VIRTUAL SEWER AND WATER UTILITIES COMMITTEE MEETING AGENDA

Tuesday, March 10, 2026 at 1:00 P.M.

This meeting will be conducted electronically via "Zoom" video conferencing software.

To access the meeting electronically, click:
https://zoom.us/j/4439901723?pwd=yAVpi40M1OIqgNufcVUE8XWCUSkKaH.1&omn=97063638580
Meeting ID: 443 990 1723 Passcode: 304078
To connect by phone: 1-301-715-8592 - Meeting ID 443 990 1723#
For additional information check: http://www.sisterbaywi.gov

AGENDA

1. Call Meeting to Order
2. Roll Call
3. Approval of Agenda
4. Approval of Minutes of the February 10, 2026 Meeting, as Published
5. Comments, Correspondence and Concerns from the Public
6. Discussion/Action Items:
    a) Facilities Study Discussion and Recommendation
    b) Non-Potable Reuse System - Expansion Tanks WWTP
    c) Wastewater Treatment Plant Operations Report
7. Matters to be placed on a future agenda or referred to a committee, official, or employee
8. Adjournment

Public Notice

Questions regarding the nature of the Agenda items or more detail on the items listed can be directed to Megan Barnes, Utilities Director, at megan.barnes@sisterbaywi.gov. It is possible that members of and possibly a quorum of members of other governmental bodies may attend the meeting to gather information; no action will be taken by any governmental body other than the body specifically referred to above. Upon reasonable notice, a good faith effort will be made to accommodate the needs of disabled individuals through sign language interpreters or other auxiliary aid or accommodation at no cost to the individual. Due to the difficulty in finding interpreters, requests should be made as far in advance as possible, preferably a minimum of 48 hours. For additional information or to request this service, contact the Sister Bay Village Administration Office at 854-4118, (FAX) 854-9637, or by writing to the Village Administration Building, 2383 Maple Drive, PO Box 769, Sister Bay, WI 54234. Copies of reports and other supporting documentation are available for review at the Village Administration Building during operating hours (8 a.m. – 4 p.m. Monday – Thursday and 8 a.m.-12 p.m. Friday).

The Village of Sister Bay is an Equal Opportunity Provider and Employer.

POSTED DATE/SIGNATURE____________________________

Sewer and Water Utilities Committee Meeting Minutes
Tuesday, February 10, 2025 at 1:00P.M.
Via Video Conference
(Unapproved)

1. Call Meeting to Order
The Sewer and Water Utilities Committee meeting was called to order by Chairperson Denise Bhirdo on Tuesday, February 10, 2026 at 1:02 PM.

2. Roll Call
A roll call was conducted, with the following members present: Chairperson Denise Bhirdo and members Nate Bell, and Kurt Harff.

Staff present: Utilities Director Megan Barnes, Village Administrator Benjamin Andrews and Administrative Assistant Sarah Bertges

Others: Harlan Davis, Scott Davis, Chad Olsen

3. Approval of Agenda
Motion by Bell, second by Harff, to approve the agenda as presented. Motion carried - all ayes.

4. Approval of Minutes of the December 9, 2025 Meeting, as Published
Motion by Bell, second by Harff, to approve the meeting minutes as presented. Motion carried - all ayes.

5. Comments, Correspondence and Concerns from the Public
There were no public comments.

6. Discussion/Action Items
a. Reed Bed Presentation
Harlan Davis and Scott Davis from Constructed Wetland Groups (formerly Reed Bed Systems) presented information on reed bed systems for biosolids management. Chad Olsen from McMahon was also present for the discussion.
Harlan Davis provided historical background on the company, noting it has been in operation for 40 years with 500+ projects across approximately 40 states, installing over 10 million square feet of constructed wetlands. He explained that the technology originated from research at the Max Planck Institute in Germany in the 1950s and 1960s, was patented in 1972, and has been continually refined since.
Scott Davis explained the operational benefits of reed beds:
- The systems reduce biosolid volume by 90-95% over a 10-year period through dewatering and mineralization of organic components
- Multiple beds (typically 6-9) are used to ensure even distribution and allow for rotation during cleanout
- Plants create pathways for drainage and transpire water, enabling more frequent sludge application than conventional drying beds
- Cold climates like Wisconsin actually benefit from the freeze-thaw action which enhances dewatering
- The systems can handle thicker sludge (2-3.7% solids) but may work better with slightly less polymer usage

When asked about specific requirements for Sister Bay, Scott Davis confirmed that McMahon's estimate of approximately one acre (44,000 square feet) for reed beds would be sufficient for Sister

Bay alone, with additional area (about 63-64,000 square feet total) if including other municipalities. The preliminary plan included 6 beds for Sister Bay and 3 additional beds for other communities. Committee members asked several questions:

- Bhirdo inquired about the configuration of multiple beds versus one large bed, with Scott Davis explaining that multiple beds allow for better management and phased cleanout
- Bell asked about leak prevention, with Scott Davis confirming the systems use 40 mil polypropylene liners with no history of leaks
- Bell also asked about alternatives to burning the reeds during maintenance, with Davis explaining that cutting and composting the reeds on site is a common alternative
- Bhirdo asked about ammonia concerns, with Davis clarifying that Sister Bay's aerobic treatment process already addresses ammonia issues before the biosolids reach the reed beds

The committee discussed potentially visiting Egg Harbor's reed bed installation for a firsthand look at the technology, particularly after the April election when new utility committee members would be in place.

b. Hwy-57 Trail-Utilities Infrastructure Discussion

Barnes presented plans for water and sewer infrastructure along Highway 57. The original plan had scheduled installation in two phases - the northern portion in 2026 and the southern portion with a lift station in 2027. However, with the trail installation potentially happening in fall 2027, there was an opportunity to complete both phases before trail construction.

Barnes explained that the total project cost would be approximately $921,633 for the pipe installation plus an estimated $1-3 million for the lift station. The project would service several properties along the highway, including both developed and undeveloped parcels.

Barnes noted that property owners would be required to connect to utilities once they abut their property, and that assessments for undeveloped properties could be deferred until development occurs or the property is sold. The assessment would include interest on the unpaid balance.

Bhirdo questioned the total project cost, noting she thought it was a $4 million project. Barnes clarified that the lift station represents a significant portion of the total cost.

Bell inquired about coordination with trail construction, asking if utilities and trail work could be done simultaneously to save costs. Staff explained that while theoretically possible, different funding requirements, bidding processes, and construction timelines make perfect coordination challenging, though they would attempt to minimize disruption.

Committee members generally supported moving forward with the accelerated timeline to complete both phases before trail construction, noting that this would open more opportunities for development and create a water main loop in the future.

Motion by Bell, second by Harff, to refer the Highway 57 utilities infrastructure project to the Finance Committee. Motion carried - all ayes.

c. Revised Land Lease Discussion

Barnes presented an updated land lease agreement for the prior land spreading site, incorporating the committee's previous recommendation to reduce the annual payment to $300. The committee discussed additional terms to include in the lease:

- Committee members emphasized that corn should not be allowed to be planted on the property
- The committee discussed whether to add a CPI escalator to the lease amount, ultimately deciding to add the lease fee to the village's fee schedule for annual review
- Barnes suggested specifying the land be used for hay production only, which would address concerns about corn planting and simplify other restrictions

The committee directed staff to update the lease agreement to specify hay production only and to add the lease fee to the village's fee schedule for annual review.

d. Wastewater Treatment Plant Operations Report

The Utilities Director, Megan Barnes provided a brief operations update:

- Staff had been addressing numerous frozen services during the recent cold snap
- Sludge hauling was reduced from 480,000 gallons the previous year to 400,000 gallons this year
- Changes to the polymer concentration in the sludge concentrator improved solids concentration to 3.7%
- Operational changes in routing influent through the flow equalization basin provided more hydraulic retention time, enabling biological phosphorus removal and reducing chemical usage
- Well rehabilitation has begun on well 1, with an expected two-week timeframe
- There are 16 well permit renewals this year
- The Eagle Mechanical water and sewer extension has been completed, with televising to be done in spring

Bell inquired about a property owner's complaint related to the Eagle Mechanical project. Barnes explained that trees had been damaged and soil pushed onto a property during construction, but arrangements have been made with the contractor to replace trees and properly grade the area in spring.

7. Matters to be placed on a future agenda or referred to a committee, official, or employee

The committee agreed to hold a meeting next month to discuss and make a recommendation regarding the sludge management options presented (dryer system and reed beds).

8. Adjournment

Motion by Bell, second by Harff, to adjourn at 2:50 PM. Motion carried - all ayes.

Respectfully submitted by Sarah Bertges, Administrative Assistant.

STAFF REPORT

Date: March 10, 2026

To: Sewer and Water Utility Committee

Re: Facility Assessment, Feasibility Study, and Long-Term Planning for the WWTP

Author(s): Megan Barnes, Utilities Director

Action(s) Requested: ☐ Ordinance ☐ Resolution ☒ Motion ☐ Receive/File

POLICY ISSUE(S)

"Should the Sewer and Water Utility Committee recommend for Village Board adoption, the completed Facility Assessment, Feasibility Study, and Long-Term Planning for the Wastewater Treatment Facility, with a recommendation as to which one of the three sludge processing projects outlined in the study to be pursued and implemented"

BACKGROUND INFORMATION

In 2024, the Village received notice from Sturgeon Bay Utilities (SBU) that their WWTP facility would be undergoing a large-scale biosolids treatment train upgrade in 2025. Due to the upgrade, the SBU facility would not be able to accept sludge from any of the northern door communities for the entire year of 2025, due to them only having the capacity to treat their own sludge produced once the upgrade started. NEW Water in Green Bay agreed to accept the sludge produced by Sister Bay for 2025, with the intent that the acceptance would be temporary, not indefinite.

In 2024, the Wisconsin Department of Natural Resources published a Guidance Document for PFAS in Biosolids.

The sludge handling and processing issues and discussions have been occurring since 2014 when Robert E. Lee was contracted to perform a Sludge Handling Study. With the SBU facility upgrade and recent biosolids PFAS limitations currently being explored by the Wisconsin Department of Natural Resources, the Village decided to compose and release an RFP to have an engineering firm complete a Facility Assessment, Feasibility Study, and Long-Term Planning for the Wastewater Treatment Facility.

In fall of 2025, SBU informed the Village that their upgrade was significantly delayed due to back-ordered equipment necessary for the upgrade. SBU communicated that the northern door communities would again have to secure alternative sludge disposal options for 2026.

Acceptance was gained at the NEW Water facility for an additional year of sludge disposal services at that facility.

In December of 2025, the Village was notified by SBU that as part of the renewal of their Wisconsin Pollutant Discharge Elimination System (WPDES) Permit, the Department would be imposing additional limitations on discharge pollutants governing perfluorooctanoic acid (PFOA) and perfluorooctanoic sulfonic acid (PFOS). To meet the WPDES requirements, SBU will be required to monitor and sample all facility contributors. As a significant biosolids contributor to the SBU WWTP, annual monitoring, testing, and reporting of perfluoroalkyl and polyfluoroalkyl compounds (PFAS), including PFOS compounds are required as part of the ongoing acceptance of the Village's municipal sludge.

The Village proactively sampled the sludge for PFAS in April of 2025. The results came back with PFOA at 16.2 ng/g and PFOS at 21.3 ng/g. A combined concentration of 37.3 ng/g, which is equal to 37.3 µg/kg. Under the current DNR Guidance, the Village falls under the criteria, sum of PFOA and PFOS values generally above 20 µg/kg, but below 50 µg/kg.

PRIOR ACTION/REVIEW

January 9, 2025: A Request for Proposals was issued for Facility Assessment, Feasibility Study, and Long-Term Facilities Planning for the Wastewater Treatment Facility.

February 11, 2025: Sewer and Water Utility Committee reviewed the received RFPs. A recommendation was made to the Village Board that McMahon Associates, Inc., be awarded the contract for the Facility Assessment, Feasibility Study, and Long-Term Facilities Planning of the Wastewater Treatment Facility.

February 18, 2025: Village board approved the contract with McMahon Associates, Inc. to complete the Facility Assessment, Feasibility Study, and Long-Term Facilities Planning of the Wastewater Treatment Facility of the Wastewater Treatment Plant.

September 9, 2025: Sewer and Water Utility Committee received a presentation from McMahon Associates, Inc. on the completed Facility Assessment, Feasibility Study, and Long-Term Facilities Planning of the Wastewater Treatment Facility. The report outlines three sludge disposal options as well as a few WWTP system upgrades.

1. Sludge Drying Facility
2. Reed Bed System Addition
3. Continue Hauling Sludge to Sturgeon Bay WWTP (If this option is considered, it is important to note that Sturgeon Bay may require the northern door communities to pay for the installation of an additional sludge storage tank at their facility to accommodate the space needed for the sludge produced by the northern door communities.)
4. WWTP Upgrades – Oxidation Ditch, Sludge Pump, Effluent Reuse

December 9, 2025: Sewer and Water Utility Committee received a presentation from BCR Solid Solutions. The opinion of probable cost for the proposed dryer facility is $17,800,000. The preliminary opinion of probable annual costs for Sister Bay alone is $199,800 and $247,200 with other communities. The opinion of probable annual costs assumes that the dried biosolids are distributed for free.

February 10, 2026: Sewer and Water Utility Committee received a presentation from Reed Bed Systems. The opinion of probable cost for the proposed Sister Bay alone reed bed system is $3,100,000. The preliminary opinion of probable annual costs for Sister Bay alone is $97,100. The opinion of probable cost for the proposed Sister Bay with other communities reed bed system is $4,334,100. The preliminary opinion of probable annual costs for Sister Bay with other communities is $147,500.

FINANCIAL INFORMATION

FISCAL IMPACT:

1. Is There a Fiscal Impact? Yes
2. Is it Currently Budgeted? Yes-Largest Expense Budgeted
3. If Budgeted, Where: CIP
4. Amount: $15,000,000

RECOMMENDED ACTION(S)

Village staff recommends discussion on the three sludge disposal options outlined and reviewed in the Facility Assessment, Feasibility Study, and Long-Term Planning for the Wastewater Treatment Facility, and to make a recommendation on which sludge processing option to pursue, to the Village Board.

POLICY ALTERNATIVE(S)

The Sewer and Water Utility Committee could take the following actions:

1. Approve with Recommendation as Presented

"I move to recommend the Facility Assessment, Feasibility Study, and Long-Term Planning for the Wastewater Treatment Facility as presented to the Village Board for approval, with the [Sludge Processing Option Recommended] recommended for approval."

2. Deny (No Action Alternative)

"I move to reject the Facility Assessment, Feasibility Study, and Long-Term Planning for the Wastewater Treatment Facility and take no further action at this time."

3. Postpone- Seek Additional Information

"I move to postpone action on the Facility Assessment, Feasibility Study, and Long-Term Planning for the Wastewater Treatment Facility, and direct staff to return to the SWUC with additional information regarding [List Information Sought] at a future meeting."

ATTACHMENT(S)

Facility Assessment, Feasibility Study, and Long-Term Planning for the Wastewater Treatment Facility

ENGINEERING REPORT

WASTEWATER TREATMENT FACILITY
FACILITY ASSESSMENT, FEASIBILITY STUDY & LONG-TERM FACILITY PLANNING

FOR THE

VILLAGE OF SISTER BAY
DOOR COUNTY, WISCONSIN

DECEMBER 16, 2025

McMAHON ASSOCIATES, INC.
1445 McMAHON DRIVE NEENAH, WI 54956 Mailing: PO BOX 1025 NEENAH, WI 54957-1025 PH 920.751.4200 MCMGRP.COM
McM. No. S0661-092500241 \ CTO:jlh

WASTEWATER TREATMENT FACILITY FACILITY ASSESSMENT, FEASIBILITY STUDY & LONG-TERM FACILITY PLANNING

WISCONSIN
CHAD T. OLSEN
E-35640-006
NEENAH
WI
PROFESSIONAL ENGINEER

12-16-2025

TABLE OF CONTENTS

TABLE OF CONTENTS

TABLE OF CONTENTS

ENGINEERING REPORT

WASTEWATER TREATMENT FACILITY FACILITY ASSESSMENT, FEASIBILITY STUDY & LONG-TERM FACILITY PLANNING

VILLAGE OF SISTER BAY

DOOR COUNTY, WISCONSIN

DECEMBER 16, 2025

McM. No. S0661-09-25-00241

I. INTRODUCTION

Sister Bay Utilities owns and operates a regional Wastewater Treatment Facility (WWTF) that serves the Village of Sister Bay and the Town of Liberty Grove Sanitary District No. 1. The current activated sludge plant was originally constructed in 1989. The WWTF underwent an upgrade in 2021 to update various operational equipment that reached the end of its useful life, add ultraviolet (UV) disinfection, expand office space and garage storage, and update the electrical and controls systems.

Historically, the largest challenge the Utility has faced is sludge processing and disposal. Biosolids/sludge management has been an obstacle due to the location and geological composition of Door County. Door County has very shallow bedrock, which severely limits land application opportunities.

Sister Bay has historically hauled their sludge to Sturgeon Bay Utilities for further processing and disposal. Sturgeon Bay accepts sludge from four communities in Door County. The costs for hauling and processing the sludge have increased substantially over the years. In addition, Sturgeon Bay has limited raw sludge storage and can only accept sludge during the warmer months, which can make scheduling difficult. Due to rising costs and challenges with scheduling, Sister Bay is interested in evaluating on-site sludge/biosolids handling alternatives for their WWTF.

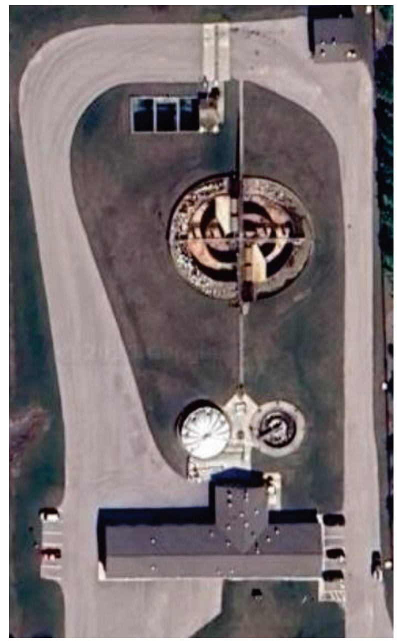
In addition to sludge/biosolids handling, Sister Bay requested that the following deficiencies at the WWTF be addressed:

- The coarse bubble diffusers for the equalization tank are mounted 10-feet above the floor of the tank. Ideally, the diffusers would be mounted near the floor of the tank for better mixing and to allow the tank to remain aerated over its entire range.
- The Village has had issues with freezing on the orbal oxidation ditch disc aerators. The Village would like to look at alternate aeration systems for the ditch.
- Currently, only one clarifier can be operated at a time due to limitations with wasting.
- One of the pressure tanks on the effluent reuse system is leaking.

The purpose of this Project is to develop a Capital Improvement Plan (CIP) to address facility shortcomings, aging infrastructure, and biosolids handling strategies. The ultimate objective is to evaluate one or several enhancements and upgrades that facilitate long-term operations, resiliency, sustainability, and cost effectiveness of the Utility, including its biosolids processing and disposal program.

II. WASTEWATER TREATMENT FACILITY DESCRIPTION

A. GENERAL



The WWTF provides wastewater treatment services for sewered flow from the Village of Sister Bay and Liberty Grove Sanitary District No. 1 along with holding tank and septic tank waste from the Village and the Town of Liberty Grove. The Utility currently has 1,507 service connections between the Village and the Sanitary District No.1.

The Village of Sister Bay's WWTF consists of the following liquids and solids treatment processes:

- Fine Screen
- Grit Removal
- Oxidation Ditch (Orbal)
- Phosphorus Removal with Iron Addition
- Final Clarifiers
- Ultraviolet Disinfection
- Hauled-Waste Receiving & Equalization
- Aerobic Digestion/Thickening/Liquid Biosolids Holding

Biosolids are removed from the site and are typically sent to the Sturgeon Bay Utilities WWTF for processing. If Sturgeon Bay is not able to accept the biosolids, they may be hauled to the New Water WWTF in Green Bay, Wisconsin.

A Process Flow Schematic of the Wastewater Treatment Facility is included in Figure II-1. Design criteria for the WWTF are included in Appendix A. A description of the facilities follows.

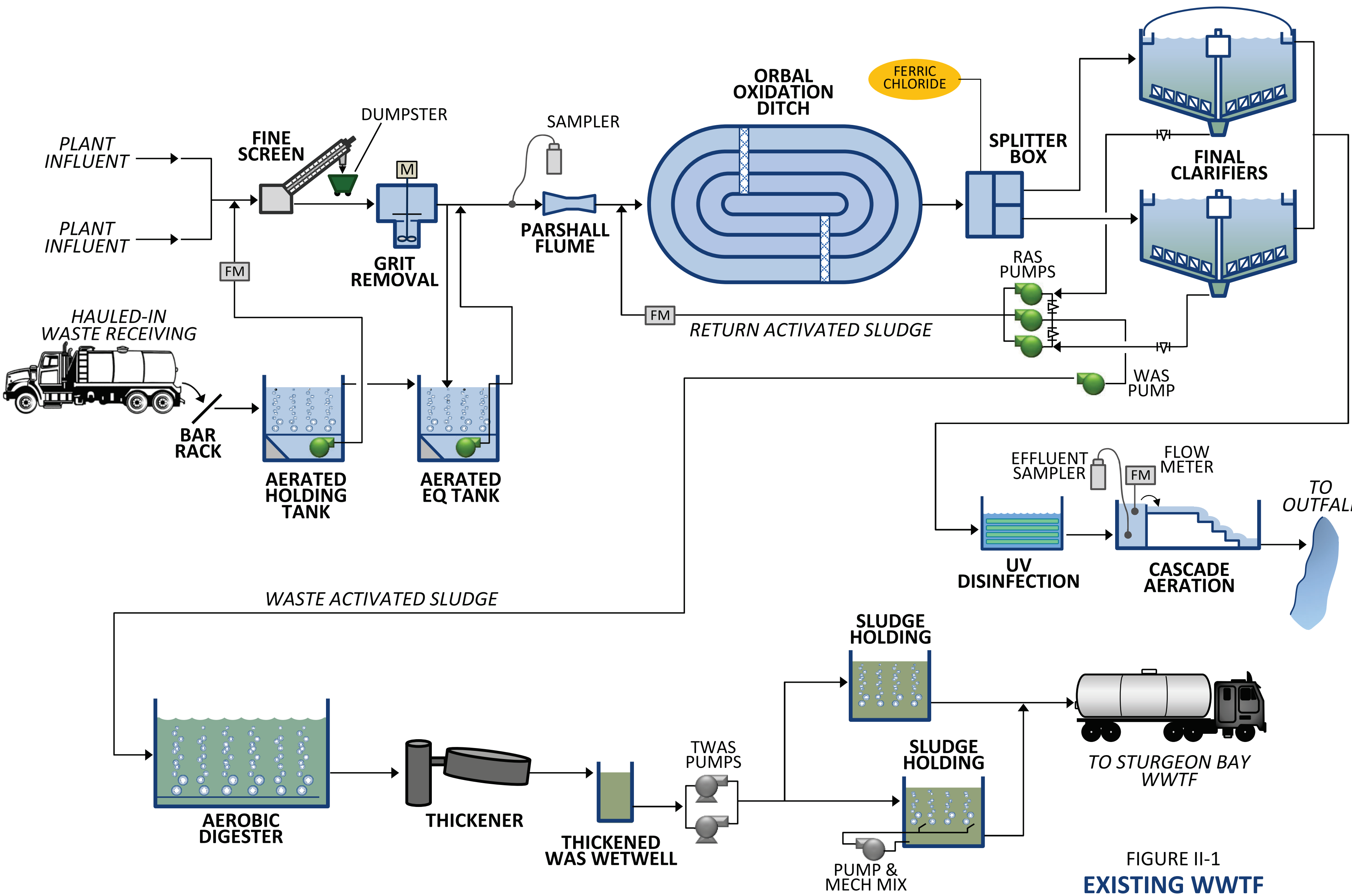


FIGURE II-1

EXISTING WWTF PROCESS FLOW SCHEMATIC

WWTF - FACILITY PLAN

VILLAGE OF SISTER BAY, WI

S0661-09-2500241.02 10-20-25

ID: \2025\MCM WI\SISTER BAY-WWTF-FACILITY PLAN SCHEMATIC.PPTX jmk/CTO

B. LIQUID TREATMENT PROCESS

Wastewater from the Village of Sister Bay and Town of Liberty Grove Sanitary District No. 1. sanitary collection systems flow to Lift Station #1 on Sunset Road. Wastewater is pumped to the Headworks of the WWTF through 8-inch ductile iron (D.I.) and 12-inch PVC force mains.

