Project	**Wastewater System Improvements Project - Alternative 2**
Owner	**Village of Three Oaks**
Date	**April, 2023**

Qty	Unit	Description		Unit Price	Amount
Collection System Improvements					
1	L.S.	Highway Lift Station Rehabilitation	@	$ 75,000	$ 75,000
1	L.S.	Swan Song Lift Station Monitoring System	@	$ 10,000	$ 10,000
1	L.S.	Featherbone Avenue Spot Repair	@	$ 15,000	$ 15,000
				Subtotal:	*$ 100,000*
Lagoon Lift Station Replacement					
1	L.S.	Site Piping and Structures	@	$ 150,000	$ 150,000
1	L.S.	Pump and Control Equipment	@	$ 200,000	$ 200,000
1	L.S.	Site Work and Excavation	@	$ 50,000	$ 50,000
1	L.S.	Electrical Feed to Site	@	$ 65,600	$ 65,600
1	L.S.	Power Panel & Breakers	@	$ 15,000	$ 15,000
1	L.S.	Erosion Control	@	$ 5,000	$ 5,000
				Subtotal:	*$ 485,600*
Lagoon Bank Restoration					
1,700	CYD	Lagoon Bank Erosion Repair	@	$ 50	$ 85,000
2,500	SYD	Lagoon Bank Restoration	@	$ 5	$ 12,500
9,700	SYD	Lagoon Bank Rip Rap	@	$ 65	$ 630,500
				Subtotal:	*$ 728,000*
Sludge Removal from Cell No. 1					
190,000	GAL	Minor Sludge Removal From Cell 1	@	$ 0.5	$ 95,000
				Subtotal:	*$ 95,000*
Miscellaneous Structure Rehabilitation					
1	L.S.	Metering Equipment Replacements	@	$ 10,000	$ 10,000
1	EA	Cell 3 Discharge Structure Improvements	@	$ 10,000	$ 10,000
3	EA	Cell 3 Discharge 10" Valve Replacement	@	$ 5,000	$ 15,000
1	EA	Cell 1 Distribution Chamber (DC-1) Rehabilitation	@	$ 7,500	$ 7,500
1	L.S.	Remove Emergency Sanitary Sewer Overflow	@	$ 5,000	$ 5,000
1	L.S.	Lagoon 3 Outfall Improvements	@	$ 15,000	$ 15,000
				Subtotal:	*$ 62,500*
Deer Creek Discharge Pipes					
1	L.S.	Replace East Stormwater Pipe Outlet and Headwall	@	$ 7,500	$ 7,500
1	L.S.	Replace West Stormwater Pipe Outlet and Headwall	@	$ 7,500	$ 7,500
3,000	SYD	Deer Creek Bank Restoration	@	$ 20	$ 60,000
				Subtotal:	*$ 75,000*
Emergency Pump and Storage Building					
1	L.S.	Replace Roof, Soffit, and Paint Siding	@	$ 30,000	$ 30,000
1	L.S.	Replace Door	@	$ 1,500	$ 1,500
				Subtotal:	*$ 31,500*

SUBTOTAL ESTIMATED CONSTRUCTION COST	***$ 1,577,600***
Construction Contingencies (10%)	$ 158,261
Assistance with ACO Requirements	$ 196,759
CWSRF Funding Application	$ 40,000
Design Engineering (8%)	$ 127,000
Construction Engineering (9%)	$ 142,000
Bond Counsel, Local Counsel, Rate Consultant (3%)	$ 48,000
Administrative Costs (0.5%)	$ 8,000
TOTAL ESTIMATED PROJECT COST	***$ 2,297,620***

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April 14, 2023

Village of Three Oaks
P.O. Box 335
Three Oaks, MI 49128

Attention: ***Mr. Dan Faulkner, Village Manager***

RE: ***WASTEWATER COLLECTION SYSTEM ASSESSMENT REPORT***

Dear Mr. Faulkner:

The following are the results of the Wastewater Collection System Assessment, which included field inspections of the two (2) sanitary lift stations located in the collection system and a conditional assessment of all known collection system assets.

1.0 Background Information

The Village of Three Oaks, Michigan is located in the south-central portion of Berrien County in southwestern Michigan, approximately three miles from the Michigan and Indiana state line. Per the 2020 US Census, 1,370 people live in the Village. Three Oaks is served by US-12, Three Oaks Road, and the Amtrak Railroad. Interstate Highway 94 bypasses the Village approximately six (6) miles to the west.

The Village of Three Oaks treats sanitary waste discharged from the Village with a series of three (3) lagoons that are located on the east side of Schwark Road north of US-12 in Three Oaks Township and one (1) mile east of the Village. This system is operated under a Surface Water Discharge Permit Certificate of Coverage (COC) No. MIG580294 that authorizes the discharge under General Permit Number MIG580000.

