CITY OF PORTLAND

IONIA COUNTY, MICHIGAN

CLEAN WATER

STATE REVOLVING FUND (SRF)

PROJECT PLAN

WASTEWATER SYSTEM IMPROVEMENTS

DRAFT

Date: April 2021
Project No.: 848390

FLEIS&VANDENBRINK
DESIGN. BUILD. OPERATE.

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ATTACHMENTS

EXECUTIVE SUMMARY

This Project Plan was completed to qualify for a loan through the State Revolving Fund (SRF) for improvements to the City of Portland wastewater system. The proposed Project includes upgrades to the Wastewater Treatment Plant (WWTP) and collection system. The SRF program assists municipalities in financing certain utility improvements projects over a 20 or 30-year term at favorable interest rates – typically between 1.875% and 2.5%. As such, projects reflect the long-term needs of the community.

This State Revolving Fund Project Plan is the first step in an application for SRF financing of the necessary improvements. This report presents the results of the engineering and scientific evaluations performed to determine the need for the project, develop alternatives to remedy identified problems, and to define the scope of the recommended/selected alternative. Background information on the existing system is also provided along with the rationale used to define alternative projects that can meet the long-term wastewater treatment needs of the City. The viable alternatives are evaluated and compared as to their financial and technical feasibility with regard to implementation.

Much of the equipment at the WWTP is inefficient or operating beyond its useful life. An evaluation of the condition of the WWTP was conducted in 2019 as part of the City's Asset Management Plan (AMP) which was funded through the SAW program. The proposed Project will focus on the most critical needs with special focus on those items that affect treatment performance and reliability, and those that have the potential for reduction in energy usage, O&M costs, and overall cost benefits to the City.

One alternative was developed that could successfully address the project objectives. This principal alternative is identified as Alternative 3. The results of the analysis show Alternative 3 is the preferred and Recommended Alternative because it has the lowest net present worth while addressing many of the needs at the WWTP and in the collection system.

Alternative 3 addresses infiltration and inflow by rehabilitating priority segments of the sanitary collection system. Cured-in-place pipe lining, manhole rehabilitation, and specific segments of sewer replacement are expected to reduce the average flow to a level that can more easily be handled at the treatment plant. A new secondary treatment process is included to increase the biological capacity of the plant. The recommended alternative also includes replacing specific aging and outdated equipment at the WWTP. These improvements will increase the overall reliability of the wastewater system and address ongoing compliance issues at the WWTP.

The User Charge for a typical residential customer is expected to increase from $40.05 to approximately $59.55 per month if the Recommended Alternative 3 is implemented, based on financing $10.12 million through an SRF loan at the current 2.125% interest for a 30-year bond period. Actual monthly costs will vary depending on financing terms, grant eligibility, individual usage, and community rate structure. If grant funding for the project is awarded, the user charge increase would be reduced proportionally. At this time it is expected that the City will qualify for Disadvantaged Community Status and/or Green Project Reserve Principal Forgiveness. Actual grant eligibility will not be determined by EGLE until later in the project planning stages.

I. INTRODUCTION

The City of Portland was established as a Village in 1869 and as a City in 1969 and is located in Ionia County approximately 23 miles west-northwest of the City of Lansing. The City, with a population of 3,923 people, owns and maintains the storm sewer system, the sanitary sewer collection system,and the wastewater treatment plant (WWTP), as well as the water supply, storage, and distribution system within the City.

The first portions of the City's sewer system was constructed in the 1930's with continuous additions and improvements through present day. The sanitary sewer system currently serves all of the parcels within the City limits. The collection system includes approximately 25 miles of 4" to 18" diameter sanitary sewer made up of vitrified clay, PVC, reinforced concrete, and ductile iron. The sewer provides service to 1,602 customers with a service poipulation of 3,923 individuals. There are three pump stations throughout the sanitary sewer system with the oldest pump station constructed in 1973 and the newest pump station constructed in 2006. A map of the Portland collection sytem is included as Figure A1, located in Appendix A.

Wastewater is collected throughout the service area and is pumped or flows by gravity to the City's WWTP, which was originally constructed as a mechanical plant. The plant has undergone three major upgrades since its construction, the most recent of which occurred in 2012, and currently employs an activated sludge treatment system with grit and screenings removal, aeration/anoxic tanks, secondary clarification, and UV disinfection. The WWTP discharges to the Grand River in accordance with Michigan Department of Environment, Great Lakes, and Energy (EGLE) Permit No. MIG570220. A copy of this permit is located in Appendix B.

An initial review of Portland's wastewater needs was performed in the fall of 2019. The initial review of the WWTP identified issues with the existing secondary treatment system, chemical feed equipment, and biosolids storage and handling. The WWTP is approaching its rated organic loading capacity. In addition, the initial review of the collection system identified issues with inflow and infiltration (I/I) in the gravity trunk sewer that runs adjacent to the Grand River, as well as a few other problematic locations.

The purpose of this Project Plan is to fulfill and document the fulfillment of requirements found in the state statutes (MCL§324.5303) and rules that govern the State Revolving Fund (SRF) and the Strategic Water Quality Initiation Fund (SWQIF) programs (Michigan Administrative Code R323.952). A copy of these rules can be found at http://www.michigan.gov/orr/0,1607,7-142-5698---,00.html.

In addition, this Project Plan provides a basis for ranking the City's proposed wastewater system improvements in comparison to projects by other municipalities in a project priority listing for a low-interest State Revolving Fund loan. This is a financially attractive program where municipalities across Michigan compete for limited funds based on the merits of their proposed projects.

The scope of this Project Plan includes a summary of current issues with the City's wastewater system, a collection system evaluation, the development of projected population growth and the wastewater needs of the service area for the 20-year planning period. The Project Plan identifies principal alternatives to meet the current and future wastewater needs and evaluates the environmental impacts of the recommended alternative.

The Project Plan presents projected user costs necessary to operate the utility and repay the low-interest loan for the recommended alternative. The Draft Project Plan will be available for public review 30 days prior to the public hearing. A summary of public participation and public comments solicited by the City regarding the Project Plan and recommended alternative will be included in Appendix E of the final report.

