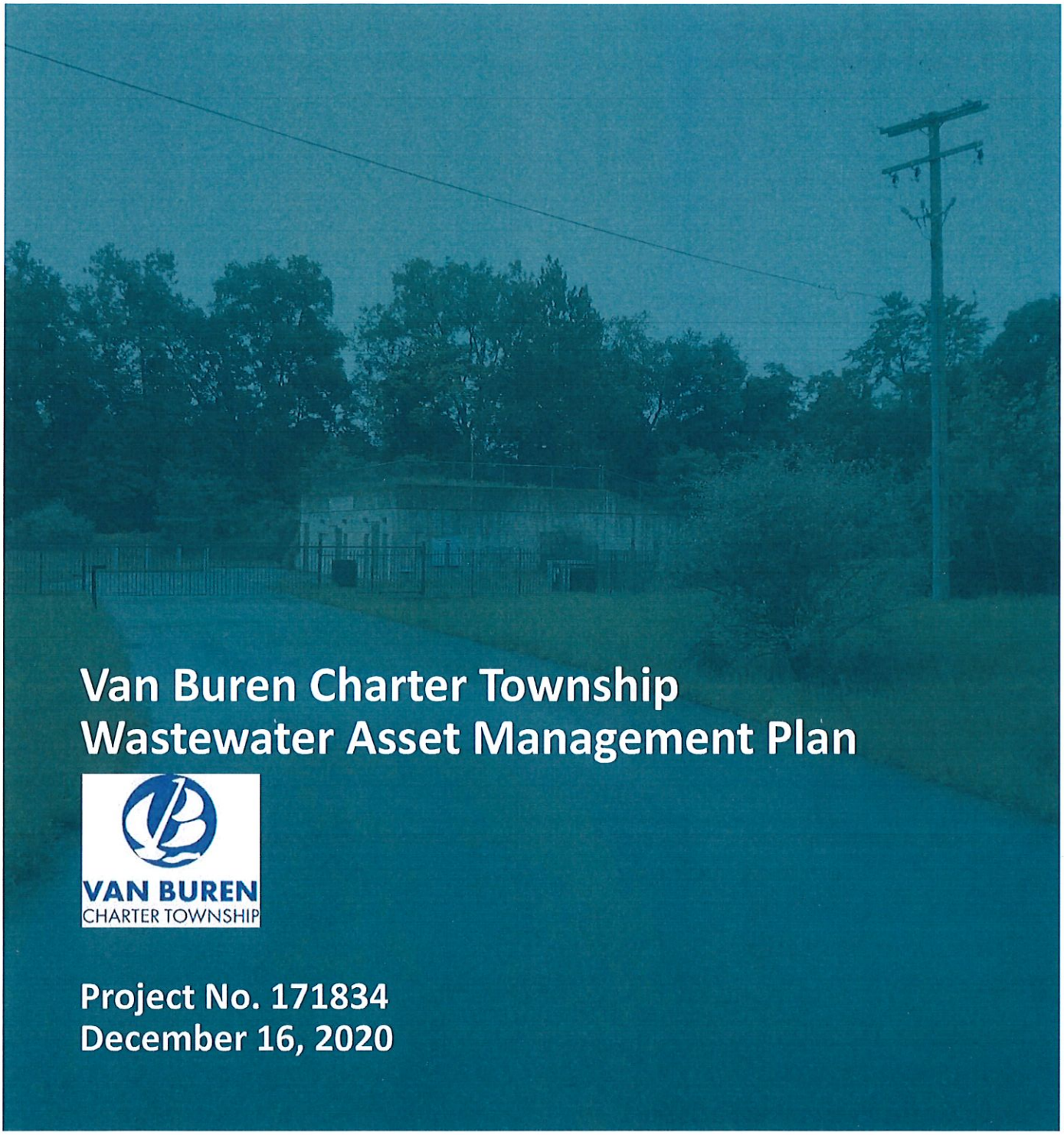

Van Buren Charter Township
Wastewater Asset Management Plan

VAN BUREN
CHARTER TOWNSHIP

Project No. 171834
December 16, 2020

fishbeck
Engineers | Architects | Scientists | Constructors

fishbeck
Engineers | Architects | Scientists | Constructors

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Wastewater Asset Management Plan

Prepared For:
Van Buren Charter Township, Michigan

VAN BUREN
CHARTER TOWNSHIP

December 16, 2020
Project No. 171834
SAW Grant Project No. 1053-01

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List of Abbreviations/Acronyms

ABS	Acrylonitrile-Butadiene-Styrene
AMP	Asset Management Plan
AUI	Advanced Underground Inspection
BRE	Business Risk Exposure
CIP	Capital Improvement Plan
CIPP	cured-in-place pipe
COF	Consequence of Failure
CCTV	closed-circuit televising
District	Sanitary Sewer District
DUWA	Downriver Utility Wastewater Authority
EGLE	Michigan Department of Environment, Great Lakes, and Energy
EQ Basin	Equalization Basin
FRP	fiberglass reinforced plastic
GIS	Geographic Information System

GLWA	Great Lakes Water Authority
gpm	gallon(s) per minute
H_2S	hydrogen sulfide
IIMM	International Infrastructure Management Manual
LOS	Level of Service
MACP	Manhole Assessment and Certification Program
NASSCO	National Association of Sewer Service Companies
NHV	North Huron Valley
NHV PS	North Huron Valley Pump Station
O&M	operation and maintenance
PACP	Pipeline Assessment and Certification Program
PM	preventative maintenance
POF	Probability of Failure
PVC	polyvinyl chloride
RVSDS	Rouge Valley Sewage Disposal System
SAW	Stormwater, Asset Management, and Wastewater
SCADA	Supervisory Control and Data Acquisition
SHVUA	South Huron Valley Utility Authority
SSO	sanitary sewer overflow
Township	Van Buren Charter Township
UFS	Utility Financial Solutions, LLC
VFD	Variable Frequency Drive
YCUA	Ypsilanti Community Utility Authority

1.0 Executive Summary

Van Buren Charter Township (Township) was awarded a grant by the Michigan Department of Environment, Great Lakes, and Energy (EGLE), under the Stormwater, Asset Management, and Wastewater (SAW) Grant Program, to develop a wastewater Asset Management Plan (AMP). This AMP was developed by Fishbeck working closely with Township staff and in accordance with EGLE's five core AMP components:

1. Asset Inventory and Condition Assessment
2. Level of Service (LOS)
3. Asset Criticality
4. Capital Improvement Plan (CIP)
5. Revenue Structure

The Township's wastewater system consists of approximately 597,354 feet of pipe ranging in size from 4 inches to 36 inches in diameter, and 2,548 manholes. The system also includes 3 diversion chambers, 14 pump stations, and a 1.2-million-gallon Equalization Basin (EQ Basin). The Township sends its wastewater flows to four different authorities for treatment:

1. Rouge Valley Sewage Disposal System (RVSDS) to Great Lakes Water Authority (GLWA)
2. South Huron Valley Utility Authority (SHVUA)
3. Downriver Utility Wastewater Authority (DUWA)
4. Ypsilanti Community Utility Authority (YCUA)

In addition to EGLE's core AMP components, Township staff requested supplementary items be included in this AMP. The tasks completed include:

1. Asset Inventory and Condition Assessment:
   a. Update the Geographic Information System (GIS) database with information collected during the study.
   b. Develop a unique naming convention for the Township's vertical assets that incorporates the location and type of asset.
   c. Develop an inventory of the Township's asset information, including equipment and process descriptions, critical attribute information, age, expended useful life, and replacement costs. Incorporate this information into the GIS database.
   d. Perform a quantitative condition assessment of each asset based on criteria specific to each asset class. Incorporate the results into the GIS database.
2. Level of Service:
   a. Assist the Township in developing a LOS based on measurable commitments to its customers and EGLE.
3. Asset Criticality:
   a. Develop a Probability of Failure (POF) rating for each asset based on the condition assessment, repair history, and age or expended useful life.
   b. Develop a Consequence of Failure (COF) rating for each asset to reflect its importance to the system and the disruption or difficulty of repair/replacement should failure occur.
   c. Compute the Business Risk Exposure (BRE) for each asset as a tool for prioritizing repair/replacement.
4. Operation and Maintenance (O&M) Strategies:
   a. Review the preventative maintenance (PM) history and system operations.
   b. Identify gaps in the PM program and system operations.
   c. Develop a revised PM program by asset.
5. Capital Improvement Plan:
   a. Use the BRE, LOS, and repair/replacement costs to develop a 20-year CIP that includes:
      - Grouping projects based on type of work and asset classes.
      - Scheduling repair/replacement through the year 2040.
      - Projecting annual system costs through the year 2040.

6. Revenue Structure:
    a. Use the information generated from the Asset Criticality and CIP tasks to develop an estimate of the annual costs to operate, maintain, and upgrade the system.
    b. Perform a cost of service analysis to evaluate utility rates.
    c. Develop a 10-year financial projection that includes the projects identified in the CIP to help the Township determine where it is financially today and over the forecast period, and how it will implement the AMP.

This AMP is a living document that should be updated regularly. Township staff are committed to this effort and have established a protocol to continue updating the AMP with corrective action and regular condition assessment work. They are also committed to updating the GIS database with new asset information.

Township staff will update the CIP list annually and are planning to perform a 20-year CIP update every 5 years. Assets will continue to be prioritized for replacement or rehabilitation in accordance with the updated AMP.

2.0 Introduction

The Township is located in Wayne County and has a population of approximately 28,821 as of the 2010 census. The Township is surrounded by Canton Township to the north, the city of Romulus to the east, Sumpter Township to the south, and Ypsilanti Township (Washtenaw County) to the west. In December 2017, the Township was awarded a grant by EGLE under the SAW Grant Program to develop a wastewater AMP. The AMP was developed by Fishbeck working closely with Township staff. The grant work extended over a 3-year period and was completed in December 2020.

The objective of this AMP is to meet the Township's required LOS in the most cost-effective manner through the proper maintenance of assets. This includes providing a summary of the condition of the assets, a basis for prioritizing the rehabilitation/replacement of the assets, an updated O&M program to routinely maintain the assets, and an assessment of the effect of implementing these tasks on the rates.

The approach for this AMP followed EGLE's five core AMP components:

1. Asset Inventory and Condition Assessment
2. LOS
3. Asset Criticality
4. CIP
5. Revenue Structure

The tasks outlined in the Executive Summary are described in detail along with the resulting data and findings in this document.

3.0 Existing System

The Township is divided into four main sanitary sewer districts (Districts). Each District discharges its flow to a separate authority for transport and treatment. Each District is named after the authority it discharges to:

1. RVSDS District
2. SHVUA District
3. DUWA District
4. YCUA District

The flows from each District are metered by the authorities at the discharge point to the respective authority systems. The city of Belleville is located within the boundaries of the Township and the DUWA District. According to the 2010 census, the city of Belleville has a population of 3,991.

Refer to Sheet 1 in Appendix 1 for the sanitary sewer system by districts.

3.1 Rouge Valley Sewage Disposal System District

The RVSDS District covers the northern third of the Township. It has an area of approximately 5,517 acres. The area is comprised of industrial, business, office/technology, and some residential sections.