Hauled-in septage and holding tank wastes brought to the WWTF are discharged into a receiving channel with a manual bar rack. The hauled-in wastes flow to a wet well where it is either pumped to the Headworks or overflows to an adjacent equalization tank.

The raw wastewater flow from the Lift Station #1 is measured through a Parshall flume. The flow is also sampled by a flow proportioned composite sampler. The hauled-in waste flow pumped from the wet well is measured by a magnetic flow meter. The combined flows travel through a ¼-inch fine screen and a vortex grit removal system. The removed grit is washed and dewatered through an inclined grit washer.

Following the Headworks, wastewater either flows by gravity to the orbal oxidation ditch or to the equalization (EQ) tank. The EQ tank is typically used to store hauled-in waste collected during the day. The hauled-in waste is pumped to the treatment facility overnight, when flows and loadings are at their lowest.

The EQ tank can also be used to store raw wastewater that passes through the Headworks during times of peak flow and/or loadings. Wastewater in the EQ tank is pumped back to the Headworks Building, downstream of the fine screen and grit removal unit. Both the EQ tank and the hauled-in waste wet well are aerated through coarse bubble diffused aeration systems that receive air from blowers in the Headworks Building.

Biological treatment is provided by a three-channel orbal oxidation ditch. The ditch is original to the 1990 construction. The oxidation ditch is an extended air activated sludge process that utilizes bacteria and microorganisms suspended in the wastewater to consume/remove the organics in the wastewater. The mixture of microorganisms and wastewater is called mixed liquor.

The oxidation ditch utilizes rotating plastic discs mounted on a shaft to aerate and mix the ditches. The rotating discs are 4.5-feet in diameter with 9 to 21-inches of the bottom of the discs submerged. The rotating discs have triangular shaped nodes that entrain air and impart velocity on the wastewater. The two inner channels of the ditch are aerated and mixed by two 30-HP disc aerators. The outer channel is aerated by two 20-HP disc aerators. The discs are original to the 1990 construction. New variable frequency drives (VFDs) were added in the 2020 construction project. Wastewater flows from the outer channels to the interior channel. Typically, all three channels are used in the summer months, and the two inner channels are used in the winter months.

Following the oxidation ditch, the mixed liquor flows to two 40-foot diameter secondary clarifiers. The drives, weirs, and scum baffles of the clarifiers were replaced in 2020. In addition, the steel inside the clarifiers was recoated in 2020. The west clarifier has a cover. The covered clarifier is used exclusively in the winter months due to concerns with freezing.

The clarifiers have tow-bro type sludge collectors that are piped directly to a header in the Service Building. Three return activated sludge (RAS) pumps in the Service Building return the sludge to the oxidation ditch to continue treatment. A single rotary lobe pump draws from the header for wasting sludge (waste activated sludge). The single waste activated sludge (WAS) pump is not able to equally draw sludge from both clarifiers. According to Plant Staff, this creates an imbalance that does not allow them to run both clarifiers at the same time.

Following clarification, the treated wastewater (effluent) flows to an UV disinfection system for seasonal disinfection. The disinfected wastewater then flows to a cascade aerator before being discharged into the Bay of Green Bay.

Ferric chloride is added to the mixed liquor exiting the oxidation ditch for phosphorus removal. The Service Building includes a bulk storage tank, day tank and chemical feed pumps for delivering the ferric chloride to the mixed liquor.

C. SOLIDS HANDLING PROCESS

Waste activated sludge (WAS) generated at the WWTF is pumped to a 170,000-gallon aerobic digester. The digester is mixed and aerated through a coarse bubble diffused aeration system.

Following digestion, the WAS is thickened with a disc thickener that was installed in 2020. The disc thickener includes an emulsion polymer system that feeds conditioned polymer to the digested sludge prior to thickening. The thickened sludge is discharged to a thickened sludge wet well in the Solids Building. The water removed from the thickener (filtrate) flows to a solids area sump adjacent to the Solids Building. The solids area sump includes a single submersible pump that pumps the filtrate to the head of the oxidation ditch.

The thickened sludge is pumped to one of two aerobic digester/storage tanks. Aerobic Digester #2 is aerated and mixed through a coarse bubble diffused aeration system. The sludge storage tank also has a coarse bubble diffused aeration system along with a pump and nozzle mixing system.

The sludge stored in the sludge storage tank and Aerobic Digester #2 is hauled by a contract hauler to the Sturgeon Bay Wastewater Treatment Facility for further processing and disposal.

III. SLUDGE REGULATIONS

A. 503 REGULATIONS

Land application of sewage sludge is regulated under CFR 40, Part 503, '*Standards For The Use Or Disposal Of Sewage Sludge*'. This regulation establishes two levels of sewage sludge quality, with respect to heavy metal concentrations [ceiling concentrations and exceptional quality (see below)], two levels of quality, with respect to pathogen densities (Class A or Class B), and two types of approaches for meeting vector attraction reduction. In order for the sludge to qualify for land application, metals must be below ceiling limits, and the sludge must meet Class B requirements for pathogens and vector attraction reduction requirements.

1. Metals

Metals limits for land application of sewage sludge are summarized below:

LAND APPLICATION POLLUTANT LIMITS
(All Weights Are On Dry Weight Basis)

Table In 503 Rule	Table #1	Table #2	Table #3	Table #4
Pollutant	Ceiling Concentration Limits* (mg/kg)	Cumulative Pollutant Loading Rates (kg/ha)	"High Quality" Pollutant Concentration Limits ** (mg/kg)	Annual Pollutant Loading Rates (lbs./acre/yr.)
Arsenic	75	41	41	1.78
Cadmium	85	39	39	1.69
Copper	4,300	1,500	1,500	66.9
Lead	840	300	300	13.4
Mercury	57	17	17	0.76
Molybdenum	75	N/A	N/A	N/A
Nickel	420	420	420	18.7
Selenium	100	100	100	4.4
Zinc	7,500	N/A	2,800	125

* Absolute Values
** Monthly Averages

To be land applied, bulk sewage sludge must meet the pollutant Ceiling Concentrations <u>and</u> Cumulative Pollutant Loading <u>or</u> Pollutant Concentrations limits.

2. Pathogen Reduction

Sewage sludge that is land applied must meet Class A or B pathogen requirements.

For Class A, the sludge must meet one of the following criteria:

- Fecal coliform density less than 1,000 Most Probable Number (MPN) per gram of total dry solids; or
- Salmonella density less than 3 MPN/4 grams of total dry solids.

Class B sewage sludge must meet one of the following pathogen requirements:

- The sewage sludge must be treated by a Process To Significantly Reduce Pathogens (PSRP) process; or
- At the time of disposal, the geometric mean of sewage sludge samples must be less than 2,000,000 MPN/gram total solids (dry weight).

3. Vector Attraction

Vector attraction reduction reduces the potential for spreading of infectious disease agents by vectors (flies, rodents and birds). At a minimum, one of the following must be met prior to land application of the sludge for aerobic processes:

- The specific oxygen uptake rate SOUR for aerobic sludge shall be equal to or less than 1.5 milligrams of oxygen per hour per gram of total solids on a dry weight basis, corrected to 20 deg. Celsius.
- Demonstrate through additional digestion, in a bench scale test, that additional volatile solids reduction for aerobically digested sludge is less than 15%.
- Injection - Liquid sludge should be injected beneath the soil surface, with no significant amount of sewage sludge present after 1-hour of injection (Class B) or 8-hours for Class A.
- Incorporation - Sewage sludge that is land applied on a surface disposal site shall be incorporated into the soil within 6-hours of application (Class B) or 8-hours for Class A. This applies to dewatered sludge.

B. WISCONSIN NR 204 REGULATIONS

The Wisconsin Department of Natural Resources (DNR) regulates sludge disposal through Chapter NR 204 of the Wisconsin Administrative Code. The 1996 Revisions to NR 204, for the most part, mirror the 503 Regulations. The NR 204 major revisions are summarized below:

- Additional testing requirements are required of the sludge, depending upon its end use and facility size. These are specified in the WPDES Permit. Additional tests could include SOUR, salmonella, viruses, viable helminth ova and a priority of pollutant scan.
- The DNR defines an 'Exceptional Quality Sludge' as one that meets Class A pathogen requirements, high quality pollutant concentrations and vector reduction requirements of the 503 Regulations. Sludge certified as 'Exceptional Quality' is exempt from the minimum separation distances to residences, businesses, recreational areas or property lines, if land applied. A permit is not required to land apply the sludge and site life is unlimited. Sludge may be commercially distributed in bulk, only if it is certified as exceptional quality.
- Application of sludge on frozen or snow covered ground is prohibited, unless a permittee can demonstrate that there are no other reasonable disposal methods available and there is absolutely no likelihood that the sludge will enter the waters of the State. Application may be approved on a case by case basis until storage is available.
- Sludge quality standards, with respect to vector attraction reduction, pathogen reduction and metals from the 503 Regulations are incorporated into these regulations, including site restrictions.
- All municipal mechanical treatment plants that land apply sludge shall have the ability to store sludge for 180-days.

C. PFAS

The Wisconsin DNR published a Guidance Document for PFAS in Biosolids in March 2024. The guidance document outlined the following criteria.

- **Sum of PFOA and PFOS Concentrations Values Generally At or Above 150 µg/kg**
  - Biosolids or industrial sludge generally exceeding a 150 µg/kg PFOA/PFOS combined value are at levels of significant concern. As a result, the Department should not approve new or transfer land application sites when combined values are above 150 µg/kg PFOA/PFOS. Future permits may include language prohibiting the authorization of the land application of biosolids and industrial sludges with PFAS concentrations above 150 µg/kg.
  - Arrange alternative treatment or disposal besides land application.

- **Sum of PFOA and PFOS Values Generally Above 50 µg/kg but Below 150 µg/kg**
  - Immediately notify DNR Staff.
  - Sample effluent and investigate potential PFAS sources to develop a source reduction program, if the WWTF operators have not already done so.
  - To reduce overall loading to a land application site, reduce land application rates to no more than 1.5 dry tons per acre (or submit to the Department for an approval of an alternative risk mitigation strategy in an updated sludge management plan prior to land application).
  - Prior to initial land application at a site, provide the PFAS analytical results to the landowner/farmer (if different) along with DNR contact information and additional information related to PFAS work in Wisconsin.
  - If land applied, track the cumulative application rates on each land application site and report to the Department.
  - WWTF operators may decide it appropriate to arrange for alternative treatment or disposal of solids.
- **Sum of PFOA and PFOS Values Generally Above 20 µg/kg but Below 50 µg/kg**
  - If over a median concentration of 20 µg/kg but below 50 µg/kg, implement PFAS source investigation and reduction efforts as well as effluent sampling. The 20 µg/kg median value is based on Michigan biosolids data collected from the sludge of approximately 40 municipal WWTFs.
  - Prior to initial land application at a site, provide the PFAS analytical results to the landowner/farmer (if different) along with DNR contact information and additional information sources related to PFAS work in Wisconsin.
  - Track application rates on each land application site.
  - If proposed application rate is greater or equal to 8 tons per acre, consult with the Department to detail concentrations and recommended tonnages per acre.
- **Sum of PFOA and PFOS Concentration Values Generally Below 20 µg/kg**
  - If below 20 µg/kg, land apply per normal approach consistent with Chapter NR 204 or NR 214, Wis. Adm. Code.

PFAS testing of the Village's biosolids in December 2024 and April 2025 resulted in a combined PFOA and PFOS concentration of 47.9 ug/kg and 37.5 ug/kg, respectively. This puts the Village in the third category listed above.

PFAS standards are currently not in place for Class A, EQ biosolids that can be publicly distributed, although it is believed that standards will be developed at some time. It is currently not known if Class A, EQ biosolids will have to adhere to the 20 ug/kg standard.

The Environmental Protection Agency (EPA) came out with a Draft Sewage Sludge Risk Assessment for PFOA and PFOS in January 2025. The Risk Assessment included the following language:

The draft risk assessment focuses on those living on or near impacted sites (e.g., farm families and their neighbors) or those that rely primarily on their products (e.g., food crops, animal products, drinking water); the draft risk assessment does not model risks for the general public. Based on the modeling in the draft sewage sludge risk assessment, the EPA finds that there may be human health risks exceeding the EPA's acceptable thresholds for some modeled scenarios when land-applying sewage sludge that contains 1 part per billion (ppb) of PFOA or PFOS.

1 part per billion equals 1 ug/kg. It is not known at this time how this study will impact future PFAS regulations on biosolids.

IV. WASTEWATER TREATMENT FACILITY FLOWS, LOADINGS & PERFORMANCE

A. PLANT LOADINGS

Influent flows and loadings and plant performance for years 2022 through 2024 are included in Tables III-1 through III-3. Influent loadings are summarized below.

COMBINED SUMMARY (2022 – 2024)

Description	Current Loadings	Design Loadings	% Capacity
Influent Flows, MGD			
Average	0.198	0.7	28%
Max Month	0.344		
Peak Day	0.586	0.945	62%
BOD, lbs./day			
Average	660	1,780	37&
Max Month	1,389		
Peak Day	2,022	2,370	85%
TSS, lbs./day			
Average	720	1,435	50%
Max Month	1,585		
Peak Day	3,168	2,180	145%

The total daily loadings were calculated as follows:

- The total flow from the Sister Bay collection system multiplied by 8.34 lbs./gal and multiplied by the collected Biological Oxygen Demand (BOD) or Total Suspended Solids (TSS) sample for that day.
- The total flow from the Liberty Grove collection system multiplied by 8.34 lbs./gal and multiplied by the collected BOD or TSS sample for that day.
- The monthly average hauled-in wastes for Sister Bay were calculated by multiplying the monthly average hauled-in waste flow for Sister Bay and multiplying by the monthly average hauled-in waste BOD/TSS concentrations and 8.34 lbs./gal.

Flow (MGD)				BOD (lbs./day)						TSS (lbs./d		
Hauled-In		Total		Sanitary Influent		Hauled-In		Total		Sanitary Influent		Hauled-
Avg	Max	Avg	Max	Avg	Max	[1] Avg	[2] Max	[3] Avg	[4] Max	Avg	Max	[1] Avg
0.010	0.053	0.118	0.175	288	411	25	175	313	436	232	359	24
0.008	0.051	0.114	0.137	287	516	29	214	316	545	206	322	20
0.008	0.058	0.153	0.296	346	981	23	273	369	1,004	326	713	17
0.015	0.049	0.244	0.371	422	940	84	1,280	506	1,024	510	1,175	94
0.018	0.055	0.221	0.336	517	783	79	560	596	862	613	1,131	118
0.036	0.089	0.267	0.350	806	1,112	186	883	993	1,299	833	1,703	132
0.042	0.090	0.320	0.398	1,196	1,786	192	804	1,389	1,979	1,447	2,338	138
0.043	0.090	0.297	0.380	845	1,085	152	586	997	1,237	721	1,207	110
0.032	0.083	0.236	0.297	708	1,216	237	1,459	945	1,453	1,087	2,847	321
0.029	0.068	0.214	0.275	895	1,484	245	1,400	1,140	1,729	1,100	1,707	377
0.015	0.054	0.135	0.188	306	516	39	268	345	555	380	1,126	52
0.011	0.055	0.124	0.212	268	388	30	315	298	418	281	445	19
0.022		0.204		571		103		674		639		114
0.043	0.090	0.320	0.398	1,196	1,786	245	1,459	1,389	1,979	1,447	2,847	377
0.037		0.267		883		210		1,093		1,022		232
0.012		0.159		348		43		391		365		47

s were calculated by taking the monthly average hauled-in waste flow and multiplying by the monthly average hauled-in waste BOD/TSS concentration and 8.34.
s for a given month were calculated by taking the max day hauled-in waste flow and multiplying by the max day hauled-in waste BOD/TSS concentration and 8.34.
lated by adding the average sanitary influent and average hauled-in waste loadings.
ulated by adding the max day sanitary influent and the average day hauled-in waste loadings.

	Flow (MGD)				BOD (lbs./day)						TSS (lbs./d		
	Hauled-In		Total		Sanitary Influent		Hauled-In		Total		Sanitary Influent		Hauled-
	Avg	Max	Avg	Max	Avg	Max	[1] Avg	[2] Max	[3] Avg	[4] Max	Avg	Max	[1] Avg
	0.012	0.047	0.111	0.173	216	291	36	192	252	327	198	248	27
	0.009	0.042	0.109	0.141	236	399	35	246	271	434	202	352	30
	0.010	0.046	0.117	0.184	240	313	35	266	275	348	174	296	24
	0.014	0.062	0.228	0.340	556	1,387	68	608	623	1,455	705	1,569	86
	0.026	0.080	0.189	0.262	503	1,172	151	762	654	1,323	581	1,294	228
	0.039	0.121	0.251	0.345	756	1,332	228	1,161	984	1,560	907	2,217	359
	0.047	0.102	0.321	0.408	1,077	1,685	222	974	1,299	1,907	970	1,414	159
	0.045	0.095	0.290	0.392	1,035	1,676	240	900	1,276	1,916	949	1,904	269
	0.029	0.100	0.228	0.321	720	1,103	144	941	864	1,247	689	1,091	196
	0.028	0.079	0.215	0.287	599	793	153	721	751	946	642	1,268	251
	0.015	0.047	0.135	0.171	372	697	82	446	454	779	395	999	135
	0.011	0.040	0.124	0.211	272	500	29	167	301	529	261	477	19
	0.024		0.194		551		112		663		557		139
	0.047	0.121	0.321	0.408	1,077	1,685	240	1,161	1,299	1,916	970	2,217	359
	0.038		0.261		842		198		1,040		835		259
	0.014		0.145		343		59		402		359		70

s were calculated by taking the monthly average hauled-in waste flow and multiplying by the monthly average hauled-in waste BOD/TSS concentration and 8.34.
s for a given month were calculated by taking the max day hauled-in waste flow and multiplying by the max day hauled-in waste BOD/TSS concentration and 8.34.
ulated by adding the average sanitary influent and average hauled-in waste loadings.
ulated by adding the max day sanitary influent and the average day hauled-in waste loadings.

low (MGD)				BOD (lbs./day)						TSS (lbs./day)							
Hauled-In		Total		Sanitary Influent		Hauled-In		Total		Sanitary Influent		Hauled-In		Total		Sanitary Influent	
	Max	Avg	Max	Avg	Max	[1] Avg	[2] Max	[3] Avg	[4] Max	Avg	Max	[1] Avg	[2] Max	[3] Avg	[4] Max	Avg	Max
3	0.049	0.105	0.154	232	313	35	236	267	349	222	313	22	111	244	335	-	-
9	0.045	0.104	0.133	206	271	30	264	236	301	186	220	15	114	201	235	-	-
0	0.054	0.116	0.162	240	485	27	292	267	512	220	483	23	247	243	506	-	-
3	0.048	0.153	0.192	345	1,101	40	442	384	1,140	380	1,213	43	504	423	1,256	-	-
3	0.075	0.239	0.407	676	1,905	117	690	793	2,022	632	978	141	1,473	773	1,119	-	-
5	0.090	0.285	0.373	978	1,339	145	736	1,123	1,484	982	1,832	179	1,291	1,161	2,011	-	-
4	0.129	0.344	0.586	1,158	1,442	146	632	1,304	1,588	1,368	2,180	163	882	1,531	2,343	-	-
5	0.112	0.285	0.378	935	1,371	184	725	1,119	1,554	1,179	1,715	394	2,239	1,573	2,109	-	-
5	0.094	0.221	0.274	652	867	156	731	808	1,023	777	1,409	299	1,813	1,076	1,708	18.2	26.7
5	0.085	0.202	0.303	653	1,559	139	815	792	1,698	574	2,075	239	2,221	812	2,314	13.6	27.3
4	0.060	0.139	0.177	307	448	43	429	351	492	302	473	34	410	336	507	-	-
2	0.054	0.143	0.258	322	806	35	262	357	841	358	704	26	130	384	730	-	-

4		0.195		551		90		641		592		116		708		15.9	
4	0.129	0.344	0.586	1,158	1,905	184	815	1,304	2,022	1,368	2,180	394	2,239	1,573	2,343	18.2	27.3

ed for September and October 2024.

0		0.267		861		161		1,023		960		271		1,231		15.9	

3		0.143		336		45		382		332		41		373		-	

4		0.198		558		102		660		596		124		720		15.9	
4	0.129	0.344	0.586	1,196	1,905	245	1,459	1,389	2,022	1,447	2,847	394	2,744	1,585	3,168	18.2	27.3

October)

3		0.265		862		192		1,054		939		253		1,192		15.9	

ugh May)

3		0.149		342		49		392		352		53		405		-	

lated by taking the monthly average hauled-in waste flow and multiplying by the monthly average hauled-in waste BOD/TSS concentration and 8.34.
month were calculated by taking the max day hauled-in waste flow and multiplying by the max day hauled-in waste BOD/TSS concentration and 8.34.
ding the average sanitary influent and average hauled-in waste loadings.
ding the max day sanitary influent and the average day hauled-in waste loadings.

- The monthly average hauled-in wastes for Liberty Grove were calculated by multiplying the monthly average hauled-in waste flow for Liberty Grove and multiplying by the same monthly average hauled-in waste BOD/TSS concentrations as above and 8.34 lbs./gal. Only one hauled-in waste sample is collected at the WWTF.
- The total loading to the WWTF is the sum of the four loadings calculated above.

The design loadings for the WWTF are based on rated summer loadings obtained from the 2019 Facility Plan. Overall, the WWTF is loaded below its design capacity. The peak day TSS loading was exceeded fifteen times during this time period, all in the summer months. It does not appear that these excursions adversely impacted the performance of the WWTF.

B. PLANT PERFORMANCE

The performance of WWTF has been excellent. 2022 through 2024 effluent results versus permit requirements are as follows.

Description	Result	Permit Limit	% of Permit Limit
BOD, mg/L			
Monthly Average	3.47	30	11.6%
Maximum Month	6.13	30	20.4%
Maximum Week	8.00	45	17.8%
TSS, mg/L			
Monthly Average	4.07	30	13.6%
Maximum Month	8.62	30	28.7%
Maximum Week	26.93	45	59.8%
Total P, mg/L			
Monthly Average	0.23	0.6	38.3%
Maximum Month	0.49	0.6	81.7%
NH3-N, mg/L (Nov 1 – April 30)			
Monthly Average	0.09	18	0.5%
Maximum Month	0.24	18	1.3%
Maximum Week	0.24	18	1.3%
Daily Maximum	0.24	18	1.3%

Overall, the plant has performed very well, with effluent results well below permit limits and no exceedances during this time period.

V. POPULATION PROJECTIONS

The 2019 WWTF Facilities Plan included the following population projections from the Wisconsin Department of Administration (DOA) for service area.

2019 FACILITY PLAN - WISCONSIN DOA PROJECTIONS

	2020	2030	2040	2050
Sister Bay	940	1,005	990	
Liberty Grove	1,740	1,765	1,650	
Total	**2,680**	**2,770**	**2,640**	

The projections were recently updated. Updated projections to year 2050 are as follows:

	2020	2030	2040	2050
Sister Bay	1,148	1,288	1,369	1,409
Liberty Grove	2,096	2,216	2,248	2,229
Total	**3,244**	**3,504**	**3,617**	**3,638**

Design Populations included in the 2019 Facilities Plan are as follows.

- Summer 4,456
- Winter.....................................2,970

Population estimates or projections are not available for summer/winter periods.

VI. PROJECTED INFLUENT DESIGN LOADINGS

Overall, summer and winter per capita loadings are included in Table VI-1, VI-2 and VI-3. Population estimates were interpolated from the most current DOA population projections. For this evaluation, summer loadings occur between June through October. Winter loadings occur from November through May.

The summer wastewater characteristics indicate a strong sewage for both BOD and TSS based on typical characteristics. According to Wisconsin Administrative Code NR 110, typical BOD loadings are 0.17 to 0.20 pounds per capita per day and typical TSS loadings are 0.20 to 0.25 pounds per capita per day. The high per capita loadings may be due to tourism. The increase in population due to tourism is not reflected in the Village’s or Town’s population numbers.