The format of this report follows the project planning guidelines for Clean Water Revolving Funds (SRF and SWQIF) prepared by the Michigan Department of Environment, Great Lakes, and Energy (EGLE), Revolving Loan Section. Section II presents extensive background information including a description of the community, the study area characteristics, the wastewater treatment capacity and the need for the project. Section III presents alternatives for resolution of the problems. Sections IV, V and VI further evaluate the recommended alternative, including a detailed description, evaluation of environmental impacts and mitigation measures.

II. PROJECT BACKGROUND

The City of Portland wastewater treatment plant is under the jurisdiction of the Michigan Department of Environment, Great Lakes, and Environment (EGLE). The WWTP is subject to both general standards and specific permit requirements under the National Pollutant Discharge Elimination System (NPDES). The State of Michigan has primacy for implementing these rules.

The City's wastewater system, including both the collection system and the WWTP, is in fair condition for its age; however, key improvements are needed to allow for continued reliable wastewater service. Since the WWTP is approaching its biological capacity, permit compliance can be a difficult task, requiring an inordinate amount of extra time and effort from the City's operational staff. The last major improvements to the WWTP were conducted in 2012, but much of the equipment and tanks were installed during the 1971 project and are nearing, at, or have exceeded their expected useful lives. Despite the plant's age and the high flows and loadings, treatment plant staff has generally been able to meet permit requirements.

A. Study Area Characteristics

Delineation of Study Area

The Study Area is the City of Portland WWTP Service Area, which includes the entire City of Portland. The WWTP service area is shown in Figure A1, in Appendix A. Figure A1 also identifies the location of the pump stations and the WWTP.

Land Use in the Study Area

The land use distribution for the City of Portland, including residential, commercial, and industrial development, is shown in Table 1. Data used to develop Table 1 came from City of Portland Master Plan (January 9, 2015). Figure A2, Current Land Use Map (found in Appendix A) is provided for a graphical summary of Table 1.

Table 1: Land Use Patterns (2015 Master Plan)

Land Use Category	Percent (%)
Agricultural	5%
Commercial	5%
Industrial	2%
Multifamily Residential	2%
Manufactured Housing	1%
Recreation / Open Space	14%
Public / Quasi-Public	13%
Single Family Residential	36%
Vacant	22%

The future land use distribution for the City of Portland is similar to the existing land use distribution with an expansion of the residential and commercial areas. A comparison between Figure A2 and Figure A3, Future Land Use, illustrates how the City is planning future development. Future land use is based on consideration of analyses, goals, policies, strategies, and public input.

Surface and Ground Waters

The Grand River is the major watercourse that flows directly through the center of the service area. The River originates from headwaters in Hillsdale County. The Looking Glass River also runs through the City. The Looking Glass River begins in Livingston County and joins with the Grand River within Portland's City limits. Treated and disinfected effluent from the City of Portland WWTP is discharged to the Grand River in accordance with the facility's NPDES permit.

The City owns and operates four municipal wells ranging in size. Three of the wells (wells No. 4, 5, and 6) are located within the Bogue Flats Recreation Area off Plant Street on the north side of the City. The fourth well (well No. 7) is located at the northwest corner of the City. The locations of the wells can be seen in Figure A4. The water distribution system includes an elevated storage tank located on the corner of Hill and Danby as well as water mains sized from 2" to 12". The City has a complete Wellhead Protection Program in place to protect the drinking water supply.

B. Economic Characteristics

The mean commute time to work for residents of Portland is 26 minutes, suggesting that many persons living in the City work in either Lansing or Grand Rapids. The people who live in the City of Portland hold jobs in a variety of sectors. Table 2 summarizes the number of people in each sector within the City in 2019. This information comes from the Census 2019 estimate.

Table 2: Occupational Sectors, 2019

	City of Portland		Ionia County	
	Number	Percentage	Number	Percentage
Management	540	27.6%	7,621	26.3%
Service	456	23.3%	5,100	17.6%
Sales and Office	350	17.9%	5,796	20.0%
Farming, Fishing, and Forestry	33	1.6%	3,738	12.9%
Construction and Extraction	58	3%		
Installation, Maintenance, and Repair	119	6%		
Production and Transportation	404	20.6%	6, 723	23.2%

Economic statistics from the U.S. Census Bureau for 2019 indicate that the median household income in the City of Portland is comparable to nearby Cities and Villages, and slightly higher than the whole of Ionia County and lower than the State of Michigan as a whole. In 2019, the estimated median household income of the City was $56,458. Table 3 shows the median income comparison for the City and surrounding areas.

Table 3: Median Income Statistics (Census 2019 Estimates)

Study Area	Per Capita Income	Household Income	% Below Poverty Level
City of Portland	$25,669	$56,458	5.1%
City of Belding	$21,045	$41,812	18%
City of Ionia	$15,624	$48,902	24.5%
Village of Clarksville	$27,588	$54,219	6.7%
Village of Lyons	$20,452	$53,750	11.7%
Village of Pewamo	$27,842	$56,406	7.5%
Ionia County	$24,864	$57,043	11.8%
State of Michigan	$31,713	$57,144	14.4%

C. Existing Facilities

Collection Facilities

A map of the City of Portland's sanitary sewer collection system is included in Appendix A, Figure A1. The collection system consists of 4" through 18" mainline sanitary sewer. Nearly half of the collection system is comprised of vitrified clay pipe (VCP), and half polyvinyl chloride (PVC) with small sections of reinforced concrete pipe (RCP) and ductile iron (DI).

Most of the sewers were constructed in the 1930s, with a significant second construction phase in the 1950s. There have been continuous upgrades or expansion since that time up until present day. The interceptors and the collector sewers are generally in fair condition; however, several areas were determined to need replacement or rehabilitation through mass flow monitoring studies and closed-circuit televising (CCTV) investigations.

Pump Stations

The collection system includes three pump stations, ranging in age from 15 years old to 48 years old. Table 4 presents details of each pump station. The pump stations are in fair condition and have historically performed well and demonstrated capability to handle the dry weather and wet weather sewage flows.