In accordance with the Village's Administrative Consent Order (ACO) dated March 10th, 2023, an assessment of the wastewater collection system is required. The following sections of the ACO describe the requirements:

3.23 The Village shall conduct a detailed inspection of the entire wastewater collection system to document and repair structural integrity defects within the wastewater collection system in accordance with the following schedule:

a. On or before March 15, 2023, the Village shall complete a detailed inspection of the entire wastewater collection system.

b. On or before April 14, 2023, the Village shall submit to EGLE, for review and approval, a report that documents the detailed inspection of the entire wastewater collection system referenced in Paragraph 3.23(a) of this Consent Order. The report shall also document any repair work, with schedule, that is necessary as a result of the inspections. The Village is advised that implementation of repairs to the wastewater collection system may require Part 41 wastewater construction permits or may require other EGLE approvals.

Repair work identified in this report must be completed within twenty-eight (28) months after the effective date of the Consent Order.

2.0 History of Existing Wastewater Collection System

The first sewers in the Village of Three Oaks were constructed around 1932 using vitrified clay pipe with oakum mortar joints. They were originally intended to be used as storm sewers, however, due to the type of soil and high groundwater table, most of the individual septic tank systems were eventually connected to the storm system. The storm system discharged directly to surface water courses without treatment of any kind. The joints used on the original system had a tendency to shrink, allowing groundwater to enter the sewer. The vitrified clay pipe used for these sewers was susceptible to cracking if not bedded or backfilled properly. This was a historic source of infiltration for the collection system.

In 1970, a major renovation of the system was completed. An attempt was made to separate the sanitary and storm sewer systems through the construction of several new storm and sanitary sewers. A lagoon system was also constructed for wastewater treatment. In an attempt to save money, as much of the existing system as possible was utilized for sanitary sewers. Approximately 18,000 linear feet of gravity sewer and a pump station on US-12 were constructed to improve the collection system in 1970. These sewers were constructed of vitrified clay pipe with premium joints. In 1978, a collection system improvements project was undertaken with the goal of removing significant amounts of inflow and infiltration (I/I) from the system. Sections of the original 1932 sewers were replaced or repaired with chemical grout and manholes were replaced or repaired with hydraulic grout as part of the 1978 project.

In 2001, an extensive sanitary collection system improvements project was completed. The separation of the sanitary and storm sewer systems was accomplished with the construction of nearly 40,000 feet of PVC gravity sewer, replacing the remaining portions of the original 1932 clay sewers as well as deteriorated sections constructed in 1970. A sewer extension was completed in 2004 to serve a manufacturing facility located north of the Village in Three Oaks Township, and gravity sewer and a small grinder station were constructed in 2005 to serve a housing development constructed in the southeast corner of the Village.

3.0 Wastewater Asset Inventory

The Village of Three Oaks operates a wastewater collection system consisting of approximately 61,000 feet of 8-inch to 15-inch gravity sewer, 221 manholes, 2 lift stations ranging from 20 to 180 gallons per minute (GPM), and 2,900 feet of pressurized force main. The collection system is split into two distinct sewer districts, separated by the Amtrak railroad which runs east-west through the center of the Village. The north trunkline sewer conveys wastewater west from Chicago Street to the Village's treatment lagoons within an easement traversing a farm field. The south trunkline sewer conveys wastewater west along US-12 to just past the Village limits, then north to the treatment lagoons. In addition to the pipes in the collection system, the Village relies on two sewage lift (pump) stations to convey the wastewater from sub-sewersheds within the system.

With a thorough knowledge of the basic layout of the collection system, a comprehensive inventory of all wastewater system assets was performed using as-built utility drawings and previously obtained on-site Global Positioning System (GPS) field locations. Using the data collected, detailed maps of the wastewater collection system were prepared using Geographical Information System (GIS) software. Table 1 contains a summary of the wastewater system assets identified.

Item	Quantity	Units
15-inch Sanitary Sewer	3,270	LF
12-inch Sanitary Sewer	4,743	LF
10-inch Sanitary Sewer	9,854	LF
8-inch Sanitary Sewer	41,895	LF
Sanitary Manholes	221	EA
Lift Station	2	EA
Backup Generator	1	EA
6-inch Force Main	2,322	LF
4-inch Force Main	578	LF

Table 1 - Wastewater system assets

4.0 System Maps

Maps of the wastewater system identifying the collection system assets by diameter, by material, and by age are included in Appendix A. These maps were developed from an existing GIS map prepared for the Village and revised with record drawing information to improve accuracy.

5.0 Asset Conditions

After completing the inventory of the utility system assets, condition assessments of all asset components were performed. The condition assessment provides the critical information needed to assess the physical condition and functionality of the assets in the collection system and estimate their remaining service life. Within the sanitary collection system, pipe condition was primarily rated based upon the age and material of the pipe. This information was gathered through as-built records which provided information for a majority of the system. Targeted sections of gravity sewer were inspected using closed-circuit televising (CCTV) equipment designed for use in sewer pipes.

