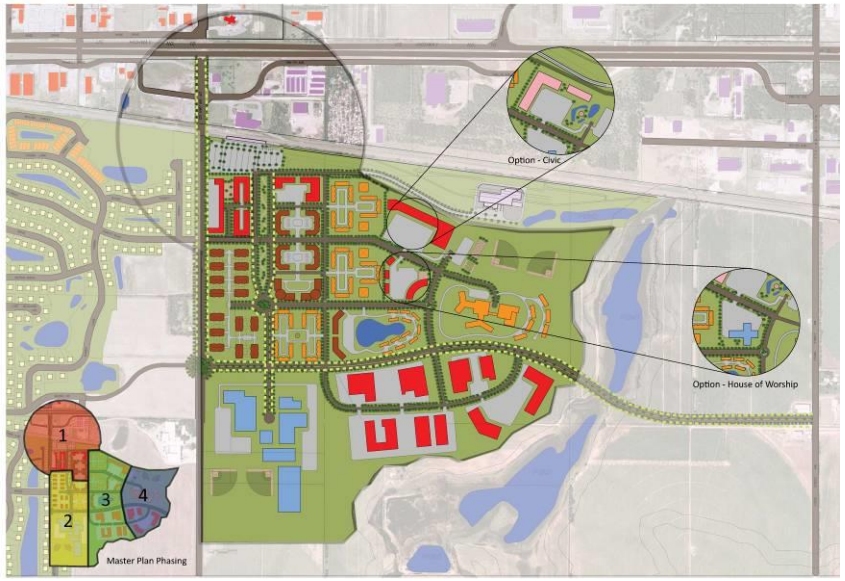


Figure 4-6: Transit Area Master Plan Graphic

Distribution Center Proposal

In 2016, a developer began discussions to build a large "distribution center" in Big Lake Township along the County Highway 17 corridor. This facility would include multiple buildings and would be served by rail and truck. In 2017, the Highway 25 Coalition and Sherburne County began a study of how to improve highway access to the site, including a new Mississippi River bridge. Sherburne County has the area planned as Industrial but zoned as Agriculture.

Orderly Annexation Agreements

The City has or is in the process of annexing three locations from the Township under the Orderly Annexation procedures prescribed by state law:

- The vicinity of Remmele Manufacturing on the south side of Highway 10
- The Industrial Park on the north side of Highway 10
- Properties at Highways 25 and 14 near the Mississippi River bridge.

The Remmele annexation began in 1992, with additional tracts being added as property owners have petitioned for City utilities. This agreement called for the City and the Township to share costs and local property tax revenues equally.

The Industrial Park agreement, signed in 1996, provided for joint approval of utility extensions, land sales, road construction, zoning and development applications along with equal sharing of property taxes, infrastructure construction costs and land sale revenue. The City owns and maintains the public utilities and maintains them at its cost.

The Highway 14 agreement from 2007 allowed annexation to occur when petitioned by the property owner(s). The Township would continue to receive all property tax revenue until one year after City sanitary sewer service is provided, then taxes would revert to the City in four annual steps. The City will control the zoning upon annexation.

Site Appearance Standards

General Landscaping

The City's zoning ordinance requires a landscaping plan with every commercial, industrial or multiple-family residential development application. The ordinance prescribes reasonable and typical quantities and sizes of plants. Also, a visual screen consisting of a planted buffer or a fence and berm is required between any non-residential land use and an abutting residential development.

Business Parks Standards

The I-1, Industrial Park, I-2, General Industry, and I-3, Isolated Industry, zoning districts each have requirements for site development above and beyond the normal landscaping and screening. These include:

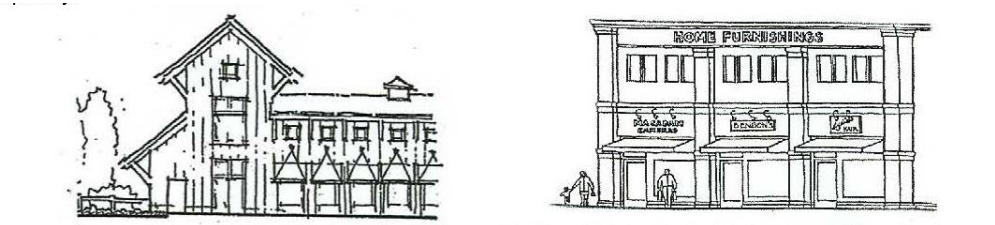
- Screening of service facilities and outdoor storage
- Underground utilities
- Paved driveways, parking and loading areas
- Controlled lighting
- Screened mechanical equipment
- Pedestrian walkways.

Downtown

In 2005 and 2008, the City adopted design guidelines and applied them in the Downtown Design Overlay zoning district. The boundaries of that district are Lake to County Road 43 and Eagle Lake Road to Pleasant Avenue. The district includes an easterly transition zone where standards are merely guidelines. These statements are voluntary guidelines as well as mandatory standards.

The document and related zoning ordinance call for:

- Vertical mixture of businesses and housing
- Retail, restaurant or entertainment businesses
- No auto-oriented development such as drive-through service windows
- Use of "Main Street" or "Prairie Style" architecture
- Compatibility with neighboring buildings
- Buildings located close to the front sidewalk
- Façade variations
- Widows and doors facing the street
- The appearance of narrow buildings
- Brick and glass exterior materials
- Rear or alley entrances
- Parking behind or along side the building
- Landscaped parking areas
- Small public or private plazas or green spaces
- Public and private walkways.



Prairie Style: roofs are hipped, low and spreading with deep overhangs and eaves.

Traditional Main Street style building: flat roofs, often an extended or false parapet on "front" side.

Figure 4-6: Downtown Architectural Styles

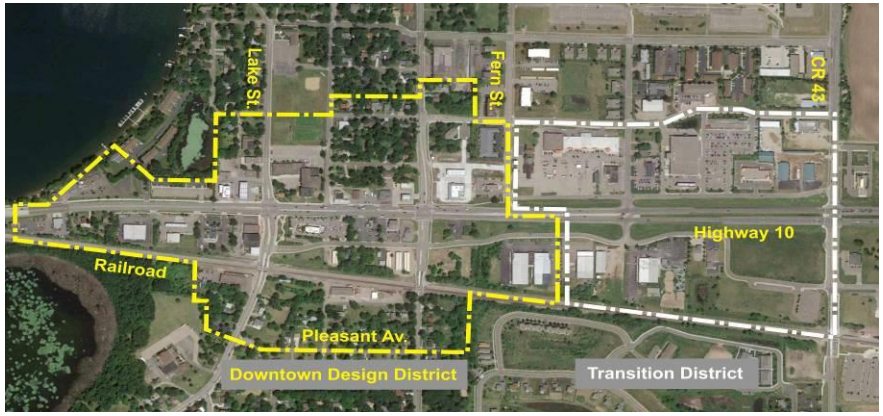


Figure 4-7: Downtown Design Overlay District

Acreage Needed to Accommodate Growth

Estimated Number of Housing Units and Population

The number of households in Big Lake has been forecast in ten-year increments from 2000 to 2040, as shown in Table 4-3. Please refer to the Demographic Assessment chapter for a forecast of population and households growth in Big Lake to year 2040.

Table 4-3
Forecast Number of Households and Persons per Household to 2040

Year	Big Lake Population	Persons per H'hold	Big Lake Households	Change per Decade
1970	1,215	3.92	310	
1980	2,210	2.86	774	464
1990	3,113	2.46	1,264	490
2000	6,063	2.86	2,117	853
2010	10,060	2.98	3,377	1,260
2015	10,285	2.81	3,660	
2020	11,311	2.80	4,040	663
2030	12,281	2.80	4,386	346
2040	13,131	2.75	4,775	389

Source: US Census; Weber Community Planning.

Housing Acreage Needed

It is estimated that approximately 383 acres of land will be needed to accommodate forecast growth in housing from 2015 to 2040, including land for streets, parks and other normal, associated development. This is based on the forecast of additional households and housing units from the Demographic Assessment.

Total Acreage Needed

Assuming that housing will comprise 65 percent of the total land needs, a typical figure, then another 206 acres may be needed for commercial and industrial needs. This is, obviously, a rough estimate not based on a market study. Thus, the total residential plus commercial-industrial land demand is estimated at approximately 589 acres. See Table 4-2, below.

Surplus or Deficit within the City

At the end of 2016, there were 1,184 acres of land zoned for residential, commercial, industrial or agricultural use but not yet developed. This total is minus wetlands and floodplains. The locations of the undeveloped land are illustrated by Figure 4-4.

Comparing that figure to the estimated total need between 2015 and 2040 (589 acres) yields a surplus of 595 acres inside the 2016 City borders.

Considering only housing needs, there is an estimated surplus of 473 acres, as shown in Table 4-2.

Figure 4-7 and Table 4-3 present the distribution of undeveloped land by zoning district. Note that undeveloped land zoned Agricultural was assumed to be available for rezoning and development as housing.

Please refer to the second page down for an explanation of why petitions for land annexation may still occur.

Table 4-2
Additional Gross Acreage Needed to Accommodate Growth, 2015 to 2040

Additional households	1,115
Additional housing units	1,148
Average units per gross acre	3.0
Additional acres needed	
Residential (65 % of total)	383
Other (35 % of total)	206
Total R, C, I or Ag	589
Undeveloped in City - zoned R, C, I or Ag	1,184
Undeveloped in City - zoned R or Ag	856
Net annexation acreage needed - total	(595)
Net annexation acreage needed in R and Ag zones	(473)

Using numbers from the Table 4-3, "Undeveloped Land by Zoning"