Table 4: Portland Existing Pump Station Information

Pump Station	Location	Year Built	Capacity (GPM)
Canal Street	Canal Street @ Clark Street	1993	80
Rindlehaven	North of Cutler Road and I-96	2006	150
Riverside	400 Riverside Drive	1973	125

Treatment Facilities

The Portland WWTP is designed to treat an average daily flow of 0.50 million gallons per day (MGD) and is designed to accept a maximum daily flow of 1.50 MGD (post-equalization). Prior to the 1971 improvements project, the plant consisted of a manual bar screen, primary settling tanks, chlorine disinfection, an anaerobic digester, and sludge drying beds. Many improvements were made during a 1971 upgrade project. These included the addition of two aeration tanks, a second chlorine contact tank, a laboratory and chemical feed building, an aerated grit chamber, a flocculation channel, and two secondary settling tanks. Improvements were also made to the solids handling system, including a secondary digester, a digester building, a waste gas burner, two biosolids storage tanks, a scum box, a biosolids holding tank room, and a return activated sludge box. Modifications to the existing Service Building were made and the four raw sewage pumps were replaced with three raw sewage pumps. In 1995, a 20,000-gallon biosolids storage tank was constructed. In 2012, upgrades included converting the secondary settling tanks to an anoxic tank and an aeration basin, adding a sludge thickening building, converting the primary settling tanks to equalization basins, adding a headworks building, adding UV disinfection, and adding two secondary clarifiers. A treatment plant site plan of the existing facility is presented in Figure A5.

The current WWTP consists of secondary treatment, chemical precipitation of phosphorus, UV disinfection, and anaerobic digestion of biosolids. The current process flow diagram and hydraulic profile for the treatment facility is included in Figure A6 in Appendix A.

Process Description

Influent wastewater is routed through a muffin monster grinder to the raw sewage wet well prior to being pumped to the treatment system. The wastewater is then pumped by three raw sewage pumps to a mechanical fine screen with a bypass option of a 2-1/4" manually cleaned inclined bar screen. The three raw sewage pumps are controlled by variable frequency drives (VFD).

A grit removal system is located downstream of the fine screen. Grit removal consists of an aerated grit removal tank, a grit washer system, and an inclined grit screw classifier. Grit is transferred to a dumpster for disposal. If used, the bar rack must be manually raked, and screenings must also be manually carried to the dumpster. Any overflow from the grit removal tank is sent to the equalization tanks, previously used as primary clarifiers.

Following screening, influent flow goes to the aeration tanks where it combines with plant recycle flows. There are three aeration tanks and one anoxic tank. The return activated sludge (RAS) is also pumped to the aeration tanks. Ferrous chloride is added in the aeration basins to aid in phosphorus removal.

Mixed liquor (a mixture of influent wastewater and return activated sludge) leaving the aeration tanks is combined in a splitter box where polymer is added as necessary to increase flocculation in the secondary clarifiers. The flow is split and transferred into the two secondary clarifiers. From the secondary clarifiers, there is a scum line and a drain that are both sent to the plant influent.

Effluent from the secondary clarifiers flows to the UV channel where it is disinfected. The UV channel utilizes two separate light banks. Treated effluent is then discharged to the Grand River in accordance with the facility's NPDES discharge permit.

Chemical Feed System

With current operations, chemical addition is necessary for proper plant operation. Ferrous chloride is added at the aeration tanks to aid in phosphorus removal. The WWTP has two bulk storage tanks with a combined capacity of 6,600 gallons. The WWTP is sometimes unable to meet its monthly phosphorus limit of 1.0 mg/L.

A polymer feed pump was installed as part of the 1972 project and the polymer mixer was installed in 1992. Polymer is used in the secondary clarifiers and in the sludge thickening process to serve as a settling aid. Polymer is stored in two 125-gallon tanks. Currently, the feed pumps are in fair condition, but the lines get plugged and cause issues.

Solids Handling

Biosolids that settle in the secondary clarifiers are transferred to a sludge wet well and pumped by three pumps to either the aeration basins as RAS, to one of the two unthickened sludge tanks as waste activated sludge (WAS), or to the equalization tanks. The three pumps were installed during the 2012 expansion and are in fair condition. Flow from the equalization tanks is routed back to the raw sludge wet well where it is sent back through the plant. WAS from the unthickened sludge storage tanks goes through the sludge thickening system.

The sludge thickening system consists of a flocculation tank where the sludge is combined with polymer. It then goes through a rotary drum thickener and a thickened sludge hopper. The thickened sludge is pumped to either the primary or secondary digester and the filtrate from the rotary drum thickener flows to the equalization tanks. The biosolids are stabilized through an anaerobic digestion process.

After the digesters, the biosolids go to one of the three sludge drying beds or the biosolids storage tank until they are removed for land application in accordance with State regulations. The plant has a flare to burn biogas produced by the anaerobic digesters, but it is currently not in operation. The WWTP struggles with biosolids due to inadequate storage volume which often requires the return of concentrated supernatant which impacts operations. Managing the biosolids has become quite cumbersome and the WWTP would benefit significantly from additional storage capacity.

Infiltration and Inflow (I/I)

Between 2018 and 2021 the plant experienced daily influent flows ranging from 0.25 to 2.00 MGD, with the average daily flow during this period being 0.35 MGD.

The most significant problems noted at the Portland WWTP are related to high flows associated with substantial infiltration and inflow. This was especially apparent during a February 2019 ice jam event in the Grand River. The Portland WWTP reportedly can normally treat and meet permit limits to a max flow of 1.5 MGD. The City currently experiences constant infiltration and suspected inflow during periods of high ground water periods and excessive wet weather flows as well as high Grand River water levels, resulting in flows from 0.55 MGD to 0.61 MGD following specific events. The maximum daily flow recorded from 2018-2019 was 2.00 MGD.

An I/I study, which is sometimes referred to as Mass Flow Monitoring (MFM) was conducted in 2019. The I/I study found that infiltration was constant and considered “excessive” by EGLE standards across the collection system. A copy of the I/I study is included as Appendix D.