Both collection system lift stations owned and maintained by the Village were inspected in detail and the equipment was assessed by Wightman employees, including drawdown testing to determine the condition of the pumping equipment and photographing the various assets comprising the lift station. Examples of some of these pictures are shown in Figures 1 through 6.

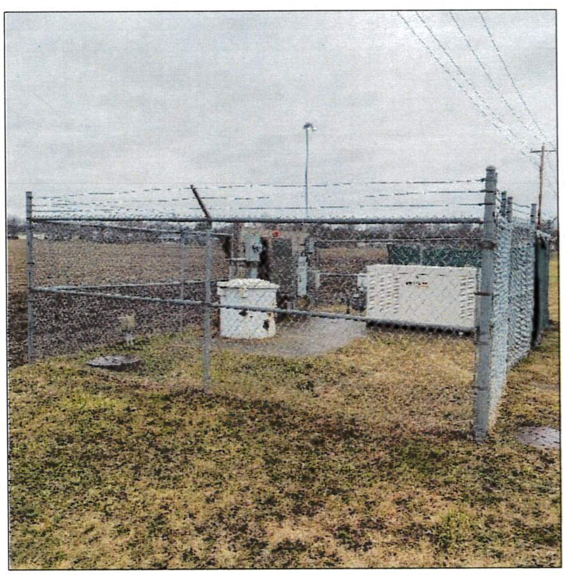

Figure 1 - Highway Lift Station

Figure 2 – Highway Lift Station Wet Well

Figure 3 - Highway Lift Station Generator

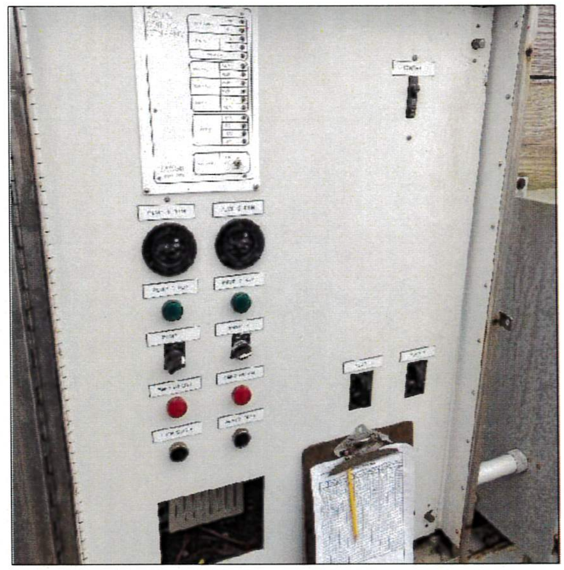

Figure 4 – Highway Lift Station Control Panel

Figure 5 – Swan Song Grinder Station

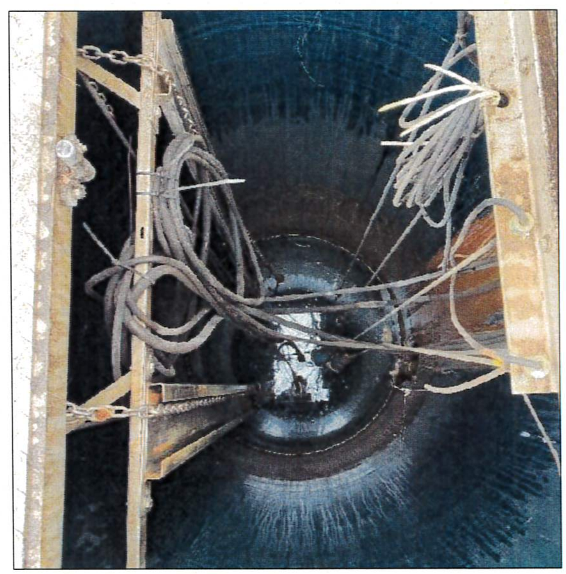

Figure 6 – Swan Song Grinder Station Wet Well

During the field inspections discussed above, any notable equipment defects were documented. This information was used to make decisions about necessary station improvements.

Overall collection system asset conditions were assessed using a systematic method to produce consistent, useful information. This information was used to make estimates of each asset's remaining useful life and its long-term performance. The age and materials for the collection system were determined based upon the most recent as-built drawings.

The conditional assessment for the collection system assets that were not physically or visually inspected were based on a numerical grading system, which defines the condition as determined by the age and material of the asset. The numerical system uses numbers ranging from 1 to 5 as shown in Table 2 below.

Pipe Condition Rating	Condition Description	Age Range
1	Very Good	0 to 24 years old
2	Good	25 to 44 years old
3	Fair	45 to 59 years old
4	Poor	60 to 74 years old
5	Very Poor	75 years or older

Table 2 - Conditional assessment system

Inspections at the lift stations included physical and visual inspections of all the major components along with drawdown tests to determine the performance of the pumping equipment, as previously discussed. Table 3 shows the design capacity, current pump rates, and the condition of the individual components of the lift stations.