The sanitary flows in the RVSDS District travel west to east. The major interceptor is located on Ecorse Service Drive. The interceptor begins as a 15-inch sewer and ends at the Township boundary on the east as a 30-inch sewer where it discharges into the RVSDS sewer system. Refer to Sheet 2 in Appendix 1 for the RVSDS District map and to Table 3.1 for an inventory of the sewers in the district by diameter.

Table 3.1 – RVSDS District Sewer Inventory

Pipe Diameter (inches)	Pipe Length (feet)
6	103
8	15,163
10	85,428
12	34,159
15	18,264
18	2,764
21	35,352
24	4,574
30	12,346
Total	208,153

Three pump stations are located within the RVSDS District. The North Huron Valley Pump Station (NHV PS), also known as the Equalization Basin Pump Station, is used to divert flows from the RVSDS District to the other Districts and is discussed in more detail in Section 3.4. The other two pump stations, Robinson River Lift Station and Schooner Lift Station, are local pump stations used to lift residential flows.

3.2 South Huron Valley Utility Authority District

The SHVUA District covers the middle third of the Township. It has an area of approximately 6,954 acres. The area is comprised mostly of residential sections with some businesses, industrial, and office/technology along Belleville Road, Haggerty Road, and the I-94 freeway. The Willow Run Airport is part of the district as is a portion of Lower Huron Metropark.

The sanitary flows in the SHVUA District travel west to east. The major interceptor is located on the south side of the I-94 service drive. The interceptor begins as a 12-inch sewer and ends as a 30-inch sewer prior to discharging into the SHVUA interceptor just west of the Township's eastern boundary. The Lower Huron Metropark sewer system discharges directly into the SHVUA system and is not part of the Township's sewer system. Refer to Sheet 3 in Appendix 1 for the SHVUA District map and to Table 3.2 for an inventory of the sewers in the District by diameter.

Table 3.2 – SHVUA District Sewer Inventory

Pipe Diameter (inches)	Pipe Length (feet)
4	10
6	164
8	37,920
10	72,601
12	42,576
15	15,387
18	13,888
21	7,359
24	10,075
27	2,417
30	15,335
Total	217,732

There are eight pump stations within the SHVUA District. They are all local lift stations.

1. Beckley Lift Station
2. Harbor Club Lift Station
3. Harmony Lane Lift Station
4. North Shore Lift Station
5. Parkwood Lift Station
6. Ryznar Lift Station
7. Van Buren Park North Lift Station
8. Van Buren Park South Lift Station

3.3 Downriver Utility Wastewater Authority District

The DUWA District covers the southern third of the Township. It has an area of approximately 7,527 acres. The area is comprised mostly of residential and agricultural sections. The city of Belleville is within the DUWA District.

The sanitary flows in the DUWA District travel west to east. The major interceptor is owned by DUWA itself; it starts in the city of Bellville and travels east. The DUWA District flows discharge into the interceptor at several locations. Refer to Sheet 4 in Appendix 1 for the DUWA District map and to Table 3.3 for an inventory of the sewers in the District by diameter.

Table 3.3 – DUWA District Sewer Inventory

Pipe Diameter (inches)	Pipe Length (feet)
8	4,395
10	94,596
12	22,632
15	23,535
16	150
18	4,922
21	4,041
24	3,516
30	5,517
36	5,660
Total	168,964

There are three pump stations within the DUWA District. They are all local lift stations.

1. Haggerty Lift Station
2. Mission Pointe Lift Station
3. Wildbrook Lift Station

3.3 Ypsilanti Community Utility Authority District

The YCUA District has an area of approximately 23 acres and includes a small residential development and a few other properties located on the western edge of the Township. The flow from the YCUA District discharges west. Refer to Table 3.4 for an inventory of the sewers in the District by diameter.

Table 3.4 – YCUA District Sewer Inventory

Pipe Diameter (inches)	Pipe Length (feet)
6	181
8	198
10	2,127
Total	2,506

3.4 Equalization Basin System

The Township constructed an EQ Basin system in 2007 as part of a State Revolving Fund Project. Included in the project were 3 diversion chambers (one each in the SHVUA, RVSDS, and DUWA Districts) as well the NHV PS and force main. The purpose of the EQ Basin system was to allow flow from each District to be diverted into the EQ Basin for temporary storage and eventual release.

The following is a brief description of each component of the system. Refer to Sheets 2 through 4 in Appendix 1 for the locations of these components and Figure 3.1 for a schematic of the EQ Basin system.

3.4.1 NHV Diversion Chamber

The North Huron Valley (NHV) Diversion Chamber consists of a manhole structure constructed on the RVSDS District interceptor. The structure includes an automated gate. Also included is an area-velocity flow meter located further downstream on the interceptor. The gate can be opened either manually using the Supervisory Control and Data Acquisition (SCADA) system or can be set to respond automatically to the meter readings.

When the gate is opened, a portion of the RVSDS District flows are diverted to the NHV PS.

3.4.2 NHV PS

The NHV PS is a triplex submersible pump station with a building that houses the valves, flow meter, standby generator, and electrical controls. Each pump is capable of pumping 1,500 gallons per minute (gpm) at 50 feet of head. The calculated pumping rate with two pumps running is approximately 2,200 gpm. The pump drives are variable frequency drives (VFDs).

The flow enters the pump station once the NHV Diversion Chamber is opened. The pump station pumps the flow through a 16-inch polyvinyl chloride (PVC) force main approximately 15,400 feet where it discharges into the DUWA District interceptor at the corner of East Huron River Drive and South Metro Parkway.

3.4.3 SHVUA Diversion Chamber

The SHVUA Diversion Chamber consists of a manhole structure constructed on the SHVUA District interceptor. The structure includes an automated gate. Also included is an area-velocity flow meter located further downstream on the interceptor. The gate can be opened either manually using the SCADA system or can be set to respond automatically to the meter readings.

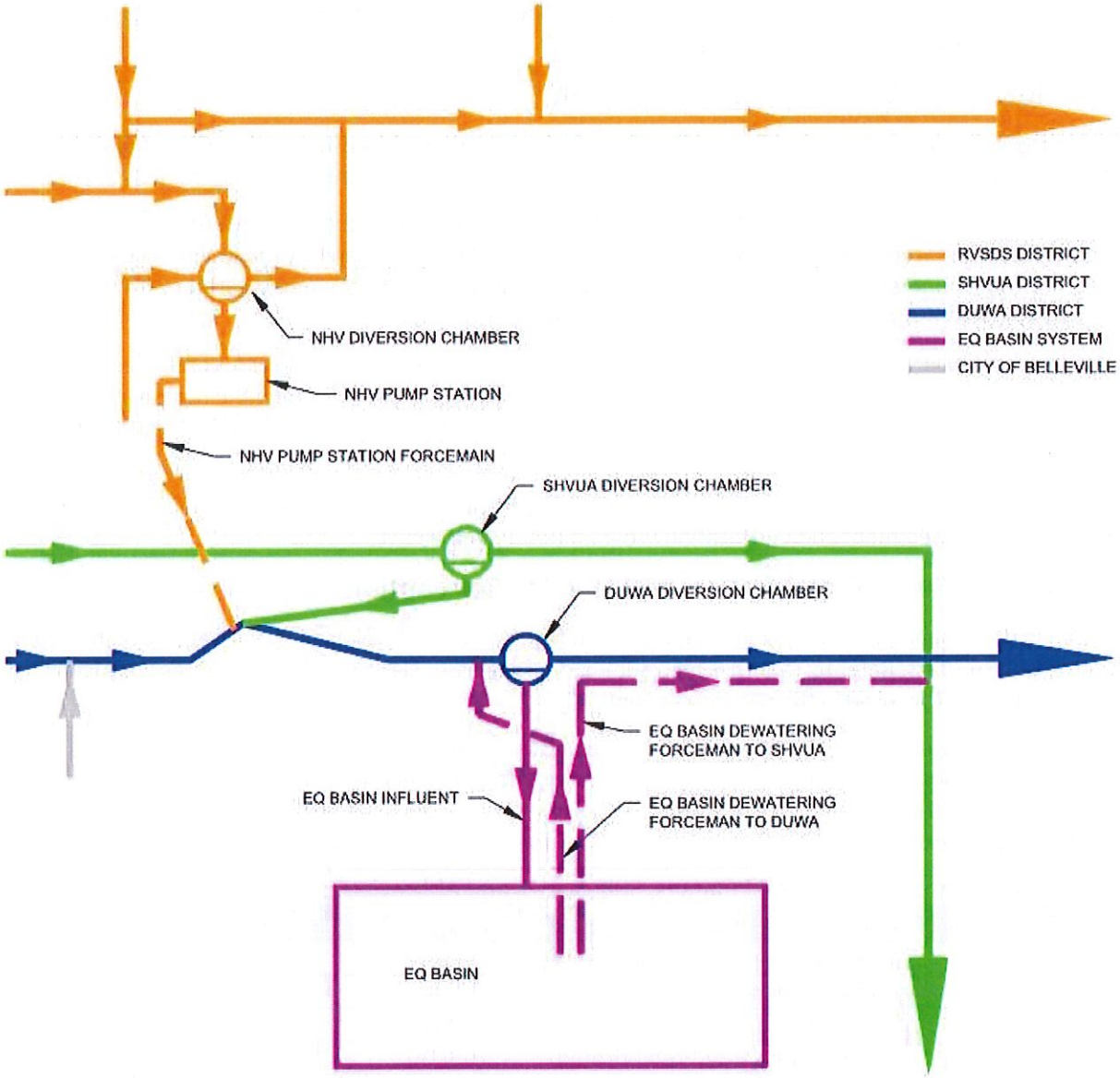
When the gate is opened, a portion of the SHVUA District flows are diverted into the DUWA District and eventually to the DUWA District interceptor at the corner of East Huron River Drive and South Metro Parkway.

3.4.4 DUWA Diversion Chamber

The DUWA Diversion Chamber consists of a manhole structure constructed on the 42-inch DUWA District interceptor. The structure includes an automated gate. Also included is an area-velocity flow meter located further downstream on the interceptor. The gate can be opened either manually using the SCADA system or can be set to respond automatically to the meter readings.

When the gate is opened, a portion of the DUWA District flows (including the city of Belleville), as well as any flow that has been diverted from the RVSDS District or the SHVUA District, are diverted into the EQ Basin via the 36-inch EQ Basin Influent Sewer.

Figure 3.1 – EQ Basin System Schematic



3.4.5 EQ Basin

The EQ Basin is a cast-in-place, reinforced concrete underground structure. The basin is filled by gravity by opening the DUWA Diversion Chamber and allowing the flow to be diverted to the basin. The basin has a storage volume of approximately 1.2 million gallons.

The basin is dewatered using three 1,500 gpm submersible pumps with VFDs. The pumps can discharge the flow through one of two force mains. One force main sends the flow to the SHVUA District. The other force main sends the flow to the DUWA District.

4.0 Asset Inventory

The purpose of the asset inventory is to identify the assets in the system and to collect necessary information (attributes) about these assets. The Township's assets were divided into two groups; horizontal assets included manholes and pipes, and vertical assets included the pump stations, diversion chambers, and the EQ Basin. The horizontal asset information was collected and stored in the Township GIS database, while the vertical asset information was collected and stored in spreadsheets.

4.1 Horizontal Asset Naming Convention

To better store and manage the horizontal asset information collected, the Township utilized GIS software that integrates asset location, asset inventory, and condition assessment records in one location.