Current Wastewater Flows

Average Influent Flow

Daily wastewater flow analysis (2018-2021) indicated that the treatment plant received an annual average wastewater flow of 0.35 MGD. Daily flows ranged from 0.25 MGD to 2.00 MGD during that period.

There are currently 1,602 sewer customers in the Service Area, corresponding to a population of 3,923. The annual average wastewater flow of 0.35 MGD can be divided by the number of people to calculate an annual average flow rate per person of approximately 90 gallons per capita per day (gpcd). Dry sewage (i.e., without infiltration and inflow) is typically 70 gpcd. The dry sewage flow for Portland should hypothetically be, according to recent standards, approximately 0.27 MGD.

The average influent from the year 2020’s Monthly Operation Reports (MORs) submitted by the City’s operator, Fleis and VandenBrink Operations, shows the average influent to be 0.365 MGD.

The average billed sewage (based on water usage) for 2020 was approximately 0.303 MGD, indicating that significant infiltration and/or inflow is entering the collection system on an annual average basis.

Wet Weather Flow

Wet weather flow (WWF) consists of dry weather flow (comprised of customer-generated sewage plus groundwater infiltration or waterbody inflow) plus rainfall-dependent inflow and infiltration (RDII). Dry weather flow plus wet weather inflow and infiltration is referred to as total inflow and infiltration or simply I/I for short.

Most treatment plants experience an increase of influent flows during and following significant rain or snowmelt events during high groundwater periods. Substantial I/I is defined using SRF threshold flow rates in gallons per capita per day (gpcd). The SRF threshold flow for infiltration is 120 gpcd. For inflow, the threshold flow rate is 275 gpcd. Amounts of I/I beyond the threshold values are considered "excessive" if the cost to transport and treat is greater than the cost to remove. This can be evaluated regionally, across the entire collection system, or can be studied in more local districts.

To improve the breakdown of I/I across the entire collection system, F&V employed a Mass Flow Monitoring (MFM) study from March 2019 through September 2019. F&V staff installed 15 flow depth monitors and two rain gauges across the City's collection system. These instruments were used to collect depth and rain data every 5 minutes throughout the project duration. This near continuous data allowed for the analysis of high ground water – dry weather flow (DWF), in addition to flow response following the top 10 wet weather events spanning from March – September 2019. Once all data was analyzed and reviewed for quality, flow areas were then prioritized for further investigation, and/or rehabilitation. The delineated flow areas, data processing approach and method can be found in the full MFM report, in Appendix D.

Table 5: General flow analysis results based on flow area.

Monitor	DWF		Wet Weather Flow (WWF)					RDII		
	Q (mgd) | (gpcd)		Peak Q (mgd) | (gpcd)					% Capture (MG/MG)		
	Event Average Dry Weather Flow	**Event Average DWF - normalized**	Maximum Observed	Design Storm Peak Hour Projection	Design Storm Peak Hour Projection - normalized	Design Storm Peak 24-hour Projection	**Design Storm Peak 24-hour Projection - normalized**	Maximum Observed	Weighted Average: Observed Capture %	**Design Storm Projection**
LL-01	0.037	***89***	0.08	0.10	*240*	0.10	***247***	1.1%	0.3%	**0.5%**
LL-02	0.020	***39***	0.06	0.10	*204*	0.09	***171***	1.2%	0.3%	**0.6%**
LL-03	0.014	***47***	0.05	0.08	*281*	0.07	***247***	2.1%	0.8%	**1.6%**
LL-04	0.043	***1,195***	0.59	0.69	*19,310*	0.57	***15,945***	1010.3%	37.4%	**42.5%**
LL-05	0.115	***62***	0.33	0.59	*323*	0.35	***191***	3.0%	1.0%	**0.6%**
LL-06	0.015	***154***	0.11	0.19	*1,895*	0.07	***733***	252.7%	3.2%	**3.0%**
LL-07	0.005	***13***	0.02	0.03	*89*	0.03	***77***	1.2%	0.4%	**0.7%**
LL-08	0.004	***21***	0.02	0.03	*150*	0.02	***100***	0.7%	0.2%	**0.4%**
LL-09	0.009	***38***	0.03	0.05	*192*	0.04	***182***	1.0%	0.4%	**0.8%**
LL-10	0.042	***31***	0.13	0.24	*177*	0.11	***82***	0.6%	0.3%	**0.7%**
LL-11	0.028	***100***	0.17	0.27	*163*	0.16	***574***	12%	5%	**6.6%**
LL-13	0.003	***29***	0.03	0.06	*568*	0.04	***341***	1.0%	0.4%	**0.6%**
LL-14	0.029	***39***	0.13	0.17	*232*	0.14	***192***	2.2%	0.7%	**1.4%**
LL-15	0.020	***26***	0.11	0.18	*236*	0.14	***178***	3.4%	0.8%	**1.0%**
LL-16	0.016	***31***	0.06	0.12	*234*	0.09	***176***	1.9%	0.5%	**0.8%**

The evaluation determined that significant wet weather flows derive not only from rainfall but from the river level also. Rainfall tends to drive this river level, but the maximum flow rates do not correlate with rainfall but often occur later when the influence of the rain is it at its peak. To better understand the source of inflow and

infiltration a comparison of WWTP flows with Grand River water levels was deemed necessary, as it is a suspected major source of inflow, as much of the trunk sewer runs beneath, and adjacent to the Grand River.

I/I in Response to Grand River Water Level

To evaluate the impact of inflow and infiltration from the Grand River on Portland WWTP flows, F&V ran a correlation analysis for a USGS River gage on the Grand River in Portland to WWTP Influent values following the top 10 storms during the study period. Figure 1, shows that there is a high correlation between flow and river gauge height. This strong correlation, along with the significant increase in WWTP flow in response to the Grand River water level, makes inflow and infiltration from Grand River the highest priority for I/I removal.