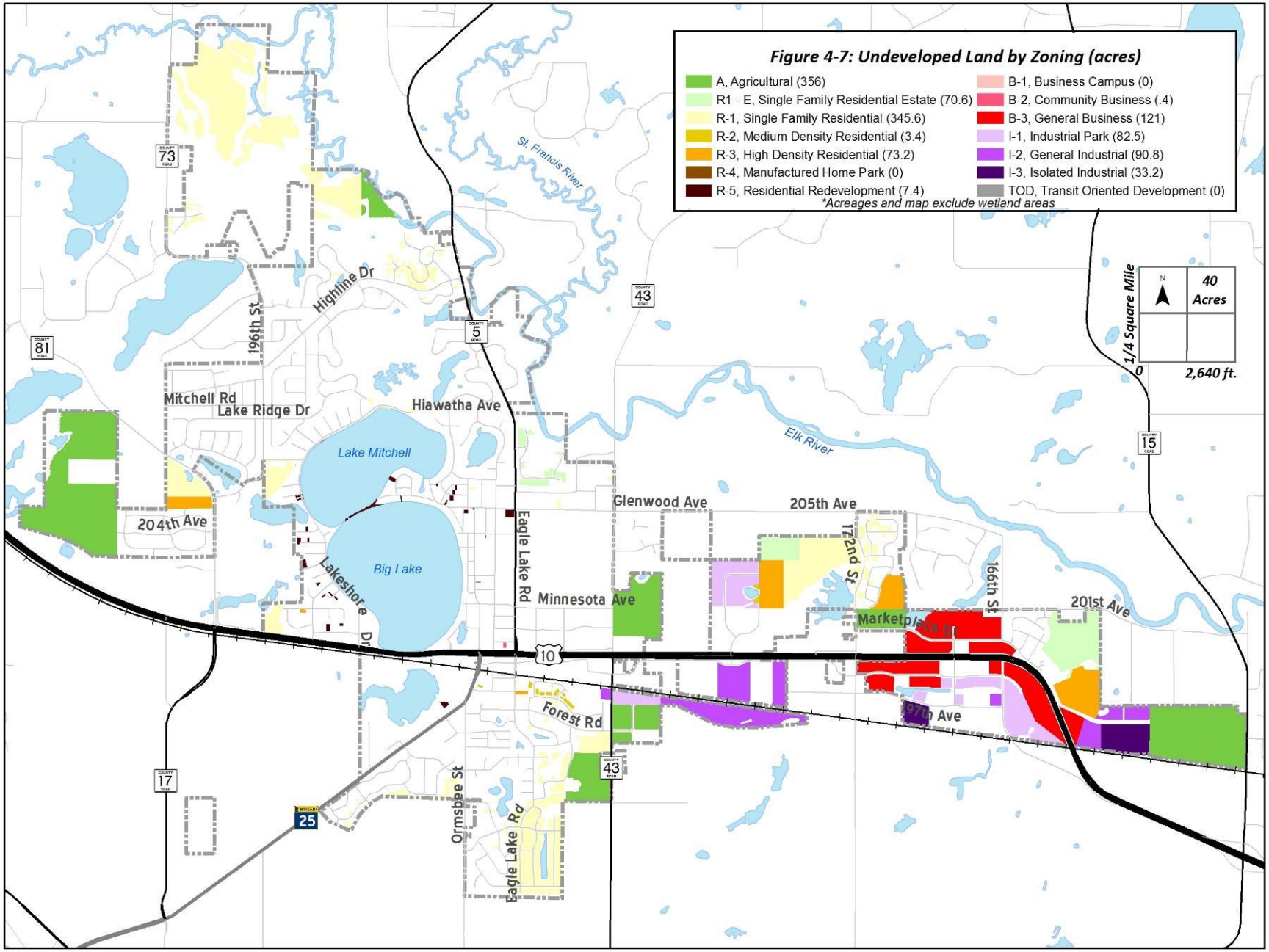


Figure 4-7: Undeveloped Land by Zoning (acres)
A, Agricultural (356)
R1 - E, Single Family Residential Estate (70.6)
R-1, Single Family Residential (345.6)
R-2, Medium Density Residential (3.4)
R-3, High Density Residential (73.2)
R-4, Manufactured Home Park (0)
R-5, Residential Redevelopment (7.4)
B-1, Business Campus (0)
B-2, Community Business (.4)
B-3, General Business (121)
I-1, Industrial Park (82.5)
I-2, General Industrial (90.8)
I-3, Isolated Industrial (33.2)
TOD, Transit Oriented Development (0)
*Acreages and map exclude wetland areas
St. Francis River
Elk River
Lake Mitchell
Big Lake
Highline Dr
196th St
Mitchell Rd
Lake Ridge Dr
Hiawatha Ave
204th Ave
Lakeshore Dr
Eagle Lake Rd
Glenwood Ave
205th Ave
172nd St
166th St
Minnesota Ave
Marketplace Dr
201st Ave
Forest Rd
197th Ave
Ormsbee St
Eagle Lake Rd
1/4 Square Mile
40 Acres
0
2,640 ft.
73
81
5
43
15
10
17
25

Table 4-3
Undeveloped Land outside of Wetlands or Floodplains, 2016

Zone	Acres
A	356
B2	0
B3	121
I1	83
I2	91
I3	33
R1	346
R1E	71
R2	3
R3	73
R5	7
	1,184

Platted but Undeveloped Residential Lots

In early 2017, there were approximately 240 platted but undeveloped parcels zoned for housing, including lots designated for single-family detached houses and attached townhouses. Approximately 20 more lots are being platted annually in the Norland Park neighborhood.

On the other hand, approximately 160 lots are expected to be built upon during 2017-18.

So, by 2019, the supply of lots should be down to approximately 100, which is equal to about 1.5 years of demand in Big Lake. That would be approaching an appropriate inventory. Thus, the over-supply of lot created during the recession will have been brought nearly into equilibrium with the demand.

Land Needed for Other Uses

It is estimated that approximately 206 acres of land will be needed to accommodate commercial, industrial and public land needs between 2015 and 2040, using the assumptions shown above. Those three categories comprise the "Other" in Table 4-2, above.

There are 328 undeveloped acres zoned as commercial or industrial that could accommodate those types of development. This leaves a surplus of 122 acres of undeveloped land zoned in the "Other" districts for the 2015 to 2040 time period.

Annexation May Still Be Desired

Note that even though there is an apparent surplus of developable land within the 2017 City borders out to year 2040, this does not mean that there will not be a market demand for other land to be annexed to the City. There are attractive residential locations just outside of the city where owners might petition the City for annexation. And, some of the undeveloped locations within the current City limits are fairly remote, such as east of the Hudson Woods neighborhood or north of Sweetwater Bend neighborhood.

It is important to have enough land zoned and serviced for development so that land prices are not artificially inflated.

State Laws Relevant to Growth Management

Annexation

Land cannot usually be annexed to a city from a township unilaterally, it usually requires cooperative action. There are a few very limited instances when a city can act on its own, known as annexation by ordinance.

Minnesota annexation laws are summarized at more length in Appendix B.

Three basic conditions must exist for annexation to occur:

- The land must adjoin the corporate limits of the annexing city.
- The Municipal Boundary Adjustment Unit may approve an annexation if it finds city governance of the area is necessary to protect the public health, safety, and welfare; if annexation is found to be in the best interests of the city and the territory to be annexed; or, if land is, or is about to become, suburban or urban in character. This generally refers to land in close proximity to the city, of limited size, suburban in character, and with a community of interest so it will adapt to city government.
- The land may not already be part of another city.

There are two major ways that annexation typically occurs:

Annexation by Ordinance

Cities may annex by ordinance when any of the following conditions exist:

- The city owns the land to be annexed.
- The land is completely surrounded by land already within city limits.
- The land abuts the city and the area to be annexed is 120 acres or less, not presently served or capable of being served by available public wastewater facilities, and all the landowners petition the city for annexation.
- The land is within two miles of the city and has been approved for platting after Aug. 1, 1995, and the platted lots average 21,780 square feet or less.

Orderly Annexation

A city and a township may agree to allow annexation of a specified area according to terms to which they agree, including timing or other conditions.

Intergovernmental Joint Powers

Cities, townships and counties may enter into a wide variety of agreements for the sharing of facilities or services.

Likewise, they may enter into agreements to shoreland use planning or zoning.

A city may not extend its zoning regulations beyond its borders if the surrounding county has adopted zoning regulations. (Sherburne County administers zoning throughout Big Lake Township.)

However, a city may extend its subdivision regulations beyond its borders if the adjoining township has not adopted such regulations. (Sherburne County administers subdivision regulations throughout Big Lake Township.)

When subdivision or zoning regulations are extended into unincorporated land outside the city boundary, any affected city council, county board, or town board may petition the county auditor to establish a joint planning board.

Please refer to Appendix C for a further description of this topic.

Public Facilities and Growth Management

The availability of public services and facilities is an important factor in encouraging and guiding land development. Described below are several public or private facilities or services that may or may not be available to residents and businesses in both the city and the adjacent townships.

The City's ability to attract new residential, commercial or industrial development is diminished to the extent that these services are available at an equal cost to locations in the townships. However, two important services, water supply and wastewater disposal, are only available to properties in the city.

School District

The Big Lake School District operates a high school, middle school and two elementary schools. Its service area includes the city, Big Lake Township and part of Orrock Township, located to the north.

Public Utilities

Public sewer and water services are only available to properties in the City of Big Lake.

Fire and Rescue Protection

The Fire Department is owned jointly by the city and the township.

Ambulance Service

Emergency medical and ambulance services are provided across the vicinity by CentraCare Health Emergency Medical Services.

Police Protection

The City of Big Lake Police Department normally only works only within the city but assists in other jurisdictions if needed. The Sherburne County Sheriff provides law enforcement in the Township.

Economic Development

The Big Lake Economic Development Authority is composed of representatives from both the city and the township and advances the interest of both communities.

Library

The Great River Regional Library has 31 locations in Sherburne, Wright, Stearns and Benton Counties.

Recreation

Parks in the city are open to anyone.

Land Use and Growth Management Plan

This chapter guides the City's regulation of perimeter growth and the general pattern of land use across the community. It includes design guidelines for residential neighborhoods and the proposed "town center." Finally, the land use plan policies are coordinated with municipal and private actions in economic development and natural resource protection.

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Major Land Use and Growth Management Issues

The following are the major issues in the topic of land use and development identified through the analysis of conditions.

1. **Protecting the Ability of the City to Grow Outward:** Will the County and Big Lake Township continue to cooperate with the City to protect the City's ability to growth outward in an efficient and economic fashion?
2. **Annexation of Town Peninsulas and Islands:** What should be done, if anything, to encourage land owners in the several Township "peninsulas" and "islands" that are surrounded by City land to petition for annexation of their land to the City?
3. **Fringe Development Pattern:** What should be the pattern of land use on the City's perimeter?
4. **Favored Locations for Perimeter Growth:** What are the most efficient and beneficial locations for perimeter growth?
5. **Locations for Multiple-Family Housing:** What are the best types of locations for multiple-family housing?
6. **Types of New Housing:** Should the plan try to guide development toward or away from certain types of housing or let the market make that decision?
7. **Appearance of New Multiple-Family Housing:** Should the City adopt design guidelines, or regulations, that help make attached housing more compatible with detached (single-family) housing?

8. **New Neighborhood Design:** Should the City require that new residential areas be designed with many of the features of the older neighborhoods such as sidewalks, street trees, a mixture of housing types, narrow streets, short front setbacks and garages set back further than the façade of the house? Should there be regulations to soften the appearance of garage doors?

9. **Downtown:** To what degree should the City promote and assist redevelopment that conforms to the recommendations of the downtown design guidelines for retail, offices, housing and mixed-use buildings? What should be the next major step forward for the downtown?

10. **Waterfront Greenways:** Should the City acquire land for a linear public park and trail plus protected open space along the Elk River?

11. **Economic Development, Jobs and Income:** What land use, zoning and development policy changes, if any, should be made to help promote economic development in Big Lake?

12. **Commercial Growth:** How much land should be planned and zoned for retail business development? Should multiple-family housing be allowed in certain commercially-zoned locations?

13. **General Redevelopment:** How proactive should the City be in encouraging redevelopment?

14. **Lakefront Land Ownership and Use:** Can or should public access to the lakes be improved?

15. **Role of the Plan:** How strong should the Comprehensive Plan be in setting City policy, ordinances and budgeting?

An example of housing in Big Lake

Sustainable Growth

Grow by investing in established neighborhoods, carefully planning new districts, providing attractive public amenities and protecting environmental resources.

A central idea in this Comprehensive Plan is that existing neighborhoods and established business areas should be maintained or renewed as new investments occur in perimeter locations. Growth on the edge of the City should be compact and adjacent to prior development, and some new housing or business should occur as redevelopment.

1. Compact and Contiguous Growth

Guide growth in Big Lake to locations either adjacent to or within presently urbanized areas. Land use should be either urban and compact or rural and very low density to preserve options for future development. This would:

- Create a stronger sense of Big Lake as a small town.
- Promote efficient use of serviced land
- Promote continued investment in older areas
- Limit public and private expenses
- Protect sensitive environmental resources
- Preserve rural character and prime farmland
- Conserve nearby fringe areas for future urbanization when public sewer and water service become available
- Reduce driving and enable increased walking and bicycling
- Preserve the distinction between urban and rural areas.

2. Spread with a Center

Develop a combination of spread or low-density neighborhoods surrounding a higher density center. There will be a town center but also some large lots.

3. New Neighborhoods

New neighborhoods should include a variety of types of housing, local streets sized to encourage appropriately slow traffic speeds, street trees and sidewalks, and parks or parkways within easy walking distance.

4. Infill and Redevelopment

Provide various incentives for the re-use or more intensive use of locations that were not previously developed, locations that have been built upon but cleared, and locations that are underused or highly deteriorated. Some part of the future growth in jobs and housing will be captured in the older parts of the City to keep those areas vital and to use prior public investments. Incentives may include planning and zoning, buying, preparing and reselling property, and improving roads, utilities, and parks.

Prime locations for infill and redevelopment include the original downtown along Lake Street and the northern frontage of Highway 10 between Lake Street and Eagle Lake Road.

5. Guiding Growth with Public Infrastructure

Use modest public investments to support new growth and encourage continuous reinvestment in established areas.