The additional flows and loadings from the population increase will be based on the following average per capita loadings:

	Average	Summer	Winter
Flow, gpd	80	80	60
BOD, lbs./day	0.20	0.33	0.12
TSS, lbs./day	0.23	0.38	0.13

Table VI-1

PER CAPITA LOADINGS | TOTAL ANNUAL AVERAGE

WWTF FACILITY ASSESSMENT, FEASIBILITY STUDY &
LONG-TERM FACILITY PLANNING

Village of Sister Bay | Door County, Wisconsin

PARAMETER	2022	2023	2024	2022 - 2024 AVG.
Service Population	3,296	3,322	3,348	3,322
Avg. Flow (MGD)	0.204	0.194	0.195	0.198
Flow (gpcd)	62	58	58	60
Avg. BOD (lbs./day)	674	663	641	659
BOD (lbs./capita/day)	0.20	0.20	0.19	0.20
Avg. TSS (lbs./day)	753	697	708	719
TSS (lbs./capita/day)	0.23	0.21	0.21	0.22
Avg. Total P (lbs./day)	-	-	18.1	18
Total P (lbs./capita/day)	-	-	0.0054	0.0054

Table VI-2

PER CAPITA LOADINGS | SUMMER AVERAGE (JUNE - OCTOBER)

WWTF FACILITY ASSESSMENT, FEASIBILITY STUDY &
LONG-TERM FACILITY PLANNING

Village of Sister Bay | Door County, Wisconsin

PARAMETER	2022	2023	2024	2022 - 2024 AVG.
Service Population	3,296	3,322	3,348	3,322
Avg. Flow (MGD)	0.267	0.261	0.267	0.265
Flow (gpcd)	81	79	80	80
Avg. BOD (lbs./day)	1,093	1,040	1,023	1,052
BOD (lbs./capita/day)	0.33	0.31	0.31	0.32
Avg. TSS (lbs./day)	1,254	1,094	1,231	1,193
TSS (lbs./capita/day)	0.38	0.33	0.37	0.36
Avg. Total P (lbs./day)	-	-	-	-
Total P (lbs./capita/day)	-	-	-	-

Table VI-3

PER CAPITA LOADINGS | WINTER AVERAGE (NOVEMBER - MAY)

WWTF FACILITY ASSESSMENT, FEASIBILITY STUDY &
LONG-TERM FACILITY PLANNING

Village of Sister Bay | Door County, Wisconsin

PARAMETER	2022	2023	2024	2022 - 2024 AVG.
Service Population	3,296	3,322	3,348	3,322
Avg. Flow (MGD)	0.159	0.145	0.143	0.149
Flow (gpcd)	48	44	43	45
Avg. BOD (lbs./day)	391	402	382	392
BOD (lbs./capita/day)	0.12	0.12	0.11	0.12
Avg. TSS (lbs./day)	413	429	373	405
TSS (lbs./capita/day)	0.13	0.13	0.11	0.12
Avg. Total P (lbs./day)	-	-	18.1	18
Total P (lbs./capita/day)	-	-	0.0054	0.0054

The current service population (2024) for the WWTF is estimated at 3,348. The projected year 2050 service population is 3,638, resulting in an increase of 290 people. The resultant year 2050 average loadings are as follows.

	Current Ave	Population Increase	Year 2050 Ave
Flow, gpd			
Average	204,000	23,200	227,200
Summer	267,000	23,200	290,200
Winter	159,000	17,400	176,400
BOD, lbs./day			
Average	674	58	732
Summer	1,093	96	1,189
Winter	402	35	437
TSS, lbs./day			
Average	753	67	820
Summer	1,254	110	1,364
Winter	429	38	467

Peak to Average ratios for average, summer and winter periods are included in Table VI-4. The peak to average ratios will be used to determine maximum month and maximum day year 2050 loadings. The projected year 2050 loadings for the Sister Bay WWTF are as follows:

ANNUAL AVERAGE

	Ratio	Year 2050 Loading	Current Design Capacity
Flow, gpd			
Average		227,200	700,000
Maximum Month	1.7	386,240	
Maximum Day	3.0	681,600	945,000
BOD, lbs./day			
Average		732	1,780
Maximum Month	2.0	1,464	
Maximum Day	3.0	2,196	2,370
TSS, lbs./day			
Average		820	1,435
Maximum Month	2.0	1,640	
Maximum Day	3.7	3,034	2,180

SUMMER LOADINGS (JUNE - OCTOBER)

	Ratio	Year 2050 Loading	Current Design Capacity
Flow, gpd			
Average		290,200	700,000
Maximum Month	1.3	377,260	
Maximum Day	2.2	638,440	945,000
BOD, lbs./day			
Average		1,189	1,780
Maximum Month	1.3	1,546	
Maximum Day*	1.8	2,196	2,370
TSS, lbs./day			
Average		1,364	1,435
Maximum Month	1.3	1,773	
Maximum Day	2.5	3,410	2,180

*****Annual Average Loading used if higher than projected summer loading.

Table VI-4

2022 - 2024 MAX TO AVERAGE RATIOS

WWTF FACILITY ASSESSMENT, FEASIBILITY STUDY &
LONG-TERM FACILITY PLANNING

Village of Sister Bay | Door County, Wisconsin

	Total				
	2022	**2023**	**2024**	**Avg**	**Max**
Flow					
Max Month:Avg	1.6	1.7	1.8	1.7	1.8
Max Day/Avg	2.0	2.1	3.0	2.4	3.0
BOD					
Max Month:Avg	2.1	2.0	2.0	2.0	2.1
Max Day/Avg	2.9	2.9	3.2	3.0	3.2
TSS					
Max Month:Avg	2.1	1.8	2.2	2.0	2.2
Max Day/Avg	4.2	3.7	3.3	3.7	4.2

	Summer Only (June through October)				
	2022	**2023**	**2024**	**Avg**	**Max**
Flow					
Max Month:Avg	1.2	1.2	1.3	1.2	1.3
Max Day/Avg	1.5	1.6	2.2	1.7	2.2
BOD					
Max Month:Avg	1.3	1.2	1.3	1.3	1.3
Max Day/Avg	1.8	1.8	1.7	1.8	1.8
TSS					
Max Month:Avg	1.3	1.2	1.3	1.2	1.3
Max Day/Avg	2.5	2.4	1.9	2.3	2.5

	Winter Only (November through May)				
	2022	**2023**	**2024**	**Avg**	**Max**
Flow					
Max Month:Avg	1.5	1.6	1.7	1.6	1.7
Max Day/Avg	2.3	2.3	2.8	2.5	2.8
BOD					
Max Month:Avg	1.5	1.6	2.1	1.7	2.1
Max Day/Avg	2.6	3.6	5.3	3.8	5.3
TSS					
Max Month:Avg	1.8	1.9	2.1	1.9	2.1
Max Day/Avg	3.1	3.9	3.4	3.4	3.9

WINTER LOADINGS (NOVEMBER - MAY)	Ratio	Year 2050 Loading	Current Design Capacity
Flow, gpd			
Average		176,400	354,000
Maximum Month	1.7	300,000	
Maximum Day	2.8	493,920	
BOD, lbs./day			
Average		437	910
Maximum Month	2.1	918	
Maximum Day	3.8	1,661	
TSS, lbs./day			
Average		467	820
Maximum Month	2.1	981	
Maximum Day	3.9	1,821	

Overall, it appears that the WWTF has adequate capacity to handle the projected year 2050 loadings. The projected maximum day TSS loading exceeds the rated maximum TSS loading of the WWTF. Based on current operations, the maximum day solids loadings do not appear to adversely impact the performance of the WWTF.

VII. PROJECTED SLUDGE LOADINGS

A. CURRENT SLUDGE GENERATION

The quantity of solids or sludge/biosolids produced at the Sister Bay WWTF for years 2022 – 2024 are included below. The quantities are based off Wisconsin DNR Forms 3400-52 – Methods of Disposal or Distribution Report and 3400-49 – Sludge Characteristics Report.

	VOLUME	SOLIDS
2022	482,500 gals	452 dry lbs./day
2023	392,000 gals	339 dry lbs./day
2024	480,000 gals	416 dry lbs./day
Average	451,500 gals	402 dry lbs./day

The solids yield per influent BOD loading for 2022 – 2024 is included in Table VII-1. The average total solids yield for the facility was 0.61 pounds of solids/pounds influent BOD.

Table VII-1

WASTEWATER TREATMENT FACILITY MASS BALANCE

WWTF FACILITY ASSESSMENT, FEASIBILITY STUDY &
LONG-TERM FACILITY PLANNING

Village of Sister Bay | Door County, Wisconsin

	Combined Influent			Solids Hauled			
	Flow	BOD	TSS	Gallons	Total Solids		Solids Yield
Year	**MGD**	**lbs./day**	**lbs./day**	**per Year**	**%**	**lbs./day**	**lbs./lbs. BOD**
2022	0.204	674	753	482,500	4.10%	452	0.67
2023	0.194	663	697	392,000	3.79%	339	0.51
2024	0.195	641	708	480,000	3.80%	416	0.65
Average	**0.198**	**659**	**719**	**451,500**	**3.90%**	**402**	**0.61**

B. SOLIDS MASS BALANCE

A mass balance was performed on the WWTF to verify the current sludge generation quantities and help determine future sludge loadings. The mass balance used the following assumptions:

- Average Influent BOD (2022-2024) .... 679 lbs./day
- Yield, lbs. MLVSS/lbs. BOD[1] 0.6
- MLVSS Concentration.................................. 70%
- Chemical Sludge Generation .... 108 lbs./day
- Volatile Solid Destruction, Aerobic Digester[2] 30%

1. Based on a very old sludge age, SRT > 30 days
2. Destruction more-than-likely less due to long SRT in oxidation ditch.

The above assumptions result in an overall average solids production rate of 568 dry lbs./day versus the 402 lbs./day obtained from the annual WI DNR reports. The reasons for the discrepancies/difference are not known. To be on the conservative side, the calculated solids loading of 568 dry lbs./day will be used as the current solids loading for the purpose of this long-term evaluation.

C. SISTER BAY DESIGN SLUDGE GENERATION QUANTITIES

Sludge/biosolids generation quantities were calculated for the Sister Bay WWTF based on projected year 2050 loadings and the rated design capacity of the WWTF. The calculations used the same assumptions that were used to determine the current solids loading of 568 dry lbs./day. The calculated sludge/biosolids loadings are as follows.

YEAR 2050 SLUDGE/BIOSOLIDS LOADINGS

Average	620 dry lbs./day
Summer Average	964 dry lbs./day
Maximum Month	1,253 dry lbs./day

SLUDGE/BIOSOLIDS LOADINGS AT WWTF DESIGN CAPACITY

Average	1,199 dry lbs./day
Summer	1,588 dry lbs./day

D. SURROUNDING COMMUNITIES LOADINGS

The Sister Bay WWTF is also interested in looking at processing sludge/biosolids from surrounding WWTFs. WWTFs contacted include Bailey's Harbor, Village of Ephraim and Village of Fish Creek.

The current (2022 - 2024) sludge quantities for the three WWTFs were determined using DNR Forms 3400-52 – Methods of Disposal or Distribution Report and 3400-49 – Sludge Characteristics Report. Future or projected sludge quantities for the three facilities were estimated by extrapolating the current sludge loadings by future DOA population estimates. The projected loadings for the three facilities are included in Table VII-2.

The combined average loading for the three WWTFs is estimated to peak at 503 dry lbs./day in year 2040. For the purpose of this evaluation, it will be assumed that the communities can store their biosolids and haul them to Sister Bay on a consistent basis.

E. COMBINED SLUDGE/BIOSOLIDS LOADINGS

The combined sludge/biosolids loadings to be used in the Long-Term Evaluation are as follows:

COMBINED SLUDGE/BIOSOLIDS LOADINGS

	Sister Bay WWTF	Other Communities	Combined
Year 2050 Loadings, dry lbs./day			
Average	620	503	1,123
Summer Average	964	503	1,467
Maximum Month	1,253	503	1,756
WWTF Design Loadings, dry lbs./day			
Average	1,199	503	1,702
Summer Average	1,588	503	2,091

Sludge/biosolids handling equipment will be evaluated for year 2050 loadings, with and without the sludge from the surrounding communities.

F. SLUDGE CHARACTERISTICS

Sister Bay sludge characteristics from 2022 through 2024 are shown in Table VII-3. Based upon these characteristics, all levels of metals in the biosolids are below the High-Quality limits established in the 503 Regulations. Therefore, the solids are suited for beneficial reuse via land application by meeting the EPA’s and Wisconsin DNR’s Exceptional Quality criteria.

Biosolids characteristics for Bailey’s Harbor, Village of Ephraim and Village of Fish Creek are included in Table VII-4. The results are similar to Sister Bay’s in that all levels of metals in the sludge are below the High-Quality limits established in the 503 Regulations. PFAS levels for these communities are not known at this time.

Table VII-2

PROJECTED SLUDGE LOADINGS FROM OTHER COMMUNITIES

WWTF FACILITY ASSESSMENT, FEASIBILITY STUDY &
LONG-TERM FACILITY PLANNING

Village of Sister Bay | Door County, Wisconsin

	Current (2022 - 2024)			2030			2040			2050		
Community	**Population**	**gpd**	**lbs./day**	**Population**	**gpd**	**lbs./day**	**Population**	**gpd**	**lbs./day**	**Population**	**gpd**	**lbs./day**
Bailey's Harbor	1,247	849	240	1,304	888	251	1,331	906	257	1,327	903	256
Ephraim	348	435	103	353	441	104	348	435	103	336	420	99
Fish Creek (Gibraltar)	1,270	459	126	1,366	494	136	1,441	521	143	1,475	534	147
Total		**1,743**	**470**		**1,823**	**492**		**1,862**	**503**		**1,857**	**502**

Table VII-3

2022 - 2024 SISTER BAY SLUDGE CHARACTERISTICS

WWTF FACILITY ASSESSMENT, FEASIBILITY STUDY & LONG-TERM FACILITY PLANNING

Village of Sister Bay | Door County, Wisconsin

Parameter	Units	2022 Sample Result	2023 Sample Result	2024 Sample Result	High Quality Limit	Ceiling Limit
Total Solids	%	4.1	3.79	3.80	-	-
Arsenic	mg/kg	<12	<6.3	<12	41	75
Cadmium	mg/kg	0.88	1.2	1.08	39	85
Copper	mg/kg	710	870	806	1,500	4,300
Lead	mg/kg	<10	14	10	300	840
Mercury	mg/kg	<1.1	<1.7	<1.9	17	57
Molybdenum	mg/kg	9.3	13	11	-	75
Nickel	mg/kg	22	34	38	420	420
Selenium	mg/kg	35	<15	<6.81	100	100
Zinc	mg/kg	740	900	889	2,800	7,500
TKN	%	5.2	5.5	5.0	-	-
Ammonium	%	0.028	0.036	<0.010	-	-
Total Phosphorus	%	2.9	3.3	0.0080	-	-
Water Ext. Phosphorus	% Total P	0.18	0.34	0.24	-	-
Potassium	%	0.38	0.46	0.336	-	-
PCBs	mg/kg	-	<8.3	-	10	50

	Baileys Harbor			Ephraim			Fish Creek			
Units	2022 Sample Result	2023 Sample Result	2024 Sample Result	2022 Sample Result	2023 Sample Result	2024 Sample Result	2022 Sample Result	2023 Sample Result	2024 Sample Result	High Q
%	3.4	3.08	3.67	2.6	3.81	2.07	2.2	3.13	4.32	
mg/kg	<7.1	<7.8	<15	9.1	<6.4	<13	<11	<7.8	<6.4	
mg/kg	0.80	1.0	0.99	0.62	0.71	<0.35	<1.3	<0.30	1.1	
mg/kg	370	390	450	630	650	300	280	27	430	
mg/kg	9.8	8.9	<11	8.8	15	<9.5	<31	<6.9	9.6	
mg/kg	2.7	<1.8	<1.9	2.1	<1.6	<2.9	<2.3	<2.3	<1.6	
mg/kg	5.2	<5.1	8.2	5.9	4.7	2.3	<24	<5.1	8.9	
mg/kg	11	11	13	14	14	<9.5	25	<6.2	35	
mg/kg	<17	<19	<28	22	<16	<25	<26	<19	<12	
mg/kg	820	920	1,000	620	750	310	390	37	600	
%	6.1	6.0	5.6	4.0	3.8	4.1	-	-	-	
%	0.18	0.41	0.31	0.10	<0.010	0.033	-	-	-	
%	2.5	2.6	3.1	3.1	0.92	1.3	-	-	-	
% Total P	0.12	0.31	0.24	0.0076	0.030	0.37	-	-	-	
%	0.30	0.31	0.23	0.23	0.15	0.22	-	-	-	
mg/kg	-	<25	-	-	<8.6	-	-	<6.2	-	

VIII. COST ANALYSIS METHODOLOGY

This Capital Planning document includes opinions of probable capital costs and opinions of probable annual costs. Opinions of probable capital costs include the following:

- Equipment costs.
- Construction and installation costs, including contractor's overhead and profit.
- Cost of engineering, design, field exploration, construction management, on-site field representative, and start-up services.
- Cost of administration and legal services, including costs of bond sales.
- Interest during construction.

Prices of components and installation are estimated on the basis of market prices as of 2025, with no allowance for inflation of wages or prices.

Vendor quotations or pricing from past projects were used for equipment capital costs. Mechanical installation is estimated at approximately 30% to 40% of the equipment capital costs. Electrical and controls costs are estimated at approximately 15% to 20% of the total project cost. Contractor general conditions costs (project management, bonding, insurance, temporary facilities, etc.) are estimated as between 7% to 10% of total construction costs.

Additional project costs (engineering, contingencies, legal, fiscal, and administrative) are estimated at 30% of capital costs; which includes 15% contingencies, and 15% for engineering, legal, fiscal, administrative, and interest costs.

Preliminary opinions of probable annual operation and maintenance (O&M) costs were also developed for comparison and planning purposes. O&M costs include all annual costs (operation and maintenance, labor, equipment parts, chemical power and fuel costs) necessary to operate and maintain the treatment facility. The costs utilized include:

- Electrical Cost (Overall) .... $0.055 per KWH
- Electrical Cost (Weekdays) .... $0.059 per KWH
- Polymer Cost .... $2.75 per pound
- Sturgeon Bay Sludge Processing................................ $0.09 per gallon
- Sludge Hauling to Sturgeon Bay .... $0.146 per gallon
- Labor... $100,000 per year per Employee

Opinions of probable annual costs are calculated based on the average design loadings.

Some of the evaluations include a comparative cost-effective analysis. The analysis is based on a simplified 20-year Present Worth Analysis, using the discount rate of 2.5%. This rate was established by the WI DNR for facility planning purposes.

IX. LIQUID TREATMENT SYSTEMS EVALUATION

A. GENERAL

Liquid treatment systems evaluated in this Study include the following:

- Equalization Tank Aeration/Mixing
- Orbal Oxidation Ditch Aeration
- Secondary Clarifiers
- Effluent Reuse Pumping

Evaluations for the above liquid train items are included below.

B. EQUALIZATION TANK AERATION/MIXING

Sister Bay accepts an average of nearly 40,000 gpd of hauled-in waste in the summer months. The hauled in waste passes through a manual bar rack before flowing into a septage receiving wet well. The hauled-in waste can either be pumped directly to Headworks or stored in the adjacent equalization tank. Normally, the hauled in waste is stored in the equalization tank and pumped back to the plant during the night when loadings are low.

The equalization tank can also be used to store screened and degritted wastewater from the Main Lift Station during peak flow events.

The equalization tank is mixed and aerated through a coarse bubble diffused aeration system. The system receives air from a blower in the Headworks Building. Due to the sloped floor, the coarse bubble diffusers are mounted approximately 10-feet from the lowest point of the floor as shown in Figure IX-1. This leaves a significant volume that is not aerated or mixed, especially when the tank is drawn down below the diffusers. Ideally, the diffusers would be mounted near the floor of the tank for better mixing and to allow the tank to remain aerated over its entire range.

Two options considered for providing additional mixing include the following. In both cases, the existing coarse bubble diffused aeration system would remain. These would be supplemental to the existing system.

- Provide a second set of coarse bubble diffusers with a new blower.
- Provide a compressed gas mixing system.

1. Provide Second Set of Coarse Bubble Diffusers

The first option considered is to provide a second set of coarse bubble diffusers that would be installed approximately 3-feet above the lowest point of the floor. A total of six stainless steel diffusers would be provided, similar to the existing

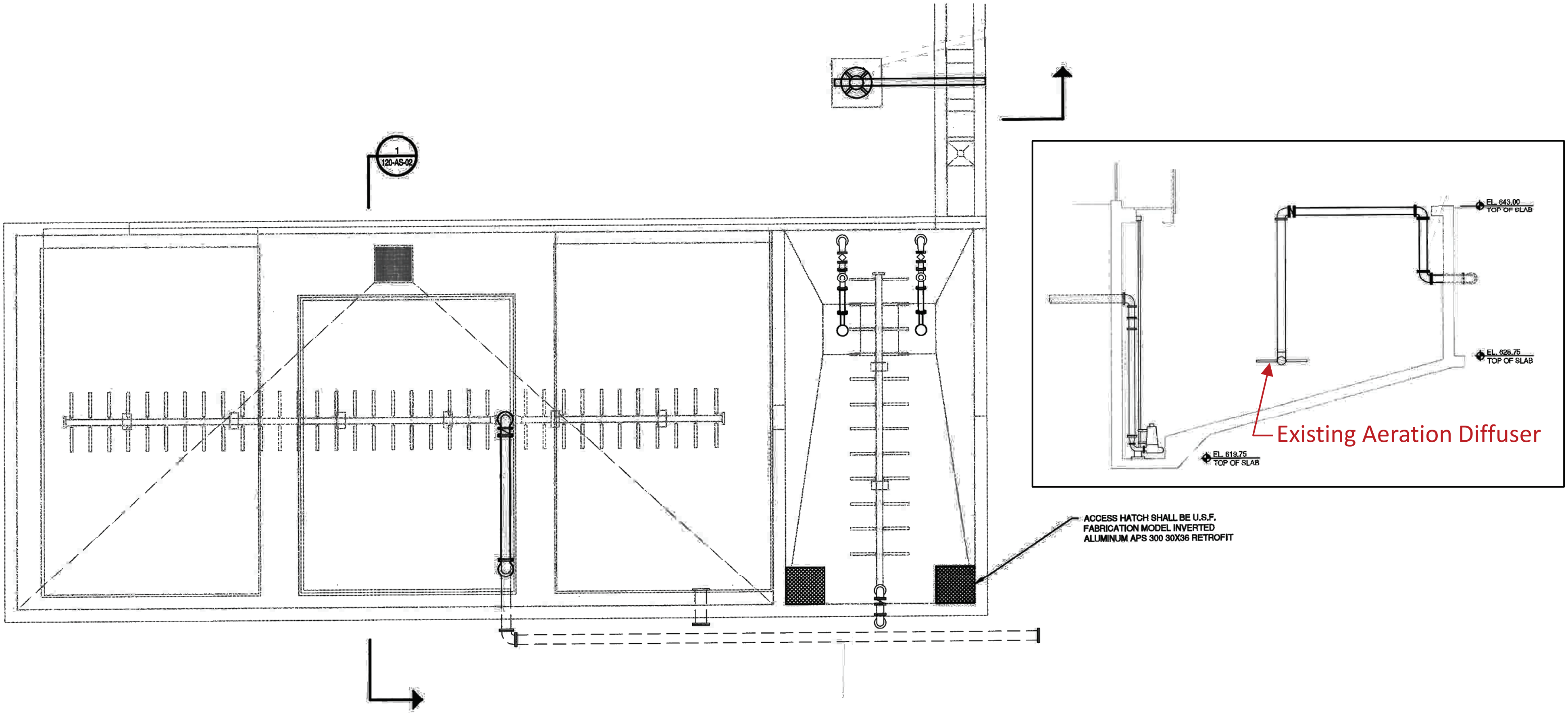


FIGURE IX-1

EQUALIZATION TANK

WWTF - FACILITY PLAN

VILLAGE OF SISTER BAY, WI

S0661-09-2500241.02 10-20-25

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ones in the tank. The new diffusers would allow mixing/aeration to continue until the level in the tank reaches approximately 4 to 5-feet.

The installation would include a new positive displacement blower located in the Headworks Room, along with a new below grade aeration line. The system would be designed to provide approximately 65 scfm of additional air.

The opinion of probable capital cost for the second aeration system is $217,700 as shown in Table IX-1.

2. Compressed Gas Mixing System

The second option considered for the equalization tank is a compressed gas mixing system. The proposed compressed gas mixing system includes six nozzles on two headers mounted on the floor of the tank. The nozzles utilize air from a compressor to generate large bubbles that travel from the floor of the tank to the surface. The nozzles induce a bottom-up mixing pattern in the tank.

The system includes automatic valving that sends compressed air to the nozzles on each header. The air would be cycled between the two nozzles. The advantage of this system is that diffusers can be mounted at the bottom of the tank, providing better coverage. An example layout is provided in Figure IX-2. A disadvantage of this system is that the large bubbles do not add dissolved oxygen to the tank.