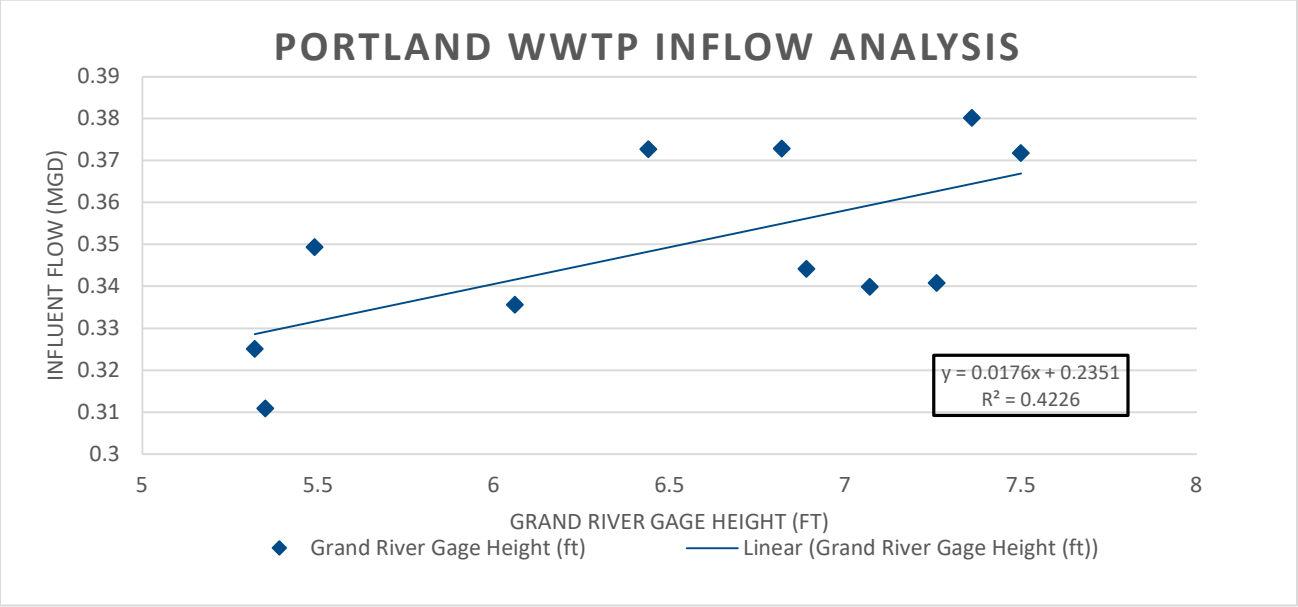

Figure 1. Portland WWTP flows compared to Grand River Gage Height.

The amount of infiltration entering the collection system is typically determined by first looking at the average daily influent flow during the high groundwater months (March, April, May) for non-precipitation days.

I/I Priority Areas and Field Investigation

The detailed I/I Evaluation found that a majority of the I/I volume is entering the system along Grand River, along Canal Street, James Street, Smith Street, Water Street, and Morse Drive, as well as the siphon river crossing beneath Grand River.

Refer to Appendix D for the Mass Flow Monitoring Report for additional details regarding the I/I study details and Appendices F and G for smoke testing and sewer televising results.

D. Need for the Project

While much of the mechanical equipment and tanks that were installed during the 1971 project remain in service today, many have exceeded their useful life and are at an increased risk of failure. Some of the equipment has already failed, resulting in additional repairs to maintain plant operations. Overall, the condition of the treatment plant is fair, considering its age. A few specific components of the treatment plant are in poor condition.

The I/I Evaluation concluded that the collection system receives an excessive amount of I/I, primarily in the form of infiltration. It is likely that the peak flows can be significantly reduced by addressing structural defects that were discovered throughout the collection system. Reduction of I/I will reduce overall treatment costs at the WWTP.

The raw sewage pumps are in fair condition; however, they experience significant clogging. They were also damaged during the 2019 ice jam. Replacement with newer, non-clog pump design would reduce downtime, provide more efficient operation, and mitigate the need for direct oversight. The mechanical screen is currently operational; however, there are broken welds and bent rake stops which pose operational challenges. It is also anticipated that finer screening will be necessary with improvements to the secondary treatment process.

The equalization basins provide some relief when they are utilized as an overflow for the system, but they are rarely used.

The aeration basins have structural issues with the concrete of the tanks. There are cracks in the concrete outside of the basins and spalling concrete between the basins. Concrete repairs/replacement is necessary to extend the service life of the tanks to provide reliable treatment. The activated sludge system provides the main treatment for removal of biological and nutrient loads to the WWTP. An evaluation of influent loadings suggests that the system is approaching its biological capacity. Improvements and replacement are necessary to meet the projected future loadings to the treatment plant.

While the secondary clarifiers are generally in good condition, there are a few performance issues. Secondary Clarifier No. 2 does not return as much sludge as Clarifier No. 1. There are also hydraulic limitations in the piping for Secondary Clarifier No. 1 which causes water to back up over the effluent weirs during sustained periods of high flow. The scum boxes also allow an excessive amount of clarified effluent to return to the front of the plant which increases treatment costs. The concrete tanks are generally in good condition with some minor cracks. The concrete should be epoxy-injected to repair the cracking and extend the service life of the tanks.

Polymer and ferrous chloride are used at the WWTP. Both systems are in fair condition overall, but each have a few issues that should be addressed. The polymer feed pumps are in poor condition and the non-potable water lines get plugged. The ferrous chloride system is losing head pressure and the chemical is drawn directly from the bulk storage tanks. The bulk tanks are also not protected from the elements and are experiencing deterioration due to UV degradation.

The UV disinfection system is overall in good condition. The only identified issue is that the UV intensity meter does not work. Algae that accumulate on the secondary clarifier effluent weirs sometimes causes plugging/blocking of the UV banks which may inhibit treatment. Methods to mitigate algae accumulation should be considered to provide continued reliable treatment.

Both the primary and secondary digesters are in poor condition. The valve seals are leaking, and the gas piping is not performing as expected. There are cracks in both the digester building and the small building attached to the secondary digester. The primary digester has cracks in the structure and the cover is in poor condition. The treatment plant also has a waste gas burner. The burner is currently not used and not operable.