Depend on private land developers to carry the great majority of the cost of new streets or utility lines. Limit public spending to those features that cannot legally be assigned to private investors or that must be spread across a wide area. Examples might include the additional cost of a parkway street compared to a standard street, a sewage lift station or a water tower.

Across the City, the parks, parkways and street improvements will be used to help keep neighborhoods attractive and sustain property values. (Refer also to the Parks System and the Utilities Chapters for further policy direction.)

6. Role of the City and Developers

Allow developers to lead in the design of new development, including lot sizes. Establish minimal standards, such as street widths, and a framework of essential features for the private sector to work within. Essential features include major roads and utilities, commercial or industrial locations, environmental protection and public safety. Continue to require developers to improve or extend local and collector streets, minor utility lines, and participate in the cost of improving arterial roads and trunk utility lines.

Land Use Plan Map

Regulate land use to ensure consistency with the Land Use Plan map and the objectives and policies of this Comprehensive Plan.

The Land Use Plan Map, Figure 11-1, is intended to serve as a guide to the zoning map and to identify sufficient areas for future land development in order to accommodate at least 20 years of forecast growth.

The Land Use Plan Map provides sufficient land both within the current City limits and nearby to meet the growth needs of the community through 2040 and beyond. More area is guided on Figure 11-1 than is probably needed by 2040 so as to provide market choice. Development decisions regarding specific tracts and parcels will be initiated through the workings of the development market and driven primarily by private investors.

Please refer to Table 11-1 for a description of the land use plan categories and their potential zoning districts.

1. Planned Land Use Map and Categories

Use the Land Use Plan Map shown by Figure 11-1 and the land use categories further defined in Table 11-1 as the general pattern of future continued physical development for the City of Big Lake. Table 11-1 provides a more detailed description of each category, along with criteria to evaluate the appropriateness of specific uses relative to each land use category.

The land use patterns shown on Figure 11-1 are generalized and do not represent precise demarcations on the ground or specific sites. For areas within existing developed neighborhoods, the Land Use Plan Map shows areas based on streets, blocks or existing use. For areas that are undeveloped, the Land Use Plan Map shows transitions from one land use category to another and is not based on defined boundaries. Likewise, locations shown for future parks or other public facilities are approximations or search areas.

Consequently, the City will use the Land Use Plan Map in conjunction with related objectives and policies in the Comprehensive Plan in reviewing rezoning and development proposals, plats, site plans, annexation petitions and other requests regarding future land use.

However, major departures from the Land Use Plan Map will be considered only in the context of an amendment to the *Comprehensive Plan.* The City will generally allow rezonings to more intensive land uses consistent with the plan provided that adequate safeguards are made to ensure that the more intense development will not adversely affect the use and enjoyment of nearby land uses as a result of excessive traffic, noise or light, inappropriate site planning or excessive or unwarranted impact on the natural environment.

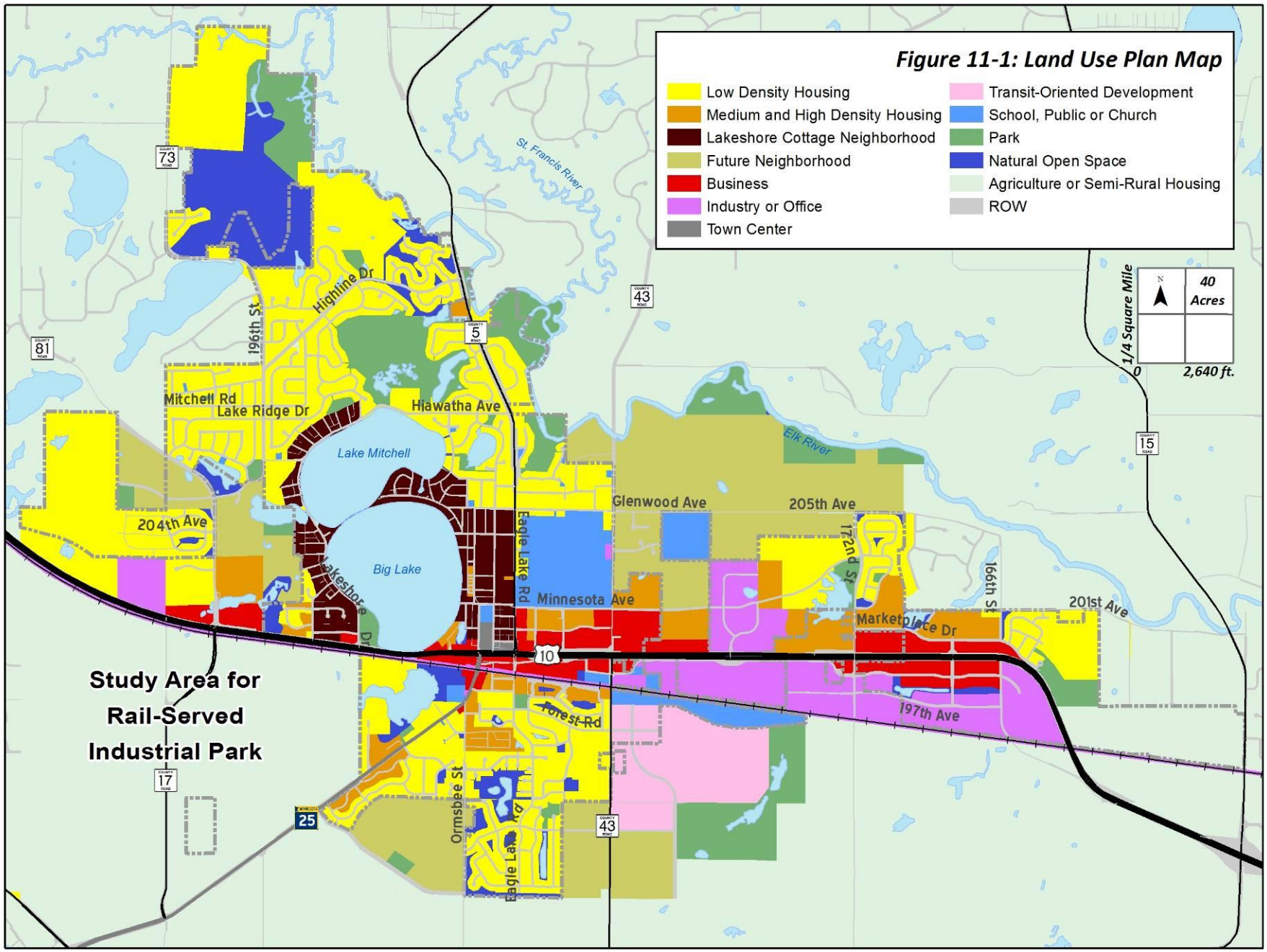
Figure 11-1: Land Use Plan Map
Low Density Housing
Medium and High Density Housing
Lakeshore Cottage Neighborhood
Future Neighborhood
Business
Industry or Office
Town Center
Transit-Oriented Development
School, Public or Church
Park
Natural Open Space
Agriculture or Semi-Rural Housing
ROW
1/4 Square Mile
40 Acres
0
2,640 ft.
St. Francis River
Elk River
Highline Dr
196th St
Mitchell Rd
Lake Ridge Dr
Hiawatha Ave
Lake Mitchell
Big Lake
Lakeshore Dr
204th Ave
Eagle Lake Rd
Glenwood Ave
205th Ave
172nd St
166th St
201st Ave
Marketplace Dr
Minnesota Ave
197th Ave
Forest Rd
Ormsbee St
Eagle Lake Dr
Study Area for Rail-Served Industrial Park
73
81
5
43
15
10
17
25
43

Table 11-1
Land Use Plan Map Categories and Proposed Zoning Map Districts

Plan Map Categories	Land Uses	Potential Zoning Districts
Low Density Housing	Includes single-family housing and two-family housing. Allowable densities range from approximately 2.5 to 4 housing units per gross acre, with lot sizes in the range of 8000 square feet and larger. Includes places of worship.	R-1E, R-1 and R-2
Medium and High Density Housing	Included in this category are small-lot single-family houses, duplexes, townhouses, 4- to 12-unit buildings that typically have individual exterior entrances, and apartment buildings, which have interior corridors. The housing is located where there is good traffic access, between Low-Density Housing and non-residential land uses, and at high-amenity locations. The density is expected to be in the range of 4 to 8 units per gross acre for the duplex, townhouse and similar buildings and up to 25 units per gross acre for apartment buildings. Locations and site plans should conform to the guidelines in this plan. Includes places of worship.	R-2, R-3 and R-4
Lakeshore Cottage Neighborhood	Allows single-family, two-unit and townhome residential development and redevelopment. Located primarily in the Shoreland Management areas adjacent to Big, Mitchell and Keller Lakes and encompasses very small lots dating from the 1890s to the 1950s. Subject to the conditions listed in the R-5 zoning district.	R-5, Residential Redevelopment District
Future Neighborhood	Future Neighborhood indicates locations where housing and supportive development are expected to occur. The exact arrangement of residential densities and types will be determined through negotiation with land development applicants. The City intends that there be a mixture of types of housing in these locations.	Agriculture district or a district determined upon annexation.
Business	Businesses providing retail trade or services for individuals or businesses. May also include professional offices.	B-1, B-2 or B-3
Industry or Office	Allows a wide range of assembly, fabrication, processing, research, warehouse, logistics or corporate office businesses. The type and intensity of allowed uses vary with the zoning district.	I-1, I-2 or I-3
Town Center	This land use category allows and promotes office, retail, housing, hospitality and civic land uses, preferably in mixed-use buildings with pedestrian orientations. May be subject to the Downtown District design guidelines.	R-3 and B-2
Transit-Oriented Development	Mid- or high-density housing and supportive public space design, all consistent with the principles of the Transit-Oriented Development Design Manual, 2008. See recommendations for amendments to the TOD Master Plan in this chapter.	Transit-Oriented Development (TOD)
Schools and Public Buildings	Includes public and private schools, City Hall and municipal public works facilities.	R-1
Park	Public parks. Locations of future parks shown on Figure 1-1, Planned Land Use, are approximate.	Any district
Open Space	Protective open space; ponds, wetlands, floodplains.	Any; Overlay district
Agricultural	Farming or very low density housing without City utilities. Housing should be no denser than 1 house per 10 acres unless planned for future City utilities. May be a transitional area for future sewered development.	A, Agricultural

Perimeter Growth

Achieve long-term, compact and cost-effective perimeter growth.

1. Strive for Adjacent Development

Only approve residential or commercial plats that are adjacent to or very near other, existing urban development even if all of the development costs are borne privately. Do not bond for and carry the cost of new utilities or streets that do not meet that condition.

2. County and Township Cooperation

The Town of Big Lake and Sherburne County agree that there is mutual benefit in staged, orderly utility extensions, annexation and compact urban growth into territory planned and regulated for that purpose.

Urge Sherburne County and Big Lake Township to rezone the land between Glenwood Avenue and the Elk River to Agriculture from General Rural. This would protect the City's ability to grow compactly by preventing that property from being divided into 2.5-acre residential parcels, which would be too small to easily re-divide into City-sized lots yet too big to economically serve with City utilities.

3. Protect Adjacent Lands for Urban Development

Petition Sherburne County and Big Lake Township to increase the minimum residential lot size to at least 5 but ideally 10 acres in the areas planned as Urban Reserve near the City.

Some of these locations are zoned General Rural, which allows houses on 2.5 acre lots. Five acres, or preferably 10, is considered the minimum practical size to allow for future re-subdivision to sewered, City-sized residential lots.

Likewise, the County's Agricultural zoning district south of the City requires a minimum lot size of only 5 acres, which is not quite adequate to safeguard the growth potential of the City. That also should be set to a minimum of 10 acres. If the City becomes ringed with houses on parcels that cannot be easily divided for lots and streets, the public and private costs of City growth will be increased and the City will need to consume more land more quickly.

4. City Services and Annexation

Require annexation or an annexation agreement to extend and connect to City sewer and water lines.

Extend the City's corporate boundaries by approving annexations consistent with this *Comprehensive Plan* and State law. Prior annexations have occurred only through petitions initiated by the individual landowners.