The proposed system includes a 20 scfm rotary screw compressor with a 60-gallon receiver tank and an automatic valve panel. The valve panel and air compressor would be housed in a 4’ x 4’ enclosure mounted next to the tank. The opinion of probable capital cost of the compressed gas mixing system is $295,400 as shown in Table IX-2.

The Village has stated that they prefer the compressed gas mixing system due to the fact it can be mounted on the floor at the tank.

C. ORBAL OXIDATION DITCH AERATION

1. General

Biological treatment is provided by a three-channel orbal oxidation ditch which utilizes rotating plastic discs mounted on a shaft to aerate and mix the ditches. The rotating discs are 4.5-feet in diameter with 9 to 21-inches of the bottom of disc submerged.

The two inner channels of the ditch are aerated and mixed by two 30-HP disc aerators. The outer channel is aerated by two 20-HP disc aerators. The discs are

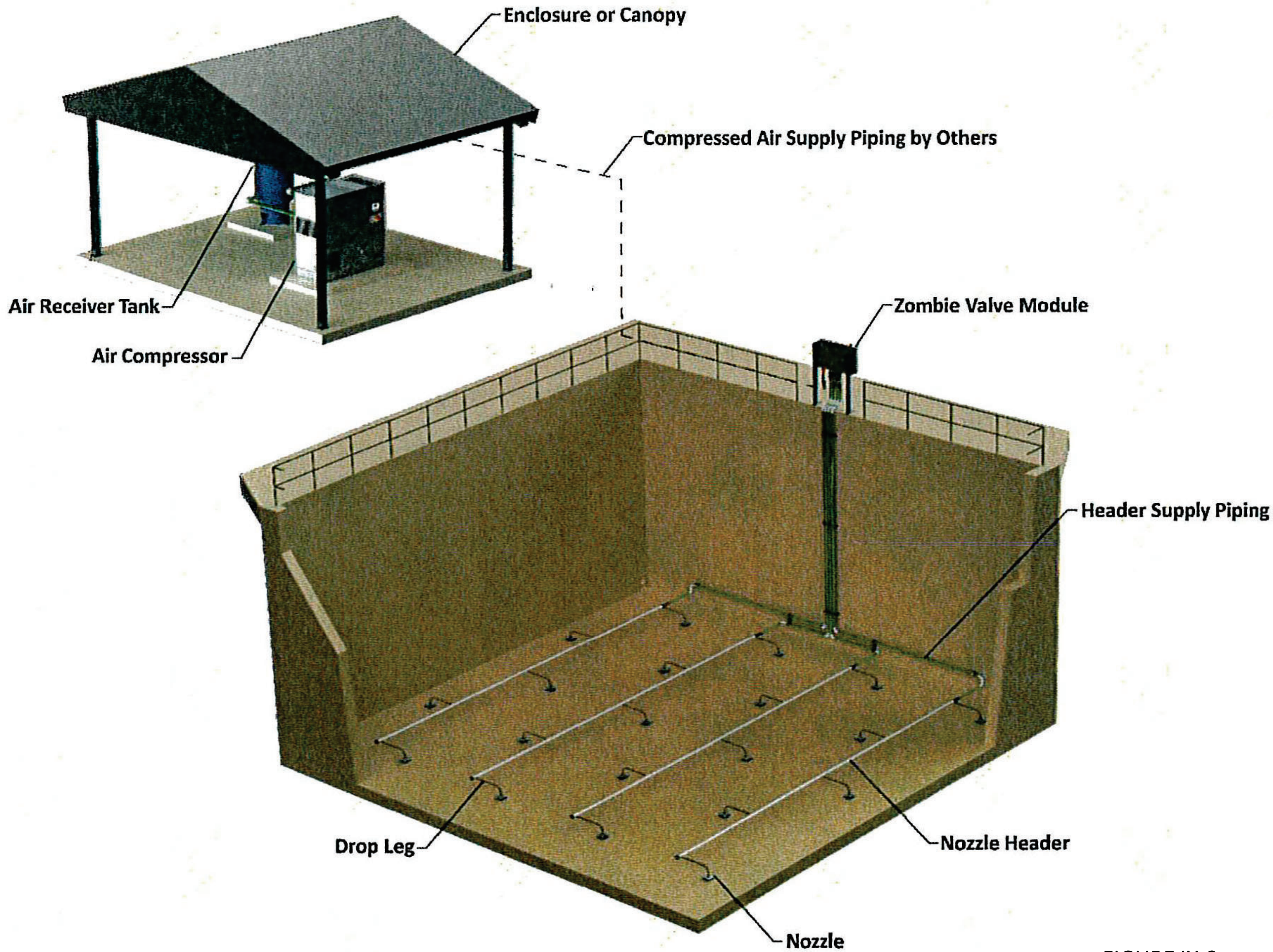

FIGURE IX-2

COMPRESSED AIR MIXING SYSTEM EXAMPLE

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S0661-09-2500241.02 10-20-25

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Table IX-1

HAULED-IN WASTE COARSE BUBBLE DIFFUSERS
PRELIMINARY OPINION OF PROBABLE CAPITAL COST

WWTF FACILITY ASSESSMENT, FEASIBILITY STUDY &
LONG-TERM FACILITY PLANNING

Village of Sister Bay | Door County, Wisconsin

Item	**Opinion of Probable Cost**
Site Piping (below grade air piping)	$40,000
Coarse Bubble Diffusers	$18,000
New Blower	$30,000
Mechanical Piping	$15,000
Insulation	$7,500
Mechanical Install	$15,000
Electrical & Controls Integration	$30,000
Subtotal	$155,500
Engineering & Contingencies (30%)	$46,650
General Conditions/Insurance (10%)	$15,550
Total Opinion of Probable Capital Cost	**$217,700**

Table IX-2

HAULED-IN WASTE COMPRESSED GAS MIXING
PRELIMINARY OPINION OF PROBABLE CAPITAL COST

WWTF FACILITY ASSESSMENT, FEASIBILITY STUDY &
LONG-TERM FACILITY PLANNING

Village of Sister Bay | Door County, Wisconsin

Item	**Opinion of Probable Cost**
Site Piping (below grade air piping)	$22,500
Compressed Gas Mixing System	$98,500
Fiberglass Enclosure for Valve Module	$25,000
Insulation	$5,000
Mechanical Install	$30,000
Electrical & Controls Integration	$30,000
Subtotal	$211,000
Engineering & Contingencies (30%)	$63,300
General Conditions/Insurance (10%)	$21,100
Total Opinion of Probable Capital Cost	**$295,400**

original to the 1990 construction. New VFDs were added in the 2020 construction project. Typically, all three channels are used in the summer months, and only the two inner channels are used in the winter months. A plan view of the existing orbal oxidation ditch is included in Figure IX-3.

The Village is interested in alternatives to the orbal disc aerators. The orbal disc aerators have experienced issues with freezing. Ice can form on the discs which could overload the shafts of the aerators. In extreme cases, this could cause breakage. Options evaluated for replacing the disc aerators include:

- Surface Aerators
- Fine Bubble Diffusers with Submersible Mixers

2. Surface Aerators

The first option considered is mixing and aerating the oxidation ditch with horizontal surface aerators. The aerators are mounted on pontoons that would be attached to the walkway on the ditch. The bottom of the aerator includes a stainless steel propeller designed for mixing/aeration. The shaft that extends from the propeller to the motor is hollow. The action of the propeller draws air through the hollow shaft and disperses into the wastewater. The aerators proposed for this application also include an auxiliary blower that would be mounted on the railing of the walkway to provide more aeration than aspiration alone.

The proposed system consists of two 10-HP mixers with 2-HP supplemental blowers for the inner channel and four (4) 20 HP mixers with 4-HP supplemental blowers for the middle and outer channels. A schematic layout of the system is included in Figure IX-4.

The existing orbal aeration system is designed to maintain a minimum velocity of 1.0-ft./sec to maintain treatment and keep solids in solution. The surface aerator manufacturer stated that the following aerators would need to be operational to maintain this velocity in the channels.

- Inner Channel – Both 10-HP aerators required
- Middle Channel – Both 20-HP aerators required
- Outer Channel – Both 20-HP aerators required

Therefore, this system would require 100-HP in the summer months just to maintain the desired velocities in the channels.

The opinion of probable capital cost for the surface aerators is $1,467,000 as shown in Table IX-3. The cost assumes spare 10-HP and 20-HP aerators are provided for back-up purposes.

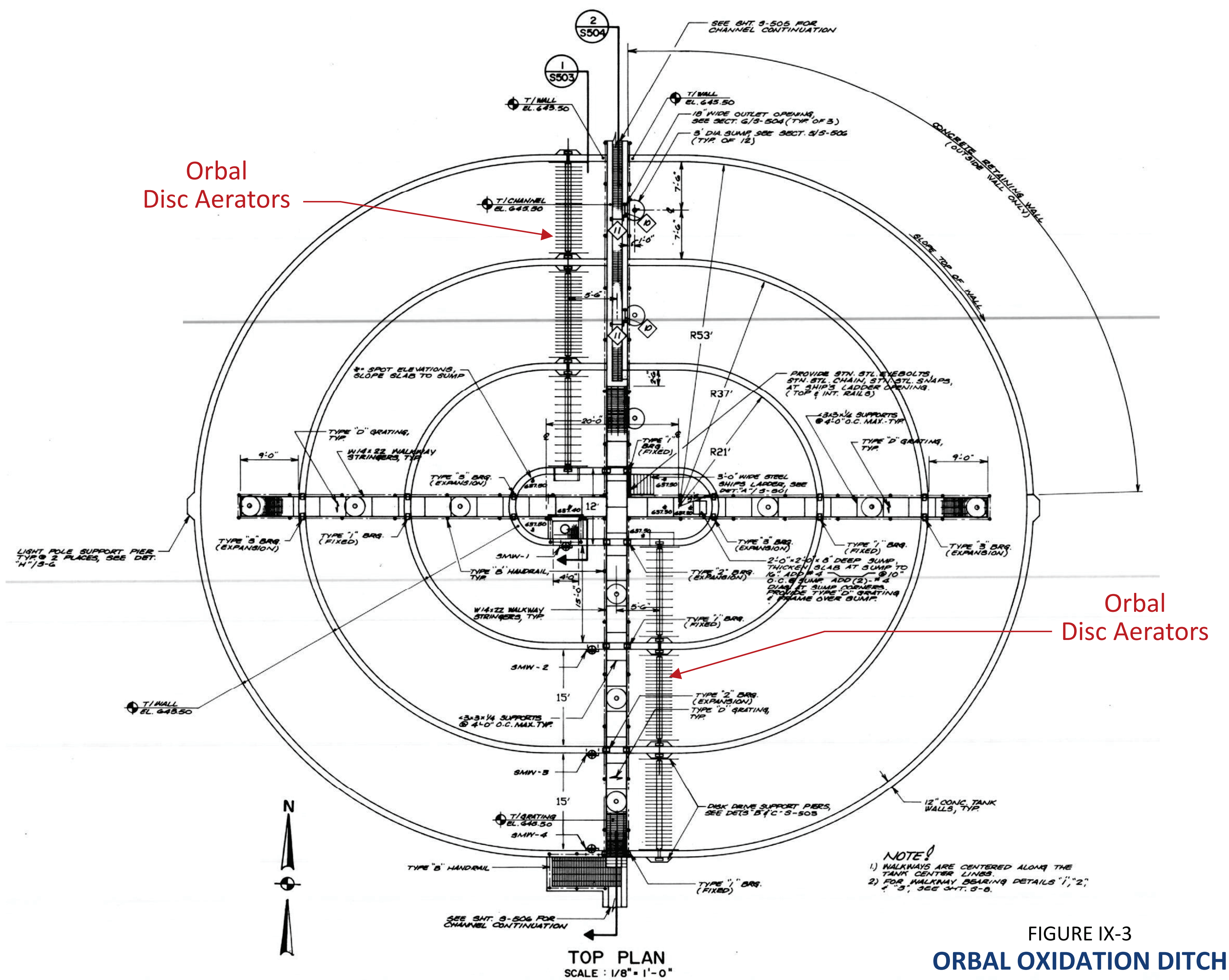

FIGURE IX-3

ORBAL OXIDATION DITCH

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S0661-09-2500241.02 10-20-25

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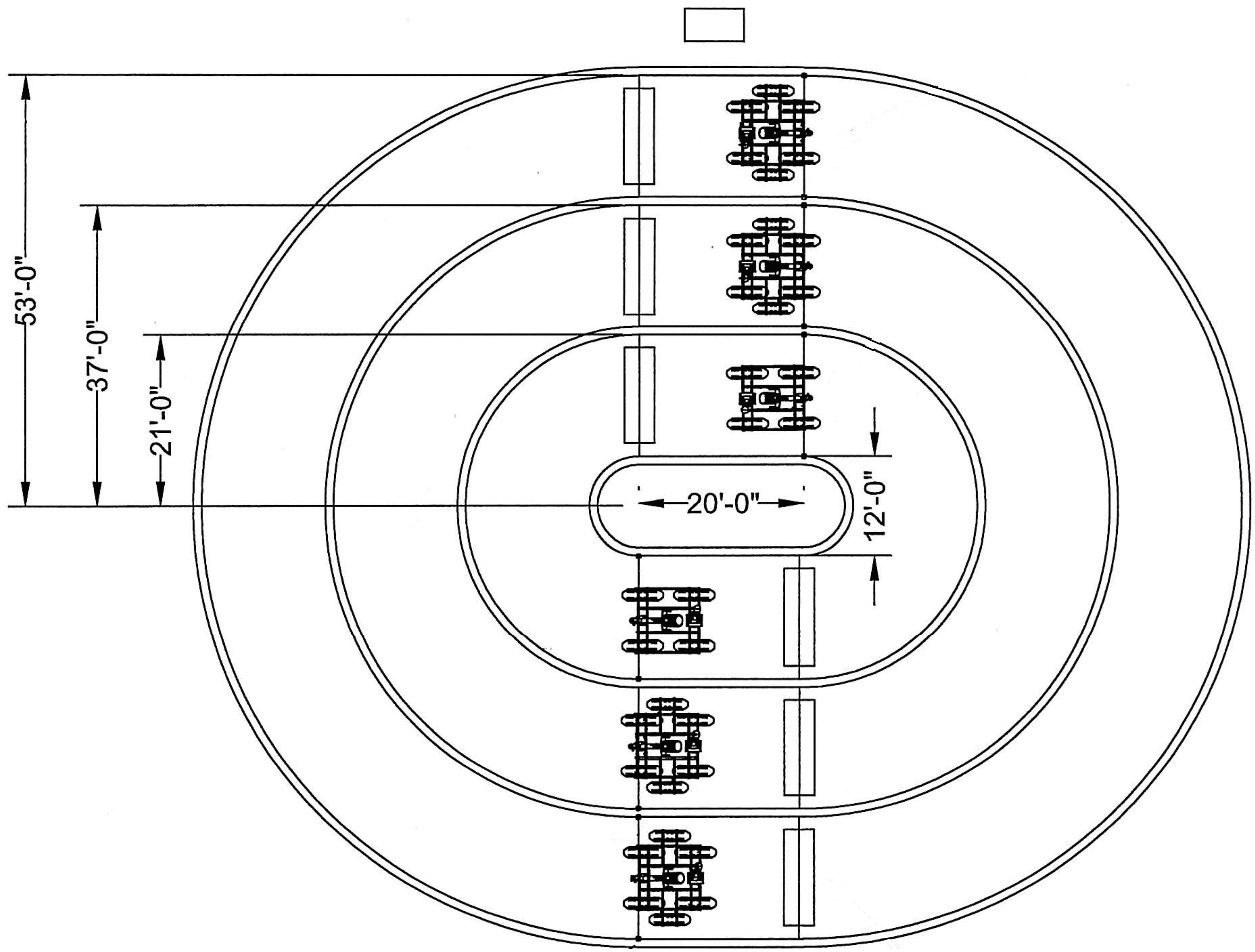

FIGURE IX-4

SURFACE AERATORS LAYOUT SCHEMATIC

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S0661-09-2500241.02 10-20-25

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Table IX-3

OXIDATION DITCH FLOATING SURFACE AERATORS
PRELIMINARY OPINION OF PROBABLE CAPITAL COST

WWTF FACILITY ASSESSMENT, FEASIBILITY STUDY &
LONG-TERM FACILITY PLANNING

Village of Sister Bay | Door County, Wisconsin

Item	**Opinion of Probable Cost**
Demo Orbal Disc Aerators	$40,000
Aeration Equipment	
Floatings Aerators (6)	$482,000
Spare Aerators (2)	$180,000
Mechanical Install (35% of Equip Cost)	$168,700
Electrical & Controls Integration	$200,000
Subtotal	$1,070,700
Engineering & Contingencies (30%)	$321,210
General Conditions/Insurance (7%)	$74,949
Total Opinion of Probable Capital Cost	**$1,466,859**

3. Fine Bubble Diffusers with Submersible Mixers

The second option considered for replacing the orbal disc aerators is fine bubble aeration with submersible mixers. In this option, air would be provided to the oxidation ditch through fine bubble diffusers. The system would include approximately 800 9-inch diffusers mounted on the floor of the ditch. A schematic layout of the diffusers is included in Figure IX-5. Compressed air would be supplied to the diffusers by new positive displacement blowers. The top of the diffusers consists of epdm membranes with small perforations or slits. As air passes through the perforations in the membrane it is broken into a multitude of tiny (fine) bubbles.

Compressed air would be supplied to the diffusers by positive displacement blowers located in a new 35’ x 17’ building east of the oxidation ditch. The building would include three blowers, a motor control center (MCC) and controls. An overhead stainless steel header would be provided to transfer compressed air from the blowers to the drop pipes of the fine bubble membrane diffusers.

A submersible mixer (3 or 4-HP) would be provided in each channel to maintain the desired velocity in the channel. The mixers would be mounted on a guiderail that extends from the floor to the walkway. A manual hoist would be provided for each mixer. Refer to Figure IX-6. The mixers could be lifted in and out of the channels without draining the tank.

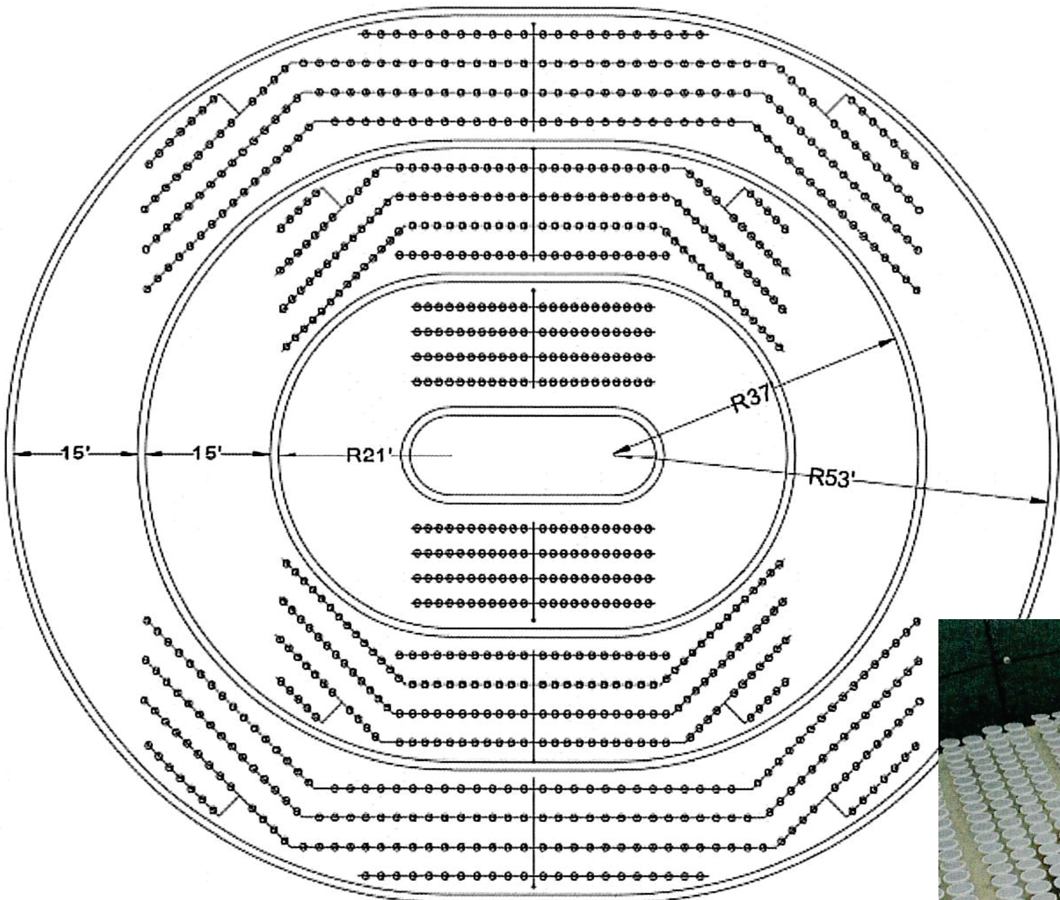
The opinion of probable capital cost for the fine bubble aeration and submersible mixer option is $2,113,500 as shown in Table IX-4. The cost assumes a spare submersible mixer is provided for back-up purposes.

4. Aeration System Operating Costs Comparison

A comparison of the electrical cost for the two options evaluated at the design year loadings along with the existing orbal disc aerators is included in the table below. The orbal disc manufacturer (Xylem) stated that only one aerator should normally be needed for each channel. The power cost for the existing orbal disc system assumes only one aerator is normally operating. Staff have indicated that they will run both aerators in each channel. Therefore, power cost for the existing orbal may be understated.

It is further assumed that all three channels are operated in the summer months and the two inner channels are operated in the winter months.

The aeration options were evaluated based on a simplified 20-year Present Worth Analysis using the discount rate of 2.5%. This is the current DNR discount rate for facilities planning purposes.