Station	Pump Design Capacity (gpm)	Pump 1 Test Rate (gpm)	Pump 2 Test Rate (gpm)	Wet Well Condition	Pump Condition	Electrical & Controls Condition	Generator Condition
Highway	180	150.3	169.1	Good	Fair	Fair	Good
Swan Song	20	18.8	15.0	Good	Good	Good	N/A

Table 3 - Wastewater system lift station condition ratings

6.0 Remaining Useful Life

Remaining useful life estimation is another method commonly used to characterize the condition of assets – especially those assets that were not physically or visually assessed. Remaining useful life is defined as an estimate of the duration of time remaining until an unacceptable condition exists or an asset no longer meets its primary function. It does not mean that the asset will fail at that point in time, but rather that replacement of the asset should be budgeted for due to rising maintenance costs, inability to find replacement parts, increased unreliability, and/or the potential for failure.

Remaining useful life for sanitary sewers is dependent on the materials used in construction. Sanitary sewer pipe materials have evolved over the years. Early piping was generally constructed of hollowed-out logs, brick, or stone and transitioned over the years to vitrified clay, cast iron, and concrete. Sewers constructed today are typically constructed from concrete, ductile iron, plastic (truss pipe), high-density polyethylene (HDPE), and polyvinyl chloride (PVC) piping. Early manholes were generally constructed of bricks, cast-in-place concrete, or segmented block and transitioned over the years to precast reinforced concrete.

Figure 7 shows the percentages of the various pipe materials that are present in the gravity sewers throughout the wastewater collection system. The pipe materials of construction are included as an attribute in each asset's entry in the electronic GIS mapping database.

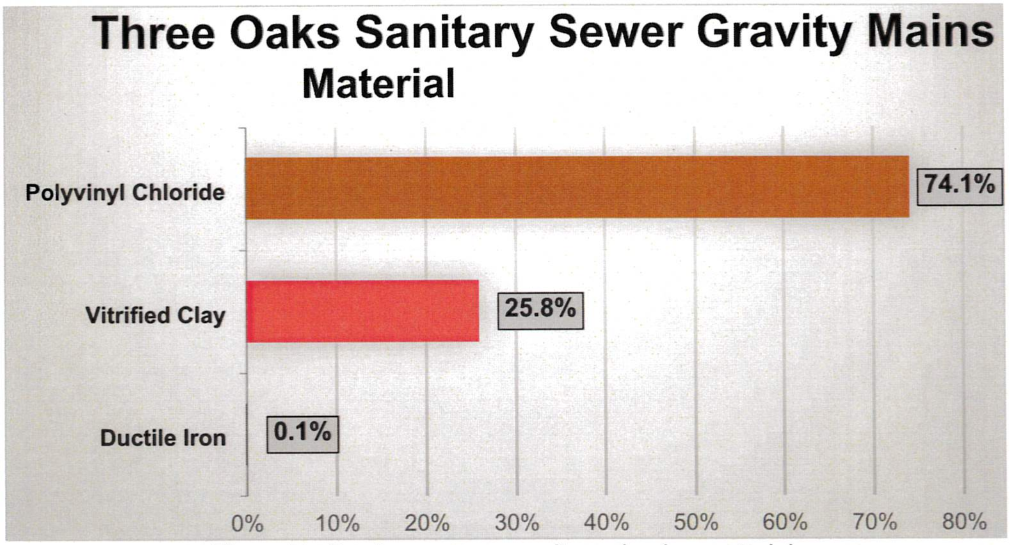

Figure 7 - Sanitary sewer gravity main pipe materials

There are several methods utilized to estimate the remaining useful life of an asset:

- The simplest method uses a typical useful life table, which lists the estimated total life of an asset type from its first day of use to when it is estimated to fail to function. Based upon the actual age of the asset, the remaining useful life is calculated. This method does not consider the current condition of the asset or any other factors.
- A second method utilizes a typical useful life table as well but applies a factor to the calculation based upon the current condition of the asset.
- A third method utilizes actual decay curves based upon the maintenance and failure experience of a specific asset or asset class for the utility in question. This is the most accurate method. However, most utilities do not have the historical data necessary to develop the decay curves.

Determining the useful life of an asset is as much art as it is science. For this report, the remaining useful life has been calculated using the second method discussed above – a typical useful life table modified by current condition factors. Table 4 presents the typical useful lives for the asset types included in the wastewater system.

Asset Type	Typical Useful Life (years)
Gravity Sewer Pipe (HDPE, PVC, Truss Pipe, Vitrified Clay)	100
Gravity Sewer Pipe (Brick, Cast Iron, Ductile Iron, ABS Plastic, Concrete)	75
Force Main Pipe (HDPE, PVC)	75
Force Main Pipe (Cast Iron, Ductile Iron)	50
Manholes/Concrete Structures	80
Pumps	20
Electrical and Controls	20
Mechanical (Equipment, Valves, etc.)	30
Structural Components	50
Land	Unlimited

Table 4 - Typical useful lives for wastewater assets

These typical useful life values have been increased or decreased for each specific asset based upon industry-standard specifications for materials and components. The estimated remaining life of each asset in the wastewater system is included as an attribute for that asset in the GIS mapping database. The estimated remaining life of the sanitary sewer gravity mains, force mains, and manholes, in ten-year increments, is shown in Figures 8 through 10.