The treatment plant has three sludge drying beds. The drying beds do not drain well and do not provide sufficient capacity. The WWTP does not have adequate biosolids storage capacity to meet the 180-day storage requirements. EGLE has identified this as a concern needing to be addressed. Due to the small

available volume for biosolids storage, the WWTP is often forced to return highly concentrated supernatant to the head of the treatment process before it can undergo necessary separation. This increases loadings on the treatment process which impacts treatment performance. The lack of storage also poses significant operational challenges on staff trying to store the biosolids prior to land application.

The HVAC units in the Laboratory and Chemical Feed Building are old and do not perform well. This often leads to the building temperatures exceeding 90°F during the summer months. The HVAC systems should be replaced to adequately maintain building temperatures for staff. Additional building improvements are necessary to extend the life of the buildings and equipment. There is also limited garage space to store and maintain equipment and the operations staff currently has no break/lunch room.

Many of the assets at the pump stations are past their useful life and are in poor condition or have a high chance of failure. All three of the pump stations need electrical/controls upgrades. The Rindlehaven pump station has operational issues. The Canal St pump station is the only station without a standby generator. The Riverside pump station is currently in a building that restricts access to the wet well and does not allow for proper cleaning/maintenance. Upgrades at all three pump stations are needed for them to continue to provide reliable performance.

Summary of Areas of Concern

A summary of the areas within the existing WWTP and pump stations that need improvement is as follows:

- The raw sewage pumps experience significant clogging due to the number of rags that enter the system.
- The aeration basins have cracks and spalling in the concrete tank structure.
- The secondary treatment process is approaching its biological design capacity and needs improvements.
- Secondary Clarifier No. 1 effluent flow is limited by piping size.
- The polymer feed system is in poor condition.
- The ferrous chloride bulk storage tanks are located outside and are in poor condition.
- The basement of the digester building floods when there are rain events.
- Operators are unable to accurately obtain the level in the digesters.
- The digester pumps need to be replaced. Pump 2 is rarely used because of its condition and the piping for the pumps is clogged and many of the valves no longer operate.
- There is a lack of biosolids storage available at the plant.
- There is no redundancy for the non-potable water used throughout the plant.
- The HVAC in the Laboratory is not adequate for the space.
- Additional space is needed to store and maintain equipment.
- The electrical and controls are outdated at all pump stations.
- The Canal St pump station does not have a standby generator.
- The Rindlehaven pump station has issues with clogging.
- The Riverside pump station is in a building that restricts access to the wet well.

Compliance Status

The Portland WWTP does occasionally have exceedances where it does not meet its NPDES discharge permit. During a 5-year review of monthly operating reports (MORs), from January 2014 to May 2019, the plant experienced 37 exceedances. These exceedances were for biological oxygen demand (BOD), total suspended solids (TSS), total phosphorous, and fecal coliform.

Noncompliance, Exceedences, Orders

The City of Portland is not currently under a consent order. The WWTP is generally meeting its treatment requirements. A copy of the current NPDES discharge permit (COC No. MIG570220) is included as Appendix B. Note that the permit expired in 2020 but was extended.

Water Quality Problems

There are no identified major point sources or non-point sources of pollution from on-site systems, storm water runoff, industries, or agriculture within the service area.

Projected Needs for the Next 20 Years

The projected 20-year wastewater needs are based on the population projections. The projected wastewater flows for design year 2040 are summarized in Table 6.

Table 6: Projected 2040 Flows

Minimum Flow:	290,000 gpd
Average Flow:	430,000 gpd
Maximum Flow:	640,000 gpd

The projected flows are not expected to exceed the current design average and maximum daily flows of 0.5 and 1.5 MGD respectively. Although the hydraulic capacity of the plant is not an issue, the secondary treatment process is approaching its biological capacity and will be addressed. The proposed project will expand the biological capacity of the WWTP as well as allow for further expansion in the future.

There is a possibility that a mobile home park to the west of the City will be added to the City of Portland collection and treatment system. There have been multiple complaints of odors coming from the existing treatment lagoons at the mobile home park. The inclusion of this community would add between 35,000 and 100,000 gpd to the WWTPs daily flow. These flows are not currently included in the 2040 projections.

E. Population Data

The City of Portland provides wastewater collection and treatment services to residents of the City of Portland. As of the 2010 Census, the study area and service area population included 1,602 customers in the City of Portland for a total population served of 3,923 people. Census data and projections for the entire City and the service area are discussed below.

Population Projections

The City of Portland had a slight increase in population from 2000 to 2010 based on the 2010 census data. Information from the West Michigan Regional Planning Commission (WMRPC), the regional planning commission for Ionia County, indicates they are expecting a slight increase in population in the County and the City of Portland (0.05% annually) through 2040. The City of Portland believes it is prudent to plan for sustained wastewater usage, therefore a population growth rate of 0.05% annually was chosen for the population and residential growth projections.

Figure 2 illustrates the historical population, WMRPC projections, and population projections based on historical and nominal growth. The WMRPC projections were calculated using an annual growth rate obtained from a document named "Population Trends and Projections through 2030 from Ionia County – *DRAFT*".