Use these criteria to evaluate annexation petitions so that policies on growth management, fiscal health and land use are furthered.

- Maintain a compact and regular pattern of growth and boundary expansion
- Incorporate "peninsulas" of township that abut the City on three sides
- Extend City streets and utilities cost-effectively.
- Deliver public services cost-effectively.
- Foster neighborhood development patterns with connecting streets and walkways
- Address a market demand for development
- Capture nearby growth in a compact and efficient pattern rather than a fragmented, costly, semi-rural pattern.

Municipal services are required for sustainable and cost-effective growth, and the City of Big Lake is most capable of providing those services.

5. Environmental Protection

On land annexed to the City or proposed for development, protect or restore sensitive or special natural resources such as flood plains, streams, wetlands, water quality, shorelines, riverbanks or major wooded areas through regulation and/or City investment. Follow this *Comprehensive Plan* and the land use regulations of the City's zoning and subdivision ordinances.

6. Prime Farmland

Minimize the loss of productive farmland from premature conversion to non-agricultural uses. Protect areas identified as productive farmland by promoting compact urban development and discouraging semi-rural large-lots outside its borders.

Residential Neighborhoods

Reinforce or create new neighborhoods with a diversity of housing, attractive public spaces, compatible land uses, and identity.

1. Residential Mixture

Plan and create a mixture of lot sizes, housing sizes, housing types and housing styles across the city. Mix housing types, with small areas of multiple-family housing.

Within some neighborhoods, have a mixture of housing types and styles, depending on the strategy of the land developer. Plan and zone locations for townhouses and apartments. However, ensure that the value and livability of single-family, detached housing is not harmed when trying to accommodate the need for other housing types. No additional "manufactured home park" zoning is recommended.

2. Street Corridor Design

Combine improved garage setbacks and garage design with narrower streets, driveways and street trees for an overall visual enhancement.

Study amendments to garage front setback requirements in the R-1 and R-2 zoning districts to improve the relationship of the house to the street. The intent would be to improve small-town charm, soften the appearance of the garage door, heighten the visual prominence of the house entry and encourage porches.

For example, a shorter front setback for the garage might be allowed if:

- The garage door is even with the front porch
- The door has windows
- The façade above the garage has second-story windows
- The garage has a turned entrance
- The third stall is set further back and the first two
- The maximum driveway width at the street is no more than 16 feet.

Exceptions may be made for narrow or small lots.

The façade-to-façade design of local residential street corridors is vitally important to the appearance of any city. See Appendix E.

3. Street Connections

Allow some cul-de-sac streets, particularly where necessary to serve difficult locations or to protect natural resources. However, interconnect most local residential streets for the sake of driving, walking and bicycling.

4. Links to Adjacent Neighborhoods

Link new neighborhoods visually and functionally to the established portions of Big Lake via street connections, bicycle facilities, pedestrian connections and, where possible, the parkway system.

5. Context-Sensitive Redevelopment and Infill

In older neighborhoods, encourage infill development that respects the characteristics of those neighborhoods and is consistent with the prevalent housing styles in each neighborhood.

This principle does not imply that all housing will be of the same type (i.e., detached or duplex) but that older and newer housing will share many design elements. Redevelopment and infill are keys to strengthening older neighborhoods and will always be done in a manner that responds to and builds on the strengths of those neighborhoods.

6. Older Neighborhoods

Continue to review zoning regulations that apply to the older neighborhoods so as to accommodate the nonconforming status of dwellings that were caused by setback or area requirements.

7. Northstar Neighborhood

Amend the Northstar transit-oriented development plan to allow more housing and accept less retail and office business in that vicinity.

8. Lakeshore Cottage Neighborhoods

Continue to administer the R-5, Residential Redevelopment, zoning district in those locations shown on the Land Use Plan Map as Lakeshore Cottage Neighborhoods. That zoning district is designed to encourage consolidation of small parcels, to protect existing houses through reasonable setback of new buildings, and to mitigate harmful surface water runoff to the lakes.

Public Utilities and Surface Water Plan

This chapter describes how the City will manage its infrastructure for wastewater conveyance and treatment, water supply and surface water management. It is essential that these major capital facilities are coordinated with other plans for land use, streets, parks and natural resource protection.

Please refer to the Utilities System Assessment, chapter 7 of this plan, for a description of the current facilities and needs.

Major Utility Systems Issues 15-1
Sanitary Sewer System..... 15-2
Surface Water Management..... 15-3
Plan Action Steps..... 15-7

Major Utility Systems Issues

Sanitary Sewer Issues

1. **Growth Locations**: Where are the most suitable locations to expand the sanitary waste system (and the city) based on cost, engineering feasibility, and environmental effects?
2. **High-Demand Users:** Should system improvements be made to accommodate the high demand of a very small number of industrial users? How will this decision affect the city's economic development strategy?

Water Supply and Distribution Issues

1. **Growth Locations**: Where are the most logical locations to expand the sanitary waste system based on cost, engineering feasibility, and environmental impacts?
2. **System Improvements**: What enhancements to the existing water treatment and supply system would be required to serve all areas of the city today and/or future areas of the city as it grows with additional residential, commercial, industrial, or institutional land uses?

Surface Water Management Issues

1. **Planning:** Should the city prepare a comprehensive surface water management plan?

Sanitary Sewer System

Ensure that the City's wastewater system reinforces the principle of compact growth while maintaining fees that are competitive with comparable cities.

1. Sewer Line Extension Plan

As new plats are approved, require that major lines are stubbed in each direction necessary to support continued urban expansion. Follow the system expansion plan prepared in 2004 by the City's consulting engineer. That plan will be updated as circumstances dictate to keep it relevant with the comprehensive land use and roads plans.

No major improvements to the existing system of trunk sewer lines are needed in the foreseeable future to accommodate forecast growth.

The need for additional lift (pump) stations will be determined through engineering studies as neighborhoods and districts are designed.

2. Service Only within the City

Require annexation or an annexation agreement to extend and connect to City sewer or water lines.

3. Annexation Petitions

It is the City's intention as stated in this plan to only approve residential or commercial plats that are adjacent to or very near other, existing urban development even if all of the development costs are borne privately. Consequently, each petitioner must demonstrate that sewer and water lines and local streets can be feasibly and economically extended from an adjacent neighborhood of the city.

4. Retiring On-Site Wastewater Systems

Require that building that discharge wastewater and that are on parcels abutted by a City wastewater line connect to the City's sewer system within 18 months. Refer to City Code section 810.02, Subdivisions 3 and 4. There are 40 to 50 parcels and buildings that are not served by the public sewer system but have their own on-site wastewater systems.

5. Maintaining Adequate Capacity in the Treatment Plant

Conduct a study of its wastewater treatment plant in 2018 or 2019 to ensure that it has adequate capacity for the foreseeable future for both the liquid volume and the biological loading of treatment demand.

6. Assessment Policy

Building and financing new sewer or water lines will be primarily the responsibility of the private land developers and builders. Any such improvements to the public sewer or water systems must be done in accordance with City standards and approved by the City before they are accepted.

Some extraordinary development costs, such as wastewater lift stations, may be spread beyond an immediate land development project and assessed according to Minnesota Statutes Chapter 429. The cost of rehabilitating City utilities or streets may also be financed through special assessments against benefiting properties.

7. Other Provisions of City Code

Continue to enforce its requirements related to the City wastewater collection system as presented in section 810 of the City Code. Those subjects include required use of public sewers, private sewage disposal, prohibited discharges, industrial wastes, sewer construction standards, practices and assessments, sump pumps, inspections and billing.

E-3 – Ordinance for Sanitary Sewer

Section 810 - Public Sewers

810.01 Definitions. For the purpose of this Chapter, the following words and terms shall have the meaning set out below, unless the context specifically indicates otherwise.

Subd. 1 BOD (Biochemical Oxygen Demand). "BOD" (Biochemical Oxygen Demand) shall mean the quantity of oxygen utilized in the biochemical oxidation of organic matter under standard laboratory procedure in five (5) days at 20□ C expressed in milligrams per liter. Laboratory procedures shall be in accordance with the latest edition of Standard Methods For The Examination Of Water and Wastewater.

Subd. 2 Building Drain. "Building Drain" shall mean that part of the lower horizontal piping of a drainage system which receives the discharge from, waste, and other sanitary drainage pipes inside the walls of the building and conveys it to the building sewer beginning five (5) feet outside the inner face of the building wall.

Subd. 3 Building Sewer. "Building Sewer" shall mean the extension from the building drain to the public sewer or other place of disposal, also called house connection.

Subd. 4 City. "City" shall mean the area within the corporate boundaries of the City of Big Lake, as presently established or as amended by Ordinance or other legal actions at a future time. The term "City" when used herein may also be used to refer to the City Council and its authorized representatives.

Subd. 5 COD. "COD" (Chemical Oxygen Demands) shall mean the quantity of oxygen utilized in the chemical oxidation of organic matter, expressed in milligrams per liter, as determined in accordance with standard laboratory procedures as set out in the latest edition of Standard Methods For the Examination Of Water and Wastewater.

Subd. 6 Combined Sewer. "Combined Sewer" shall mean a sewer originally designated to receive both surface water runoff and sewage.

Subd. 7 Garbage. "Garbage" shall mean solid waste resulting from the domestic and commercial preparation, cooking, and dispensing of food and from the handling, storage, or sale of meat, fish, fowl, fruit, vegetable, or condemned food.

Subd. 8 Industrial Wastes. "Industrial Wastes" shall mean the solid, liquid, or gaseous wastes resulting from industrial or manufacturing processes, trade or business, or from the development, recovery, or processing of natural resources.

Subd. 9 NPDES Permit (National Pollutant Discharge Elimination System Permit). "NPDES Permit" (National Pollutant Discharge Elimination System Permit shall mean the system for issuing, conditioning and denying permits for the discharge of pollutants from point sources into the navigable waters, the contiguous zone, and the oceans by the Environmental Protection Agency pursuant to the Federal Water Pollution Control Act of 1972, Sections 402 and 405.

Subd. 10 Natural Outlet. "Natural Outlet" shall mean any outlet into a watercourse, pond, ditch, lake, or other body of surface or groundwater.

Subd. 11 Normal Domestic Strength Wastes. "Normal Domestic Strength Wastes" shall mean wastes which are characterized by a per capita discharge of 100 gallons per day at a loading of 300 mg. per liter BOD, and 250 mg. per liter suspended solids.

Subd. 12 Other Wastes. "Other Wastes" shall mean garbage, municipal refuse, decayed wood, sawdust, shavings, bark, lime, sand, ashes, oil tar, chemicals, offal, and other substances except sewage and other wastes.

Subd. 13 Person. "Person" shall mean any individual, firm, company, association, society, corporation, municipal corporation, governmental unit, or group.

Subd. 14 pH. "pH" shall mean the logarithm of the reciprocal of the weight of hydrogen ions in grams per liter of solution.

Subd. 15 Process Water. "Process Water" shall mean any water used in the manufacturing, preparation or production of goods, materials, or food. Process water is an industrial waste.

Subd. 16 Public Sewer. "Public Sewer" shall mean any sewer owned or operated by a unit or agency of government.

Subd. 17 Sanitary Sewer. "Sanitary Sewer" shall mean a sewer which carries sewage and to which storm, surface, and groundwater are not intentionally admitted.

Subd. 18 Sanitary Waste. "Sanitary Waste" shall mean the liquid and water carried wastes discharged from sanitary plumbing facilities.

Subd. 19 Sewage or Wastewater. "Sewage" or "Wastewater" shall mean the water carried waste products from residences, public buildings, institutions, industrial establishments or other buildings including the excrementitious or other discharge from the bodies of human beings or animals.

Subd. 20 Sewer. "Sewer" shall mean a pipe or conduit for carrying sewage, industrial wastes or other waste liquids.

Subd. 21 Sewer System. "Sewer System" shall mean pipelines or conduits, pumping stations, force mains, and all other devices and appliances appurtenant thereto, used for collecting or conducting sewage, industrial wastes or other wastes to a point of ultimate disposal.