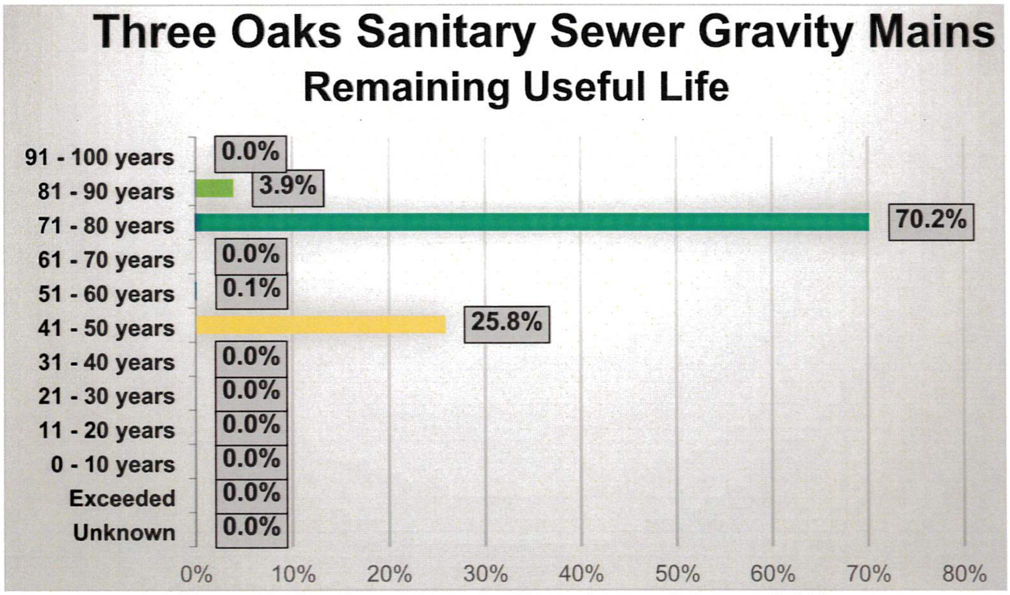

Figure 8 - Sanitary sewer gravity main remaining useful life

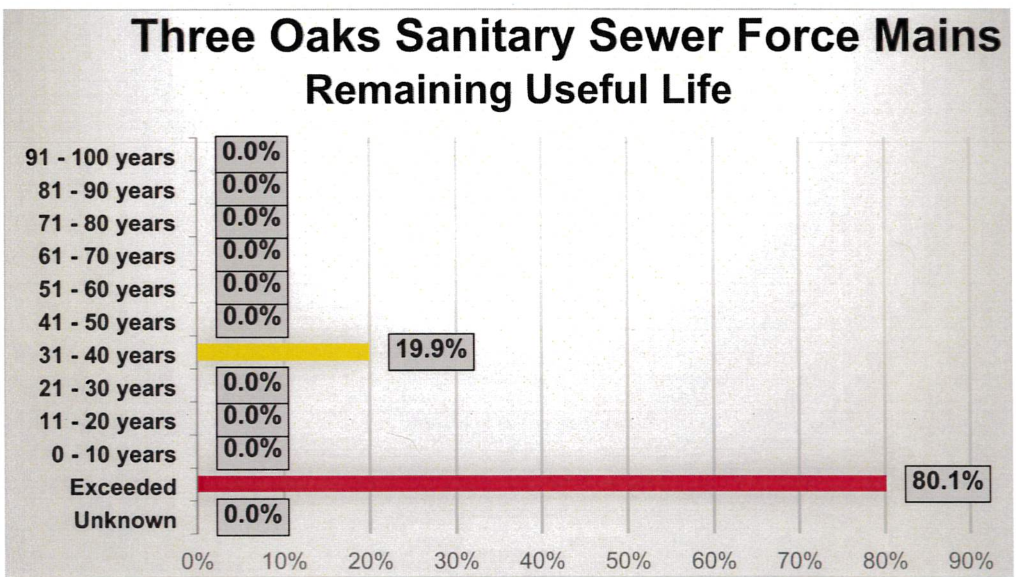

Figure 9 - Sanitary sewer force main remaining useful life

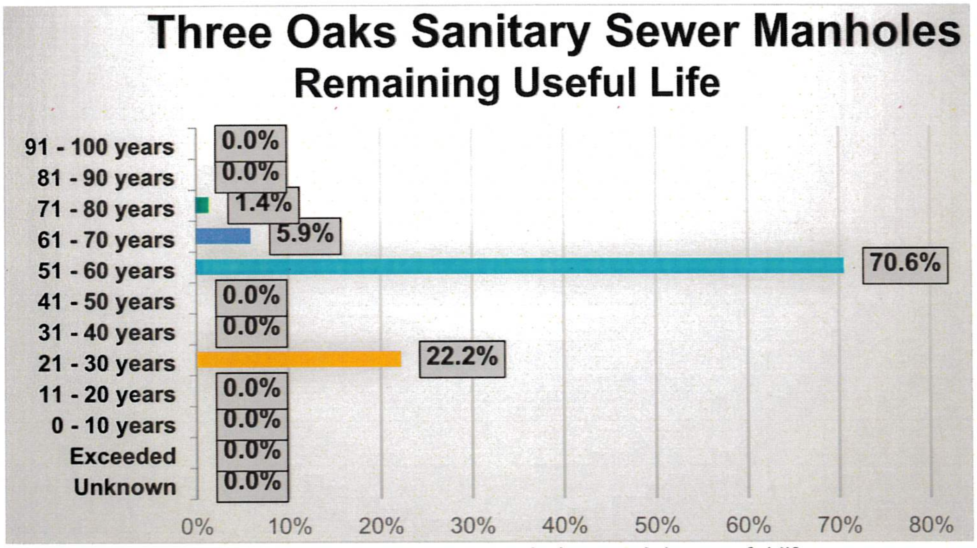

Figure 10 - Sanitary sewer manhole remaining useful life

7.0 Criticality, Likelihood of Failure, and Consequence of Failure

Not all assets are equally important to a utility's operation. While some assets may have a high likelihood of failure, their failure may cause little to no disruption in the ability of the utility to meet their level of service. Correspondingly, some assets may be unlikely to fail but their failure may cause a catastrophic disruption to the utility's ability to meet their desired level of service. Criticality is a rating that is applied to the assets that considers both the likelihood and the consequences of an asset failing.

Criticality is determined by multiplying the likelihood of failure by the consequence of failure and is a significant factor in prioritizing capital improvements. In general, the higher the criticality of an asset, the more resources that should be allocated to maintain the asset, or the higher the priority that repairs to that asset should take. However, criticality is only one tool that can be utilized to analyze and prioritize capital improvements and its use is subject to careful evaluation of the asset(s) in question and sound engineering judgement.

For gravity sanitary sewers, sanitary manholes, and lift station components, the likelihood of failure was determined by the conditional rating of the asset with consideration given to the remaining asset life as shown below in Table 5. The methodology of examining the asset conditions and assigning conditional ratings to noted defects was discussed previously. The likelihood of failure for all assets assessed based only on the remaining asset life was determined in accordance with Table 5.

Likelihood of Failure Rating	Asset Condition/ Description	Remaining Useful Life
1	Very Good	More than 90%
2	Good	60 to 89.9%
3	Fair	30 to 59.9%
4	Poor	10 to 29.9%
5	Very Poor	Less than 10%

Table 5 – Likelihood of failure assessment methodology

It should be noted, however, that the condition descriptions are carried over in the GIS model as the likelihood of failure. In other words, if an asset's condition is rated as a "4" (Poor) or "5" (Very Poor), that same description carries over as the likelihood of failure indicating that the asset is in "Poor" or "Very Poor" condition rather than that the likelihood of failure is "Poor" or "Very Poor". The opposite applies as well, with assets whose condition is rated as a "1" (Very Good) or "2" (Good) showing a likelihood of failure of "Very Good" or "Good", again describing the condition of the asset rather than the likelihood that it will fail.

To determine the consequence of failure, it is important to consider the significant costs of failure. These costs include not only the monetary cost of the repair, but could also include:

- Social costs associated with the failure of the asset.
- Repair/replacement costs related to collateral damage caused by the failure.
- Legal costs related to damage caused by the failure.
- Regulatory fines resulting from a Sanitary Sewage Overflow (SSO) related to the failure.
- Environmental costs (and possible environmental cleanup costs) created by the failure.
- Loss of business revenue to the community caused by the failure.
- Other miscellaneous costs associated with the asset failure.

The consequence of failure can be high if any one of these costs is significant or if the accumulation of several costs occurs due to a failure. In the case of the failure of a wastewater asset, the environmental, social, and legal costs can outweigh the costs of collateral damage and even the cost of repairing the failure itself. The consequence of failure was assessed using the criteria presented in Table 6.