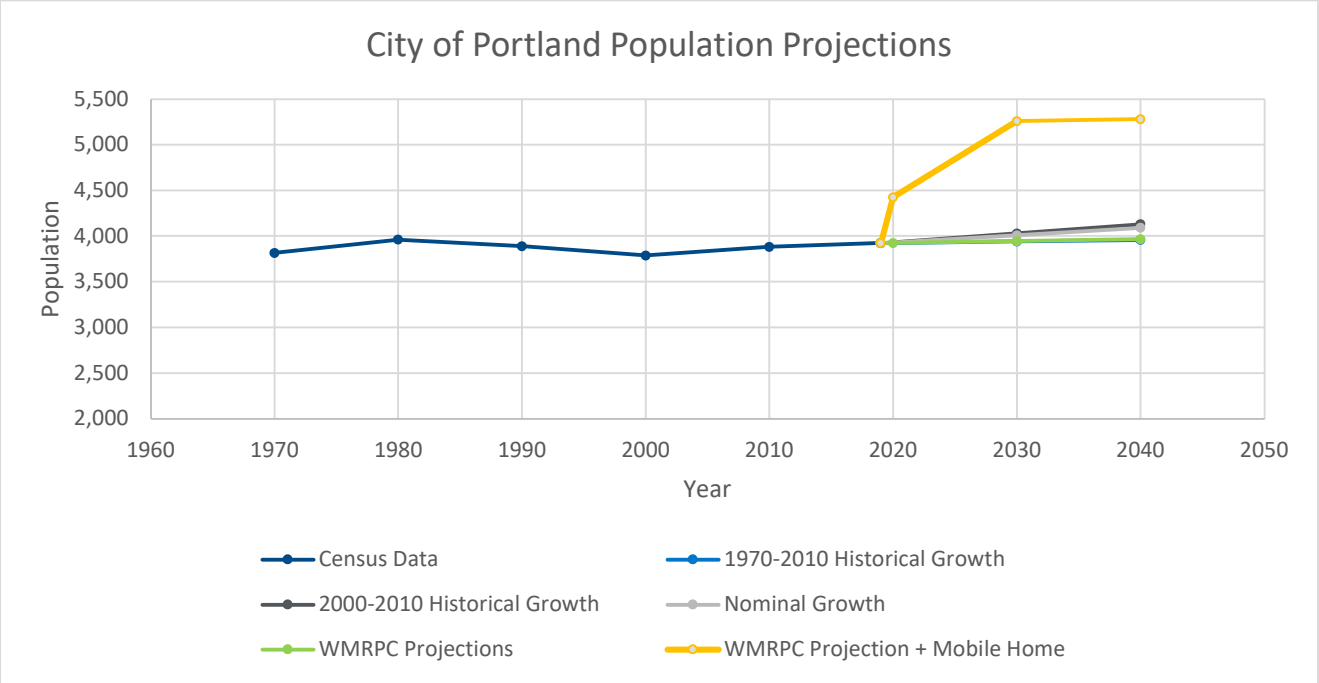

Figure 2 - Population Projections

Service Population

At the time of the 2010 Census, the population of the City of Portland was 3,883 people (the 2019 Census estimate was 3,923 people). The WWTP serves the entire City of Portland. Growth through 2040 is expected. There are multiple industrial users that add approximately 0.09 MGD currently. Using a value of 70 gal/cap/day, these users equate to approximately 1290 persons. The projected service population is 5,253 persons for design year 2040.

There is a remote possibility of including a mobile home park into the service area. The population of the mobile home park is not included in the 2040 flow projections. This mobile home park currently has 190 lots but has plans to expand to up to 500 lots. Using the average household size of 2.63 persons/house, the mobile home park would add approximately 499 persons currently to the service population and 1,315 persons if fully built out. The projected 2040 service population with the expanded mobile home park and industrial users included is 7,853 persons. The proposed design will consider options for expansion if the mobile home park is added to the City collection system.

F. Environmental Setting

Cultural Resources

The City of Portland is located adjacent to the Grand River and the Looking Glass River, which are important features of the area.

A search of the Michigan Historic Sites Online website did not identify any state registered historical sites within the City of Portland. The National Register of Historic Places lists the Portland First Congressional Church as well as the Downtown Historic District, made up of 44 different buildings. The City of Portland Master Plan identified the following as historical sites within the City:

- Portland First Congressional Church (Corner of Warren and Bridge)
- Location of historical event, the first woman exercising her right to vote under the Woman's Suffrage Amendment

A State Historic Preservation Office (SHPO) review will be conducted at the sites of the proposed improvements. There are no known issues with the current sites. The proposed project will affect only existing utility rights-of-way and City owned pump station and WWTP sites. No landscape changes are proposed, and the sites will be restored to pre-project conditions.

The proposed project has the possibility to have impacts on tribally important cultural or religious sites of the following Native American tribes associated with Ionia County: Hannahville Potawatomi Indian Community, Little River Band of Ottawa Indians, Match-e-be-nash-shee-wish Gun Lake Band of Potawatomi Indians, Nottawaseppi Band of Huron Potawatomi, and Pokagon Band of Potawatomi. These tribes will be contacted by EGLE to review the proposed sites.

The Natural Environment

Climate

Climatological data for the area is based on information from the Michigan State University Climatology Program. The average January climatic conditions include average minimum temperatures of 15.12° F and average maximum temperatures of 31.52° F. The average July climatic conditions include average minimum temperatures of 58.67° F and average maximum temperatures of 82.92° F. The average rainfall is 37.38 inches and the average annual snowfall is 62.8 inches.

These climate conditions, specifically the winter conditions and design frost levels, would have equal design and construction impacts on all the principal alternatives and equally affect the length of construction seasons for all alternatives.

Air Quality

Air quality impacts due to construction dust and emissions in the area due to construction equipment would be temporary and similar for the principal alternatives.

Wetlands

A wetlands map was generated at the USFWS National Wetlands Inventory website. The map is included in Appendix A as Figure A7. Areas of freshwater emergent and freshwater forested/shrub wetlands are immediately adjacent to the Grand River and the Looking Glass River.

It is not anticipated that this project will have any long-term impacts on area wetlands. The WWTP is adjacent to the Grand River, a riverine system. Like the WWTP, some of the collection system improvements are adjacent to the Grand River riverine system.

EGLE will review any potential impacts to land-water interfaces.

The proper permits will be acquired before any construction commences.

Floodplains

The City of Portland participates in the FEMA Flood insurance map program. The FEMA issued Flood Insurance Rate Maps (FIRM) are shown in Figure A8. Areas adjacent to the Grand River are located in “Zone AE”, the 100-year flood area, as well as “Zone X”, the 500-year flood area. The 100-year flood plain elevation along the Grand River through the City of Portland ranges from approximately 706.7 feet to 708.3 feet. Sections of the WWTP site are located in the 100-year flood area, 500-year flood area, and floodway. Two of the pump stations are also located within the floodway, and the 100 and 500-year flood areas. Various sections of the collection system improvements are located within the 100 and 500-year flood areas. Appropriate permits will be acquired before any construction commences.