A naming convention was established for the assets. Each asset was given a unique ID to ensure database functionality. Manholes were named starting with asset prefix (e.g., SMH for a sanitary manhole), followed by the quarter section page number grid (e.g., 001, 067), then the next available 3-digit number starting with 001. For example, a manhole ID using this naming convention would be SMH001001

Sewers followed a similar naming convention in which the pipe would be labeled by the asset prefix (e.g., SGM for a sanitary sewer), followed by the quarter section page number grid (e.g., 001, 067), then the next available 3-digit number starting with 001. For example, a pipe ID using this naming convention would be SGM002002.

The manholes and pipes were first located in the field, then attributes were collected based in accordance with the National Association of Sewer Service Companies (NASSCO) Manhole Assessment and Certification Program (MACP) and Pipeline Assessment and Certification Program (PACP) guidelines.

4.2 Vertical Asset Classification and Naming Convention

The first step in determining what to include in the asset inventory was to develop a list of assets and categorize them by class and subclass. Refer to Table 4.1 for a summary of the asset classes and subclasses as well as the asset subclass abbreviation used in the naming convention.

The next step was to develop lists of class specific attributes that would be collected for each of the 7 asset classes and 27 subclasses. Certain attributes are necessary for all assets regardless of class. These were referred to as "common to all attributes" and included items such as asset name, installation date, replacement cost, etc. Other attributes are specific to the asset class, such as "size" for a gate, and "horsepower" for a pump motor.

Table 4.1 – Summary of Vertical Asset Classes, Subclasses, and Abbreviations

Asset Class	Asset Subclass	Asset Subclass Abbreviation
Area	Driveway (Asphalt/Concrete/Gravel)	DRV
	Site & Landscaping	LND
Structure	Basin – Concrete	BSN
	Building (Masonry/Prefabricated)	BLDG
	Prefabricated Pump Station (Steel/FRP)	CAN
	Valve Structure	VLVS
	Wet Well	WW
Structure Appurtenance	Hatch, Hatch W/Safety grating	HTCH
Mechanical	Blower	BLOW
	Intake Fan	IFAN

Table 4.1 – Summary of Vertical Asset Classes, Subclasses, and Abbreviations

Asset Class	Asset Subclass	Asset Subclass Abbreviation
Equipment	Gate – Sluice	SLGT
	Hydraulic Actuator System	HAS
	Pump – All Types	PUMP
	Odor Control System – FRP Tank	OCS
	Valve – Air Release	AVLV
	Valve – Check	CVLV
	Valve – Gate	GVLV
	Valve – Plug	PVLV
Instrumentation	Flow Meter (Magnetic/Area-Velocity)	FLOW
	Level Sensor – Pressure Transducer	TRNS
Electrical	Automatic Transfer Switch	ATS
	Control Panel	CP
	Distribution Panel	DP
	Generator	GEN
	Lighting Panel	LP
	Motor Control Center	MCC
	Transformer	XFMR

FRP fiberglass reinforced plastic

Finally, an asset naming convention was established for the vertical assets where each asset has a unique ID. Each asset starts with a 4-digit letter that indicates location. Refer to Table 4.2 for the location abbreviations. The second set of characters in the asset ID includes the asset subclass abbreviation, as presented in Table 4.1. The third set of characters is based on the number of these assets in the system.

As an example, the four gate valves at the Beckley Road Lift Station would be named BRLS-GVLV-01 through BRLS-GVLV-04.

Table 4.2 – Asset Location Abbreviations

Location	Abbreviation
Beckley Road Lift Station	BRLS
Downriver Diversion Chamber	DRD
EQ Basin	EQB
Equalization Basin Pump Station (also known as NHV PS)	EQPS
Harbor Club Lift Station	HCLS
Harmony Lane Lift Station	HLLS
Haggerty Road Lift Station	HRLS
Mission Pointe Lift Station	MPLS
North Huron Valley Diversion Chamber	NHVD
North Shore Lift Station	NSLS
Parkwood Lift Station	PWLS
Robinson River Lift Station	RRLS
Ryznar Road Lift Station	RZLS
Schooner Drive Lift Station	SDLS
South Huron Valley Diversion Chamber	SHVD
Van Buren Park North Lift Station	VBPN
Van Buren Park South Lift Station	VBPS
Wildbrook Lift Station	WBLS

4.3 Horizontal Asset Inventory

4.3.1 Manholes

The manholes were surveyed by Fishbeck and Township staff from 2018 through 2020 using Global Positioning System survey equipment. The northing and easting were recorded for each structure using the State Plane Coordinate System to provide a location, and the rim elevation was collected using the North American Vertical Datum of 1988. Of the 2,548 sanitary manholes believed to exist in the system, 2,520 were found and surveyed (99%). The information was downloaded into the GIS database and the manholes were numbered. Refer to Sheet 5 in Appendix 1 for a map of the surveyed manholes.

The manholes were then inspected/inventoried in accordance with MACP requirements by Fishbeck and Township staff from 2018 through 2020. The inspections included MACP Level 1 information, which according to NASSCO, provides "information about components gathered from a visual inspection at the top of the manhole without entry," as well as additional information, such as rim to invert depth and information on the pipe connections. Inspections were completed for 2,271 of the 2,548 manholes (89%).

Fishbeck and Township staff used tablet computers pre-loaded with the manhole locations and asset IDs. The Collector for ArcGIS app was used to collect the inspection information for each manhole, including pictures. Typically, three pictures were taken for each structure showing the general location of the manhole in relation to the surroundings, the chimney section, and an overall picture looking down into the manhole. The inspection information was then downloaded into the GIS database. Refer to Sheet 6 in Appendix 1 for a map of the inspected manholes. Refer to Figure 4.1 for a sample manhole inspection form.

Figure 4.1 – Sample Manhole Inspection Form

MACP Inspection Form

Structure # SMH042045

Client	Van Buren Township	Pre Cleaning	No pre-cleaning
Project	Wastewater Asset Management Project	Street Name and Number	7513 Kirkridge st
Project Number	171834	City	Van Buren Township
Date/Time (UTC)	2/14/2018 2:15:46 PM	Location	Sidewalk
Surveyed By	SMP/ASA	Surface Type	Concrete/Pavement
Certification #	U-1117-07010087	Pavement Condition	Good
Weather	Snow	Potential for Runoff	None
Inspection Level	Level 1	Manhole Use	Sanitary
Purpose	CIP Assessment	Access Type	Manhole
Cover Type	Solid	Hole Vent Diameter	None
Gasketed	No	Hole # (# of Vent Holes)	0
Bolted or Locked	No	Cover/Frame Fit	Good
Cover Shape	Circular	Cover Condition	Sound
Cover Size (in)	26	Cover Insert Type	None
Cover Size Width (in)	<null>	Cover Insert Condition	None
Cover Material	Cast Iron		
Adjustment Ring Type	None	Adjustment Ring Condition	None
Adjustment Ring Material	None		
Frame Material	Cast Iron	Frame Offset Distance (in)	0
Frame Condition	Sound	Frame Seal Inflow (I/I)	None
Frame Seal Condition	Sound		
Chimney Present	Yes	Chimney Depth (ft)	2.1
Chimney Material	Brick	Chimney Lining Interior (Coating)	None-No coating
Chimney I/I	None	Chimney Condition	Good
Cone Type	Conical Off Centered (Eccentric)	Cone Lining Interior (Coating)	Cementitious
Cone Material	Concrete (precast)	Cone I/I	None
Cone Depth (ft)	3.9	Cone Condition	Good
Wall Material	Concrete (precast)	Wall Lining Interior (Coating)	Cementitious
Wall Depth (ft)	12.3	Wall I/I	None
Wall Diameter (Length-in)	48	Wall Condition	Good
Bench Present	Yes	Bench I/I	None
Bench Material	Concrete (cast in place)	Bench Condition	Good
Bench Lining (Coating)	None-No coating		
Channel Installed	Yes	Channel Exposure	Fully Open
Channel Material	Concrete (cast in place)	Channel Condition	Good
Steps	Yes	Step Material	Metal
Evidence of Surcharge?	No	Debris Present?	Yes
Evidence of H2S?	No	% Pipe Full (Outgoing Pipe)	0
RIM Elevation (ft)	<null>	Grade to Invert (Outgoing-ft)	12.9
RIM to Invert (Outgoing-ft)	12.9	RIM to Grade (ft)	0

Manhole # SMH042045

Pipe Number	1	Diameter 1 (height-in)	12
Clock Position (N is 12 o'clock)	12	Diameter 2 (width-in)	<null>
Rim to Invert	12.9	Pipe Condition	Sound
Flow Direction	Out	Seal Condition	Sound
Material	Truss Pipe	Pipe Type	Gravity Connection
Shape	Circular		
Comments	<null>		
Pipe Number	2	Diameter 1 (height-in)	12
Clock Position (N is 12 o'clock)	3	Diameter 2 (width-in)	<null>
Rim to Invert	12.4	Pipe Condition	Sound
Flow Direction	In	Seal Condition	Sound
Material	Truss Pipe	Pipe Type	Gravity Connection
Shape	Circular		
Comments	Abandoned pipe		
Pipe Number	3	Diameter 1 (height-in)	12
Clock Position (N is 12 o'clock)	6	Diameter 2 (width-in)	<null>
Rim to Invert	12.7	Pipe Condition	Sound
Flow Direction	In	Seal Condition	Sound
Material	Truss Pipe	Pipe Type	Gravity Connection
Shape	Circular		
Comments	<null>		
Pipe Number	4	Diameter 1 (height-in)	<null>
Clock Position (N is 12 o'clock)	<null>	Diameter 2 (width-in)	<null>
Rim to Invert	<null>	Pipe Condition	<null>
Flow Direction	<null>	Seal Condition	<null>
Material	<null>	Pipe Type	<null>
Shape	<null>		
Comments	<null>		
Pipe Number	5	Diameter 1 (height-in)	<null>
Clock Position (N is 12 o'clock)	<null>	Diameter 2 (width-in)	<null>
Rim to Invert	<null>	Pipe Condition	<null>
Flow Direction	<null>	Seal Condition	<null>
Material	<null>	Pipe Type	<null>
Shape	<null>		
Comments	<null>		
Pipe Number	6	Diameter 1 (height-in)	<null>
Clock Position (N is 12 o'clock)	<null>	Diameter 2 (width-in)	<null>
Rim to Invert	<null>	Pipe Condition	<null>
Flow Direction	<null>	Seal Condition	<null>
Material	<null>	Pipe Type	<null>
Shape	<null>		
Comments	<null>		

General Remarks: <null>

Follow up on Site Issues?	No
Inspection Complete	Yes
Inspection Status	Surface Inspection

4.3.2 Pipes

In accordance with SAW Grant requirements, only sewers older than 20 years could be televised. Township staff determined which sewers would be inspected via closed-circuit televising (CCTV) and issued requests for proposals to sewer televising contractors. The Township awarded a contract to Advanced Underground Inspection (AUI) in 2018 to televise the sewers. A contract for a second phase of sewer televising was awarded to AUI in early 2019 and work was finished in late 2019. All sewer televising was performed in accordance with PACP standards and by PACP-certified technicians.

As part of the SAW Grant, 65,621 feet of sewer has been televised and reviewed. Refer to Table 4.3 for the linear footage of pipe televised in each phase.