Consequence of Failure Rating	Social, Human, and Environmental Effects	Collateral Damage Effects
1 (Insignificant)	< 10% loss of service, limited potential for human contact with sewage, minimal property damage	Structure/pipe outside of road right-of-way (ROW), no impact to traffic or other structures
2 (Minor)	10% to 24% loss of service, potential for human contact with sewage, minimal property damage	Structure/pipe located under the pavement or curb of a residential or minor local road
3 (Moderate)	25% to 49% loss of service, potential for human contact with sewage, limited property damage, disruption to essential services/major industry	Structure/pipe located under the pavement or curb of a major collector roadway
4 (Major)	50% to 89% loss of service, likely human contact with sewage, moderate property damage, disruption to multiple industries/essential services	Structure/pipe located along state roadways, interstate highways, railroad ROW, or close enough to a building to cause collateral damage
5 (Catastrophic)	90+% loss of service, high potential of human contact with sewage, extensive property damage	Structure/pipe located under the pavement or curb of state roadways or interstate highways, under railroad tracks, or underneath a building

Table 6 - Consequence of failure rating scheme for wastewater assets

Utilizing the above ranking system, a thorough knowledge of the service area, and sound engineering judgement, a consequence of failure was assigned to each asset in the wastewater system. These consequence of failure values for each asset are included as an attribute for that asset in the GIS mapping database. The consequence of failure for the various asset classes in the wastewater collection system is shown in Figures 11 through 13 below.