Subd. 22 Shall/May. "Shall" shall mean mandatory. "May" shall mean permissive.

Subd. 23 Slug. "Slug" shall mean any discharge of water, wastewater or industrial waste which in concentration of any given constituent, or in quantity of flow exceeds for any period of duration longer than fifteen (15) minutes more than five (5) times the average twenty-four (24) hour concentration of flows during the normal operation.

Subd. 24 Storm Sewer. "Storm Sewer" (sometimes termed Storm Drain) shall mean a sewer which carries storm or surface water and drainage, but excludes sewage and industrial waste, other than unpolluted cooling or process water.

Subd. 25 Suspended Solids. "Suspended Solids" shall mean solids that either float on the surface of or are in suspension in water, sewage, or other liquids and which are removable by laboratory filtering in accordance with the latest edition of Standard Method For The Examination Of Water and Wastewater.

Subd. 26 Unpolluted Water. "Unpolluted Water" shall mean clean water uncontaminated by industrial wastes, other wastes, or any substance which renders such water unclean or noxious or impure so as to be actually or potentially harmful or detrimental, or injurious to public health, safety, or welfare to domestic, commercial, industrial or recreational uses; or to livestock, wild animals, birds, fish, or other aquatic life.

Subd. 27 Wastewater Facilities. "Wastewater Facilities" shall mean the structures, equipment, or processes required to collect, carry away, and treat domestic and industrial wastes and dispose of the effluent.

Subd. 28 Wastewater Treatment Works or Treatment Works. "Wastewater Treatment Works" or "Treatment Works" shall mean an arrangement of devices and structures for treatment of wastewater, industrial waste, and sludge, sometimes used as synonymous for "Wastewater treatment plant" or "Waste treatment plant" or "water pollution control plant" or "sewage treatment plant".

810.02 Required Use of Public Sewers.

Subd. 1 Unlawful Discharge. It shall be unlawful to discharge to any natural outlet within the City or any area under the jurisdiction of the City any sewage or other polluted waters, except where suitable treatment has been provided in accordance with subsequent provisions of this Chapter.

Subd. 2 Privies. Except as hereinafter provided, it shall be unlawful to construct or maintain any privy, privy vault, septic tank, cesspool or other facility intended or used for the disposal of sewage if adequate and feasible City facilities are available.

Subd. 3 Mandatory Connection. The owner of any building or property which is located within the City and from which wastewater is discharged, shall be required to connect to a public sewer at his or her expense within eighteen (18) months of the date the public sewer is operational. All properties proposed to be served shall be served. All future buildings constructed on property adjacent to the public sewer shall be required to immediately connect to the public sewer. If sewer connections are not being made pursuant to this Chapter, an official 90 day notice shall be served instructing the affected property owner to make the required connection.

Subd. 4 Failure to Connect In the event an owner shall fail to connect to a public sewer in compliance with a notice given under this Chapter, the City may undertake to have the connection made and shall assess the cost thereof against the benefited property. The assessment shall be a lien against the property. The assessment, when levied, shall bear interest at the maximum legal rate for local improvements and shall be certified to the County Auditor and shall be collected and remitted to the City in the same manner as assessments for local improvements. The rights of the City shall be in addition to any remedial or enforcement provisions of this Chapter.

Subd. 5 Exceptions. New connections to the sanitary sewer system shall be prohibited unless sufficient capacity is available in all downstream facilities, including, but not limited to, capacity for flow, BOD, and suspended solids.

810.03 Private Sewage Disposal.

Subd. 1 When Allowed. Where a public sanitary sewer is not available under the provisions of this Chapter, the building sewer shall be connected to a private sewage disposal system complying with the rules and regulations of the City, State, and Pollution Control Agency.

Subd. 2 Construction. No new private sewer systems or sewer system extensions shall be constructed within the City without first obtaining written approval of the system plan and the materials to be used in the construction of the system, designed by a designer licensed by the Minnesota Pollution Control Agency.

810.04 Prohibited Discharges.

Subd. 1 Unpolluted Waters. No person, firm, or corporation shall discharge or cause to be discharged directly or indirectly any storm water, groundwater, roof runoff, yard drainage, yard fountain water, pond or pool overflow, subsurface drainage, waste from on-site disposal systems, unpolluted cooling or processing water to any sanitary sewer except as permitted by the City or other local unit government. Storm water and all other unpolluted discharged to a storm sewer if available, except that unpolluted cooling or processing water shall only be so discharged upon approval by the City or other unit of local government.

Subd. 2 Foreign or Hazardous Substances.

A. Any gasoline, benzene, naphtha, fuel oil, or other flammable or explosive liquid, solid, or gas;

B. Any water or wastes containing toxic or poisonous solids, liquids, or gases in sufficient quantity, either singly or by interaction with other wastes, to injure or interfere with any sewage treatment process, constitute a hazard to humans or animals, create a public nuisance, or create any hazard in the wastewater treatment works;

C. Any water or waste having a pH lower than 5.5 or having any other corrosive property capable of causing damage or hazard to structures, equipment and personnel of the wastewater treatment works;

D. Solid or viscous substances, either whole or ground, in quantities or of such size capable of causing obstruction to the flow in the sewers, or other interference with the proper continuation of the wastewater facilities but not limited to ashes, cinders, disposable diapers, glass grinding or polishing wastes, stone cuttings or polishing wastes, sand, mud, straw, shavings, metal, glass, rags, feathers, tar, plastics, wood, underground garbage, whole blood, paunch manure, hair and fleshings, entrails, sanitary napkins, paper dishes, cups, milk containers, and other paper products;

E. Noxious or malodorous liquids, gases, or substances which either singly or by interaction with other wastes are sufficient to create a public nuisance or hazard to life or are sufficient to prevent entry into the sewers for their maintenance or repairs.

810.05 Regulated Discharges. No person shall discharge or cause to be discharged directly or indirectly the following described substances to any public sewer unless in the opinion of the City the discharge will not harm the wastewater facilities, nor cause obstruction to the flow in sewers, nor otherwise endanger life, limb, or public property, nor constitute a nuisance. In forming its opinion as to the acceptability of the wastes, the City may give consideration to such factors as the

relation of flows and velocities in the sewers, nature of the sewage treatment process, capacity of the sewage plant, the City's NPDES permit, and other pertinent determinations either on a general basis or as to discharges from individual users or specific discharges, and may prohibit certain discharges from individual users because of unusual concentrations or combinations which may occur.

The substances restricted shall be:

A. Any liquid or vapor having a temperature in excess of one hundred fifty (150) degrees F (65 degrees C);

B. Any water or waste containing fats, wax, grease, or oils, whether emulsified or not, in excess of one hundred (100) milligrams per liter or containing substances which may solidify or become viscous at temperatures between thirty-two (32) and one hundred fifty (150) degrees F. (zero (0) and sixty-five (65) degrees C.);

C. Any garbage that has not been ground or comminuted to such degree that all particles will be carried freely in suspension under flows normally prevailing in the public sewers, with no particles greater than one-half inch in any dimension;

D. Any water or wastes containing strong acid, iron pickling wastes, or concentrated plating solutions, whether neutralized or not;

E. Any water or wastes containing phenols or other taste or odor producing substances which constitute a nuisance or hazard to the structures, equipment, or personnel of the sewage works, or which interfere with the treatment required to meet the requirements of the State or Federal Government, or any other public agency with proper authority to regulate the discharge from the sewage treatment plant;

F. Any radioactive wastes or isotopes of such half-life or concentration that they are not in compliance with regulations issued by the appropriate authority having control over their use or may cause damage or hazards to the treatment works or personnel operating it;

G. Any water or wastes having a pH in excess of 9.5;

H. Materials which exert or cause:

1. Unusual concentrations of suspended solids, (such as, but not limited to, Fuller's earth, lime slurries, and lime residues) or of dissolved solids (such as, but not limited to, sodium chloride or sodium sulfate);

2. Excessive discoloration (such as, but not limited to, dye wastes and vegetable tanning solutions);

3. Unusual BOD, chemical oxygen demand, or chlorine requirements in such quantities as to constitute a significant load on the wastewater treatment works;

4. Unusual volume of flow or concentration of wastes constituting a slug;

5. Water or water containing substances which are not amenable to treatment or reduction by the sewage treatment processes employed, or are amenable to treatment only to such degree that the sewage treatment plant effluent cannot meet the requirements of the NPDES Permit, or requirements of other governmental agencies having jurisdiction over discharge from the sewage treatment plant;

810.06 Response to Improper Discharge. If any water or wastes are discharged, or are proposed to be discharged directly or indirectly to the public sewers, which water or wastes do not meet the standards set out in or promulgated under this Section, or which in the jurisdiction of the City may have a deleterious effect upon the treatment works, processes, equipment, or receiving waters, or which otherwise create a hazard to life, or constitute a public nuisance, the City may take all or any of the following steps:

A. Refuse to accept the discharges;

B. Require control over the quantities and rates of discharge;

C. Require pretreatment to an acceptable condition for the discharge to the public sewers. The design and installation of the plant and equipment for pretreatment of equalization of flows shall be subject to the review and approval of the City, and subject to the requirements of 40 CFR 403, entitled "Pretreatment Standards", and the Minnesota Pollution Control Agency.

D. Require payment to cover the added cost of handling or treating the wastes;

810.07 Interceptors. Grease, oil, and mud interceptors shall be provided when they are necessary for the proper handling of liquid wastes containing floatable grease in excessive amounts, as specified in this Chapter, or any flammable wastes, sand, or other harmful ingredients; except that such interceptors shall not be required for private living quarters or dwelling units. All interceptors shall be of a type and capacity approved by the City and shall be located as to be readily and easily accessible for cleaning and inspection.

810.08 Operation and Inspection. Where preliminary treatment flow equalization or inter-ceptors are required for any water or waste, they shall be effectively operated and maintained continuously in satisfactory and effective condition by the owner at his or her expense and shall be available for inspection by the City at all reasonable times.

810.09 Testing.

Subd. 1 Required. When required by the City, the owner of any property serviced by a building sewer carrying industrial wastes shall install a suitable control structure together with such necessary meters and other appurtenances in the building sewer to facilitate observation, sampling, and measurement of the wastes. Such structure and equipment, when required, shall be constructed at the owner's expense in accordance with plans approved by the City and shall be maintained by the owner so as to be safe and accessible at all times.

Subd. 2 Standards. All measurements, tests, and analyses of the characteristics of water and waste to which reference is made in this Chapter shall be determined in accordance with 40 CFR 136 "Guidelines Establishing Test Procedures for the Analysis of Pollutants"; the latest edition of Standard Methods For the Examination Of Water and Wastewater, and shall be determined at the control structure provided, or upon suitable samples taken at the control structure. In the event that no special structure has been required, the control structure shall be considered to be the nearest downstream manhole in the public sewer from the point at which the building sewer is connected. Sampling shall be carried out by customarily accepted methods to reflect the effluent constituents and their effect upon the treatment works and to determine the existence of hazards to life, health and property. Sampling methods location, times, duration, and frequencies are to be determined on an individual basis subject to approval by the City.

810.10 Industrial Waste.

Subd. 1 General. The owner of any property serviced by a building sewer carrying industrial wastes shall, at the discretion of the City, be required to provide laboratory measurements, tests, and analyses of waters or wastes to illustrate compliance with this Chapter and any special condition for discharge established by the City or regulatory agencies having jurisdiction over the discharge. The number, type, and frequency of sampling and laboratory analyses to be performed by the owner shall be as stipulated by the City. The industry must supply a complete analysis of the constituents of the wastewater discharge to assure that compliance with the Federal, State and local standards are being met. The owner shall bear the expense of all measurements, analyses and reporting required by the City. At such times as deemed necessary the City reserves the right to take measurements and samples for analysis by an outside laboratory.

Subd. 2 Special Agreement. No statement contained in this Chapter shall be construed as preventing any special agreement or arrangement between the City and any industrial concern whereby an industrial waste of unusual strength or character may be accepted by the City for treatment, subject to payment therefore by the industrial concern, in accordance with applicable ordinances and any supplemental agreements with the City.