Table 4.3 – Sewer Televising Summary

Contract	Year	Footage
Phase 1	2018	52,951
Phase 2	2019	12,670
	Total	65,621

The information collected from the sewer televising was incorporated into the GIS database, including pipe diameter, material, connections, and flow directions. Refer to Sheet 7 in Appendix 1 for a map of the sewers televised. A sample sewer televising form is provided in Figure 4.2. The sewer televising forms and sewer televising videos were hyperlinked to each pipe segment in the GIS database.

Figure 4.2 – Sample Sewer Televising Form

Advanced Underground Inspection L.L.C.
38657 Webb Drive
Westland MI 48185
734-721-0081
info@adlvl.com

Inspection Report

Date	P/O. No.	Weather	Surveyor's Name	Pipe Segment Reference	Section No.
6/4/2019		Dry	JAKE G		7
Certificate No.	**Survey Customer**	**System Owner**	**Date Cleaned**	**Pre-Cleaning**	**Sewer Category**
U-213-16245	VAN BUREN TWP.	VAN BUREN TWP.		Not Known	

Street123	DELLOR ST	Use of Sewer	Sanitary	Upstream MH	SMH 22-21
City	VAN BUREN TWP	Drainage Area		Dowstream MH	SMH 22-10
Loc. details		Flow Control	Not Controlled	Dir. of Survey	Upstream
Location Code	Light highway	Length surveyed	333.80 ft	Section Length	333.80 ft

Purpose of Survey		Joint Length	
Year Laid		Dia./Height	10 inch
Year Rehabilitated		Material	Reinforced Concrete Pipe
Tape / Media No.		Lining Method	

Add. Information :

1:810	Position		Observation
SMH 22-10	0.00		Water Level, 5 %of cross sectional area
	0.00		Downstream Manhole, Survey Begins / SMH 22-10
	1.80	S1	Surface Aggregate Visible, from 07 to 05 o'clock, within 8 inches of joint: YES, Start
	19.80		Broken Soil Visible, from 07 to 09 o'clock, within 8 inches of joint: YES / BROKEN AT JOINT
	59.50		Tap Factory Made, at 02 o'clock, -, within 8 inches of joint: YES, 6"
	93.10		Tap Factory Made, at 10 o'clock, -, within 8 inches of joint: YES, 6"
	245.50		General Photograph / GREASE COLLECTING 10%
	247.50		Tap Factory Made, at 10 o'clock, -, within 8 inches of joint: YES, 6"
	286.20		General Photograph / GREASE BUILD UP / 15% / LINE IS DIRTY
	287.60		Tap Factory Made, at 12 o'clock, -, within 8 inches of joint: YES, 6"
	290.20		Water Level, 15 %of cross sectional area
	322.10		Infiltration Runner, from 03 to 09 o'clock, within 8 inches of joint: YES / MINERAL BUILD UP
	322.90		Crack Longitudinal, at 02 o'clock, within 8 inches of joint: YES
SMH 22-21	333.80		Upstream Manhole, Survey Ends / SMH 22-21


245.5 FT


286.2 FT

QSR	QMR	SPR	MPR	OPR	SPRI	MPRI	OPRI
5131	4100	10	4	14	3.33	4	3.5

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4.4 Vertical Asset Inventory

Several meetings were held with Township staff to determine the level of detail that would be appropriate for the vertical asset inventory. If the asset list includes too may assets, it could become cumbersome to maintain and the staff may be less likely to use it. Too few assets limits the ability of the staff to properly use the database to keep track of the assets and plan for the future in any level of detail. In general, the following was used as criteria in defining an asset:

1. Equipment over $2,000 would be considered an asset.
2. Equipment that requires regular maintenance and needs to be included in the PM program would be considered an asset.
3. Valves, piping, and other appurtenances fewer than 6 inches in diameter were not considered assets.

This resulted in 296 assets being created as follows:

- 218 assets were created for the 14 pump stations.
- 53 assets were created for the EQ Basin system.
- 18 assets were created for the 3 diversion chambers.
- 7 rain gauge assets were created.

Site visits were performed by Fishbeck and Township staff to collect attribute information. The information was then input into a Microsoft Excel spreadsheet. Refer to Appendix 2 for the vertical asset inventory summary.

Basic information collected during site visits was also added to the attribute field in the GIS database for each pump station and the EQ Basin. The information included installation date, location description, name, operation date, ownership, number of pumps, pump ID, manufacturer, horsepower, and motor phase of pumps.

Refer to Sheet 8 in Appendix 1 for a map of the overall wastewater collection system showing the manholes, pipes, pump stations, and EQ Basin.

5.0 Condition Assessment

5.1 Condition Assessment

There are several different methods to determine the condition of an asset, depending on the type of asset and the budget and resources available. For the horizontal assets, condition assessments consisted primarily of manhole inspection and CCTV inspection of the sewers. For vertical assets, condition assessments comprised of physical evaluations of the asset and the completion of an inspection form specific to its asset class.

In all cases, the objective of the condition assessment was to generate an overall rating for each asset on a scale of 1 through 5, based on Table 5.1. The range of values presented in Table 5.1 was used throughout the condition assessments as well as to generate maps indicating the manhole and pipe condition ratings.

Table 5.1 – Condition Rating

Rating	Range	Asset Condition
5	≥ 4.50	Asset Unserviceable – Over 50% of the asset requires replacement
4	3.50 – 4.49	Significant Deterioration – Significant renewal/upgrade required (20%–40%)
3	2.50 – 3.49	Moderate Deterioration – Significant maintenance required (10%–20%)
2	1.50 – 2.49	Minor Deterioration – Minor maintenance required (5%)
1	≤ 1.49	New or Excellent Condition – Only normal maintenance required

5.2 Horizontal Asset Condition Assessment

5.2.1 Manholes

The manholes were inspected by Fishbeck and Township staff. Detailed condition assessment information was collected for every structure in accordance with MACP guidelines. The components that were evaluated in each structure and used to develop a condition assessment rating are presented in Table 5.2. Completed manhole inspection forms can be found in Appendix 3.

Table 5.2 – Manhole Components

	Structure Component	Defect Type
Chimney Upper One-Third	Cover Condition	Structural
	Frame Condition	Structural
	Frame Seal Condition	Structural
	Frame Seal Inflow	O&M
	Chimney Inflow/Infiltration	O&M
	Chimney Structural Condition	Structural
Structure Bottom Two-Thirds	Cone Inflow/Infiltration	O&M
	Cone Structural Condition	Structural
	Wall Inflow/Infiltration	O&M
	Wall Structural Condition	Structural
	Bench Inflow/Infiltration	O&M
	Bench Structural Condition	Structural
	Channel Structural Condition	Structural
	Pipe Condition	Structural
	Pipe Seal Condition	O&M

For each asset, the 15 components identified in Table 5.2 were each assigned a 1 through 5 rating. Fishbeck used the component ratings with a variation of the Quick Rating method to determine the condition of the manholes. The manhole Quick Rating is a shorthand way of expressing the number of occurrences for the two highest severity grades. The Quick Rating is a four-character score compiled as follows:

- First Character = Highest severity grade occurring within the structure.
- Second Character = Total number of occurrences of the highest severity grade. If the number exceeds 9, alphabetic characters are used as follows: A = 10-14, B = 15-19, C = 20-24, etc.
- Third Character = Second highest severity grade occurring within the structure.
- Fourth Character = Total number of occurrences of the second highest severity grade. If the number exceeds 9, alphabetic characters are used as follows: A = 10-14, B = 15-19, C = 20-24, etc.

The Quick Rating was then used to generate a 1 through 5 overall Composite Rating including all structural and O&M defects using the guidelines in Table 5.3.

Table 5.3 – Quick Rating to Composite Rating Score Conversion

Description
If there are no defects noted and the Quick Score is 0, Score = 1
If the Quick Rating contains a letter, letter = 9
Multiply the 4-digit Quick Rating by 0.00085 = numeric score
If the resulting score ≥ 5, Score = 5
If the resulting score ≤ 1, Score = 1

Refer to Appendix 4 for the summary of the condition assessment ratings for the manholes. The results indicated that in general, the manholes are in good condition; however, there were 35 manholes with a Composite Rating (structural and O&M) greater than 4.0, as listed in Table 5.4.

Table 5.4 – Manholes with High Composite Condition Assessment Ratings

Asset ID	Asset Class	Overall Condition Rating	Asset ID	Asset Class	Overall Condition Rating
SMH042006	Manhole	4.49	SMH060003	Manhole	4.31
SMH006030	Manhole	4.40	SMH086055	Manhole	4.31
SMH007010	Manhole	4.40	SMH037031	Manhole	4.31
SMH105022	Manhole	4.39	SMH042042	Manhole	4.31
SMH005002	Manhole	4.39	SMH061009	Manhole	4.31
SMH004014	Manhole	4.32	SMH113004	Manhole	4.31
SMH011018	Manhole	4.32	SMH114060	Manhole	4.31
SMH033010	Manhole	4.32	SMH002001	Manhole	4.31
SMH046013	Manhole	4.32	SMH010035	Manhole	4.31
SMH057037	Manhole	4.32	SMH040079	Manhole	4.31
SMH096043	Manhole	4.32	SMH085009	Manhole	4.31
SMH098006	Manhole	4.32	SMH094008	Manhole	4.31
SMH008003	Manhole	4.32	SMH053013	Manhole	4.30
SMH010066	Manhole	4.32	SMH038033	Manhole	4.30
SMH056075	Manhole	4.32	SMH040020	Manhole	4.30
SMH010028	Manhole	4.32	SMH045027	Manhole	4.30
SMH010034	Manhole	4.32	SMH053030	Manhole	4.30
SMH033011	Manhole	4.32			

The defects observed in the manholes were primarily located in the frame and chimney sections. The defects included cracked chimneys; corroded manhole frames; intruding roots; broken covers; and infiltration through frame seals, pipe seals, and wall joints. Refer to Sheet 9 in Appendix 1 for a map showing the Composite Ratings of the manholes. The MACP inspection forms for all the manholes inspected as part of the SAW Grant were provided to the Township. They are stored on the Township's network and are hyperlinked to the GIS database.

The following photographs display some of the defects observed during manhole inspections.

Manhole SMH042006: Infiltration in frame and wall joints, corroded frame, roots in wall joint.

Manhole SMH006030: Infiltration in wall joints, infiltration in chimney, corroded frame.

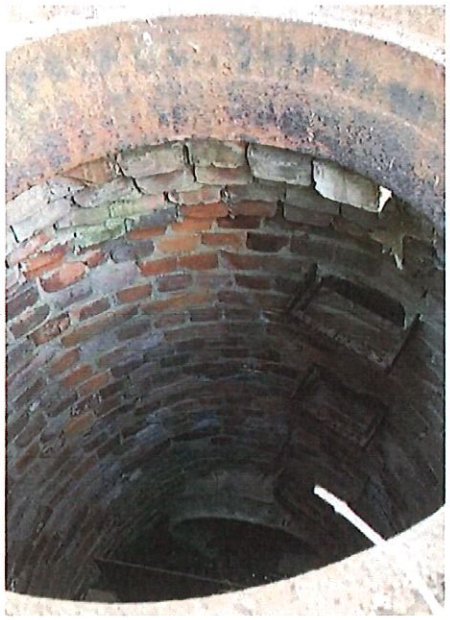
Manhole SMH007010: Infiltration in chimney, wall joints, and frame seal; cracking in chimney.