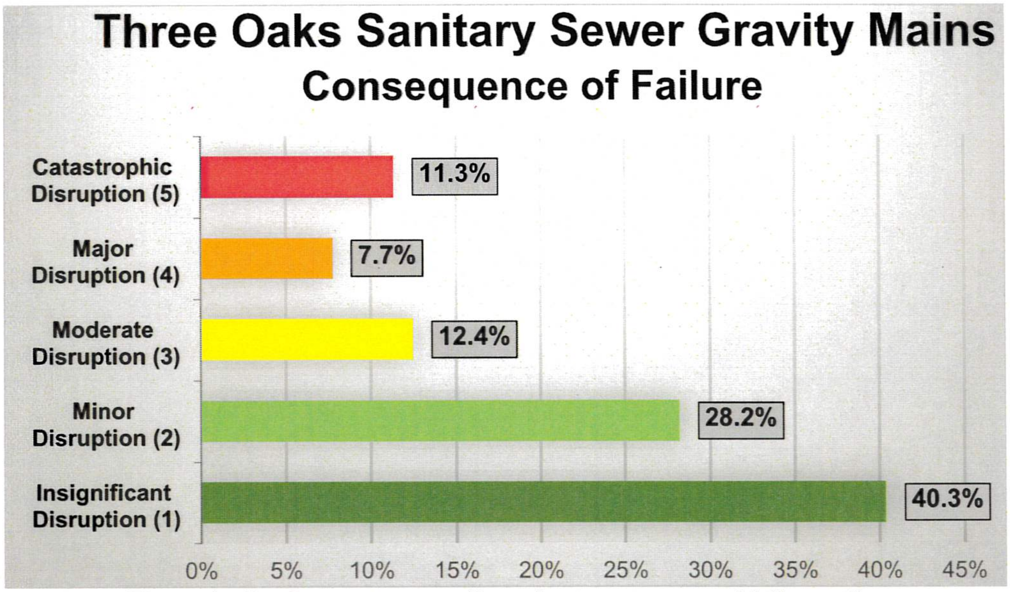

Figure 1 - Sanitary sewer gravity main consequence of failure rating

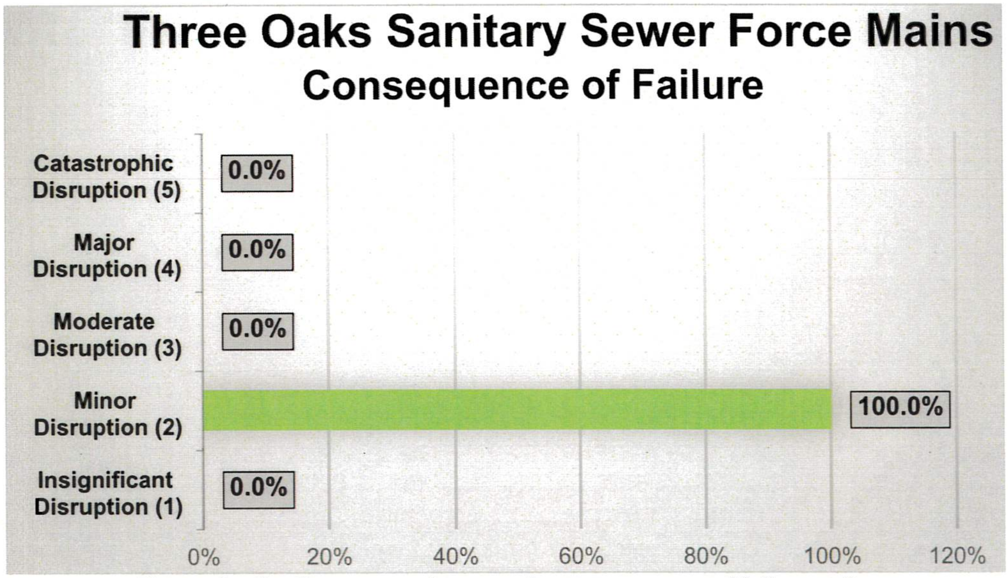

Figure 2 - Sanitary sewer force main consequence of failure rating

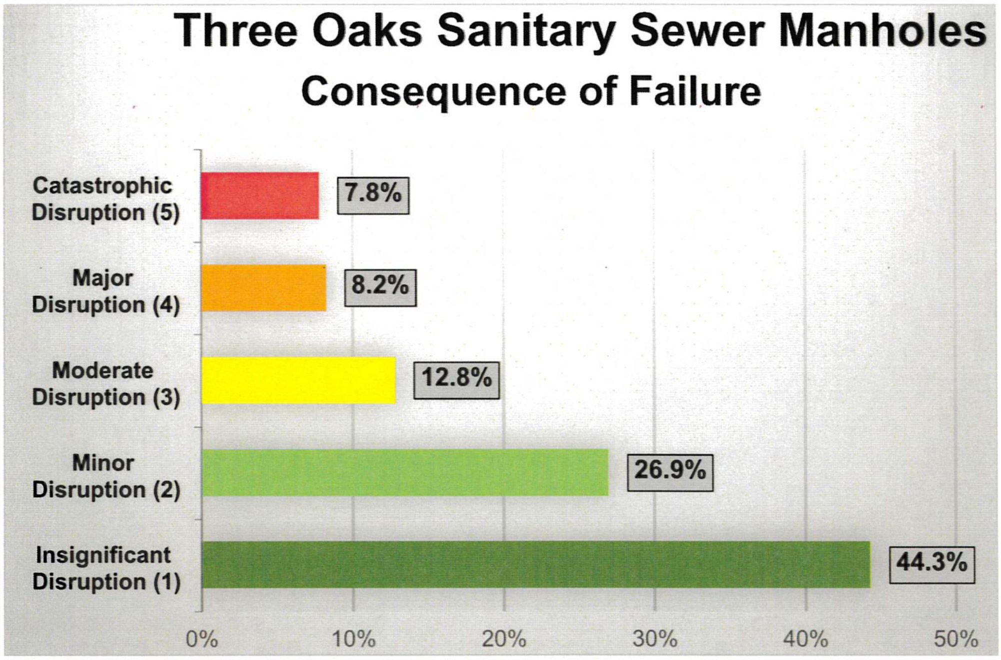

Figure 3 - Sanitary sewer manhole consequence of failure rating

8.0 Criticality Map

As previously discussed, the criticality of each asset was calculated by multiplying the condition rating corresponding to the likelihood of failure of the asset by the consequence of failure rating of the asset. As such, the range of criticality numbers that can be assigned to an asset is 1 to 25 with the criticality of the asset increasing the higher the number assigned to it, as shown in Table 7. The resulting criticality of each asset is included as an attribute for that asset in the GIS mapping database. A map of the wastewater collection system showing asset criticality is included in Appendix B.

Criticality Rating	Criticality Description
1 to 5	Very Low
6 to 10	Low
11 to 15	Moderate
16 to 20	High
21 to 25	Very High

Table 7 - Criticality rating descriptions

While the criticality ratings provide a point of reference to help in determining issues that may need to be addressed, it is only a tool. Sound engineering judgement still needs to be applied to determine if there is an issue with an asset that needs to be addressed by a capital improvement project.

9.0 Recommended Improvements

Based on the information gathered, the Village of Three Oaks sanitary collection system is generally in very good condition. CCTV inspections identified one (1) section of PVC gravity sewer approximately five (5) feet long on Featherbone Avenue that appears to have been crushed, likely during installation. We recommend the location be excavated and a spot repair be completed to replace the section of crushed pipe.