810.11 Building Sewers and Connections.

Subd. 1 Private Sewer Lines.

A. It shall be unlawful for any person to engage in the work or business of installing private sewer service lines and appurtenances for others without a license therefore from the City.

B. Any person desiring to engage in such work shall make application to the City on forms to be supplied by the City together with a fee in the amount set out in the fee schedule. All licenses issued shall be for one (1) calendar year only and each renewal shall be made by application together with the annual fee as established in the fee schedule.

C. Each applicant for license shall sign an agreement on such form as may be delivered by the City agreeing to pay the City the actual cost of repair for any damage caused to the City sewer system by the applicant, or by any of his or her employees or agents. This agreement shall accompany the license application.

D. Each applicant shall accompany his or her application with a certificate of insurance in a company acceptable to the City showing public liability insurance coverage with limits of at least $100,000 per person, $300,000 per occupance, and $100,000 for property damage. The certificate shall specifically state that the insurance covers underground construction operations and shall contain a provision that the coverage afforded under the policies shall not be canceled or materially changed until at least fifteen (15) days prior written notice has been given to the City.

Subd. 2 Connection to City Sanitary Sewer. No person, unless authorized by a written permit from the City, shall make, install, repair, alter, disturb, uncover, open, or break any sewer connection to the sanitary sewer system of the City. Permits for connection of a new sewer service or repairs to an existing service shall be issued by the City after consideration of the application for the permit with regard to compliance with other Subdivisions of this Chapter. Permits shall be issued in the following manner:

A. Application for a permit to perform work on a sewer service connection within the City shall be made on a form supplied by the City by the person or firm who will be performing the work to the City along with a fee as set in the fee schedule for the installation of a new connection. The City may waive the fee requirements for repair work. The person or firm performing the work shall be licensed to perform such work by the City.

B. After approval of the permit application by the City, the applicant shall furnish to the City a performance bond in the amount of $5,000.00. The performance bond shall be for the good and faithful performance of all work on public property relative to the work being performed. The bond shall be payable to the City of Big Lake. The bond shall warrant the work for a period of one year from the date of completion.

C. The City shall issue a permit for the work after the application is approved and the bond is received, and in all instances where the property or parcel was not assessed for a Residential Equivalency Charge for Project 1976-1, which assessment roll was adopted by the Council September 9, 1981, after payment of such other sum as the Council may from time to time establish in the fee schedule the payment being in lieu of the REC assessment.

Subd. 3 Costs. All costs and expenses incidental to the installation and connection of the building sewer or repairs to an existing connection shall be borne by the owner. The owner shall indemnify and hold harmless the City from any loss or damage to the public sewer that may directly or indirectly be occasioned by the installation of the building sewer.

Subd. 4 Independent Sewers. A separate and independent building sewer shall be provided for every building except where two or more buildings are situated on one parcel such that the parcel may not be subdivided. A joint use private sewer may be extended to the rear building or buildings and the whole considered as one joint use private sewer provided the buildings are the property of a single owner. Special variances will be considered by the City.

Subd. 5 Old Sewers. Old building sewers may be used in connection with new buildings only when they shall be found, upon examination and testing by the City, to meet all requirements of this Chapter.

Subd. 6 Standards. The size, slope, alignment, and materials of construction of a building, sewer and the method used in excavating, placing of the pipe, jointing, testing and backfilling the trench shall all conform to the requirements of the building code and plumbing code or other applicable rules and regulations. In the absence of code provisions, or in amplifications thereof, the materials and procedures set forth in appropriate specifications of the "Water Pollution Control Federation (W.P.C.F.) Manual of Practice No. 9" and the American Society for Testing Materials (A.S.T.M.) Standards shall apply.

Subd. 7 Elevation. Whenever possible the building sewer shall be brought to the building at an elevation below the basement floor. In all buildings in which any building drain is too low to permit gravity flow to the public sewer the building drain shall be provided with a lifting device by an approved means and discharged to the building sewer.

Subd. 8 Illegal Cross-Connections. No person shall make connection of roof downspouts, roof drains, exterior foundation drains, areaway drains, sump pumps, drain tile, swimming pool discharge, or other sources of surface runoff or groundwater to a building sewer or building drain which, in turn, is connected directly or indirectly to a public sanitary sewer, nor shall any such connection be made directly to the sanitary sewer system. All illegal cross-connections shall be disconnected by the owner within two weeks of receiving notice of the unlawful connection from the City, and if the owner shall fail to make the disconnection, the City shall disconnect the illegal cross-connection and assess the costs back to the property. Cross connections may be allowed where storm water or ground water discharge would create a safety hazard during freezing weather. Exceptions shall be granted on a case by case basis as determined by the Council.

Subd. 9 Plumbing Code. The construction of the building sewer and its connection into the public sewer shall conform to the requirements of the State of Minnesota Plumbing Code, the sewer specifications included herein, and other applicable rules and regulations and procedures adopted by the City. All such construction shall be made gas tight and watertight. Any deviation from the prescribed procedures and materials must be approved by the City prior to installation.

Subd. 10 Inspection. Employees of the City shall be allowed to inspect the work at any stage of construction and, in any event, the applicant for the permit shall notify the City when the work is ready for final inspection and no underground portions shall be covered before the final inspection is complete. The connection shall be made under the supervision of the City or its representative.

Subd. 11 Excavations. All excavations for building sewer installations shall be adequately guarded with barricades and lights so as to protect the public from hazards. Streets, sidewalks, parkways and other public property disturbed during the course of the work shall be restored in a manner satisfactory to the City.

810.12 Main and Lateral Sewer Construction.

Subd. 1 Authorized Personnel. No person, unless authorized shall uncover, make any connection with or opening into, use, alter, or disturb any sanitary or storm sewer within the City or any part of the City wastewater facilities.

Subd. 2 Sanitary and Storm Construction. No sanitary or storm sewers shall be constructed in the City (except house or building service sewers) except by the City or by others in accordance with plans and specifications approved by a professional engineer. No such sewers shall be constructed or considered to be part of the public sewer system unless accepted by the City.

Subd. 3 Standards. The size, slope, alignment, material of construction, methods to be used in excavation, placing of pipe, jointing, testing, backfilling, and other work connected with the construction of sewers shall conform to the requirements of the City.

810.13 Protection from Damage. No unauthorized person shall maliciously, willfully, or negligently break, damage, destroy, uncover, deface, or tamper with any structure, appurtenance, or equipment which is part of the wastewater facilities.

810.14 Sump Pumps. All sump pumps shall have a discharge pipe installed to the outside wall of the building with one inch (1") minimum diameter, with union or other couplings for easy pump disconnection or repair and replacement. The pipe attachments shall be rigid and permanent. The discharge shall extend at least three feet (3') outside of the foundation wall and shall be directed toward the front or rear yards of the property. All new construction having a sump basket shall have permanent piping installed to the sump basket with permanent fittings and discharged to the outside of the foundation wall as described in this Chapter. Such work shall be completed prior to the final building inspection and issuance of a Certificate of Occupancy.

810.15 Backfilling. It shall be recommended that unused septic tanks, cesspools, leaching pits, and similar devices and structures shall be backfilled or made safe and unusable in a manner acceptable to the City.

810.16 Authority of Inspectors.

Subd. 1 Entering Property. Duly authorized employees of the City shall be permitted to enter all properties for the purpose of inspection, observation, confirmation that illegal connections are not present, measurement, sampling, and testing in accordance with the provisions of this Section. Those employees shall have no authority to inquire into processes including metallurgical, chemical, oil, refining, ceramic, paper, or other industries except as is necessary to determine the kind and source of the discharge to the public sewer. Each property may be inspected at least once per year, even if found in compliance.

Subd. 2 Safety Rules. While performing the necessary work on private property as referred to in Subd. 1 of this Subsection, the authorized employees of the City shall observe all safety rules applicable to the premises.

Subd. 3 Easements. Duly authorized employees of the City shall be permitted to enter all private properties through which the City holds easements for the purpose of, but not limited to, inspection, observation, maintenance, and construction of public sewers.

Subd. 4 Surcharge. Any person refusing to allow their property to be inspected shall be subject to a surcharge as provided in the City fee schedule. The surcharge shall in no way restrict the City's right to seek an injunction in court ordering the necessary connections or disconnections to the sewer system, or from pursuing any other legal remedy.

810.17 Rates. Sewer rates shall be as established by the Big Lake City Council in the fee schedule.

810.18 Billing Payment. All rates and rents for sewer use shall be charged directly to the owner of the real estate on which the sewer use occurred and billings paid by owners within thirty (30) days after period of use. Bills shall be paid promptly when due at the office of the City Administrator or to the utility billing contractor. The City Administrator shall, in case bills are not paid when due, add a penalty identified in the City Fee Schedule to the amount of the bills and collect the bills. In case of a failure to pay the bills by the fourth month, notice shall be given by mail to the owner of the real estate upon which the sewer use occurred, and if the bill shall not have been paid, the amount of the bill shall be certified to the County Auditor, to be included with the taxes against the real estate involved and to be collected therewith. In addition, after notice to the owner and resident of the premises, the City may proceed with shutting off the water supply to the premises as provided in subsection 800.20 of this Code. (Ord. 2004-31, 10/27/04).

810.19 Payment Dates. The rates and rents shall be payable when due. The rates and rents for users of the City shall be due monthly. (Ord. 2004-31, 10/27/04).

810.20 Violations.

Subd. 1. Any person found to be violating any provisions of this Section shall be served by the City with written notice stating the nature of the violation and providing a reasonable time limit for the satisfactory correction thereof. The offender shall within the time period stated in such notice permanently cease all violation.

Subd. 2. Any person who shall continue any violation beyond the time limit provided for in the written notice shall be guilty of a misdemeanor. Each day in which any such violation shall continue shall be deemed a separate offense.

Subd. 3. Any person violating any of the provisions of this Section shall become liable to the City for any expense, loss or damage occasioned by the City by reason of the violation.

Section 820 – Storm Water Drainage Utility

820.01 Name. This utility shall be called the Storm Water Drainage Utility in and for the City of Big Lake. The Storm Water Drainage Utility shall be operated as a public utility pursuant to the City Charter, City Code, and applicable statutes. The revenues there from shall be derived subject to the provisions of this Ordinance and Chapter 444, Minnesota Statutes.

820.02 Purpose. The purpose of the Storm Water Drainage Utility is to manage and fund the construction and maintenance of the storm water drainage system in the City of Big Lake. The Storm Water Drainage Utility will not be established for the purpose of financing past due debt or generating a return on investment for the City of Big Lake.

820.03 Definitions. The following terms shall have the definitions as hereinafter stated with respect to the construction and interpretation of this Ordinance:

Subd. 1 Construction. Construction shall mean the improvements to the storm water system in areas not previously served with lateral and trunk lines.

Subd. 2 Maintenance. Maintenance shall include direct and indirect costs as well as equipment costs for repairs and cleaning. Cleaning includes catch basin cleaning, jetting, thawing pipes, and any other operation which assures a dependable drainage system. It shall also include the administrative costs.

Subd. 3 Reconstruction. Reconstruction shall mean the improvements made to the storm water drainage system in areas previously served with lateral and trunk lines.

Subd. 4 Administrative. Administrative costs as associated with acquiring and maintaining the necessary contour maps which define the watershed in and for the City of Big Lake. Also included shall be periodic planning and engineering studies which shall determine the adequacy and condition of the storm sewer drainage system.

Subd. 5 Developed Land. The term developed land is land which has been platted. Undeveloped land is any land which has not been platted.

820.04 Storm Water Drainage Fees.

Subd. 1 Billing Schedule. Storm water drainage fees for each land parcel shall be implemented as part of the typical utility billing schedule, which is on a monthly basis.