Manhole SMH105022: Broken frame and cover.

Manhole SMH005002: Cover and frame are missing, infiltration in top of structure and lift holes.

Manhole SMH004014: Encrustation throughout manhole, corroded frame, infiltration in wall joints and bench.

Manhole SMH033010: Infiltration in chimney, frame and roots coming in through chimney.



Manhole SMH096043: Frame and cover corroded, chimney bricks falling out near ladder.

Manhole SMH098006: Deposits and cracking in chimney; infiltration in chimney, cone, and wall; encrustation from chimney to wall; channel blocked by debris.

5.2.2 Pipes

The sewers were inspected using CCTV in accordance with PACP standards by AUI. The PACP Condition Grading System evaluates pipes for structural and O&M defects. Structural defects include, but are not limited to, cracks, fractures, breaks, holes, deformations, collapse, joint defects, and surface damage. O&M defects include, but are not limited to, the presence of deposits, roots, infiltration, obstacles, and vermin. Refer to Appendix 5 for the completed sewer televising forms.

The PACP Condition Grading System provides three ways to express the condition of pipe segments:

- Overall Pipe Rating
- Pipe Rating Index
- Quick Rating

The pipe ratings are based on the number of occurrences of each condition grade within individual pipe segments and are calculated separately for structural and O&M defects. The Pipe Rating Index was used for the Township's assets. The Pipe Rating Index provides an indication of the overall defect severity within a pipe segment. The index is calculated by dividing the overall pipe rating by the number of defects. An example of the computation is provided in Table 5.5.

Table 5.5 – Sample Pipe Rating Index Calculation

Condition Grade	No. of Defects		Segment Grade	
	Structural	O&M	Structural	O&M
5	2	0	10	0
4	0	0	0	0
3	1	3	3	9
2	3	2	6	4
1	0	0	0	0
Total Defects	6	5		
Overall Pipe Rating			19	13
Pipe Rating Index			3.2	2.6

It is important to note that the Pipe Rating Index simply represents an average of the segment grading scores. It does not indicate whether there are many or few defects with high or low condition grades. A PACP-certified engineer reviewed the CCTV footage and adjusted the Pipe Rating Index based on engineering judgement to identify pipe segments with more severe defects that need rehabilitation. Refer to Appendix 6 for the summary of the condition assessment ratings for the sewers. The results indicated that in general, the sewers are in good condition, although there were 18 segments with a structural rating greater than 4.0. These are listed in Table 5.6.

Table 5.6 – Sewer Structural Assessment Ratings Greater than 4.0

Asset ID	Asset Class	Structural Condition Rating	Asset ID	Asset Class	Structural Condition Rating
SGM022010	Pipe	4.36	SGM010013	Pipe	4.18
SGM074005	Pipe	4.35	SGM056007	Pipe	4.17
SGM022008	Pipe	4.20	SGM056020	Pipe	4.17
SGM059023	Pipe	4.20	SGM056044	Pipe	4.17
SGM060008	Pipe	4.20	SGM090002	Pipe	4.17
SGM074023	Pipe	4.20	SGM090020	Pipe	4.17
SGM089018	Pipe	4.20	SGM093033	Pipe	4.17
SGM090010	Pipe	4.19	SGM094003	Pipe	4.17
SGM090018	Pipe	4.19	SGM060009	Pipe	4.08

The pipes listed in Table 5.6 are reinforced concrete and clay pipes, and range in size from 10 inches to 30 inches in diameter. The structural defects observed include cracks, fractures, and broken pipes. In addition, most of

these pipes showed signs of corrosion likely caused by hydrogen sulfide (H_2S) attack. Various stages of surface damage were observed, which included visible aggregate and visible reinforcement.

Table 5.7 presents the 12 segments with an O&M rating above 4.0.

Table 5.7 – Sewer O&M Assessment Ratings Greater than 4.0

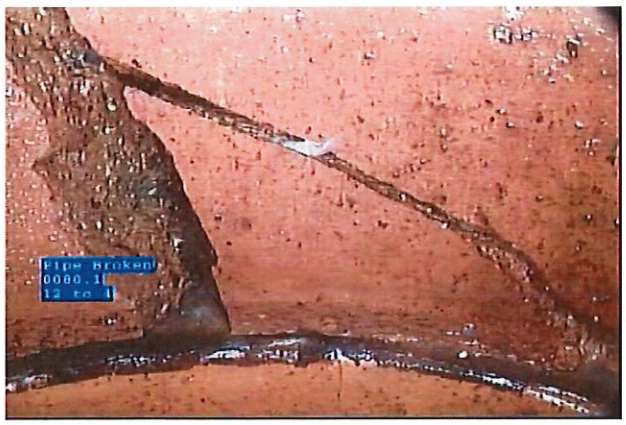
Asset ID	Asset Class	O&M Condition Rating	Asset ID	Asset Class	O&M Condition Rating
SGM074023	Pipe	4.45	SGM022017	Pipe	4.36
SGM085011	Pipe	4.37	SGM023001	Pipe	4.36
SGM082005	Pipe	4.37	SGM037024	Pipe	4.36
SGM039011	Pipe	4.37	SGM003017	Pipe	4.36
SGM003026	Pipe	4.36	SGM058005	Pipe	4.36
SGM010067	Pipe	4.36	SGM003019	Pipe	4.36

The pipes listed in Table 5.7 are primarily reinforced concrete pipes, with one clay pipe, and range in size from 8 inches to 30 inches in diameter. The O&M defects observed include encrustation/mineral deposits, obstacles in the pipe, roots, dripping infiltration, running infiltration, and gushing infiltration.

Refer to Sheet 10 in Appendix 1 for a map showing the structural ratings and Sheet 11 for a map showing the O&M ratings for sewers. The color-coded maps are based on the range of values presented in Table 5.1. For example, pipes with a rating between 3.50 and 4.49 are illustrated on the map with a rating of 4.00 and are shaded pink. Based on this rounding, the quantity of pipes illustrated in pink on the maps may be greater than the quantity of pipes identified in Tables 5.6 and 5.7 as having ratings greater than 4.00. This discrepancy in quantities is evident throughout this report when comparing the tables and figures.

The wastewater CCTV inspection reports and videos for all pipes televised as part of the SAW Grant were provided to the Township. They are stored on the Township's network and are hyperlinked to the GIS database.

The following photographs display some of the more severe defects observed in the CCTV videos of the sewer.



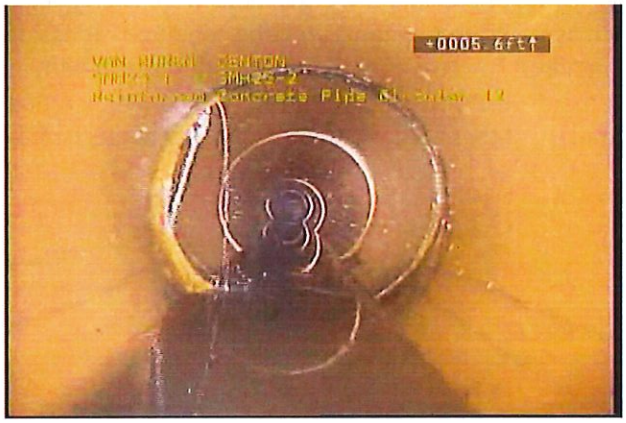
This defect is located in Sewer SGM074005, 80.1 feet downstream of Manhole SMH074007. This clay pipe is 10 inches in diameter. The pipe is broken in this section, and a hole is visible, which could result in infiltration or further structural damage to the pipe. This pipe has a structural rating of 4.35 and an O&M rating of 3.51.

This defect is located in Sewer SGM074023. This concrete pipe is 12 inches in diameter. This pipe has missing aggregate in the pipe wall, which spans the length of the segment. This pipe has a structural rating of 4.20 and an O&M rating of 4.45.

This defect is located in Sewer SGM022017, 183 feet downstream of Manhole SMH022016. This reinforced concrete pipe is 12 inches in diameter. Infiltration is gushing in through the joint. This pipe has a structural rating of 3.32 and an O&M rating of 4.36.

This defect is located in Sewer SGM090010. This reinforced concrete pipe is 30 inches in diameter. Aggregate is missing along the walls of this pipe as a result of H_2S corrosion. This pipe has a structural rating of 4.19 and an O&M rating of 2.66.

This defect is located in Sewer SGM085011. This reinforced concrete pipe is 30 inches in diameter. Encrustation is forming near the seal of Manhole SMH085007, and running infiltration is coming in at this area 388 feet downstream of SMH085002. This pipe has a structural rating of 2.40 and an O&M rating of 4.37.



This defect is located in Sewer SGM023001. This clay pipe is 10 inches in diameter. Infiltration is gushing into the pipe at a joint approximately 8 feet downstream of Manhole SMH023001. This pipe has a structural rating of 1.00 and an O&M rating of 4.36.

5.3 Vertical Asset Condition Assessment

For the vertical assets, 27 inspection forms were created, each specific to an asset class or a combination of asset classes. A total of 296 assets were inspected using these forms. The forms were customized to reflect the Township's system. The first few questions on each form are generic and are common to most of the forms, such as:

- All Components Present
- All Safety Features Present
- General Appearance
- Functional
- Cleaning
- Installation/Accessibility

The remainder of the questions are asset class-specific, such as "corrosion" for pipes or valves, or "cavitation" for pumps.

The questions were all multiple choice, with corresponding quantitative values. The values ranged from 1 through 5, with 1 representing excellent condition and 5 representing very poor condition. Some questions required a "yes" or "no" answer or a "functional" or "not functional" answer, in which case the answers were values of either 2 or 4, respectively. These binary responses used 2 and 4 instead of 1 and 5 since using 1 and 5 results in skewing of the overall ranking to the extreme ends.

All the questions on the forms were weighted equally and were averaged to generate the overall 1 through 5 condition rating score. However, there were a number of questions that were included in the condition assessment that were not weighted nor included in the overall condition rating score. It was decided that information on these questions should be collected while the inspection was being performed, but they were not

relevant to the condition of the asset. These questions were usually pertaining to safety or code requirements and included:

- All Safety Features Present
- Arc Flash Boundary Available and Posted
- Certification Current
- Proper Drawings Accessible

Site visits were conducted in 2019 to complete the forms. Process and electrical engineers were engaged for the condition assessment process. Township personnel responsible for maintaining and operating the pump stations were also present during the condition assessments and were consulted to determine if there were operation concerns and whether any improvements are required. The completed vertical asset inspection forms can be found in Appendix 7.

The results of the answered questions were averaged, and an overall condition rating score was generated for each asset. A table summarizing the condition ratings determined for all vertical assets can be found in Appendix 8. There was a total of 5 vertical assets with an overall condition rating score of 4.0 or greater and another 5 vertical assets with an overall condition rating score between 4.0 and 3.5. Refer to Table 5.8 for a summary of these assets. All other vertical assets had an overall condition rating score below 3.5.