FIXED SYSTEM LAYOUT 9.5' (SWD)

FIGURE IX-5

FINE BUBBLE DIFFUSERS LAYOUT

WWTF - FACILITY PLAN

VILLAGE OF SISTER BAY, WI

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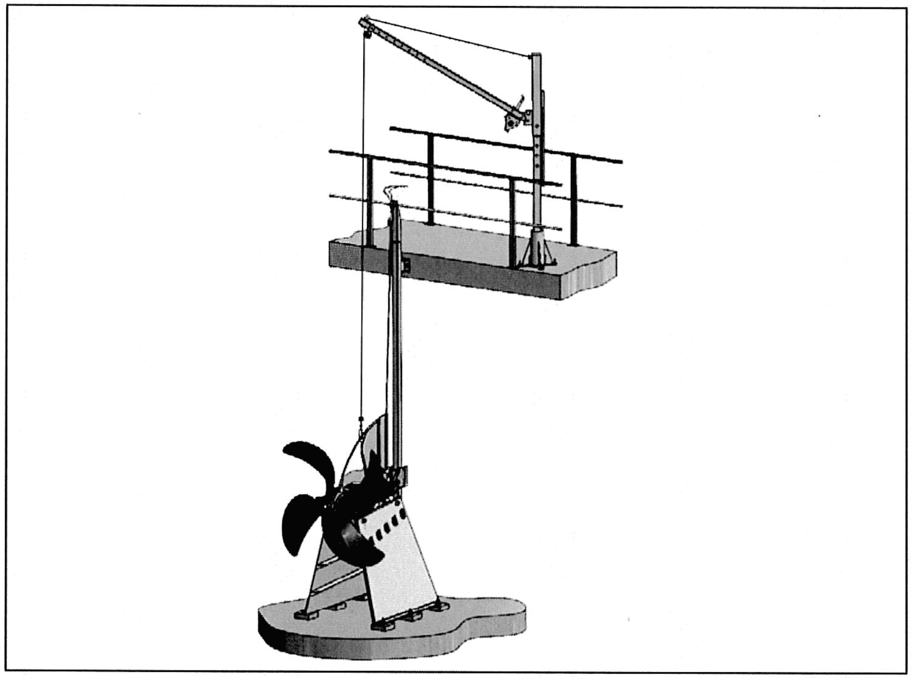
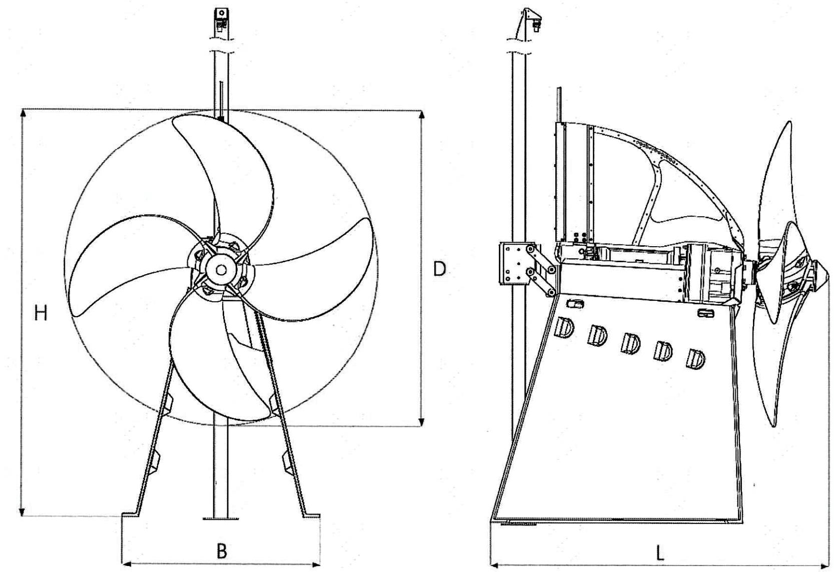


The item numbers in Figure A.1 refer to the following components of the hyperboloid mixer:

- Item 1: Propeller
- Item 2: "Anti-vortex" fin
- Item 3:: Power train
- Item 4: Lifting construction
- Item 5: Base frame

CyberFlow® Dimensions



L	3.000	mm
B	750	mm
D	2.500	mm
H	2.750	mm

FIGURE IX-6
SUBMERSIBLE MIXER
WWTF - FACILITY PLAN
VILLAGE OF SISTER BAY, WI
S0661-09-2500241.02 10-20-25
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Table IX-4

OXIDATION DITCH FINE BUBBLE DIFFUSED AERATION
PRELIMINARY OPINION OF PROBABLE CAPITAL COST

WWTF FACILITY ASSESSMENT, FEASIBILITY STUDY &
LONG-TERM FACILITY PLANNING

Village of Sister Bay | Door County, Wisconsin

Item	**Opinion of Probable Cost**
Site Work	$30,000
Site Aeration Piping	$165,000
Demo Orbal Disc Aerators	$40,000
Empty & Powerwash Ditch	$22,500
New Blower Building	
Foundation	$31,000
Building (@ $800/sq. ft.)	$476,000
Aeration Equipment	
Fine Bubble Diffusers	$80,000
Mixers (3)	$148,000
Spare Mixer	$40,000
Blowers (3)	$135,000
Mechanical Install (40% of Equip Cost)	$145,200
Blower Piping	$40,000
Electrical & Controls Integration	$190,000
Subtotal	$1,542,700
Engineering & Contingencies (30%)	$462,810
General Conditions/Insurance (7%)	$107,989
Total Opinion of Probable Capital Cost	**$2,113,499**

	Existing Orbal	Surface Aerators	Fine Bubble Diffusers W/ Submersible Mixers
Opinion of Probable Capital Cost	-	$1,467,000	$2,113,500
Opinion of Probable Annual Cost – Year 2050	$19,222	$41,397	$18,499
Present Worth Annual Cost	$299,655	$645,344	$288,384
Total Present Worth Cost	**$299,655**	**$2,112,344**	**$2,401,884**

The surface aerator option has the lowest present worth cost due to its lower capital cost; although its annual cost is over double that of the fine bubble diffusers with submersible mixer option.

The fine bubble with submersible mixers has a distinct operational advantage of the surface aerator option in that the fine bubble system provides better dissolved oxygen (D.O.) control. The blowers can be ramped up/down to provide the desired D.O. level, allowing the Operators to maintain desired levels. The supplemental blowers on the surface aerators can be cycled on/off based on D.O. levels, but air will always be provided as long as the aerator is operating. Each basin will require two aerators to be on at all times to maintain the desired velocity in the oxidation ditch channels.

Based on its operational advantages, it is recommended that a fine bubble diffused aeration system with submersible mixers be provided if Sister Bay chooses to replace their orbal aeration system.

D. SECONDARY CLARIFIERS

The WWTF includes two 40-foot diameter secondary clarifiers. The west clarifier is enclosed with concrete sidewalls and a fiberglass cover. The second clarifier is not covered and open to the elements. The covered clarifier is used exclusively in the winter months due to concerns with freezing. If the west clarifier failed during the winter months, the Village would be required to operate the open clarifier. With the low flows experienced during the winter months, the surface of the clarifier could freeze, causing damage to the mechanism.

Providing a cover over the east clarifier would provide redundancy in the winter months. An aluminum dome cover with 8-foot sidewalls could be constructed over the existing clarifier to keep it from freezing. The opinion of probable cost of a new aluminum dome cover is $297,000 as shown in Table IX-5, including new lights mounted on the catwalk.

Both clarifiers have tow-bro type sludge collectors that are piped directly to a header in the Service Building. Three RAS pumps in the Service Building return the sludge to the oxidation ditch to continue treatment. A single rotary lobe pump draws from the header for wasting sludge (waste activated sludge). The single WAS pump is not able to equally draw sludge from both clarifiers. According to Plant Staff, this creates an imbalance that does not allow them to run both clarifiers at the same time.

Table IX-5

NEW SECONDARY CLARIFIER ALUMINUM DOME COVER
PRELIMINARY OPINION OF PROBABLE CAPITAL COST

WWTF FACILITY ASSESSMENT, FEASIBILITY STUDY &
LONG-TERM FACILITY PLANNING

Village of Sister Bay | Door County, Wisconsin

Item	**Opinion of Probable Cost**
Demolish Railing	$3,000
New Aluminum Dome Cover	$72,000
Access Hatches for Cleaning Weirs	$8,000
Platform/Steps	$25,000
Lights/Receptacles	$10,000
Aluminum Dome Installation	$94,000
Subtotal	$212,000
Engineering & Contingencies (30%)	$63,600
General Conditions/Insurance (10%)	$21,200
Total Opinion of Probable Capital Cost	**$296,800**

Sister Bay is interested in installing a second rotary lobe WAS pump to allow them to operate both clarifiers in the summer months and to provide redundancy. To accommodate the second pump, the first pump will need to be relocated to make room for the second pump. The opinion of probable cost of the second pump is $171,000 as shown in Table IX-6.

E. EFFLUENT REUSE

The Sister Bay WWTF utilizes plant effluent for general washdown, use as spray water in the fine screen and as spray water for the sludge thickener. The system includes a 15-HP centrifugal pump that draws water from the old chlorine contact channels surrounding the clarifiers. The pump is rated for 155 gpm at 75 psig of head. The pump was installed with the 2020 WWTP Modifications Project. The system also includes two 36-inch diameter, 264-gallon hydropneumatics tanks. The tanks are original to the 1990 construction project.

One of the tanks is currently leaking. At a design flow of 155 gpm, a 500-gallon hydropneumatic tank is generally recommended. The effluent reuse system will need to be reevaluated once the long-term solids handling option is determined.

X. SOLIDS HANDLING SYSTEMS EVALUATION

A. GENERAL

The Village of Sister Bay currently thickens WAS and hauls it to the Sturgeon Bay Utilities WWTF for processing and disposal. Solids handling alternatives evaluated for this Study include the following:

- Continue to Haul to Sturgeon Bay Utilities
- Reed Bed Disposal
- Biosolids Drying

Evaluations for the three solids handling options are included below.

B. CONTINUE TO HAUL TO STURGEON BAY UTILITIES

Sturgeon Bay Utilities was contacted regarding the continued acceptance of Sister Bay's sludge. Sturgeon Bay currently charges $0.09/gallon for the hauled-in sludge. Sturgeon Bay stated that they are willing to continue to accept the solids for the time being. Sturgeon Bay is holding off on a long-term commitment until PFAS regulations are finalized.

In 2022, prior to the PFAS guidance document, Sturgeon Bay looked into the feasibility of installing a below-grade hauled-in sludge receiving tank. The tank would allow for the year-round of acceptance of sludge from member communities. Currently, Sturgeon Bay

Table IX-6

NEW WAS PUMP

PRELIMINARY OPINION OF PROBABLE CAPITAL COST

WWTF FACILITY ASSESSMENT, FEASIBILITY STUDY &
LONG-TERM FACILITY PLANNING

Village of Sister Bay | Door County, Wisconsin

Item	**Opinion of Probable Cost**
Demo Base of Existing WAS Pump & Provide 2 New Bases	$10,000
New WAS Pump	$25,000
Mechanical Piping	$26,000
Painting	$5,000
Mechanical Install	$16,000
Electrical & Controls Integration	$40,000
Subtotal	$122,000
Engineering & Contingencies (30%)	$36,600
General Conditions/Insurance (10%)	$12,200
Total Opinion of Probable Capital Cost	**$170,800**

does not accept sludge during the winter months due to freezing concerns. Based on that evaluation, the preliminary opinion of probable cost for the new tank, including a submersible mixer and pump is $1,500,000. The cost of the tank would be recovered by user fees, which would require a long-term contract with member communities. The estimated impact on fees, assuming a 20-year loan at 1.551% and receiving 1,000,000 gallons of sludge per year from the member communities are as follows:

- The tank would add approximately $0.09/gallon to the current charge.
- If the project received 30% principal forgiveness, the adder would be approximately $0.06/gallon.

C. REED BED DISPOSAL

The second solids handling alternative considered is reed bed disposal. In this option, WAS from the WWTF would still be aerobically digested and thickened. The thickened WAS would be pumped to reed beds for treatment on a regular schedule. A schematic of this option is included in Figure X-1.

Each bed is provided with a synthetic liner and a layer of stone, pea gravel and sand in which the reeds are planted. Concrete walls provide the bed structure. Underdrains collect water that separates from the biosolids during dewatering and any rainwater not taken up by the reeds. A detail of a reed bed is included in Figure X-2.

The reed beds consist of a sand drying bed with reeds planted at approximately 18-inches on center. Native reeds are proposed for the Sister Bay application. The system combines the action of conventional drying beds with the effects of aquatic plants on water bearing substrates. The great demand for water by these plants causes them to extend their root systems into the biosolids deposits. This extended root system not only draws water from the biosolids, but also causes the establishment of rich microflora, which feeds on the organic content of the biosolids. As a result, more than 95% of the sludge solids are eventually converted to carbon dioxide and water, with a corresponding volume reduction. The final product in the reed beds resembles topsoil.

The reeds must be harvested annually to a stubble of approximately 10-inches, promoting lateral growth of the rhizomes (a horizontal creeping stem). Even though the reeds are harvested, biosolids may still be applied year-round. The life of each reed bed is approximately 7 to 10-years, at which time the biosolids must be removed and disposed of by landfilling. Sufficient root structure should remain intact after emptying the beds; therefore, replanting should not be necessary.

The reeds improve the ability of the drying beds to dewater and reduce solids. Stabilized biosolids are applied to the beds until a level of 4-inches of standing liquid is on the surface. Loading schedules are typically one application every 10 to 20 days. The reed stems provide vertical crevices that allow approximately 40% of the applied volume to seep to the under-drain system within six hours. The newly deposited biosolids form a layer across the reed beds approximately 4-inches thick. Further drying will reduce the

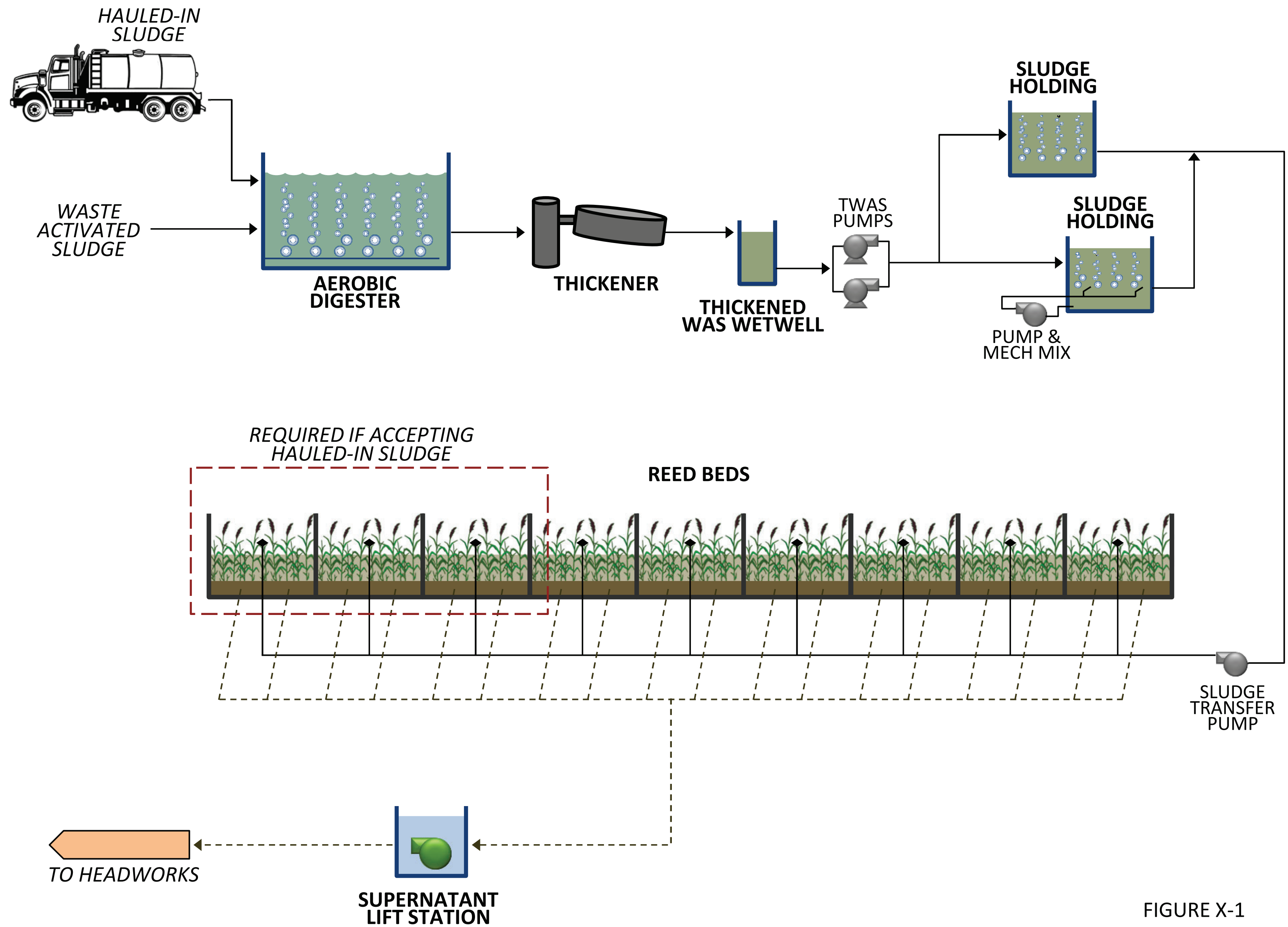

FIGURE X-1
REED BED OPTION
PROCESS FLOW SCHEMATIC
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VILLAGE OF SISTER BAY, WI
S0661-09-2500241.02 10-20-25
ID: \2025\MCM WI\SISTER BAY-WWTF-FACILITY PLAN SCHEMATIC.PPTX jmk/CTO

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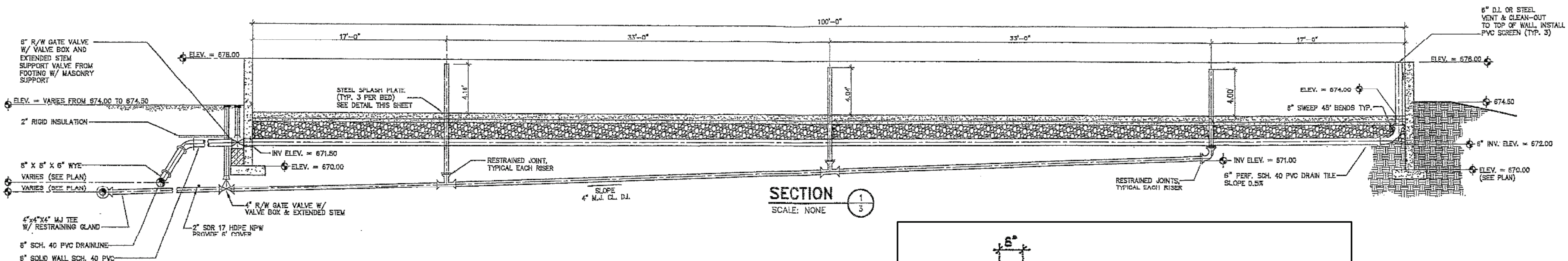

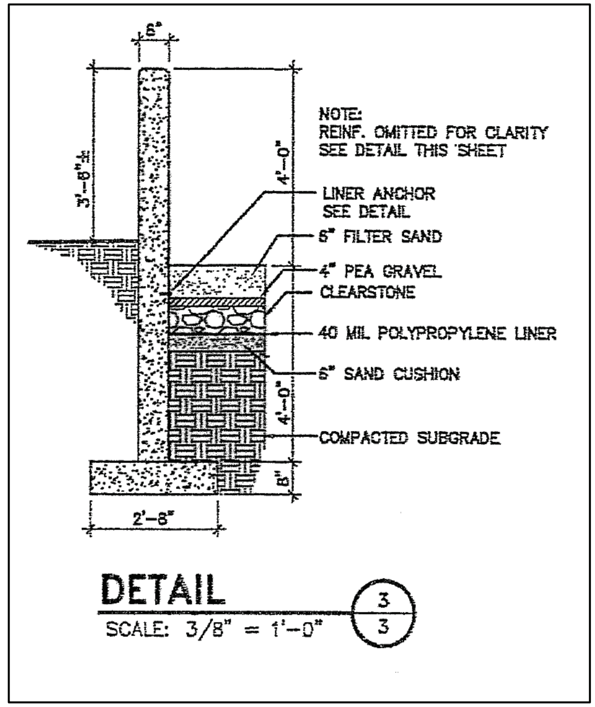

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FIGURE X-2

TYPICAL REED BED SECTION

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VILLAGE OF SISTER BAY, WI

S0661-09-2500241.02 10-20-25

ID: \2025\MCM WI\SISTER BAY-WWTF-FACILITY PLAN SCHEMATIC.PPTX jmk/CTO

layer to approximately 1/4-inch. Vertical drainage channels around each reed stem are kept open by the swaying motion of the reeds in the wind.

The demand for water by the root system below the surface creates additional crevices on the surface, which further enhances evaporation. Water absorbed by the root system of the plants is released to the atmosphere through evaporation. The stems of the reeds contain nodes, which provide secondary root growth. As the nodes are submerged in the biosolids, a series of rhizomes branch off the stem and extend the root system horizontally. Additional vertical plant stems sprout from the rhizomes, and the growth process repeats itself until a limiting factor, such as root density or competition for water and sunlight, restrict growth. Evaporation may account for up to 40% of the loaded volume of liquid biosolids.

The reeds have hollow stems that convey oxygen from the leaves to the root system. The oxygen provides an aerobic condition within the root system, in which microorganisms can thrive. The rich microflora, which exists beneath the surface, serves to reduce the organic content of the biosolids. The plants also excrete sugars and organic acids that are utilized by soil bacteria. Nitrifying bacteria (nitrosomonas and nitrobacter) establish themselves within the rhizosphere of the root system. Conversion of ammonia to nitrite and nitrate is regulated principally by temperature, oxygen and the rate of liquid flow through the rhizosphere. The microflora are also protected against rapid pH swings by root hairs.

As stated earlier, the reed bed is, basically, a sand drying bed with reeds planted in them. The beds allow a portion of the liquid sludge to pass through. As the liquid passes through the sand and underlying granular layers, the biosolids are filtered out. The resulting filtrate is collected at the bottom of the bed by a 40-mil impermeable polypropylene liner. The liner is sloped toward the center of the bed to promote drainage. Collected drainage flows to a lift station to be returned to the WWTF for treatment.

Stabilized biosolids are typically applied to a maximum standing liquid depth of 4-inches in the reed beds. Therefore, a 7,200 square foot reed bed can accept 18,000-gallons in a single loading. Reed beds can typically accept a loading of stabilized biosolids every 10 to 20 days.

Stabilized biosolids may be routinely applied to the reed beds until the overall depth approaches 39 to 42-inches. Above this level, the bed’s ability to dewater is reduced. The depth of biosolids in the beds can be estimated by measuring down, from the top of the concrete walls. At the end of the life of a reed bed, the biosolids are removed and disposed of by landfilling. Loading rates to the beds must be carefully planned, especially around the seventh, eighth and ninth years, to allow a 1-year rest period, to allow for mineralization of the biosolids prior to disposal.

The reeds should be harvested annually in the late fall or early winter, after the plants have gone dormant but prior to them shedding their leaves. This is necessary to avoid clumps of dead vegetation, which would interfere with biosolids distribution on the bed. A hard freeze is typically viewed as favorable, because it provides a firm surface to stand on while harvesting the reeds. As an alternate to annual harvesting, the reeds may be burned within the confines of the reed beds. Any burning of the reeds should comply with local ordinances and regulations and only take place when weather conditions are conducive.

The existing sludge transfer pumps would be used to pump the thickened digested sludge from the aerobic digesters/holding tank to the reed beds.

For Sister Bay's loadings, six 7,200 square foot beds would be required to handle year 2050 loadings. Sister Bay could install three additional beds to be able to handle hauled-in sludge from Bailey's Harbor, Ephraim and Fish Creek. The reed beds are sized on the basis of 25-gallons of biosolids / square foot/year loading. Preliminary layouts of the reed beds is included in Figure X-3 and X-4.

The opinion of probable capital cost for the reed system for Sister Bay alone is $3,151,000 as shown in Table X-1. The annual cost, assuming the beds are emptied on a 10-year basis is $99,300 as shown in Table X-2.

The opinion of probable capital cost for the reed system for Sister Bay and the three other communities is $4,334,100 as shown in Table X-3. The annual cost, assuming the beds are emptied on a 10-year basis is $150,000 as shown in Table X-4.

D. BIOSOLIDS DRYING

1. General

The third solids handling alternative considered is biosolids drying. In this option, WAS from the WWTF would still be aerobically digested. The digested solids would be dewatered and dried on a weekly or bi-weekly basis, depending on the time of year. The system would be sized to handle Year 2050 loadings from Sister Bay and loadings from Bailey's Harbor, Ephraim and Fish Creek. The dried biosolids would be pelletized and bagged for distribution.

2. Dewatering

Before the drying process, the digested biosolids need to be dewatered to a minimum of 15% total solids. Sister Bay currently thickens the biosolids out of the aerobic digester using a disc thickener. The disc thickener removes water from the solids to thicken the solids from less than 1% total solids to approximately 5% total solids, significantly reducing the volume to haul.