Subd. 2 Zoning Rate Schedule. The following Zoning Rate Schedule shall be used to calculate Storm Water Drainage Fees for each parcel of land as follows:

A. B-1; Business Campus District - REF Multiplier = 1.25
B. B-2; Community Business District – REF Multiplier = 2

E-4 – Significant Industrial User Agreements

Signed Final

INDUSTRIAL WASTEWATER TREATMENT AGREEMENT CARGILL, INCORPORATED

THIS INDUSTRIAL WASTEWATER TREATMENT AGREEMENT (this "Agreement") is made and entered into this 28th day of June, 2017, by and between the City of Big Lake, Minnesota, a municipal corporation, (hereinafter referred to as the "City") and the Cargill Kitchen Solutions, Inc. business unit of Cargill, Incorporated, a corporation organized under the laws of the State of Delaware (hereinafter referred to as "Cargill Kitchen Solutions" or the "Company").

WHEREAS, the City is the owner and operator of a Wastewater Treatment Plant (hereinafter the "Plant") located within the City of Big Lake, County of Sherburne, and State of Minnesota, which has controlled and permitted discharge to the Mississippi River, and

WHEREAS, the City holds a NPDES operating permit (Number MN. 0041076) for the Plant as a part of the national and state disposal permit program administered by the Minnesota State Pollution Control Agency under the Clean Water Act as amended (33 USC 1251) MSA Chapters 115 and 116, and amended by Minnesota Rules Chapter 7701, and

WHEREAS, Cargill Kitchen Solutions operates a food processing facility (the "Facility") which discharges wastewater into the City's municipal sanitary sewer system for treatment at the City's Plant pursuant to a Industrial Wastewater Treatment Agreement, executed September 27,2006,, by and between the City and Cargill Kitchen Solutions (formerly Sunny Fresh Foods) (the "2006 Agreement"), and

WHEREAS, because under definitions set forth in the NPDES operating permit for the plant, Cargill Kitchen Solutions is within the definition of a significant industrial user, the City is required to prepare, execute, and maintain an industrial wastewater treatment agreement with Cargill Kitchen Solutions as a significant industrial user.

WHEREAS, the 2006 Agreement is set to expire September 2016, the City and Cargill Kitchen Solutions hereby execute this Agreement, which shall amend and supersede all terms of the 2006 Agreement.

NOW THEREFORE, in consideration of the foregoing premises and the mutual covenants and promises hereinafter set forth the parties hereto agree as follows.

ARTICLE I. DEFINITIONS

As used in this Agreement, unless a different meaning clearly appears from the context:

A. "Act" - The Federal Water Pollution Control Act, also referred to as the Clean Water Act, as amended, 33. U.S.C. 1251 ET seq.

B. "Building Drain" - That point of a building, which conveys wastewater to the building sewer, beginning immediately outside the building wall.

C. "City" - The area within the corporate boundaries of the City of Big Lake, the City Council, its authorized representative, or the authorized representative of the sanitary sewer district.

D. "Industrial User"

(a) Any entity as defined in the Standard Industrial Manual (latest edition) as categorized that discharge wastewater to the public sewer.

Division A: Agriculture, Forestry and Fishing

Division B: Mining

Division D: Manufacturing

Division E: Transportation, Communications, Electric, Gas, and Sanitary Sewers

Division I: Services

(b) Any user whose discharges, singly or by interaction with other wastes:

- contaminate the sludge of the wastewater treatment system,
- injure or interfere with the treatment process,
- create a public nuisance or hazard,
- have an adverse effect on the waters receiving wastewater treatment plant discharges,
- exceed Normal Domestic Strength Waste (NDSW) limitations,
- exceed normal residential unit volumes of wastewater.

E. "Infiltration/Inflow (I/I)" - Water other than wastewater that enters the sewer system from the ground or from surface runoff, as defined in Minnesota Rules.

F. "MPCA" - Minnesota Pollution Control Agency.

G. "National Categorical Pretreatment Standards" - Federal regulations establishing pretreatment standards for introduction of pollutants in publicly owned wastewater treatment facilities. Section 307(b) of the Act.

H. "National Pollutant Discharge Elimination System (NPDES) Permit" - A permit issued by the MPCA, setting limits on pollutants that a permittee may legally discharge pursuant to Sections 402 and 405 of the Act.

I. "Normal Domestic Strength Waste"(NDSW) - Wastewater that primarily introduced by residential users with BOD5 concentrations not greater than 200 mg/l and total suspended solids (TSS) concentrations not greater than 200 mg/l.

J. "Non-residential User" - A user of the treatment facility whose building is not used as a private residence, and discharges NDSW.

K. "TP" means phosphorous which is contained in the wastewater. The methods for determining phosphorous limits shall be set forth in the latest edition of "Standard Methods".

L. "State Disposal System (SDS) Permit" - A permit issued by the MPCA pursuant to Minn. Stat. ' 115.07 for a disposal system as defined by Minn. Stat. ' 115.01, subd. 8.

M. "Significant Industrial User" - Any industrial user of the wastewater disposal system which (1) has a discharge flow of 25,000 gallons or more per average work day, or (2) has a flow or loading greater than 5 percent of the flow in the wastewater disposal system, or (3) has in its wastes toxic pollutants as defined pursuant to Section 307 of the Act or Minnesota Statutes and rules, or (4) has a significant impact, either singly or in combination with other contributing industries, on the wastewater disposal system, the quality of sludge, the system's effluent quality, or air emissions generated by the system.

N. "BOD" means 5-day carbonaceous biochemical oxygen demand, determined under standard laboratory procedures as set forth in the latest edition of Standard Methods for the Examination of Water and Wastewater, published jointly by the American Public Health Association, the American Water Works Association and the Water Environment Federation (Standard Methods).

O. "Cargill Kitchen Solutions' Allocated Share" shall mean the following quantity, quality and composition of constituents, which Cargill Kitchen Solutions will be entitled to discharge into the sewerage system on a daily basis:

(1.) Flow 60,000 gal. /day (calculated on the basis of calendar monthly average)
60,000 gal. /day (calculated on the basis of maximum daily)

(2.) BOD 600 lb./day (calculated on the basis of calendar monthly average)
600 lb./day (calculated on the basis of a maximum daily)

(3.) TSS 600 lb./day (calculated on the basis of calendar monthly average)

600 lb./day (calculated on the basis of a maximum daily)

(4.) pH Not less than 5.5 or greater than 9.5

(5.) TP 7 lb./day (calculated on the basis of monthly average)

The monthly and daily values presented above are based on production and clean-up days.

P. "Flow" means total sewage volume discharged to the sewerage system as measured by flow rate measurement equipment.

Q. "Industrial Waste" means any solid, liquid or gaseous substance discharged, permitted to flow or escaping from any industrial manufacturing process, trade or business into the sewerage system, except Sanitary Sewage.

R. "Sanitary Sewage" means a combination of water carried wastes from personal and domestic and water uses, such as bathroom and kitchen uses, from residences, business buildings, institutions and industrial plants, together with ground, surface and storm waters as may be present.

S. "Sewage" means Industrial Waste and Sanitary Sewage.

T. "Sewerage System" means all land, buildings, machinery, interceptor and sewers and other tangible and intangible property, whether now or later owned or used by the City for collecting, transmitting, treating or disposing of Sewage, but shall not include sewer laterals connecting users to the sewer mains of the City.

U. "TSS" means total suspended solids, which are solids that either float on the surface of, or are in suspension in Sewage, and which are removable by a laboratory filtration device. The methods for determining suspended solids shall be those set forth in the latest edition of Standard Methods.

V. "User" means any person partnership, corporation or other organization or entity, public or private, which discharges Sewage into the Sewerage System.

W. "Authorized Representative" means the person or persons designated by the City Council to represent the City on wastewater related issues.

X. "Upset Conditions" means that the wastewater treatment process has received flows, loadings or materials that causes the treatment process to not function properly and results in violations of the City's NPDES permit limits.

Y. "Catastrophic Event" means any event or occurrence, including, but not limited to damage or destruction of Cargill Kitchen Solutions' Facility, as shall interfere with and prevent the conduct of business at Cargill Kitchen Solutions' Facility and whether caused by: fire; earthquake; explosion; flood; tornado; the elements; acts of God or the public enemy; actions, restrictions, limitations or interference of governmental authorities or agents; war; invasion; insurrection; rebellion; or any other cause which is beyond the reasonable control of Cargill Kitchen Solutions.

ARTICLE II. AUTHORITY AND SCOPE

A. This Agreement is made pursuant to Article 10, Section 810 of the City of Big Lake's Public Sewer's Ordinance.

B. The language within the Articles of this Agreement shall have precedence over the language used within the Articles of the Wastewater Treatment Ordinance as long as all requirements and the clear written intent of the Wastewater Treatment Ordinance are satisfied.

ARTICLE III. COLLECTION AND TREATMENT

A. Cargill Kitchen Solutions may discharge Sewage to the Sewerage System, and the City will collect and treat, Cargill Kitchen Solutions' Sewage, as set forth in this Agreement.

B. Cargill Kitchen Solutions shall operate and maintain wastewater metering facilities in order to measure sewage flow on a continuous basis. The wastewater metering facilities shall be equipped with a flow volume totalizer. The control panel for Cargill Kitchen Solutions totalizer shall be secured in an enclosure. Cargill Kitchen Solutions shall record the daily flows and provide the City with a summary of the written daily flows and loading on a monthly basis during the terms of the Agreement. . All flow monitoring equipment shall be approved by the City Engineer.

C. Cargill Kitchen Solutions shall maintain a flow proportional sampler. The composite sampler shall be located at the Cargill Kitchen Solutions wastewater metering facility. Cargill Kitchen Solutions shall collect samples and such samples will be analyzed for the constituents listed in Section I.O. by a certified testing laboratory. The sampling method shall be flow proportional, 24-hour composite sampling. The frequency of sampling and testing shall be at once per production days. The frequency of sampling will be evaluated after 6 months and if the test results of the parameters show a consistent pattern, then the sample frequency will be reduced to an amount that is agreeable by both the City and Cargill Kitchen Solutions. In the event that the flow proportional sample should fail and a sample cannot be provided for a specific production day, Cargill Kitchen Solutions shall be charged based on the highest monthly loading for that current month for that specific production day. Cargill Kitchen Solutions shall maintain copies of all analyses and laboratory reports during the term of this agreement and make said reports available to the City for review during normal business hours upon two (2) business

days' notice. The City shall deliver to Cargill Kitchen Solutions copies of all correspondence, not within the attorney-client privilege or other privilege recognized by law, to or from the City, concerning violations or potential violations of this Agreement or the Wastewater Treatment Ordinance, within two (2) business days after the City sends or receives such correspondence.

Upon reasonable notice, the City shall have the right to observe the testing and sampling procedures utilized by Cargill Kitchen Solutions at the composite sampler site, and to split any samples collected by Cargill Kitchen Solutions for the City's own analysis at the City's sole cost and expense. The City shall have the right to collect its own samples at the wastewater metering facilities at the City's sole cost and expense.

D. The City will submit to Cargill Kitchen Solutions a written statement setting forth any violations of quality or quantity or composition of the Sewage the Company has discharged into the Sewerage System during the preceding billing report.

E. The City shall have the right of access to the wastewater metering facilities, during normal business hours, subject to reasonable sanitary and safety regulations of Cargill Kitchen Solutions. Cargill Kitchen Solutions shall make the City aware of such sanitary and safety regulations. The intent of this provision is to provide the City with free and unimpeded access during normal business hours, subject to the aforementioned reasonable sanitary and safety regulations of Cargill Kitchen Solutions, to the Facility's wastewater metering facilities.

F. Cargill Kitchen Solutions shall be responsible for maintaining and repairing the aforementioned wastewater metering facilities and shall calibrate said components to operate within the manufacturers' established limits of accuracy. Cargill Kitchen Solutions shall recalibrate the flow volume totalizer twice each year at the cost of the Cargill Kitchen Solutions. The City may request that the totalizer be calibrated at such other times as it may reasonably

suspect the meter is not within established calibrations. If the meter is found to be within five percent (5%) of its calibration level, the cost of the recalibration shall be reimbursed by the City.