Table 5.8 – Vertical Assets with Condition Rating Score Greater than 3.5

Township Asset ID	Fishbeck Asset ID	Description	Asset Location	Asset Class	Asset Subclass	Overall Condition Rating
SSS073001	VBPN-CAN-HTCH	Hatch – Wet Well & Valve	Van Buren Park North LS	Structure Appurtenance	Hatch	4.50
SSP073001	VBPN-PUMP-01	Pump 1	Van Buren Park North LS	Equipment	Pump, Centrifugal Submersible	4.00
SLV098001	HRLS-ULT-01	Ultrasonic Level Sensor	Haggerty Road LS	Instrumentation	Level Sensor – Ultrasonic	4.00
SLS073001	VBPN-CAN-01	Prefabricated Pump Station	Van Buren Park North LS	Structure	Prefabricated PS – Steel	4.00
LSA073001	VBPN-LND	No Fence or Landscape, Close to Water's Edge	Van Buren Park North LS	Area	Site & Landscaping	4.00
SLS077001	BRLS-CAN	Prefabricated Pump Station	Beckley Road LS	Structure	Prefabricated PS – Steel	3.50
SSS077004	BRLS-CAN-HTCH	Pump Station Hatch	Beckley Road LS	Structure Appurtenance	Hatch	3.50
SSP073002	VBPN-PUMP-02	Pump 2	Van Buren Park North LS	Equipment	Pump, Centrifugal Submersible	3.50
PKG137001	WBLS-DRV	Concrete Driveway	Wildbrook LS	Area	Driveway – Concrete	3.50
SSS077002	BRLS-WW-01	Wet Well	Beckley Road LS	Structure	Wet Well	3.50

5.4 Useful Life

All assets have an anticipated useful life that is used to estimate when the asset should, in theory, be replaced. This is referred to as theoretical useful life, since assets could reach the end of their useful lives much earlier or later, depending on usage, maintenance practices, and surrounding environment.

For the Township, the theoretical useful life for most assets was defined early in the process and input into the analysis by asset subclass. A summary is displayed in Table 5.9.

Table 5.9 – Asset Theoretical Useful Life

Asset Class	Asset Subclass	Theoretical Useful Life (years)
Area	Driveway – Concrete	30
	Driveway – Asphalt	20
	Site & Landscape	50
Structure	Basin – Concrete	100
	Building – Masonry	100
	Building – Prefabricated	30
	Prefabricated Pump Station – FRP	50
	Prefabricated Pump Station – Steel	50
	Valve Structure	100
	Wet Well	100
Structure Appurtenance	Hatch	30
Mechanical	Blower	25
	Intake Fan	25
	Supply Fan	25
	Exhaust Fan	25
Equipment	Chemical Feed System	15
	Gate – Sluice	40
	Hydraulic Actuator System	25
	Pump, Grinder Submersible	20
	Pump, Chopper Submersible	20
	Pump, Centrifugal Submersible	20
	Pump, Horizontal Centrifugal	25
	Pump, Vertical Turbine	20
	Process Piping	50
	Odor Control System – FRP Tank	50
	Valve – Air Release	30
	Valve – Check	30
	Valve – Cone Check	30
	Valve – Gate	30
	Valve – Plug	30
Instrumentation	Flow Meter – Magnetic	20
	Flow Meter – Area, Velocity	20
	Level Sensor – Ultrasonic	10
	Level Sensor – Pressure Transducer	10
	Rain Gauge	10

Table 5.9 – Asset Theoretical Useful Life

Asset Class	Asset Subclass	Theoretical Useful Life (years)
Electrical	Automatic Transfer Switch	20
	Control Panel	40
	Controller	25
	Distribution Panel	50
	Generator	35
	Lighting Panel	25
	Motor Control Center	35
	Motor Starter	25
	Manual Transfer Switch	20
	Transformer	30
	VFD	25
Manholes	Block	75
	Brick	75
	Concrete (Cast-in-Place)	75
	Concrete (Precast)	75
Pipes	ABS Truss	75
	Asbestos Cement	85
	Cast Iron	50
	CIPP Liner	50
	Clay	80
	Concrete Pipe	85
	Ductile Iron Pipe	50
	High Density Polyethylene	70
	Polyvinyl Chloride	75
	PVC Truss	75
	Reinforced Concrete Pipe	85

ABS Acrylonitrile-Butadiene-Styrene
CIPP cured-in-place pipe

The remaining useful life for each asset was determined based on the useful life assigned to the asset subclass and the individual asset's installation date collected as part of the asset inventory.

The theoretical and remaining useful lives of an asset can be extended if certain repairs/rehabilitation are performed. For example, structural lining of a sewer can almost double its useful life. As a result, as assets are rehabilitated, the useful life of the asset should be re-evaluated.

For certain long-lasting structural assets, a theoretical useful life of 100 years was used. This included assets such as buildings. Since it is impossible to reach the end of the useful life of these assets in 50 or 75 years and simply tear them down and replace them with new ones, they were assigned a 100-year useful life as long as they undergo continuous rehabilitation and upgrades to keep them in service.

The percent useful life expended was generated for each asset based on the following equation:

$$\%\ \text{Useful Life Expended} = 1 - \frac{\text{Remaining Useful Life}}{\text{Theoretical Useful Life}}$$

This value was used alongside the condition assessment and current O&M status to generate the POF for each asset, as discussed in Section 6.0.

5.5 Asset Value/Replacement Cost

The asset value is the cost to replace the asset in today's dollars should the asset fail or reach the end of its useful life. For the Township, it was determined that the replacement cost would include the equipment cost and the installation cost. The asset value does not include any design, engineering, or analysis required to verify size or location.

To establish an asset value, the unit quantities of the asset needed to be established. For equipment, such as pumps, quantities were obtained directly from the asset inventory. Larger items and facilities required a component breakdown and quantity take off. For example, a pump station building includes concrete foundation, walls, and floors that must be quantified to establish a total replacement value for the structure.

Once the quantities were established, various sources were used to develop unit costs. Some of these sources included RSMeans construction cost estimating data, historical bid tabulations, internet searches, and vendor/manufacturer quotations. Historical costs were escalated to 2020 values using Engineering News Record Construction Cost Indices. Equipment and material costs were multiplied by a factor ranging from 1.25 (simple) to 1.50 (complex) to cover the cost of installation.

In some instances, the asset was installed so long ago that it is no longer being manufactured. A replacement cost for an equivalent asset was generated in such a case.

6.0 Criticality

Assets are not typically of equal importance to a system's performance. Some assets are highly critical to maintaining proper operations of a system while others are auxiliary and are far less critical. For example, the pumps are highly critical to the operation of a pump station, while the air conditioning system is not. The criticality of an asset type also varies depending on the function of the asset. For example, a wastewater interceptor sewer is extremely critical in transporting large amounts of flow from residential areas, and its collapse would disrupt a large portion of the Township. A small lead sewer at the end of a line, while necessary to transport flow from a few houses, will not cause as much damage in the event of failure and is easier to bypass and repair.

EGLE has defined criticality as a function of two items:

1. How likely is the asset to fail?
2. How important is the asset?

By answering these two questions for each asset, a prioritization list can be generated that aids the Township in managing the risk and determining when and where to spend O&M and capital expenditure dollars.

6.1 Probability of Failure

The POF is the method used to answer the question, "How likely is the asset to fail?" The POF rating is a 1 through 5 score, with 5 indicating imminent failure that requires immediate attention. Refer to Table 6.1 for the POF rating summary.

Table 6.1 – Probability of Failure Rating Summary

Rating	Description
5	Imminent – Likely to occur in the life of the asset
4	Probable – Will occur several times in the life of the asset
3	Occasional – Likely to occur sometime in the life of the asset
2	Remote – Unlikely, but possible to occur in the life of the asset
1	Improbable – So unlikely, it can be assumed occurrence may not be experienced

To determine the POF rating, the Township looked at a number of factors. Eventually, three different scoring methods were developed.

1. For the sewers, the PACP Pipe Rating Index method was used to generate a 1 through 5 structural score and a 1 through 5 O&M score, as discussed in Section 5.0. These scores were weighted 50% for structural and 50% for O&M, and an overall POF score for each pipe segment was generated. For pipes that were not inspected following PACP guidelines, the POF was solely based on the expended useful life. Refer to Table 6.2 for the interpretation summary.
2. For the manholes, a variation of the MACP Quick Rating method was used to generate a 1 through 5 composite score for each manhole, including structural and O&M defects. For manholes that were not inspected following MACP guidelines, the POF was calculated based on the expended useful life. Refer to Table 6.3 for the interpretation summary.
3. For the vertical assets, the condition assessment score was used along with the expended useful life, as described in Section 5.0. These scores were weighted 60% for physical condition and 40% for useful life, and an overall POF score was generated for each vertical asset. For vertical assets that were not inspected, POF was calculated based on the expended useful life. Refer to Table 6.4 for the interpretation summary.

Table 6.2 – Pipe Probability of Failure

		Weighting Factor	5 Imminent	4 Probable	3 Occasional	2 Remote	1 Improbable
POF	O&M Quick Rating (PACP)	50%	If there are no defects noted and the quick score is 0, Score = 1 If the quick score is denoted by a letter, letter = 9 Multiply the 4-digit quick score by 0.00085 = Score If resulting score ≥ 5, Score = 5 If resulting score ≤ 1, Score = 1				
	Structural Quick Rating (PACP)	50%	If there are no defects noted and the quick score is 0, Score = 1 If the quick score is denoted by a letter, letter = 9 Multiply the 4-digit quick score by 0.00085 = Score If resulting score ≥ 5, Score = 5 If resulting score ≤ 1, Score = 1				
Useful Life Expended (used only when pipe not PACP inspected)		100%	% Useful Life Expended: 81%–100%	% Useful Life Expended: 61%–80%	% Useful Life Expended: 41%–60%	% Useful Life Expended: 21%–40%	% Useful Life Expended: 0%–20%

Table 6.3 – Manhole Probability of Failure

		Weighting Factor	5 Imminent	4 Probable	3 Occasional	2 Remote	1 Improbable
POF	Structural and O&M Quick Rating (MACP)	100%	If there are no defects noted and the quick score is 0, Score = 1 If the quick score is denoted by a letter, letter = 9 Multiply the 4-digit quick score by 0.00085 = Score If resulting score ≥ 5, Score = 5 If resulting score ≤ 1, Score = 1				
	Useful Life Expended (used only when manhole not MACP inspected)	100%	% Useful Life Expended: 81%–100%	% Useful Life Expended: 61%–80%	% Useful Life Expended: 41%–60%	% Useful Life Expended: 21%–40%	% Useful Life Expended: 0%–20%

Table 6.4 – Vertical Asset Probability of Failure

		Weighting Factor	5	4	3	2	1
			Imminent	Probable	Occasional	Remote	Improbable
POF	Condition Assessment	60%	Very Poor (ACI = 5)	Poor (ACI = 4)	Fair (ACI = 3)	Good (ACI = 2)	Very Good (ACI = 1)
	Useful Life Expended	40% (100% when asset not inspected)	% Useful Life Expended: 81%–100%	% Useful Life Expended: 61%–80%	% Useful Life Expended: 41%–60%	% Useful Life Expended: 21%–40%	% Useful Life Expended: 0%–20%

6.2 Consequence of Failure

The COF is the method used to answer the question, "How important is the asset to the system?" The COF rating is a 1 through 5 score, with 5 indicating catastrophic disruption to the system should the asset fail. Refer to Table 6.5 for the COF rating summary.