Dewatering takes this process further. Dewatering is the process of removing significantly more water from sludge or biosolids to create a solid cake which can

SISTER BAY LOADINGS ONLY
Six (6) 60'x120' Reed Beds for Year 2050 Loadings

McMAHON ENGINEERS ARCHITECTS

FIGURE X-3

REED BEDS LAYOUT - SISTER BAY ONLY

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VILLAGE OF SISTER BAY, WI

S0661-09-2500241.02 10-20-25

ID: \2025\MCM WI\SISTER BAY-WWTF-FACILITY PLAN SCHEMATIC.PPTX jmk/CTO

COMBINED LOADINGS
Nine (9) 60'x120' Reed Beds for Year 2050 Loadings

McMAHON ENGINEERS ARCHITECTS

FIGURE X-4
REED BEDS LAYOUT - SISTER BAY w/SURROUNDING COMMUNITIES
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VILLAGE OF SISTER BAY, WI
S0661-09-2500241.02 10-20-25
ID: \2025\MCM WI\SISTER BAY-WWTF-FACILITY PLAN SCHEMATIC.PPTX jmk/CTO

Table X-1

SIX REED BEDS OPTION | SISTER BAY LOADINGS ONLY

PRELIMINARY OPINION OF PROBABLE CAPITAL COST

WWTF FACILITY ASSESSMENT, FEASIBILITY STUDY &

LONG-TERM FACILITY PLANNING

Village of Sister Bay | Door County, Wisconsin

Description	Quantity	Unit	Unit Price	Contract Cost
Excavation & Backfill (Reed Beds)	8,470	CY	$25	$211,800
Excavation & Backfill (Site Piping)	1,200	CY	$25	$30,000
Site Restoration (Fine Graded Topsoil, Seeding & Fertilizer)	5,000	SY	$7	$35,000
Concrete Walls	310	CY	$1,000	$310,000
Concrete Footing	103	CY	$600	$61,800
Clean Sand	1,600	CY	$31	$49,600
Pea Gravel	533	CY	$40	$21,300
Clean Rock/Stone	800	CY	$43	$34,400
40 mil Poly Liner (Includes Installation)	50,760	SF	$10	$507,600
Furnish & Plant Native Reeds	1	LS	$110,000	$110,000
4" DI Feed Piping	1,500	LF	$150	$225,000
4" Buried Plug Valve, Valve Box, & Stem	6	Ea	$2,300	$13,800
6" SDR18 PVC Filtrate Piping	900	LF	$150	$135,000
8" SDR18 PVC Filtrate Piping	350	LF	$160	$56,000
Submersible Filtrate Simplex Lift Station	1	LS	$200,000	$200,000
4" SDR18 PVC Filtrate Force Main	300	LF	$150	$45,000
2" DR9 HDPE NPW Piping	570	LF	$50	$28,500
Yard Hydrant	6	Ea	$500	$3,000
Asphalt Driveway (12" CABC, fine grade agg base, 4" asphalt)	12,600	SF	$8	$100,800
Chain Link Fencing	960	LF	$75	$72,000
Subtotal				$2,250,600
Contractor General Conditions (10%)				$225,100
Engineering & Contingencies (30%)				$675,200
Total Opinion of Probable Capital Cost				**$3,150,900**

Table X-2

SIX REED BEDS OPTION | SISTER BAY LOADINGS ONLY

PRELIMINARY OPINION OF PROBABLE ANNUAL COST

WWTF FACILITY ASSESSMENT, FEASIBILITY STUDY &

LONG-TERM FACILITY PLANNING

Village of Sister Bay | Door County, Wisconsin

Description	**Annual Quantity**	**Unit**	**Unit Price**	**Annual Cost**
Polymer Demand	6.2	lbs./day	-	$6,300
Harvest Reeds (Labor)	6	hrs	$100	$600
Mow/Rake Lawn (Labor)	8	hrs	$100	$800
Trim/Burn Plant Material (Labor)	12	hrs	$100	$1,200
Transfer Sludge to Beds (Labor)	12	hrs	$100	$1,200
Biosolids Removal & Hauling (Once Every 10 Years)	533	CY	$120	$64,000
Biosolids Disposal @ Landfill (Once Every 10 Years)	360	tons	$70	$25,200
Total Opinion of Probable Annual Cost				**$99,300**

Table X-3

NINE REED BEDS OPTION | SISTER BAY LOADINGS PLUS OTHER COMMUNITIES

PRELIMINARY OPINION OF PROBABLE CAPITAL COST

WWTF FACILITY ASSESSMENT, FEASIBILITY STUDY &

LONG-TERM FACILITY PLANNING

Village of Sister Bay | Door County, Wisconsin

Description	Quantity	Unit	Unit Price	Contract Cost
Excavation & Backfill (Reed Beds)	12,630	CY	$25	$315,800
Excavation & Backfill (Site Piping)	1,500	CY	$25	$37,500
Site Restoration (Fine Graded Topsoil, Seeding & Fertilizer)	8,000	SY	$7	$56,000
Concrete Walls	453	CY	$1,000	$453,000
Concrete Footing	151	CY	$600	$90,600
Clean Sand	2,400	CY	$31	$74,400
Pea Gravel	800	CY	$40	$32,000
Clean Rock/Stone	1,200	CY	$43	$51,600
40 mil Poly Liner (Includes Installation)	76,140	SF	$10	$761,400
Furnish & Plant Native Reeds	1	LS	$160,000	$160,000
4" DI Feed Piping	1,900	LF	$150	$285,000
4" Buried Plug Valve, Valve Box, & Stem	9	Ea	$2,300	$20,700
6" SDR18 PVC Filtrate Piping	1,400	LF	$150	$210,000
8" SDR18 PVC Filtrate Piping	120	LF	$160	$19,200
10" SDR18 PVC Filtrate Piping	330	LF	$170	$56,100
Submersible Filtrate Simplex Lift Station	1	LS	$200,000	$200,000
4" SDR18 PVC Filtrate Force Main	300	LF	$150	$45,000
2" DR9 HDPE NPW Piping	700	LF	$50	$35,000
Yard Hydrant	9	Ea	$500	$4,500
Asphalt Driveway (12" CABC, fine grade agg base, 4" asphalt)	13,000	SF	$8	$104,000
Chain Link Fencing	1,120	LF	$75	$84,000
Subtotal				$3,095,800
Contractor General Conditions (10%)				$309,600
Engineering & Contingencies (30%)				$928,700
Total Opinion of Probable Capital Cost				**$4,334,100**

Table X-4

NINE REED BEDS OPTION | SISTER BAY LOADINGS PLUS OTHER COMMUNITIES
PRELIMINARY OPINION OF PROBABLE ANNUAL COST
WWTF FACILITY ASSESSMENT, FEASIBILITY STUDY &
LONG-TERM FACILITY PLANNING
Village of Sister Bay | Door County, Wisconsin

Description	Annual Quantity	Unit	Unit Price	Annual Cost
Polymer	11.2	lbs./day	-	$11,300
Harvest Reeds (Labor)	9	hrs	$100	$900
Mow/Rake Lawn (Labor)	12	hrs	$100	$1,200
Trim/Burn Plant Material (Labor)	16	hrs	$100	$1,600
Transfer Sludge to Beds (Labor)	12	hrs	$100	$1,200
Biosolids Removal & Hauling (Once Every 10 Years)	800	CY	$120	$96,000
Biosolids Disposal @ Landfill (Once Every 10 Years)	540	tons	$70	$37,800
Total Opinion of Probable Annual Cost				**$150,000**

be conveyed on a conveyor and stacked. Dewatering processes typically produce a cake that is 15% to 30% total solids. The solids are not free-flowing and resemble wet clay.

Dewatering processes apply a significant mechanical force to achieve increased water removal over that possible from thickening. The most common processes operate by pressing the sludge to force the water (or filtrate) through a permeable medium (belt filter press, screw press, or filter press); or by rapidly rotating the sludge in a cylindrical vessel to force the denser solids to the internal walls of the vessel and the water to its center, the water forming the diluted centrate stream (centrifuge).

Similar to the existing thickening process, the dewatering equipment use polymer to condition the sludge, making it easier to separate water from solids. The polymer acts as a flocculant that binds tiny particles together into larger clumps, called flocs.

The drier the solids (cake), the less energy required to dry the solids. The dewatering processes considered for Sister Bay include the following:

	Predicted Cake Dryness, % TS	Predicted Polymer Demand, lbs./dry ton	Equipment Budget Cost
Centrifuge	20%	35	$400,000
Belt Filter Press	17%	15	$458,500
Volute Press	16%	35	$427,000
Screw Press	16%	35	$450,000

The dryer will need to operate 24-hours per day. It cannot be shut down at the end of a shift due to the time required to start and heat the unit. Therefore, the dewatering equipment will need to be capable of running 24-hours per day and unattended for 12 to 16-hours per day. Centrifuges and belt filter presses are relatively complex pieces of equipment and would require more attention than the volute or screw presses. Screw presses are more robust and slow moving than volute presses.

Based on its slow operation and ability to be operated unattended for significant periods of time, a screw press will be used as the dewatering technology in this analysis. A schematic of a screw press is included in Figure X-5.

3. Biosolids Drying

Biosolids drying involves using heat, either direct or indirect, to evaporate water from wastewater solids. For Sister Bay, biosolids from the dewatering process would be loaded into a drying process to remove more moisture and produce a biosolid with a total solids content of greater than 90%. The selected drying process would produce a Class A biosolid.

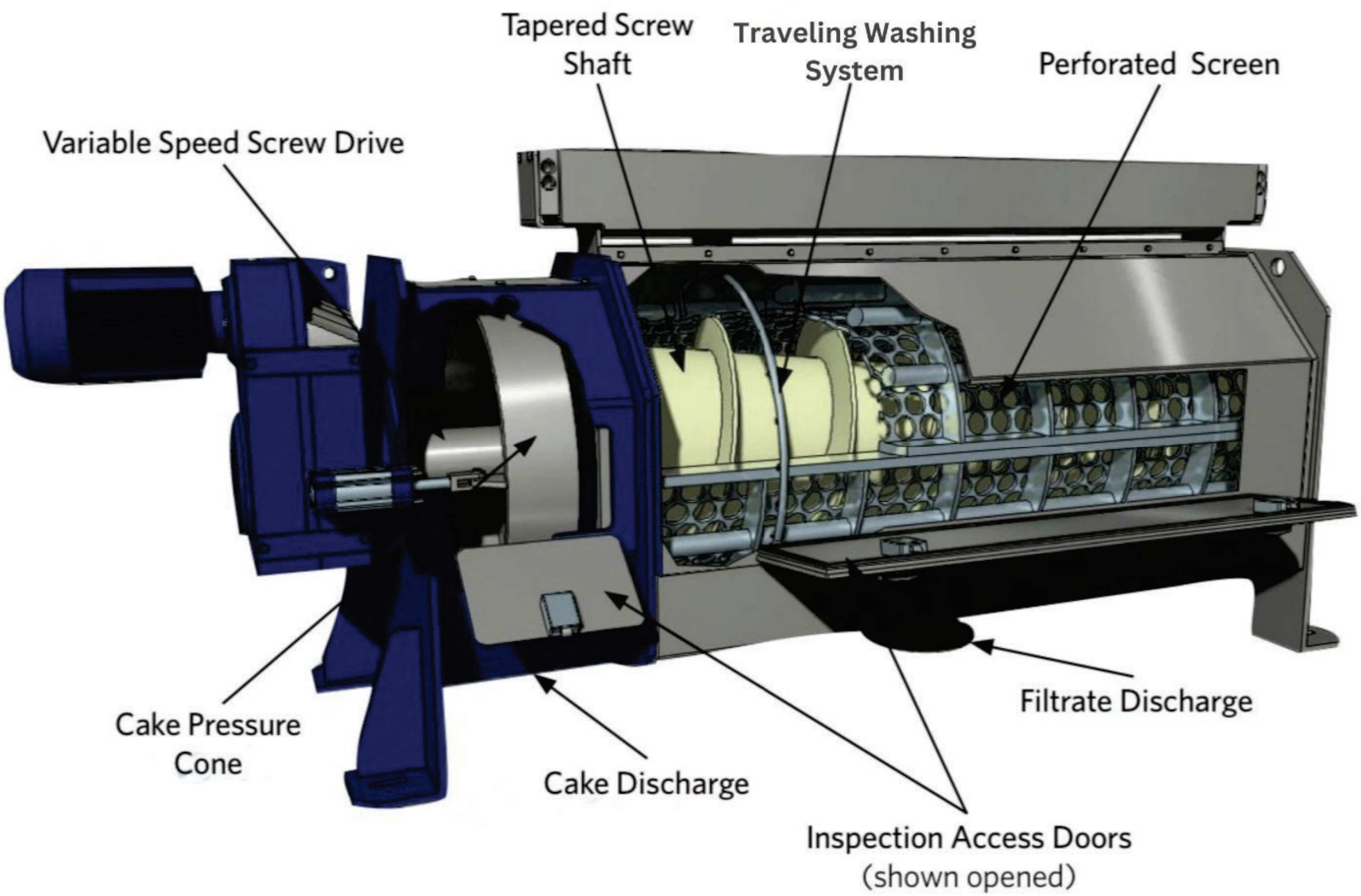

FIGURE X-5

SCREW PRESS DEWATERING

WWTF - FACILITY PLAN
VILLAGE OF SISTER BAY, WI

S0661-09-2500241.02 10-20-25

ID: \2025\MCM WI\SISTER BAY-WWTF-FACILITY PLAN SCHEMATIC.PPTX jmk/CTO

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The following three dryers were evaluated for Sister Bay.

- PW Tech/MB Plate Belt Dryer
- Bioforcetech BioDryer
- BCR Indirect Rotary Screw Dryer

Natural gas is not available on-site. All three options utilize electric heaters for producing the heat required for drying.

a. PW Tech/MB Plate Belt Dryer

The first option considered for drying is a PW Tech/MB low-temperature plate belt sludge dryer. The dryer has a dosing belt on top. The belt moves back and forth spreading the dewatered biosolids evenly on a plated dryer belt made from steel plates. The plates turn at the end, dropping the product on the returning parts of the belt, thus making use of the same belt twice for increased drying surface. The product laying on the drying belt, is dried by outside air, heated by a water/air heat-exchanger, which is being pulled through the wet material to cause the moisture to evaporate. As of the end of 2025, the dryer has not received a Class A designation from the Wisconsin DNR.

The dryer includes heat recovery to capture heat from exiting air to preheat the incoming air. The system also includes a chemical and biological scrubber for odor control to treat the exhausted air from the dryer.

PW Tech/MB provided a budget price of $3,115,000 for the plate belt dryer package equipment. The equipment includes a cake storage hopper, conveyor, one dryer, heat source and odor control scrubbers.

b. BioForcetech BioDryer

The second dryer system considered is the Bioforcetech BioDryer. The dryer is unique in that if combines composting and heat drying in the same vessel. Composting reduces the energy required to thermally dry the solids.

The BioForcetech dryer uses air and bacteria to dry biosolids. In the first phase, air is pushed through the biosolids to cultivate thermophilic bacteria. The exothermic reaction of the bacteria creates heat. The BioDryer chamber increases in temperature to approximately 150°F and the water in the biosolids begins to evaporate. The thermophilic bacteria flourish, generating large amounts of heat. This causes the bulk of the moisture in the chamber to evaporate without an external heat source.

The BioDryer unit continues to modulate airflow in order to maximize this process. After the thermophilic compost stage, the BioDryer introduces an external hot airflow to finish the drying process. After drying is complete, the vessel is partly emptied. Some biosolids are retained to provide bacteria for the next composting cycle.

Unlike the other two drying options considered which are continuous feed, the BioForcetech system is a batch process. The BioDryer can take several days to complete its process. For Sister Bay, two dryers are proposed. To combat odors, the system requires a sulfuric acid chemical scrubber followed by a biological or carbon-based odor control scrubber.

BioForcetech provided a budget price of $2,599,114 for two BioDryer packages that include conveyors, an odor control scrubber and an electric heater.

BioForcetech request biosolids with a minimum solids concentration of 20%. This may be difficult to achieve with aerobically digested WAS and hauled-in sludges from other communities. In addition, the compost process requires volatiles in the sludge to dive the composting process. The sludges from Sister Bay and the surrounding communities are generated from extended aeration processes. Even prior to aerobic digestion or storage, the sludge will have relatively low volatile solids due to the activated sludge treatment process.

BioDryer includes a biological component. The dryer will not be fed on a consistent basis, especially in the winter months. Therefore, the dryer may not perform as designed during periods of low loadings.

Due to the fact that the process requests solids at 20% solids, the low volatile solids content of the feed and intermittent loading, the BioDryer will not be considered further for this application.

c. <u>BCR Indirect Rotary Screw Dryer</u>

The third dryer system considered is the BCR Environmental BIO-SCRU® Indirect Rotary Screw Dryer. The dryers are automated, indirectly heated, continuous flow drying systems with a separate thermal fluid heating module and a dryer module. The dryers accept 13% to 30% total solids wet cake. BCR has nearby systems in Wisconsin Rapids and Wisconsin Dells.

The dryer qualifies as a PFRP (Processes to Further Reduce Pathogens) via heat drying. The sludge is dried to less than 10% moisture, and the temperature of the exiting material is greater than 176°F. The system controls monitor and record the temperature of the exiting material with a date stamp for compliance monitoring. The dryer complies with the pathogen reduction and the vector attraction reduction requirements for class A biosolids.

The BIO-SCRU’s® drying chamber is a sealed, sub-ambient pressure, anaerobic atmosphere. A schematic of the BIO-SCRU® dryer is included in Figure X-6. The drying chamber is kept constantly full to minimize head space in the chamber and to maximize thermal operating efficiency. The BIO-SCRU’s® heat energy is provided by the thermal fluid circulating through the hollow rotor flighting, rotor shaft and dryer chamber housing. This method of heating is indirect, meaning the heating medium is not in contact with the product being heated.

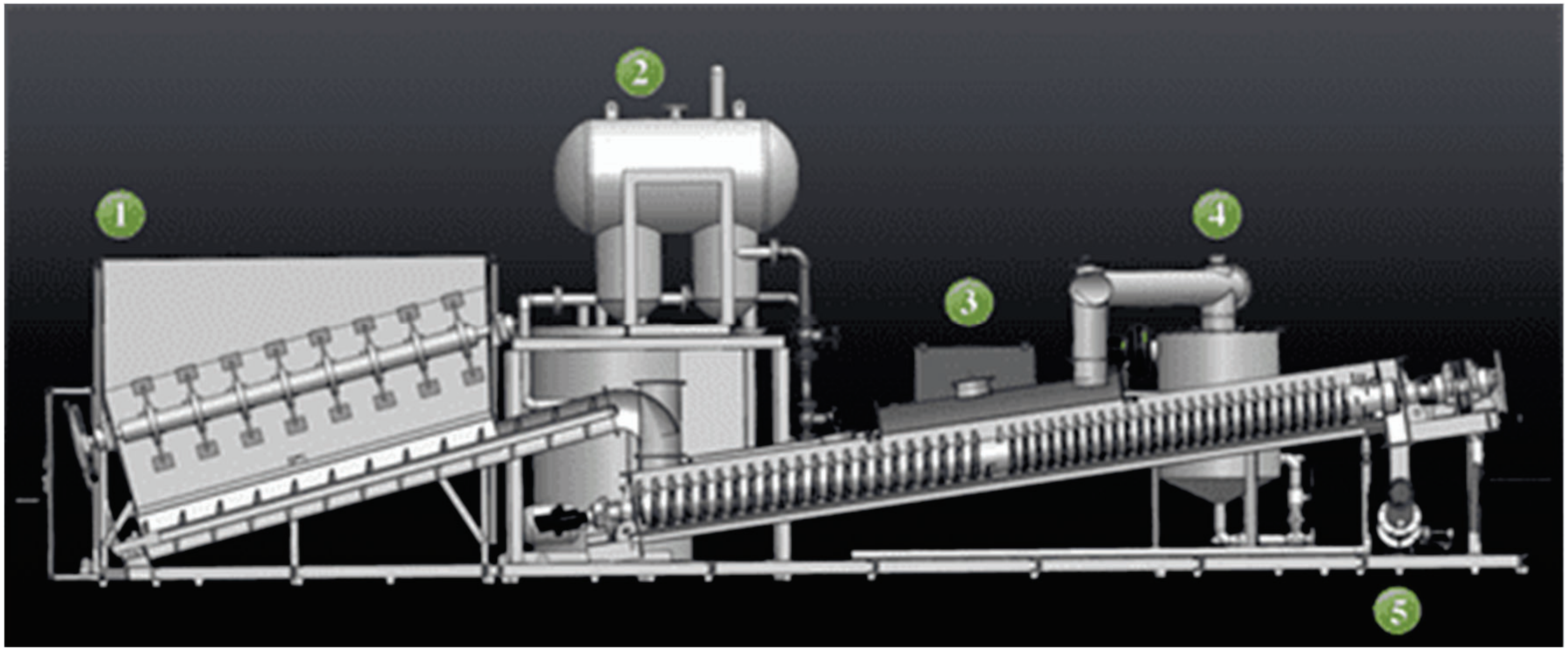
The rotors slowly rotate, agitating and conveying the sludge through the dryer as water evaporates, leaving dried residual solids that are greater than 90% by weight.

Dewatered sludge is fed to the dryer by a positive-displacement pump from a dewatered solids storage hopper. At the same time, the dried product is discharged from the dryer to a cooling screw through a rotary valve to minimize air intrusion into the system. Water is used in the hollow-shaft, jacketed cooling screw to reduce the hot, dried solids to a safe-handling temperature. Steam generated in the drying process is condensed in a multi-stage, direct-contact spray condenser. Residual non-condensable gases are chemically scrubbed by an odor control unit to reduce emissions and odor. The entire system operates at a very slight vacuum to keep odors contained, while minimizing air intrusion, either through shaft seal leaks or the discharge rotary valve. This minimizes the volume of non-condensable gas to be treated.

BCR Environmental provided a budget price of $3,325,000 for the BIO-SCRU® Indirect Rotary Screw Dryer package. The equipment includes a cake feed hopper with live bottom screws, a progressive cavity cake pump to feed the dryer, one dryer, an electric thermal heat module, a vapor condenser, a discharge screw and a water-cooled inclined screw, odor control scrubbers, and an automatic inerting system consisting of a nitrogen generator. The inerting system is required as dust from biosolids drying can create an explosive condition.

BCR Environmental can also include a pelletizer and automatic bagging with their package.

BCR Environmental provided the most complete package in their budgetary proposal. Based on the completeness of the proposal,



STEPS

1 Feed Hopper

2 Thermal Fluid Heater

3 BIO-SCRU® Dryer
The dryer chamber includes twin, intermeshed HOLO-SCRUTM rotors

4 Scrubber/Condenser

5 Cooling Screw

FIGURE X-6
BCR DRYER SCHEMATIC
WWTF - FACILITY PLAN
VILLAGE OF SISTER BAY, WI
S0661-09-2500241.02 10-20-25
ID: \2025\MCM WI\SISTER BAY-WWTF-FACILITY PLAN SCHEMATIC.PPTX jmk/CTO

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experience producing Class A biosolids in Wisconsin and ability to integrate pelletizing and bagging, the BCR BIO-SCRU® dryer will be utilized for the purposes of this evaluation.

4. Proposed Drying Facility

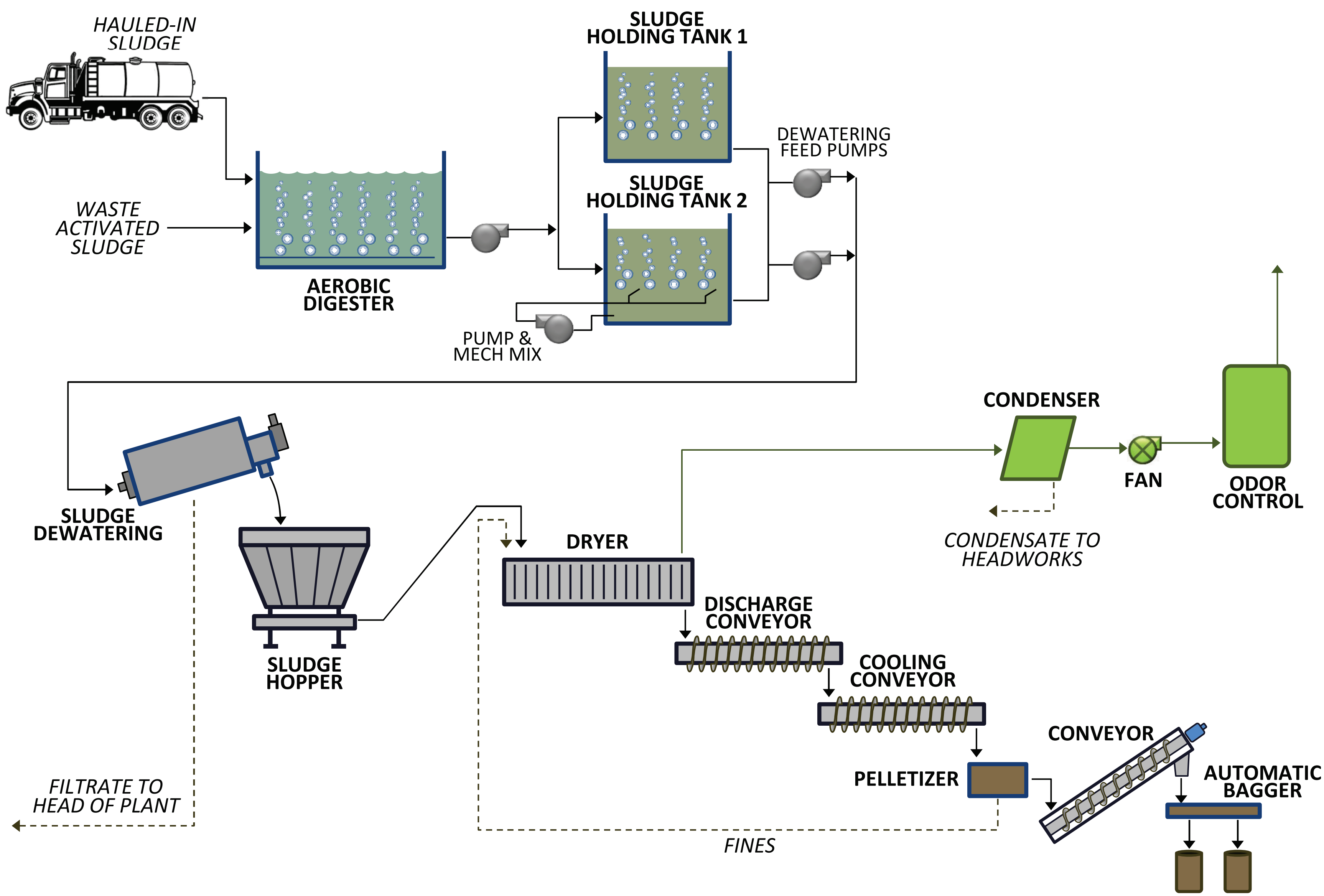
The proposed drying system for the Village of Sister Bay consists of a rotary screw press, an indirect rotary screw dryer, a pelletizer and automatic bagging system. WAS from the WWTF would still be aerobically digested. The digested solids would be dewatered and dried on a weekly or bi-weekly basis, depending on the time of year. The system would be sized to handle Year 2050 loadings from Sister Bay and loadings from Bailey's Harbor, Ephraim and Fish Creek. A schematic of this option is included in Figure X-7.