The Highway Lift Station located on US-12 conveys wastewater flows from the residential areas in the southeast section of the Village. Minor improvements have been completed at the station since it was constructed in 1970, and cyclical pump replacements and replacement of the control panel are needed at this time. Additionally, we recommend telemetry improvements be completed at both the Highway Lift Station and Swan Song Lift Station, such as the addition of Mission Control panels, to improve station monitoring and increase system reliability.

10.0 Schedule for Completion of Improvements

The Village of Three Oaks is in the process of applying to the Michigan Department of Environment, Great Lakes, and Energy's (EGLE) Clean Water State Revolving Fund (CWSRF) loan program for the above-mentioned collection system improvements, as well as for improvements identified at the wastewater treatment lagoons. The final Project Plan will be submitted to EGLE by the May 1, 2023 deadline for consideration of 2024 funding.

Plans, specifications, and permit applications will be completed by early 2024, with an anticipated project bid issuance occurring in April of 2024. If material and equipment procurement timelines continue to be prolonged, as has been the case since the COVID-19 pandemic disrupted supply-chains and manufacturing, construction of the improvements is likely to begin in early 2025. If material and equipment procurement timelines revert to pre-COVID-19 conditions, construction could start by late summer or early fall of 2024.

Sincerely,

WIGHTMAN & ASSOCIATES, INC.

Mary Q. Nykamp

Mary Deneau Nykamp, P.E.
mnykamp@gowightman.com