Table 6.5 – Consequence of Failure Rating Summary

Rating	Description
5	Catastrophic Disruption
4	Major Disruption
3	Moderate Disruption
2	Minor Disruption
1	Insignificant Disruption

To determine the COF rating, Fishbeck looked at many factors. Meetings were held with the Township staff and a COF rating system was developed for all assets. Refer to Table 6.6 for the manhole and pipe COF summary and refer to Table 6.7 for the vertical asset COF summary. Refer to Sheets 12, 13, 14 and 15 in Appendix 1 for maps showing the pipe diameter score, physical location score, service area score, and overall COF score for manholes and sewers, respectively.

Table 6.6 – Manhole and Pipe Consequence of Failure

		Weighting Factor	5	4	3	2	1
			Catastrophic Disruption	Major Disruption	Moderate Disruption	Minor Disruption	Insignificant Disruption
COF	Diameter Score	33%	≥ 36-inch	24-inch to 30-inch	15-inch to 21-inch	12-inch	≤ 6-inch to 10-inch
	Physical Location Score	33%	State Trunk Lines, Railroad Crossings, Water Crossing	-	Primary County Roads and Major Township Roads	-	Minor Township Roads
	Service Area Score	33%	Schools, Water Crossings	-	Churches, Township Facilities, Industrial, Commercial	-	Single-Family Residential and Multi-Family Residential

Table 6.7 – Vertical Asset Consequence of Failure

			Weighting Factor	5 Catastrophic Disruption	4 Major Disruption	3 Moderate Disruption	2 Minor Disruption	1 Insignificant Disruption
COF	Reliability	Disruption to the Community (Pump Stations)	20%	Long-term impact; area-wide disruption	Short-term impact but substantial disruption	Sporadic service disruptions	Minor disruption	No disruption
		Process Impact (EQ Basin)		Mission critical – Unable to accomplish mission	Process shutdown	Potential process upset	Loss of redundancy	No impact on process
	Financial Input		20%	Major cost (>$1 million)	Significant cost ($500,000–$1,000,000)	Moderate cost ($10,000–$500,000)	Minor cost ($1,000–$10,000)	Insignificant ($1–$1,000)
	Safety		20%	Loss of life	Severe Injury to employees or public	Minor injury requiring treatment offsite or lost time	Minor injury requiring no medical treatment with no lost time	No injury
	Environmental/ Regulatory Impact		20%	Enforcement action with fines or ACO	Localized and minimal impact on the environment and ecosystem	Violation with minor enforcement action	Technical violation, but no enforcement action	100% compliance with permits
	Required Response Time		20%	1/2 hour or less	8 hours	1 day	1 Week	>1 Week

6.3 Business Risk Exposure

The assets that have the greatest POF and the greatest COF will be the assets that are most critical to the system. The BRE is the overall score that takes into account the POF and COF and quantifies that criticality.

$$\text{BRE} = \text{POF} \times \text{COF}$$

Since the POF and COF each have a score of 1 through 5, the BRE score is 1 through 25. The International Infrastructure Management Manual (IIMM) BRE matrix is shown in Figure 6.1.

Figure 6.1 – Business Risk Exposure Matrix

25	20	15	10	5	5	Consequence of Failure
20	16	12	8	4	4	
15	12	9	6	3	3	
10	8	6	4	2	2	
5	4	3	2	1	1	
5	4	3	2	1		
Probability of Failure						

High	High Priority (16.00–25.00)
Medium	Medium Priority (5.00–15.99)
Low	Low Priority (1.00–4.99)

Assets with the highest BRE score are those that should be rehabilitated or replaced first. Assets with the lowest scores are those that do not currently require any rehabilitation or replacement and should be monitored at regular intervals to verify the scores do not change. Assets in the middle should be evaluated on a case-by-case basis to determine their priority. EGLE guidelines for determining criticality state a BRE score above 16.0 is deemed high. Figures 6.2, 6.3, and 6.4 present a summary of the BRE scores for manholes, sewers, and vertical assets, respectively.

Figure 6.2 – Manhole BRE Summary

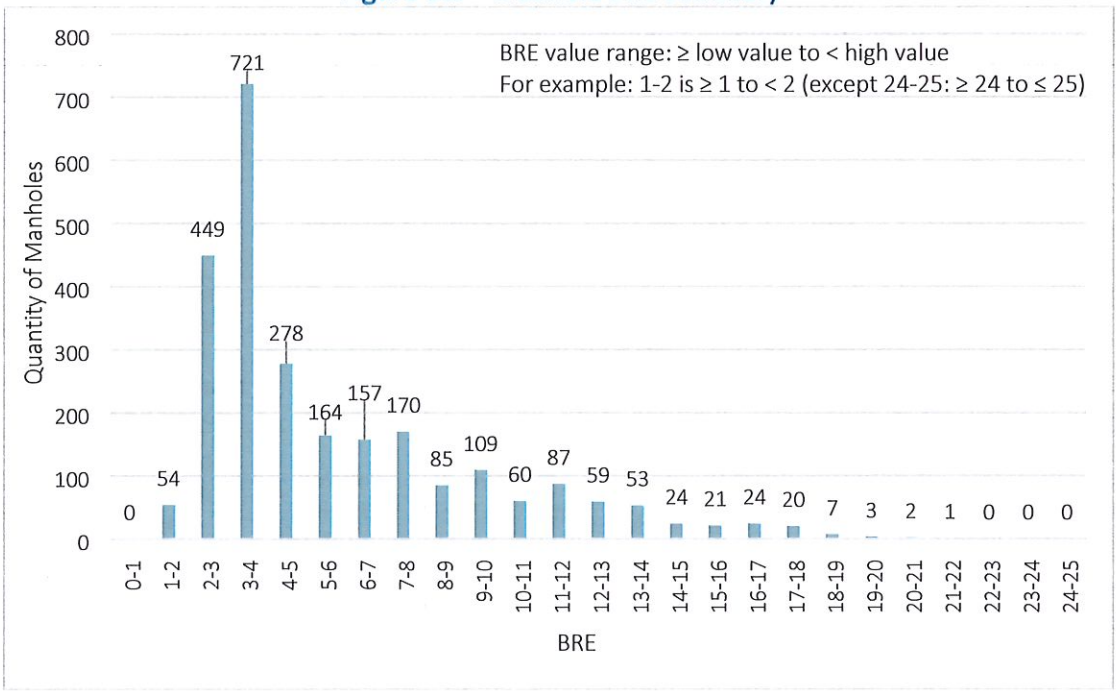


Figure 6.3 – Sewer BRE Summary

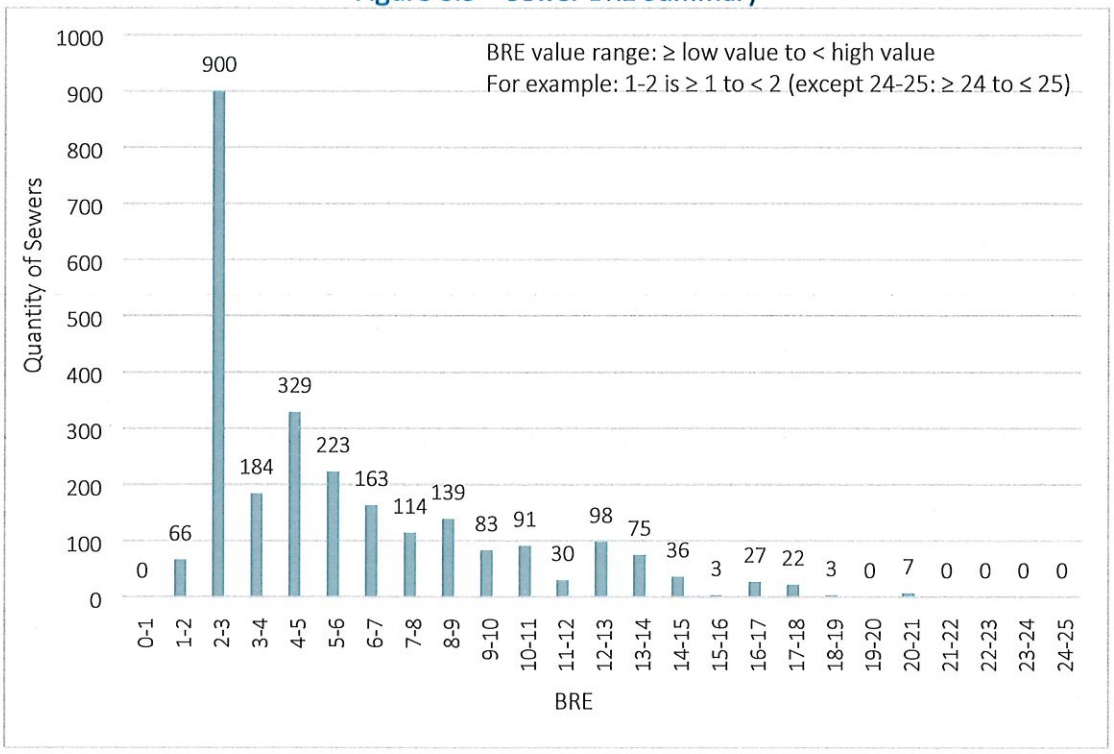
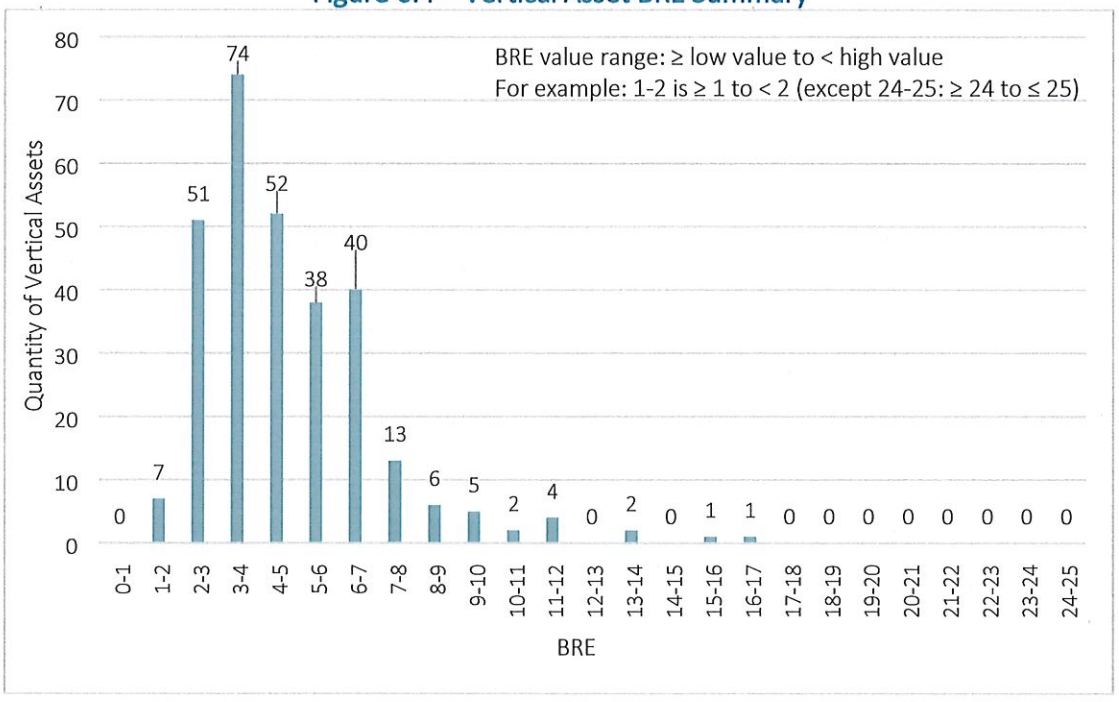


Figure 6.4 – Vertical Asset BRE Summary



Refer to Appendix 9 for a detailed summary of the POF, COF, and BRE scores for each of the Township's individual assets. Sheet 16 in Appendix 1 is a map showing the horizontal asset BRE scores.