The drying facility would be housed in a new 80' x 52' building with a mezzanine, as shown in Figure X-8. Aerobically digested biosolids would be dewatered using a screw press located on the mezzanine of the new building. A conveyor would transport the dewatered biosolids to a feed hopper on the first floor. The hopper would be sized to hold approximately one-days' worth of dewatered biosolids.

The feed hopper includes live bottom screws to transport the solids to a progressive cavity feed pump. The progressive cavity feed pump conveys the biosolids from the hopper to the inlet of the rotary screw dryer. The dryer consists of two intermeshed hollow-flight rotors and a jacketed housing. The heat energy required for the dryer will be provided indirectly by heat-transfer fluid that is remotely heated and circulated through both the rotors and the housing. Dewatered sludge is pumped into the dryer. Water is removed from the wet sludge by indirectly heating it from ambient temperature to greater than 100°C/212°F, changing the water from liquid to steam. Steam is evacuated from the dryer under a slight vacuum and condensed by direct contact with water in an external condenser system. Steam and particulate are recovered and sent back to the wastewater treatment plant for treatment.

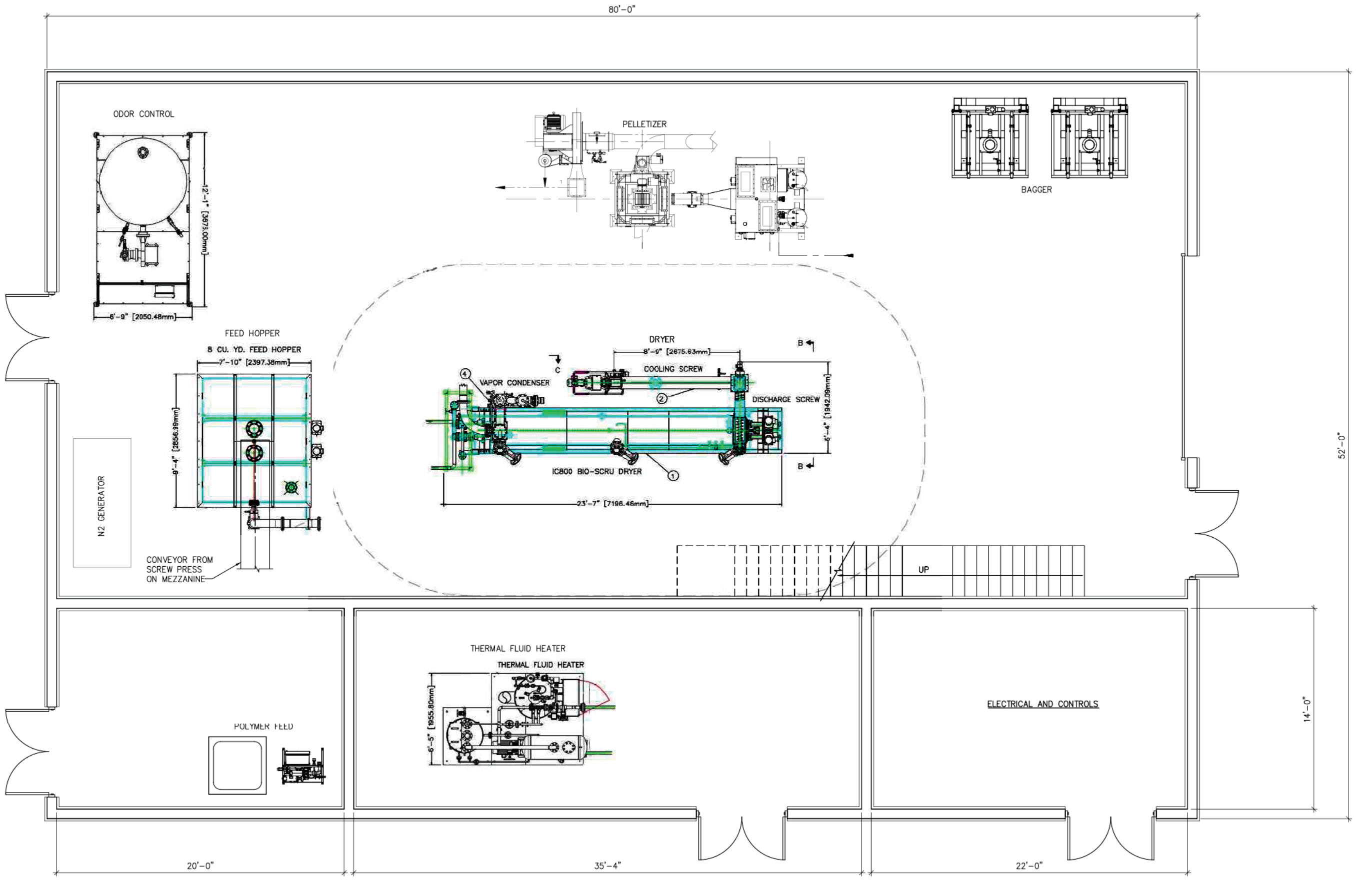
Following the dryer, the dried solids exit the dryer on to the discharge screw and then into the cooling screw. Like the dryer, the cooling screw consists of a rotor and a jacketed housing. Cooling the dried solids and removal of heat is accomplished by circulation of water through the cooler's rotor and jacketed housing. A rotary airlock on the discharge of the cooling screw retains a sealed condition on the dryer discharge.

Following cooling, the dried biosolids are fed into an adjacent pellet mill. An example pellet mill is shown in Figure X-9. The mill uses high pressure to force the dried solids through a die with small, cylindrical holes. As the dried biosolid is squeezed through the die, it is compressed into a solid, uniform pellet shape. The proposed pellet mill is designed to produce 1/8-inch diameter pellets. The pellet



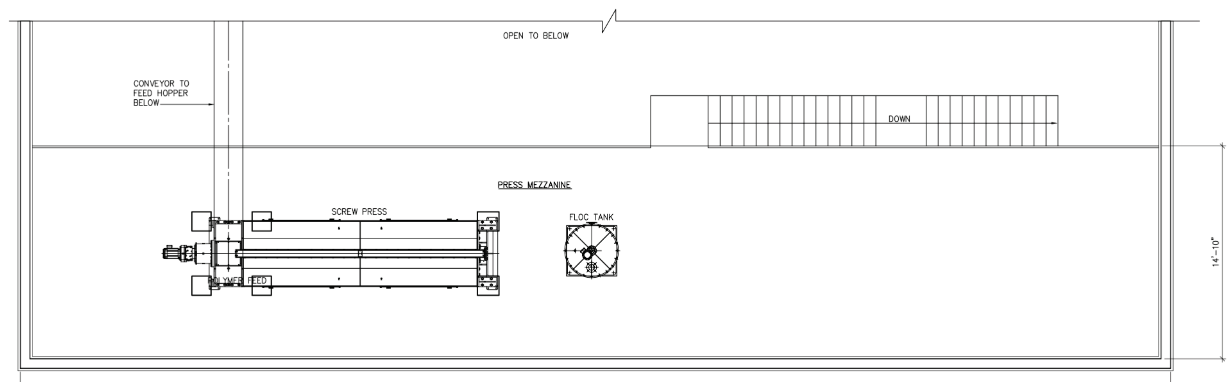
McMAHON
ENGINEERS ARCHITECTS

FIGURE X-7
SLUDGE DRYING
PROCESS FLOW SCHEMATIC
WWTF - FACILITY PLAN
VILLAGE OF SISTER BAY, WI
S0661-09-2500241.02 10-20-25
ID: \2025\MCM WI\SISTER BAY-WWTF-FACILITY PLAN SCHEMATIC.PPTX jmk/CTO



0 2'-0" 4'-0" 8'-0"
SCALE – FEET

FIRST FLOOR



MEZZANINE

FIGURE X-8

CONCEPTUAL SLUDGE DRYING FACILITY

WWTF - FACILITY PLAN

VILLAGE OF SISTER BAY, WI

S0661-09-2500241.02 10-20-25

ID: \2025\MCM WI\SISTER BAY-WWTF-FACILITY PLAN SCHEMATIC.PPTX jmk/CTO

McMAHON ENGINEERS ARCHITECTS

Pellet Mill

Biosolids Pellets

FIGURE X-9

PELLET MILL

WWTF - FACILITY PLAN
VILLAGE OF SISTER BAY, WI

S0661-09-2500241.02 10-20-25

ID: \2025\MCM WI\SISTER BAY-WWTF-FACILITY PLAN SCHEMATIC.PPTX jmk/CTO

McMAHON ENGINEERS ARCHITECTS

mill significantly reduces dust, creating a safer and stable pellet. The pellet mill produces a biosolid that is safer to store and resembles a product similar to commercially available fertilizer.

The pellet mill includes a vertical flat die type pellet mill, a pellet bucket elevator, a pellet cooling system, duct collection system and a pellet loadout conveyor.

Following the pellet mill, the dried biosolids are conveyed to an automatic bagging system. The biosolids are loaded into supersacks for storage and transport.

The system includes a media-based odor control system to treat the off-gas and other odor sources in the drying facility. The system also includes a pressure swing adsorption (PSA) nitrogen generator to provide a continuous nitrogen purge to maintain nonexplosive conditions in the dryer and accompanying equipment.

5. Frequency of Operation

As stated earlier, the dryer will need to operate 24-hours per day. It cannot be shut down at the end of a shift due to the time required to start and heat the unit. Projected year 2050 operating times are as follows. The run times assume the system is operated at 80% of its design capacity.

- Sister Bay Alone
  - Average Summer Loadings - Per Month
    - 2 weeks at 4 days continuous
    - 1 week at 2 days continuous
  - Average Winter Loadings - Per Month
    - 2 weeks at 2.5 days continuous
- Sister Bay & Other Communities
  - Average Summer Loadings - Per Month
    - 4 weeks at 4.25 days continuous
  - Average Winter Loadings - Per Month
    - 3 weeks at 3.3 days continuous

6. Opinion of Probable Costs

The preliminary opinion of probable cost for proposed dryer facility is $17,800,000 as shown in Table X-5. The preliminary opinion of probable annual costs for Sister Bay alone is $199,800 and $247,200 with other communities as shown in Table X-6. The opinion of probable annual costs assume the dried biosolids are distributed for free.

E. SOLIDS HANDLING OPTIONS COST EFFECTIVE ANALYSIS

1. Present Worth Analysis

The solids handling options were evaluated based on a simplified 20-year Present Worth Analysis using the discount rate of 2.5%. This is the current DNR discount rate for facilities planning purposes.

SISTER BAY ALONE

	Reed Bed Disposal	Dewatering & Drying	Haul to Sturgeon Bay	Haul to Sturgeon Bay – New Tank
Opinion of Probable Capital Cost	$3,151,000	$17,800,000	-	-
Opinion of Probable Annual Cost – Year 2050	$99,300	$199,800	$166,443	$227,544
Present Worth Annual Cost	$1,548,004	$3,114,715	$2,594,707	$3,547,220
Total Present Worth Cost	**$4,699,004**	**$20,914,715**	**$2,594,707**	**$3,547,220**

Continuing to haul sludge to the Sturgeon Bay WWTF is the most cost-effective alternative. The most cost-effective alternative that allows Sister Bay to process their own sludge is reed bed disposal.

SISTER BAY WITH OTHER COMMUNITIES

	Reed Bed Disposal	Dewatering & Drying	Haul to Sturgeon Bay	Haul to Sturgeon Bay – New Tank
Opinion of Probable Capital Cost	$4,334,100	$17,800,000	-	-
Opinion of Probable Annual Cost – Year 2050	$150,000	$247,200	$326,405	$448,509
Present Worth Annual Cost	$2,338,374	$3,853,641	$5,088,380	$6,991,879
Total Present Worth Cost	**$6,672,474**	**$21,653,641**	**$5,088,380**	**$6,991,879**

As above, continuing to haul sludge to the Sturgeon Bay WWTF is the most cost-effective alternative. If Sturgeon Bay were to add a hauled-in sludge receiving tank, hauling to Sturgeon Bay and reed bed disposal are withing 5% of one another. At this planning level, the options are considered relatively equal. The most cost-effective alternative that allows Sister Bay to process their own sludge along with Bailey's Harbor's, Ephraim's and Fish Creek's sludge is reed bed disposal.

Table X-5

BIOSOLIDS DEWATERING & ROTARY SCREW TYPE DRYING FACILITY
PRELIMINARY OPINION OF PROBABLE CAPITAL COST

WWTF FACILITY ASSESSMENT, FEASIBILITY STUDY &
LONG-TERM FACILITY PLANNING

Village of Sister Bay | Door County, Wisconsin

Item	**Opinion of Probable Cost**
Site Work	$50,000
Fencing	$25,000
Site Piping	$240,000
Plant Return Lift Station	$200,000
Dewatering/Drying Building	
Foundation	$127,000
Building (@ $750/sq. ft.)	$3,120,000
Dewatering Equipment	
Screw Press	$450,000
Elevated Platform	$30,000
Polymer Feed System	$60,000
Polymer Tote Containment	$8,000
Screw Conveyor	$100,000
Drying Equipment	
Screw Type Dryer Equipment	$3,325,000
Biosolids Pelletizer	$1,100,000
Automated Bulk Bagging System	$650,000
Forklift	$50,000
Mechanical Install (30% of Equip Cost)	$1,707,900
Electrical	$1,600,000
Controls/Integration	$75,000
Access Control/Cameras	$40,000
Subtotal	$12,957,900
Engineering & Contingencies (30%)	$3,887,370
General Conditions/Insurance (7%)	$907,053
Total Opinion of Probable Capital Cost	**$17,752,323**

Table X-6

DEWATERING & DRYING FACILITY

PRELIMINARY OPINION OF PROBABLE ANNUAL COST

WWTF FACILITY ASSESSMENT, FEASIBILITY STUDY &
LONG-TERM FACILITY PLANNING

Village of Sister Bay | Door County, Wisconsin

Item	Sister Bay Alone	Sister Bay with Other Comm
Electrical	$72,001	$97,338
Dewatering Polymer	$27,750	$49,833
Biosolids Pellet Bags	-	-
Additional Labor	$100,000	$100,000
Total	**$199,751**	**$247,171**

2. Annual Cost Analysis

The solids handling options were also evaluated based on the projected year 2050 annual cost of the options. The annual costs assume a 20-year loan at the current Clean Water Fund subsidized discount rate of 1.551%. Projected annual costs were calculated with and without principal forgiveness. Principal forgiveness is calculated based on what is available through year 2027 and shown below. It is not known the amount of principal forgiveness that would be available after 2027.

- Sister Bay .... up to 60% Principal Forgiveness, capped at $2,100,000
- Sturgeon Bay .... estimated at 30%, capped at $2,100,000

A preliminary per gallon cost for the reed bed disposal and dewatering/drying options for the surrounding communities is also included in the following tables.

SISTER BAY ALONE – YEAR 2050

	Reed Bed Disposal	Dewatering & Drying	Haul to Sturgeon Bay	Haul to Sturgeon Bay – New Tank
Without Principal Forgiveness				
Opinion of Probable Capital Cost	$3,151,000	$17,800,000	-	-
Principal & Interest Payment	$184,456	$1,041,994	-	-
Annual Operational Cost	$99,300	$199,800	$166,443	$227,544
Total Annual Cost	**$283,756**	**$1,241,794**	**$166,443**	**$227,544**
Assuming Principal Forgiveness				
Opinion of Probable Capital Cost	$3,151,000	$17,800,000	-	-
Principal Forgiveness	$1,860,000	$2,100,000	-	-
Loan Amount	$1,291,000	$15,700,000	-	-
Principal & Interest Payment	$75,574	$919,062	-	-
Annual Operation Cost	$99,300	$199,800	$166,443	$207,177
Total Annual Cost	**$174,874**	**$1,118,862**	**$166,443**	**$207,177**

SISTER BAY WITH OTHER COMMUNITIES – YEAR 2050

	Reed Bed Disposal	Dewatering & Drying	Haul to Sturgeon Bay	Haul to Sturgeon Bay – New Tank
Without Principal Forgiveness				
Opinion of Probable Capital Cost	$4,334,100	$17,800,000	-	-
Principal & Interest Payment	$253,714	$1,041,994	-	-
Annual Operational Cost	$150,000	$247,200	$326,405	$448,509
Total Annual Cost	**$403,714**	**$1,289,194**	**$326,405**	**$448,509**
Cost Per Gallon for Other Communities	**$0.27**	**$.85**	**-**	**-**
Assuming Principal Forgiveness				
Opinion of Probable Capital Cost	$4,334,100	$17,800,000	-	-
Principal Forgiveness	$2,100,000	$2,100,000	-	-
Loan Amount	$2,234,100	$15,700,000	-	-
Principal & Interest Payment	$130,782	$919,062	-	-
Annual Operation Cost	$150,000	$247,200	$326,405	$407,808
Total Annual Cost	**$280,782**	**$1,166,262**	**$326,405**	**$407,808**
Cost Per Gallon for Other Communities	**$0.19**	**$0.77**	**-**	**-**

The solids handling options were also evaluated based on the annual cost of the options using current average sludge quantities. Current average sludge quantities used in the analysis are as follows.

	dry lbs./day	**Gpd**
Sister Bay	402	1,237 or 4,820 @ 1.0%
Other Communities	470	1,743

As with year 2050 loadings, a preliminary per gallon cost for the reed bed disposal and dewatering/drying options for the surrounding communities is included in the following tables.

SISTER BAY ALONE – CURRENT YEAR

	Reed Bed Disposal	Dewatering & Drying	Haul to Sturgeon Bay	Haul to Sturgeon Bay – New Tank
Without Principal Forgiveness				
Opinion of Probable Capital Cost	$3,100,000	$17,800,000	-	-
Principal & Interest Payment	$181,471	$1,041,994	-	-
Annual Operational Cost	$97,100	$164,700	$107,403	$146,823
Total Annual Cost	**$278,571**	**$1,206,694**	**$107,403**	**$146,823**
Assuming Principal Forgiveness				
Opinion of Probable Capital Cost	$3,100,000	$17,800,000	-	-
Principal Forgiveness	$1,860,000	$2,100,000	-	-
Loan Amount	$1,240,000	$15,700,000	-	-
Principal & Interest Payment	$72,588	$919,062	-	-
Annual Operation Cost	$97,100	$164,700	$107,403	$133,683
Total Annual Cost	**$169,688**	**$1,083,762**	**$107,403**	**$133,683**

Continuing to haul to Sturgeon Bay has the lowest opinion of probable annual cost without principal forgiveness. Reed bed disposal has the lowest opinion of probable annual cost that allows Sister Bay to handle their biosolids in-house.

SISTER BAY WITH OTHER COMMUNITIES – CURRENT YEAR

	Reed Bed Disposal	Dewatering & Drying	Haul to Sturgeon Bay	Haul to Sturgeon Bay – New Tank
Without Principal Forgiveness				
Opinion of Probable Capital Cost	$4,334,100	$17,800,000	-	-
Principal & Interest Payment	$253,714	$1,041,994	-	-
Annual Operational Cost	$147,500	$214,400	$257,545	$354,223
Total Annual Cost	**$401,214**	**$1,256,394**	**$257,545**	**$354,223**
Cost Per Gallon for Other Communities	**$0.34**	**$1.07**	**-**	**-**
Assuming Principal Forgiveness				
Opinion of Probable Capital Cost	$4,334,100	$17,800,000	-	-
Principal Forgiveness	$2,100,000	$2,100,000	-	-
Loan Amount	$2,234,100	$15,700,000	-	-
Principal & Interest Payment	$130,782	$919,062	-	-
Annual Operation Cost	$147,500	$214,400	$257,545	$321,997
Total Annual Cost	**$278,282**	**$1,133,462**	**$257,545**	**$321,997**
Cost Per Gallon for Other Communities	**$0.24**	**$0.96**		

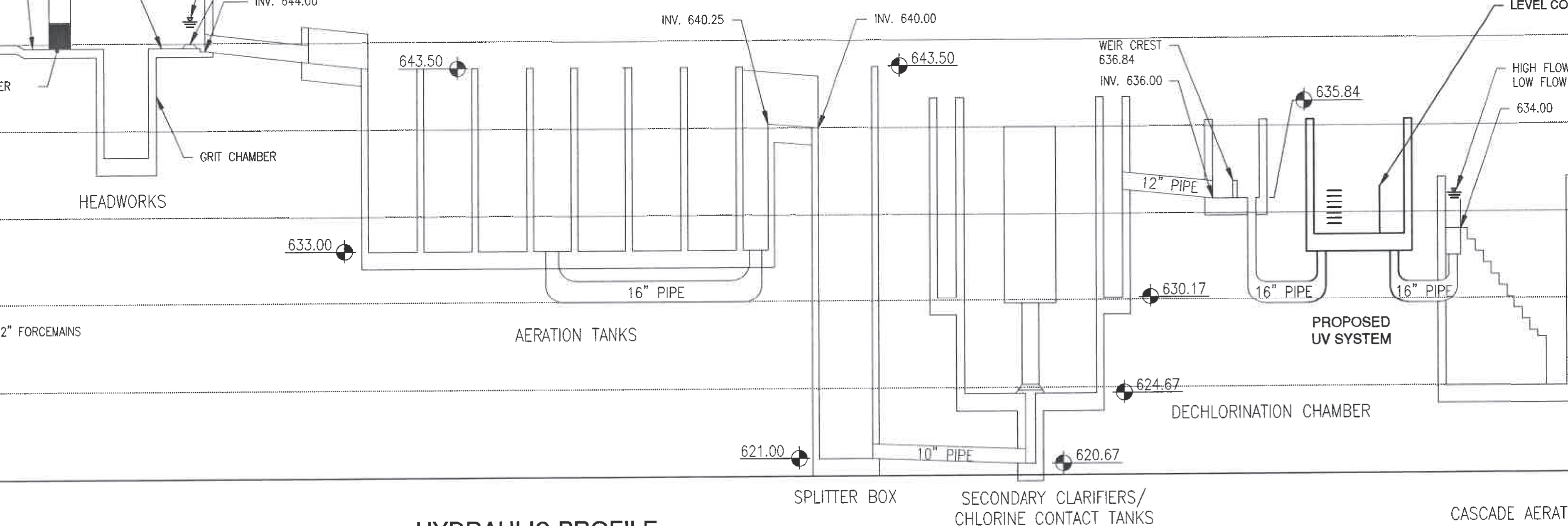
Continuing to haul to Sturgeon Bay has the lowest opinion of probable annual cost without principal forgiveness.

Reed bed disposal has the lowest opinion of annual cost if principal forgiveness was available and Sturgeon Bay constructed a hauled-in sludge storage tank.

It should be noted that installing a dryer at this time with the plan to distribute a Class A biosolid carries risk at this time. The impact of pending PFAS regulations on the distribution of biosolids is not known.