G. No unpolluted water or storm water shall be discharged to the sanitary sewer. Such water shall be discharged only to storm sewers or to natural outlets approved by the City and other regulatory agencies.

H. Wastewater discharges of the following substances to the City shall be limited to concentrations or quantities, which will not materially harm the Plant, streams, soils, vegetation, ground water, and will not otherwise create a hazard or nuisance in violation of this Agreement or applicable laws. The City may set limitations lower than the prohibition limits outlined below following prior notice and discussion with the Facility. Consideration will be given to such factors as the quantity of waste in relation to flows.

(a) Wastewater having a temperature greater than 150° F (65.6° C), or causing, individually or in combination with other wastewater, the influent at the treatment facilities to have a temperature exceeding 104° F (40° C), or having heat in amounts which will be detrimental to biological activity in the treatment facilities.

(b) Objectively noxious or malodorous liquids, gases, or solids.

(c) Radioactive wastes or isotopes in concentrations that exceed limits established by applicable state and federal regulations.

ARTICLE IV. CHARGES

A. Cargill Kitchen Solutions agrees to pay certain "User Charges" to the City for discharging wastewater flows and loadings to the Plant. The User Charges will consist of a monthly "base charge" for the capital costs and a monthly "usage charge" for the operation,

maintenance and replacement costs. The monthly base charge shall be $18.10. The monthly base charge will be paid by Cargill Kitchen Solutions regardless of actual flow and loading parameters that are being discharged into the Plant. The usage charge will be determined based on actual flow and loading parameters that are discharged into the Plant. The usage charge will not include any discounts or averaging used to calculate charges under the City's Fee Schedule. The usage charges are presented below:

Flow	$7.32 per 1000 gallons
BOD	$0.17 per pound
TSS	$0.05 per pound
TP	$4.25 per pound

The base charge and usage charges may be reviewed annually and necessary adjustments made by the City with no more than an 8% increase annually.

C. The City shall publish public notice at least 30 days' prior to any proposed change to the City's usage charges for wastewater and provide opportunity for public notice and comment.

D. The User Charges shall be payable monthly within thirty (30) days after receipt of the City's User Charges bill to Cargill Kitchen Solutions.

E. Cargill Kitchen Solutions shall also pay the City a one-time Sewer Access Charge of $1,168,201. The Sewer access charge will be paid in a one-time lump sum payment to the City within thirty (30) days of this Agreement's date of execution. During the term of this Agreement, the City shall not assess any additional Sewer Access Charges on Cargill Kitchen Solutions. The parties acknowledge Cargill Kitchen Solutions' one-time lump payment of this Sewer Access Charge, rather than equal

payments over five years, is consideration for the City's agreement to forego further Sewer Access Charges as set forth in this paragraph. Notwithstanding the foregoing, if Cargill Kitchen Solutions exceeds Cargill Kitchen Solutions' Allocated Share of Flow discharge on three or more days per month for three consecutive months within the same calendar month, or if this agreement is renegotiated for any reason, the City may, upon notice to Cargill, charge an additional Sewer Access Charge.

F. Any surcharges or penalties incurred under Article VI of this Agreement shall be in addition to the base charge and usage charges, as set forth in Article IV.A of this Agreement, for allowable discharges under this Agreement.

ARTICLE V. TERM OF AGREEMENT

The Agreement is for a five (5) year period, beginning July 1, 2017, and will be renewed for an additional five (5) year period unless either of the parties provides the other with __90__ days prior written notice of its intent for this Agreement to terminate. Notwithstanding the foregoing, upon not less than two months advance notice, and to effectuate the sale of the Facility or of all or substantially all the assets of Cargill Kitchen Solutions, Cargill Kitchen Solutions may terminate this Agreement without penalty, including the obligation to pay usage charges pursuant to Article IV. The Agreement shall be effective upon each party's signing of this Agreement. The terms and conditions, other than those relating to rates, SAC, costs or any other expenses to be incurred by Cargill Kitchen Solutions, of this Agreement may be subject to renegotiation and modification during the term of the Agreement if limitations on discharge from the wastewater treatment facility, as set forth in the NPDES Permit, are modified. The City shall notify Cargill Kitchen Solutions of any such proposed change in this Agreement

at least 6 months prior to the effective date of change and negotiate in good faith to limit and minimize any changes to the Agreement to those required to support the NPDES modification. Cargill Kitchen Solutions agrees to periodically meet with the City and its representatives to discuss issues related to the operation of the Plant, the status of the physical equipment and any proposed usage charge rates. The City may terminate this Agreement for cause upon thirty (30) days written notice to Cargill Kitchen Solutions. If Cargill Kitchen Solutions exceeds Cargill Kitchen Solutions' Allocated Share of discharge on three or more days per month for three consecutive months, the City may upon notice to Cargill, renegotiate the usage charges to reflect actual flow and loading parameters that are being discharged into the Plant.

ARTICLE VI. SURCHARGES AND PENALTIES

A. In the event that the Facility's Sewage discharge exceeds Cargill Kitchen Solutions Allocated Share for any constituent as defined in Article I..O., the City shall impose the surcharges set forth below. The parties agree the City's assessment of surcharges, and Cargill Kitchen Solutions' payment of such surcharges, shall waive the need for or validity of any notice of violation of any terms of this agreement or Article 10, Section 810 of the City of Big Lake's Public Sewer's Ordinance.

B. Cargill Kitchen Solutions shall pay the City surcharges based upon the following rates for each constituent discharged in excess of the Cargill Kitchen Solutions' Allocated Share:

(1.) BOD $.34 per pound

(2.) TSS $.10 per pound

(3.) Flow $14.64 per 1000 gallons

(4.) pH $50.00 per day that the pH is less than 5.5 or greater than 9.5 as calculated on a daily average basis of samples collected

(5.) TP $8.50 per pound

Surcharge calculations shall be based each day on the pounds or flow of each constituent in excess of the maximum daily limit for that constituent. The surcharges shall apply to the mass discharged in excess of Cargill Kitchen Solutions' Allocated Share for BOD, TSS and TP for each date testing was performed that confirms a discharge in excess of the maximum daily limit. The surcharge shall apply to the Flow discharged in excess of Cargill Kitchen Solutions' Allocated Share for Flow. The flow and loadings shall be based on production and clean-up days. The surcharge rates shall increase automatically upon any increase of the corresponding usage charges and at all times the surcharge rates shall be in amounts that are double the corresponding usage charge rates applicable at that time.

Cargill Kitchen Solutions shall notify the City immediately by phone and within seven (7) days in writing, of any spill or discharge which may result in a violation of the limits stated in this Agreement or may cause Upset Conditions. To the extent the City receives any fines or penalties under its NPDES permit due to an Upset Condition, these fines or penalties will be assessed to Cargill Kitchen Solutions to the extent directly associated with a spill or discharge caused by the actions of Cargill Kitchen Solutions, as supported by reasonably certain data or events..

ARTICLE VII. MISCELLANEOUS PROVISIONS

A. The City will keep books, records and accounts in which complete entries shall be made available of all transactions and costs relating to the Sewerage System. The books, records and accounts shall at all reasonable times be subject to inspection and copying by any party to this Agreement. Cargill Kitchen Solutions may review such books and records upon request.

The City shall also provide to Cargill Kitchen Solutions such information regarding the design or other technical information regarding the Plant and its Sewerage System as Company may request from time to time.

B. The City and Cargill Kitchen Solutions warrant that each has right, title and authority to enter into this Agreement and to perform each and every term, covenant and condition in it.

C. The City and Cargill Kitchen Solutions agree that this Agreement constitutes the entire understanding of the parties hereto, and that no prior or contemporaneous oral or written understandings of the parties shall be applicable hereto except as specifically set forth herein. Nothing in this Agreement shall prohibit the City from adopting and enforcing ordinances rules or regulations providing for pretreatment of Sewage, exclusion of Sewage, or the establishing of sewerage user charges periodically, provided that no such action shall affect the Cargill Kitchen Solutions' rights or obligations hereunder.

D. Except as otherwise expressly provided hereunder, this Agreement may not be amended, changed or modified unless such amendment, change or modification is in writing and signed by both parties.

E. All notices, requests, demands and other communications hereunder shall be in writing and shall be deemed to have been given if and when delivered or mailed, postage prepaid, by certified or registered mail, or email to:

(1) City of Big Lake

Attn: Clay Wilfahrt , City Administrator
City of Big Lake
160 Lake Street North
Big Lake, MN 55309

(2) Cargill Kitchen Solutions

Attn: Facility Manager
20021 176th Street
Big Lake, MN 55309

F. This Agreement shall be governed by and construed in accordance with the laws of the State of Minnesota. Subject to Article VIII.J below, the remedies provided in this Agreement are not exclusive of any other rights or remedies that might be available to the parties at law or in equity.

G. This Agreement shall bind and inure to the benefit of the parties and their respective successors and assigns, except as herein limited.

H. Any provision of this Agreement, which is prohibited or unenforceable in any jurisdiction, shall, as to such jurisdiction, be ineffective to the extent of such prohibition or unenforceability without invalidating the remaining provisions hereof or affecting the validity or enforce ability of such provision in any other jurisdiction.

I. Cargill Kitchen Solutions agrees to indemnify, defend and hold the City and its officers, employees, and agents harmless from any and all loss, cost, damage and expense (including reasonable attorney's fees and court costs) resulting from, arising out of, or incurred by reason of any claims, actions or suits based upon or alleging property damage or noncompliance with state of federal regulations arising out of or resulting from Cargill Kitchen Solutions' operations, duties or responsibilities under this Agreement.

J. If a dispute occurs between Cargill Kitchen Solutions and the City regarding monitoring data or either party's interpretation or use under the Agreement, Cargill Kitchen Solutions may request the City obtain an opinion from its consulting engineer regarding such

dispute. Upon the request of Cargill Kitchen Solutions, the City shall, at its sole cost, provide the opinion of its consulting engineer to Cargill Kitchen Solutions in an attempt to resolve the dispute and, at its sole cost, Cargill Kitchen Solutions may provide an opinion of its third-party consulting engineer for mutual consideration.

K. If a dispute continues to occur between Cargill Kitchen Solutions and the City, after invoking Article VII.J, an independent professional engineer experienced in municipal sanitary engineering not regularly within the employ of the either the City or Cargill Kitchen Solutions shall be mutually agreed upon and designated by the City and Cargill Kitchen Solutions to review the matter in dispute and issue a technical opinion thereof. The City and Cargill Kitchen Solutions shall agree on the selection of such engineer. If the technical opinion of the independent professional engineer substantially conforms to the opinion of the City and its consulting engineer, the cost for such review shall be borne in its entirety by Cargill Kitchen Solutions. If the technical opinion by the independent professional engineer substantially conforms to the position of Cargill Kitchen Solutions, or its third-party engineer or consultant, if any, the cost for such review shall be borne in its entirety by the City.

Any other dispute arising in connection with this Agreement may be settled by binding arbitration conducted in accordance with the rules of the American Arbitration Association if the City and Cargill Kitchen Solutions then mutually-agree to arbitrate such dispute.

WITNESS WHEREOF the parties have hereunto executed this agreement the date and year first above written.

CITY OF BIG LAKE

By Raeanne Danielowski,
Mayor Raeanne Danielowski

By _____,
City Administrator Clay Wilfahrt

CARGILL, INCOPORATED
Cargill Kitchens Solutions

By _____,

Title: VP of Engineering

PAO Loe
Environmental Specialist

Kurt Zweifel KDZ
Operations Lead

Appendix F

Solicitation for Public Comments

F-1 – Affidavit of Public Notice for Public Hearing
F-2 – Meeting Minutes for Public Hearing
F-3 – Public Hearing Presentation
F-4 – Resolution Approving Wastewater Treatment Facilities Plan
F-5 – State Environmental review process (SERP) Mailing List

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Building a Better World for All of Us®

Sustainable buildings, sound infrastructure, safe transportation systems, clean water, renewable energy and a balanced environment. Building a Better World for All of Us communicates a company-wide commitment to act in the best interests of our clients and the world around us.

We're confident in our ability to balance these requirements.

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