There were 57 manholes identified with BRE scores greater than or equal to 16.00. Of these manholes, 37 were inspected. The remaining 20 structures were not inspected. The POF for these 20 structures was calculated based only on expended useful life, and this, in combination with high COF scores, resulted in high BRE scores. These structures should be inspected to obtain a better understanding of their current conditions.

There were 59 sewer segments identified with a BRE score greater than or equal to 16.00. Of these sewers, 54 were not televised as part of the SAW Grant. The POF for these pipes was calculated based on expended useful life, and this, in combination with high COF scores, resulted in high BRE scores. These pipes should be inspected to obtain a better understanding of their current conditions.

The other 5 sewer segments were televised as part of the CCTV inspections. SGM060008 (BRE = 18.19) and SGM060009 (BRE = 17.71) are 21-inch concrete pipes showing moderate to severe H_2S damage throughout, varying levels of infiltration, and attached deposits at the pipe joints and along the flow line. SGM089018 (BRE = 16.70), SGM056007 (BRE = 16.63), and SGM056044 (BRE = 16.26) are all 30-inch concrete pipes showing moderate to severe H_2S damage throughout, attached deposits, and varying levels of infiltration. Recommendations for rehabilitating these sewers have been provided in the 20-year CIP and include removal of deposits and installation of CIPP liners.

Table 6.8 identifies the 116 horizontal assets with a BRE score greater than or equal to 16.00.

Table 6.8 – Horizontal Assets with High BRE

Asset ID	Asset Class	BRE Score	Asset ID	Asset Class	BRE Score
SGM081072	Pipe	20.00*	SGM059018	Pipe	16.00*
SGM081073	Pipe	20.00*	SMH094008	Manhole	21.55
SGM082020	Pipe	20.00*	SMH094011	Manhole	20.00*
SGM086020	Pipe	20.00*	SMH094026	Manhole	20.00*
SGM093024	Pipe	20.00*	SMH042006	Manhole	19.75
SGM094017	Pipe	20.00*	SMH004014	Manhole	19.01
SGM094025	Pipe	20.00*	SMH008003	Manhole	19.00
SGM056011	Pipe	18.67*	SMH042042	Manhole	18.97
SGM073016	Pipe	18.67*	SMH085009	Manhole	18.96
SGM060008	Pipe	18.19	SMH041032	Manhole	18.90
SGM060009	Pipe	17.71	SMH077036	Manhole	18.80*
SGM056052	Pipe	17.34*	SMH081067	Manhole	18.80*
SGM081037	Pipe	17.34*	SMH082022	Manhole	18.80*
SGM081068	Pipe	17.34*	SMH093033	Manhole	18.80*
SGM082003	Pipe	17.34*	SMH060002	Manhole	17.90
SGM082013	Pipe	17.34*	SMH003002	Manhole	17.78
SGM082014	Pipe	17.34*	SMH041034	Manhole	17.77
SGM086003	Pipe	17.34*	SMH094015	Manhole	17.77
SGM086030	Pipe	17.34*	SMH003008	Manhole	17.74
SGM086042	Pipe	17.34*	SMH056012	Manhole	17.60*
SGM086043	Pipe	17.34*	SMH056054	Manhole	17.60*
SGM086058	Pipe	17.34*	SMH072010	Manhole	17.60*
SGM093009	Pipe	17.34*	SMH077038	Manhole	17.60*
SGM093016	Pipe	17.34*	SMH078047	Manhole	17.60*
SGM093026	Pipe	17.34*	SMH107002	Manhole	17.60*
SGM093045	Pipe	17.34*	SMH005002	Manhole	17.58

Table 6.8 – Horizontal Assets with High BRE

Asset ID	Asset Class	BRE Score	Asset ID	Asset Class	BRE Score
SGM093046	Pipe	17.34*	SMH041033	Manhole	17.36
SGM093048	Pipe	17.34*	SMH041031	Manhole	17.35
SGM096018	Pipe	17.34*	SMH041041	Manhole	17.35
SGM105011	Pipe	17.34*	SMH018017	Manhole	17.35
SGM105021	Pipe	17.34*	SMH033010	Manhole	17.28
SGM105027	Pipe	17.34*	SMH033011	Manhole	17.27
SGM089018	Pipe	16.70	SMH002001	Manhole	17.24
SGM056007	Pipe	16.63	SMH053013	Manhole	17.22
SGM056044	Pipe	16.26	SMH010015	Manhole	16.71
SGM002026	Pipe	16.00*	SMH004010	Manhole	16.32
SGM002027	Pipe	16.00*	SMH073010	Manhole	16.32
SGM005001	Pipe	16.00*	SMH018037	Manhole	16.32
SGM005002	Pipe	16.00*	SMH013005	Manhole	16.31
SGM005003	Pipe	16.00*	SMH020010	Manhole	16.31
SGM005004	Pipe	16.00*	SMH033009	Manhole	16.31
SGM005006	Pipe	16.00*	SMH013006	Manhole	16.31
SGM005007	Pipe	16.00*	SMH017001	Manhole	16.31
SGM005010	Pipe	16.00*	SMH018015	Manhole	16.31
SGM053005	Pipe	16.00*	SMH033007	Manhole	16.29
SGM053034	Pipe	16.00*	SMH041010	Manhole	16.28
SGM053037	Pipe	16.00*	SMH003006	Manhole	16.01
SGM053043	Pipe	16.00*	SMH004012	Manhole	16.01
SGM056024	Pipe	16.00*	SMH004018	Manhole	16.01
SGM056058	Pipe	16.00*	SMH090020	Manhole	16.01
SGM056064	Pipe	16.00*	SMH021011	Manhole	16.00*
SGM059005	Pipe	16.00*	SMH021020	Manhole	16.00*
SGM059007	Pipe	16.00*	SMH064012	Manhole	16.00*
SGM059011	Pipe	16.00*	SMH078021	Manhole	16.00*
SGM059014	Pipe	16.00*	SMH081003	Manhole	16.00*
SGM059015	Pipe	16.00*	SMH093001	Manhole	16.00*
SGM059016	Pipe	16.00*	SMH093017	Manhole	16.00*
SGM059017	Pipe	16.00*	SMH106020	Manhole	16.00*

*Asset was not inspected. Rating is estimated based on the expended useful life of the asset.

There was one vertical asset identified with a BRE score greater than or equal to 16.00. This asset, BRLS-CAN, is the prefabricated dry well structure at the Beckley Road Lift Station. It has a BRE score of 16.40 and shows rust on the floor and walls of the structure, as well as peeling interior coating. Rehabilitation of this asset has not been included in the 20-year CIP as the defects of this asset do not impact its functionality. This structure should be regularly inspected for future rehabilitation.

Table 6.9 identifies the vertical asset with a BRE score greater than or equal to 16.00.

Table 6.9 – Vertical Assets with High BRE

Asset ID	Asset Class	BRE Score
BRLS-CAN	Structure	16.40

The BRE rankings will assist Township staff in the decision-making process of allocating resources. The condition of these assets and the resulting POF scores will change over time. Occasionally, the COF scores may change as well. The Township staff understands they will need to re-inspect the assets and reassess the BRE scores regularly.

7.0 Operation and Maintenance Strategies

As part of the SAW Grant, a detailed review of the current O&M procedures was completed and recommendations for improvements were provided to address future needs.

7.1 Preventative Maintenance Needs

Township staff currently have a PM program for some of the major assets within the Township. As part of this SAW Grant evaluation, a review of each asset was performed to determine:

1. If regular PM is currently being performed on the asset.
2. If the PM work should be updated/expanded.
3. How frequently the PM should be performed.
4. Whether the PM should be performed in-house or subcontracted out.
5. The effort required to perform the PM (cost and/or staff hours).

Typical PM tasks performed by the Township include maintaining the pump stations to ensure continued operation, performing manhole and sewer inspections, and performing sewer cleaning. Maintenance work that fits under the PM category is work that should be performed on an annual or more frequent basis. Maintenance required every few years was typically considered capital improvement work and was included in the CIP (discussed in Section 10.0).

For the horizontal assets, Township and Fishbeck staff developed a maintenance program that includes televising the sewers and inspecting the manholes on a 7-year cycle. The manhole inspection and sewer televising will be performed by a contractor. Annually, approximately 85,600 feet of sewer will be televised, and the associated manholes (approximately 365 manholes) will be inspected. The Township will perform the sewer cleaning annually ahead of the contractor. Refer to Table 7.1 for a summary of the Township hours needed for the horizontal asset PM program.

Table 7.1 – Horizontal Asset – Township Preventative Maintenance Program

Task	Number of Assets/ Components	Cycle (Years)	Assets Inspected per Year	In-House Staff	Assets Inspected per Day	Total Hours per Year	Total Days per Year
Sewer Cleaning	598,625 feet	7	85,600	2	1,200	1,152	72
Inspection Oversite	598,625 feet	7	85,600	1	3,000	240	30
Total In-House Yearly Hours						1,392	102

For the pump stations and EQ Basin system, Fishbeck and Township staff reviewed each of the assets identified as part of the SAW Grant and developed a maintenance program for the system. A schedule to perform the maintenance was also developed. Refer to Appendix 10 for a summary of the vertical asset PM program.

7.2 Staffing Needs

As part of the SAW Grant, a staffing study was developed for employees of the Township Water and Sewer Department whose job responsibilities include maintaining the sanitary sewer collection system, EQ Basin system,

and pump stations. The study compared the hours available for actual work against the hours needed to perform the PM work identified. Refer to Figure 7.1 for the staffing plan summary.

Each employee works 2,080 hours a year. Taking into account vacations, holidays, training, etc., as well as the different types of employee contractors, each hourly employee is available for 1,190 hours per year to perform their duties, plus on average 120 hours of overtime per year. The Township has 9 hourly employees available to perform the PM work for a total of 11,790 hours per year. In addition to the work on the sanitary sewer systems, the employees also perform other duties for the Township including water main repair/maintenance, MISS DIG staking, cemetery burials, and other miscellaneous tasks. Typical tasks performed by the staff include:

- Pump station facilities and EQ Basin system maintenance.
- Sewer cleaning and maintenance.
- Hydrant maintenance and winterization.
- Meter installation, repair, and read verification.
- Emergency repair and corrective maintenance.

The results of the analysis indicate the current staff can perform the current duties and no additional staff are needed.

As part of this AMP, the Township is planning to have the sanitary sewers and manholes inspected on a 7-year cycle. While this work will be performed by a contractor, the Township intends to use in-house staff to clean the sewers ahead of the sewer televising as well as provide an inspector to oversee the inspection. Based upon the number of staff that would be required to complete this additional work, as well as the additional work proposed for maintenance of the water system, the analysis indicates that almost one additional hourly worker would be needed to complete the inspection work.