APPENDIX A

Wastewater Treatment Facility Design Criteria



HYDRAULIC PROFILE

567.75
WET WELL BOTTOM

TION

DESIGN DATA

DESIGN FLOW	
MAXIMUM DAY FLOW, GPD	945,000
SUMMER AVERAGE DAILY FLOW, GPD	700,000
WINTER AVERAGE DAILY FLOW, GPD	356,000
PEAK HOURLY FLOW, GPM	
SEWERED	1,300
SEPTAGE	350
DESIGN LOADINGS	
SUMMER MAXIMUM DAY	
BODS, LBS/DAY	2,370
SS, LBS/DAY	2,180
P, LBS/DAY	102
SUMMER AVERAGE DAILY	
BODS, LBS/DAY	1,780
SS, LBS/DAY	1,635
P, LBS/DAY	75
WINTER AVERAGE DAILY	
BODS, LBS/DAY	910
SS, LBS/DAY	820
P, LBS/DAY	38
RAW WASTEWATER PUMPS (LIFT STATION NO. 1)	
NUMBER	3
CAPACITY, GPM	
PUMP NO. 1	300
PUMP NO. 2	1,000
PUMP NO. 3	1,000
SEPTAGE RECEIVING FACILITIES	
VOLUME, GALLONS	50,000
PUMPING CAPACITY, GPM	
PUMP NO. 1	425
PUMP NO. 2	350
AERATION BLOWER NO. 1, Hp	10
FLOW EQUALIZATION FACILITIES	
VOLUME, GALLONS	200,000
PUMPING CAPACITY, GPM	400
AERATION BLOWER NO. 2, Hp	30
VORTEX GRIT CHAMBER	
NUMBER	1
MAXIMUM CAPACITY, MGD	2.5

PARSHALL FLUME THROAT WIDTH, IN	3
INCLINED SCREEN	
NUMBER	1
MOTOR, Hp	2
ACTIVATED SLUDGE SYSTEM	
TOTAL VOLUME, 1000 CU FT	79.08
UNIT LOADINGS	
LBS BODS/1000 CU FT	30
LBS BODS/LB MLSS @ 2000 MG/L	0.24
DETENTION TIME, HRS	22.5
AERATION CHANNELS	
VOLUME, 1000 CU FT	
CHANNEL NO. 1	14.23
CHANNEL NO. 2	26.09
CHANNEL NO. 3	38.75
LIQUID DEPTH, FT	9.5
DISK AERATORS	
NUMBER OF SHAFTS	2
(2) INSIDE CHANNEL MOTOR, Hp	20
OUTSIDE CHANNEL MOTOR, Hp	30
TOTAL MOTOR HP	100
STANDARD AERATION EFFICIENCY LBS 02HP/HP-HR	3.5
FIELD TRANSFER EFFICIENCY, LBS 02/HP-HR	2.9
SHAFT SPEED, RPM	43
NUMBER OF DISCS PER SHAFT	57
SECONDARY CLARIFIERS	
NUMBER	2
DIAMETER, FT	40
MOTOR, Hp	1/2
SURFACE AREA, SQ. FT	1,256
OVERFLOW RATE, GPD/SQ. FT	
AVERAGE FLOW	376
PEAK FLOW (EQUALIZED)	376
WEIR LENGTH, FT	195
WEIR LOADING, GPD/FT	
AVERAGE FLOW	2,429
PEAK FLOW (EQUALIZED)	2,429
CHLORINE CONTACT TANKS	
NUMBER	2
VOLUME, CU FT	2,578
DEPTH, FT	7.00

AEROBIC DIGESTER / STORAGE TANKS	
NUMBER	3
DIGESTER NO. 1	
DIAMETER, FT	40
VOLUME, 1000 CU FT	22.7
VOLUME, 1000 GALLONS	170
DIGESTER NO. 2	
DIAMETER, FT	40
VOLUME, 1000 CU FT	22.7
VOLUME, 1000 GALLONS	170
SLUDGE STORAGE TANK	
DIAMETER FT	25
VOLUME, 1000 CU FT	9.0
VOLUME, 1000 GALLONS	67
DIGESTER AERATION BLOWERS	
NUMBER	3
CAPACITY, CFM @ PSI	680
HORSEPOWER, EACH	40
SLUDGE THICKENER - BELT PRESS	
NUMBER	1
CAPACITY, GPM	35
CAPACITY, LBS SOLIDS/HR @ 2% FEED	350
RETURN ACTIVATED SLUDGE PUMPS	
NUMBER	3
CAPACITY, GPM	250
MOTOR, Hp	2
WASTE ACTIVATED SLUDGE PUMP	
NUMBER	1
CAPACITY, GPM	100
MOTOR, Hp	5
DIGESTED SLUDGE PUMPS	
NUMBER	2
CAPACITY, GPM	100
MOTOR, Hp	5

CONCENTRATED SLUDGE PUMPS	
NUMBER	
CAPACITY, GPM	
MOTOR, Hp	
SCUM AND DRAIN PUMPS	
NUMBER	
CAPACITY, GPM	
SLUDGE MIXING / LOADING PUMP	
NUMBER	
CAPACITY, GPM	
MOTOR, Hp	
CHEMICAL FEED SYSTEMS	
PHOSPHOROUS REMOVAL CHEMICALS	
STORAGE TANK	
NUMBER	
VOLUME, GALLONS	
DAY TANK	
NUMBER	
VOLUME, GALLONS	
TRANSFER PUMP	
NUMBER	
VOLUME, GALLONS	
CHEMICAL FEED PUMPS	
NUMBER	
VOLUME, GALLONS	
POLYMER FOR SLUDGE DEWATERING	
DAY TANK	
NUMBER	
VOLUME, GALLONS	
POLYMER FEED PUMP	
NUMBER	
CAPACITY, GPM	
NPW PUMP	
NUMBER	
MOTOR, Hp	

STAFF REPORT

Date: March 10, 2026

To: Sewer and Water Utility Committee

Re: Non-Potable System Expansion Tank Replacement

Author(s): Megan Barnes, Utilities Director

Action(s) Requested: ☐ Ordinance ☐ Resolution ☒ Motion ☐ Receive/File

POLICY ISSUE(S)

"Should the Sewer and Water Utility Committee recommend to the Village Board:

1. Approve the cost of two non-potable water system expansion tank replacements for 2026."

BACKGROUND INFORMATION

The non-potable water (NPW) system at the WWTP is routinely used for tank maintenance and for the various systems that can operate at the WWTP with non-potable water. The main equipment that utilizes the NPW system for water supply includes the ferric chloride pumps, the concentrator system, and the influent fine screen.

The NPW system at the WWTP utilizes two pressure expansion tanks that operators discovered have ruptured bladders. Replacing the bladders was the initial approach. When attempting to secure the replacement parts necessary for the two expansion tanks on site, it was discovered that the tanks on site were discontinued. Because of this, the necessary bladder repair parts cannot be purchased.

PRIOR ACTION/REVIEW

In 2025, the Village budgeted for WWTP non-potable water system upgrades. The current NPW pump is significantly undersized, and the Gould's eSVX Vertical Multi Stage Pump replacement will outperform the current pump by operating with a VFD to maintain the designated pressure setpoint. The isolation valve replacements were also budgeted for replacement due to operators no longer being able to operate them freely. Isolation valves tend to become hard turns, or sometimes completely inoperable, due to age and wear. These system improvements were budgeted and approved for 2026.

FINANCIAL INFORMATION

FISCAL IMPACT:

1. Is There a Fiscal Impact? No-WWTP Replacement Fund
2. Is it Currently Budgeted? No-WWTP Replacement Fund
3. If Budgeted, Where: WWTP
4. Amount: $19,180 - See Estimate

If the two expansion tank replacements were approved, the following funding option would be utilized:

1. WWTP Replacement Funds

RECOMMENDED ACTION(S)

Village staff recommends that the cost of the two expansion tank replacements be approved.

POLICY ALTERNATIVE(S)

The Sewer and Water Utility Committee could take the following actions:

1. Approve Replacement Quotation as Presented

"I move to recommend the quotation for the replacement of the two expansion tanks as presented to the Village Board for approval."

2. Postpone Quotation – Seek Additional Information

"I move to postpone action on the quotation for the replacement of the two expansion tanks at the WWTP and direct staff to return to the SWUC with additional information regarding [List Information Sought] at a future meeting."

3. Deny Quotation (No Action Alternative)

"I move to reject the quotation for the replacement of the two expansion tanks at the WWTP and take no further action at this time."

ATTACHMENT(S)

1. NPW Expansion Tank Replacement Quotation

QUOTE

Number	CESQ119915
Date	Feb 23, 2026
Expires	Mar 9, 2026

Headquarters
707 Ford Street, Kimberly, WI 54136
t. 920-733-4425 f. 920-733-0211

Minnesota Office
12265 Nicollet Ave., Burnsville, MN 55337
t. 952-444-1949

Sold To

Sister Bay, Village of
Megan Barnes
2124 Autumn Ct.
P. O. Box 91
Sister Bay, WI 54234

megan.barnes@sisterbaywi.gov
Phone 920-854-2246
Fax 920-854-7602

Ship To

Sister Bay, Village of
Megan Barnes
2124 Autumn Ct.
P. O. Box 91
Sister Bay, WI 54234

megan.barnes@sisterbaywi.gov
Phone 920-854-2246
Fax 920-854-7602

Sales Rep

Fluid Technology Sales
Nate Johnson 920-850-2901
n.johnson@craneengineering.net

Fluid Technology Sales
Nate Johnson 920-850-2901
n.johnson@craneengineering.net

Terms	RFQ	Ship Via	FOB	Crane Order#
		Best Way	Warehouse	

Line	Qty	Product	Lead Time	Unit Price	Ext. Price
1	2	**Amtrol Hydronic Expansion Tanks** - Furnish and Install Two (2) Amtrol Expansion Tanks - Series L, Model 1000-L - ASME Approved Steel Shell - Replaceable Bladder Design - Red Oxide Primer Finish	*6 Weeks*	$7,365.00	$14,730.00
2	1	**Installation** - Remove Existing Tanks From System - Set New Tanks and Make Plumbing Connections		$4,450.00	$4,450.00

Total	**$19,180.00**

Please contact me if I can be of further assistance.

Does not include tax and shipping charges unless stated above.
Effective Nov. 1st, 2025, all new orders paid by credit card will be assessed a 3% fee. If you wish to pay by ACH, please email ar@craneengineering.net to request banking information.

We reserve the right to adjust quoted pricing due to the current volatility of the materials market.
We will make every effort to maintain the quoted price.

1. **Governing Provisions**. These Terms and Conditions of Sale (the "Agreement") constitute an offer by Crane Engineering Sales, Inc. ("Seller") to provide the Products as set forth on the Contract of Sale attached to this Agreement (the "Products") to Buyer, subject to the terms and conditions set forth below. Buyer may not modify, renounce or waive any term or condition hereof or any of Seller's rights hereunder unless Seller consents in writing. Seller agrees to provide the Products to Buyer only on the terms of this Agreement (except as supplemented and/or modified by the parties Contract of Sale), notwithstanding any language in Buyer's purchase order, if one exists, or other writing or oral representation previously or hereafter received by Seller purporting to modify or replace the terms of this Agreement with any different or additional terms or reciting that provision or delivery of the Products or any other action or inaction by Seller constitutes agreement or consent by Seller to such modification or replacement. SELLER'S AGREEMENT TO PROVIDE THE PRODUCTS IS EXPRESSLY CONDITIONED ON BUYER'S ASSENT TO ALL OF THE TERMS AND CONDITIONS SET FORTH BELOW AND, NOTWITHSTANDING BUYER'S SUBMISSION OF A PURCHASE ORDER, THE TERMS AND CONDITIONS OF SALE OF THIS AGREEMENT (AND THE DISTRIBUTOR AGREEMENT) SHALL CONTROL.

2. **Purchase Orders and Payment**. All orders must be accompanied by a signed purchase order and must be approved for credit. For orders under $50,000 the terms are net 15 days from the date of invoice, unless agreed to otherwise in writing by both parties prior to order entry. Seller may require full or partial payment or a payment guarantee in advance of shipment whenever, in its opinion, the financial condition of the Buyer so warrants. For orders exceeding $50,000 in sell price, terms of payment will be 40% down with order, 20% payable upon approved drawings, 20% payable upon inspection and approval of assembly prior to shipment (witness test available as an optional charge), 10% payable upon shipment, and 10% payable upon commissioning of equipment not to exceed 90 days from shipment. Note: Equipment will be shipped after receipt of 80% of the value of the order. From time to time Buyer (or its Customers) will be asked to fill out a credit application, which is subject to Seller's Credit Department's approval. Seller reserves the right to change the terms and required method of payment at any time, and to charge Buyer a 1.25% finance charge per month on any past due amounts, or the highest rate applicable by law. Buyer agrees to reimburse Seller for all costs incurred by Seller in collecting any sums owed by Buyer to Seller, including without limitation, interest and attorney's fees. Each purchase order that Buyer delivers to Seller for the purchase of Products ("Order") shall set forth the following terms as agreed upon by Seller and Buyer for such Order: the quantity, description and prices of the Products being ordered; the address for delivery of the Products; requested delivery dates; shipping instructions; and the address to which Seller's invoice shall be sent. Any other terms contained in any Order shall be objected to by Seller without need for further notice of objection, shall not be binding upon Seller and shall have no force or effect. Buyer's mutually agreed change orders shall be subject to all provisions of this Agreement, whether or not the Order or change order so states. All Orders shall be subject to Seller's acceptance. Seller shall promptly provide notice to Buyer of acceptance or rejection of Buyer's Orders.

3. **Acceptance**. Buyer shall be deemed to have accepted this Agreement on the earliest to occur of the following: (a) Seller's receipt of Buyer's Order, if Seller has previously supplied Buyer with a copy of the terms and conditions of sales set forth in this Agreement, (b) Buyer's payment of any amounts due under this Agreement; (c) Buyer's or its representative's or customer's receipt of the Products; or (d) any other event constituting acceptance under applicable law.

4. **Cancellation or Modification**. Buyer may not cancel or modify any Order except upon terms accepted by Seller in a writing signed by Seller's authorized officer. In the event of such cancellation or modification, Buyer shall compensate Seller for all resulting costs and damages, including, but not limited to, out-of-pocket expenses, lost profit, allocable overhead and all other incidental and consequential damages.

5. **Returns**. No Products may be returned to Seller for refund or credit without Seller's prior written approval and, if permitted, shall be subject to an inspection/restocking charge and/or depreciation fee when applicable, plus the costs of freight, packaging and insurance costs.

6. **Prices**. Buyer shall purchase from Seller the Products at the prices determined by Seller from time to time. Seller may at any time and in its sole discretion change the prices of Products, without notice, and the price at time of shipment applies except when specifically covered by a firm price quotation. Unless otherwise agreed in writing, all prices shall be F.O.B. Shipping Point.

7. **Taxes and Other Costs**. All charges for freight, insurance, any sales, use, excise and other federal, state and local taxes, broker fees, or required by any governmental agency incident to the sale shall be paid by Buyer in addition to the price for the Products unless otherwise agreed upon. Such charges will be added at rates in effect at time of delivery except when forbidden by law to be collected by Seller from Buyer, unless Buyer furnishes Seller an exemption certificate acceptable to taxing authorities.

8. **Delivery**. Delivery dates are approximate. Seller shall not be liable for any loss or damage due to delays in delivery or manufacture, resulting from causes beyond Seller's reasonable control, including, without limitation, an event of Force Majeure (as defined below). Partial deliveries shall be permitted. Title to Products and all risk of loss of or damage to Products shall pass to Buyer when Seller delivers the Products to the F.O.B. shipping point. Seller is not responsible for loss or damage in transit. If shipment is deferred at Buyer's (or its Customer's) request beyond the shipping date specified in the original Order, Seller reserves the right to immediately bill Buyer (or its Customer, as the case may be) for such unshipped portion, and for expenses incurred for storage, it being understood that unshipped material become Buyer's (or its Customer's, as the case may be) property and Seller's liability is that of warehouseman only.

9. **Warranties and Remedy**. Seller warrants that all new Products manufactured by Seller will be free from material defects in workmanship and material for a period of 12 months from date of delivery under normal use and service. The warranty for all components in Seller's Products and all parts and Products not manufactured by Seller is limited to the warranty specified by original manufacturer of such component, part or Product. Buyer must make claims to Seller in writing for shortages in the Products within 10 days following the date of delivery of the Products and for defects in the Products within the Warranty Time Period specified herein and, in either case, within ten days after discovery of such shortage or defect. Buyer's failure to inspect the Products and/or make a claim pursuant to this section for shortages within 10 days following the date of delivery of the Products and for defects within the specified Warranty Time Period and, in either case, within ten days after discovering such shortage or defect shall constitute Buyer's irrevocable acceptance of the Products and Buyer's acknowledgment that the Products fully comply with the terms, conditions and specifications of this Agreement.

Seller's obligation under this warranty is limited to repairing or replacing, at Seller's option, any part which upon Seller's examination proves defective. Alternatively, at Seller's option, Seller may grant Buyer a credit toward future purchases in the amount of the net price paid for any Products proved to be defective. All credits are subject to inspection and approval by Seller's authorized representatives. Such warranty satisfaction shall be available only: (a) with respect to shortages, in the 10 days following the date of delivery of the Products; and (b) with respect to defects, within the specified Warranty Time Period; provided, however, Seller is notified in writing within ten days after discovery of alleged shortage or defect and the defect has not been caused by Buyer's or its representative's or customer's misuse, neglect or alteration or by physical environment.

This warranty excludes Products and any parts, failures and damage:

- (i) to which repair or replacement becomes necessary due to normal wear and tear;
- (ii) which are exhaustible items, including but not limited to such items as filter bags and seals;
- (iii) on which repairs, alterations or adjustments have been performed or begun by Buyer or any third party without Seller's consent;
- (iv) which are not promptly reported to Seller within the warranty period above;
- (v) which are modified without Seller's written approval;
- (vi) which are due to negligence other than that of Seller;
- (vii) which are due to accident, misuse, abuse, overloading, jamming, improper installation (other than installations made by Seller), improper operation, or abnormal conditions of temperature, moisture, dirt or corrosive matter or other environmental factors; or
- (viii) which have been damaged otherwise without the fault of Seller.

Seller's obligation or liability under this warranty does not include any transportation or other charges or liability for direct, indirect, special or consequential damages or delay resulting from the improper use or application of the product or the substitution upon it of parts or accessories not approved by Seller or repair by anyone other than a Seller authorized representative. Buyer shall be responsible for all parts and service technician charges relating to work not covered by warranty. Buyer shall pay Seller for such parts and service work not under warranty within 15 days of the date of Seller's invoice. A past due charge of 1.25% per month shall apply to amounts past due.

10. LIMITATION OF LIABILITY. SELLER'S AGGREGATE LIABILITY WITH RESPECT TO DEFECTIVE PRODUCTS SHALL BE LIMITED TO THE MONIES PAID BY BUYER TO SELLER FOR THE DEFECTIVE PRODUCTS MANUFACTURED BY SELLER. SELLER EXTENDS NO WARRANTY, INCLUDING WITHOUT LIMITATION ANY WARRANTY AGAINST DEFECTS, IN PRODUCTS MANUFACTURED BY PARTIES OTHER THAN SELLER.

SELLER SHALL NOT BE LIABLE TO BUYER, OR TO ANYONE CLAIMING UNDER BUYER, FOR ANY OTHER OBLIGATIONS OR LIABILITIES, INCLUDING, BUT NOT LIMITED TO, OBLIGATIONS OR LIABILITIES ARISING OUT OF BREACH OF CONTRACT OR WARRANTY, NEGLIGENCE OR OTHER TORT OR ANY THEORY OF STRICT LIABILITY, WITH RESPECT TO THE PRODUCTS OR SELLER'S UNDERTAKINGS, ACTS OR OMISSIONS. IN NO EVENT SHALL SELLER BE LIABLE FOR INDIRECT, INCIDENTAL OR CONSEQUENTIAL DAMAGES OF BUYER, ITS CUSTOMERS OR USERS OF THE PRODUCTS, INCLUDING BUT NOT LIMITED TO, LOSS OF PROFITS.

11. DISCLAIMER OF IMPLIED WARRANTIES. SELLER AND BUYER AGREE THAT THE FOREGOING WARRANTIES ARE EXCLUSIVE AND IN LIEU OF ALL OTHER EXPRESS OR IMPLIED WARRANTIES, INCLUDING, BUT NOT LIMITED TO, ANY WARRANTY OF MERCHANTABILITY OR THE IMPLIED WARRANTY OF FITNESS FOR A PARTUCULAR PURPOSE. SELLER HEREBY DISCLAIMS ALL OTHER EXPRESS OR IMPLIED WARRANTIES. Any oral or written description of the Products is for the sole purpose of identifying the Products and shall not be construed as an express warranty.

12. ASSIGNMENT. BUYER SHALL NOT, WITHOUT THE PRIOR WRITTEN CONSENT OF SELLER, ASSIGN ITS RIGHTS OR OBLIGATIONS UNDER THIS AGREEMENT TO ANY THIRD PARTY. SUBJECT TO THE FOREGOING, THIS AGREEMENT SHALL BIND AND INURE TO THE BENEFIT OF SELLER AND BUYER AND THEIR RESPECTIVE PERMITTED SUCCESSORS AND ASSIGNS.

13. Force Majeure. Seller shall be entitled to suspend performance of its obligations under the Agreement to the extent that such performance is impeded by circumstances beyond the reasonable control of Seller, including, but not limited to war (whether declared or not), revolution, national strikes, natural disasters, acts of government, export or import prohibitions, fire, explosions, floods, accidents, sabotage, civil unrest, riots, and breakage or loss during transportation or storage as well as subcontractors' material and part shortages and delivery delays.

14. Governing Law and Jurisdiction. This Agreement shall be governed by and construed in accordance with the internal laws of the State of Wisconsin. Upon termination of this Agreement for any reason, Seller shall have all of the rights and remedies provided by law, including without limitation the rights of a secured party under Chapter 409, Wisconsin Statutes or any successor statute or similar statute in the jurisdiction where Buyer is located or stores the Products.

15. Miscellaneous. Seller reserves the right to correct clerical or similar errors relating to price or any other term shown in this Agreement. If any provision of this Agreement shall be determined to be invalid, illegal or unenforceable, the validity, legality and enforceability of the remaining provisions shall not in any way be affected thereby. No waiver of breach of any of the provisions of this Agreement shall be construed to be a waiver of any succeeding breach of the same or any other provision.

Village of Sister Bay
Sewer and Water Utilities Committee Operations Report

Sewer and Water Utilities Committee Meeting
March 10, 2026

Capacity Report
See the attached report for January 2026.

Well 1 Rehabilitation
Well 1 was reinstalled on February 26, 2026, and placed back into operation on March 2, 2026. The rehabilitation was performed by CTW. Well 2 rehabilitation is expected to start on March 5, 2026.

Main Lift Station Check Valve Replacement
Crane Engineering installed new check valves on pumps 2 and 3 at the Main Lift Station.

Sludge Storage Tank
The coarse bubble diffuser system that is suspended above the base of the sludge storage tank appears to have sustained ice damage that the department is working on getting fixed as soon as possible. The sludge loadout pump has the ability to operate as a mixer. Operators have changed the valving to allow for additional mixing utilizing the sludge loadout pump, which will also hopefully melt the ice shelf still present in the sludge tank. To complete the repair, we need to empty the sludge tank by transferring the sludge currently stored in sludge tank 1 to sludge tank 2, which we cannot do while the ice is still present. Once the sludge is moved we can then observe the damage and complete the necessary repairs.

WHOPRS Annual Tier II Reports
The WHOPRS Tier II Annual reports have been submitted for the chlorine gas located at Well 2 and the ferric chloride located at the WWTP.

2027 CWFP Intent to Apply
McMahon submitted three separate intent to apply (ITA) applications to the Clean Water Fund Program (CWFP) for the potential projects presented in the facilities study. The three projects have been reviewed and uploaded into the CWFP system and will be placed on the state fiscal year (SFY) 2027 CWFP Project Priority List (PPL). The three separate applications are listed below.
1. Upgrade WWTP – Oxidation Ditch, Sludge Pump, Effluent Reuse
2. Upgrade WWTP – Reed Bed Addition
3. WWTP Upgrade – Sludge Drying Facility

Megan Barnes, Utilities Director

Village of Sister Bay Utilities

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Sister Bay, Liberty Grove Utility District, and Town of Liberty Grove

Treament Plant Capacities Calculations

For: **January-2026**

	WWTP	Sister Bay			LGSD #1	Liberty Grove
	Influent	Hauled	Sewered	Total Sister Bay Flow	Sewered	Hauled
Hydraulic Flow (mgd)	3.740	0.034	3.098	3.132	0.362	0.245
Water Sales Ratios			**0.8953**		**0.1047**	

	WWTP	Sister Bay			LGSD #1	Liberty Grove
	Influent	Hauled	Sewered	Total Sister Bay Flow	Sewered	Hauled
SEWERED BOD lbs/day	9182		8221		961	
HAULED BOD lbs/day	809	99				709
Total BOD lbs	**9991**			**8320**	**961**	**709**

	WWTP	Sister Bay			LGSD #1	Liberty Grove
	Influent	Hauled	Sewered	Total Sister Bay Flow	Sewered	Hauled
SEWERED TSS lbs/day	7890		7063		826	
HAULED TSS lbs/day	615	75				540
Total TSS lbs	**8504**			**7139**	**826**	**540**

	Sister Bay	LGSD #1	Liberty Grove
Purchased Flow Capacity in mgd	0.62	0.059	0.266
Monthly Daily Average	0.101	0.012	0.008
Percent of used Capacity	16.30%	19.81%	2.97%
Purchased BOD Capacity in lbs/day	905	105	1359
Monthly Daily Average	268	31	23
Percent of used Capacity	30%	29.53%	1.68%
Purchased TSS Capacity in lbs/day	1076	101	999
Monthly Daily Average	230	27	17
Percent of used Capacity	21.40%	26.38%	1.74%