Special Designation Rivers (Trout, Natural, Wild & Scenic)

The Wild and Scenic Rivers Act, as amended by the Michigan Scenic Rivers Act of 1991, prohibits federal assistance to a project which will have a direct and adverse effect on the values for which a river segment listed in the National Wild and Scenic Rivers System or designated for study on the National Rivers Inventory was established.

The Grand River is listed on the National Wild and Scenic Rivers System website, administered by the National Park System, the Looking Glass River is not. Neither river is found on the Michigan Natural Rivers System found on the Michigan Department Environment, Great Lakes, and Energy website.

Major Surface Waters

The most noticeable natural feature in the Service Area is the Grand River. The Grand River provides recreational opportunities and aesthetic beauty to the area. The Grand River flows into the City of Portland from the Southwest and flows out to the North. The river continues west, emptying into Lake Michigan.

The Looking Glass River also flows through the City of Portland. The Looking Glass River flows through the City from the Southeast and joins the Grand River in the center of the City.

Recreational Facilities

Figure A2 shows the City’s current recreational facilities. The Bogue Flats Recreation Area is located to the north of the City, adjacent to the WWTP. Powers Park and William Toan Park are in the center of the City, located off S Water Street. Two Rivers Park is located on the north side of the City off Looking Glass Ave,

across the Grand River from the WWTP. The parks include baseball fields, soccer fields, and open areas. A local library is located on Kent Street. There are also many church and semi-public recreational facilities located within the City, as well as a river trail system.

No improvements proposed in this Plan are anticipated to impact any of these facilities.

Topography and Geology

Figure A9 shows the existing topography from the USGS quadrangle map. The elevations in the City gradually slope towards the Grand River. Ground elevations vary from 795 feet to 705 feet.

The regional geology for the area is based on a review of the Quaternary Geology of Michigan Map (W.R. Farrand, 1982), see Figure A10; and the Bedrock Geology of Michigan Map (MDNR Geological Survey Division, 1987), see Figure A11.

The general geology of the Portland area is characterized by glacial outwash sand and gravel and post glacial alluvium as well as end moraines of coarse textured till which overlie the Grand River formations.

Soils

Figure A12 is the USDA National Resources Conservation Service soil map for the City of Portland. Soils located at the WWTP site are boyer loamy sands, which are well drained.

There are a variety of soil types located throughout the City collection system. Where there is proposed sewer rehabilitation, the soils are mostly Landes-Genesee loams and Fox sandy loam. These soil types are well drained and commonly experience little to no flooding.

Agricultural Resources

Figure A13 shows the Farmland Classification for the soil types in the City. Soils at the WWTP site are classified as farmland of local importance.

Soils located in the areas proposed for sewer rehabilitation are generally classified as prime farmland. Because the sewer rehabilitation improvements are limited to existing pump station sites and existing sewers located in rights-of-way or existing easements, the proposed improvements in both principal alternatives are not anticipated to have impacts on agricultural resources.

Flora and Fauna

A USFWS Section 7 review will be completed for this project. According to the USFWS website, there are three federally listed endangered species, two threatened species, and one candidate species known to inhabit Ionia County. These include the Indiana bat, Karner Blue Butterfly, Snuffbox Mussel, Eastern Prairie Fringed Orchid, Northern Long-Eared Bat, and the Monarch Butterfly.

Because the proposed work is limited to the existing WWTP, pump stations, and the existing collection system, it was determined that no impacts to federally listed endangered or threatened species are anticipated.

Unique Natural Features

An MNFI review considering potential impacts to rare species or unique natural features will be completed. It is anticipated that no protected resources will be impacted.

III. Analysis of Alternatives

A. Identification of Potential Alternatives

Alternatives to accomplish improvements to the City of Portland Wastewater Collection and Treatment System were developed and evaluated based on their ability to meet the scope of the project while remaining within financial, regulatory, and technical constraints.

Project objectives include:

- Ensure reliable wastewater service (collection and treatment) to customers.
- Rehabilitate/repair high priority areas of existing wastewater infrastructure.
- Reduce infiltration and inflow in the collection system.
- Ensure facilities can provide consistent reliable services and continued compliance with the NPDES discharge permit limitations.
- Minimize financial burden to the sewer system users.
- Minimize environmental impact during construction of the improvements project.
- Minimize environmental impact of WWTP operations and discharge.

Four alternatives were developed for the City of Portland Wastewater System Improvements Project.

1. No Action
2. Regional Alternative: Pump to the City of Grand Ledge WWTP
3. Optimize Existing Facilities with I/I Removal
4. Build a New Treatment Plant

The No Action and Regional alternatives were evaluated to meet SRF Project Plan requirements. The other alternatives were developed to address the issues identified.

The alternatives are described in detail in the following report subsections. Each alternative was initially screened based on effectiveness, implementability, and financial requirements. Feasible alternatives were then subjected to a comprehensive evaluation with attention to detailed economic, technical, environmental, and public concerns.

Financial analysis of feasible alternatives followed a present worth methodology. Capital costs, operations, maintenance and replacement costs, and salvage values were determined separately and discounted back to present value. The sum of these costs represents the present worth of the project.

Table 7 summarizes the capital costs and operation, maintenance, and replacement costs for principal Alternative No. 3.

Table 7: Summary of Capital, Annual OM&R Costs

Alternative	Total Capital Cost	Annual Operation, Maintenance & Replacement
3	$10,124,000	$457,130

The Alternatives are described in the following sections.

Alternative 1 - No Action

The “No Action” alternative must be evaluated in accordance with SRF Project Plan guidance. No improvements would be implemented for this alternative. The “No Action” alternative would maintain current system operations.

The infiltration and inflow problems would not be addressed. Leaving these problems unaddressed poses a serious risk of causing sewer back-ups, or sewer damage which could lead to lack of service during an unplanned emergency repair and possibly a sanitary sewer overflow.

The issues at the treatment facility, including inoperable equipment, biological capacity issues, and crumbling concrete tanks would also not be fixed with the No Action alternative. Aging equipment would continue to age until ultimate failure, which could result in compliance problems in the future.

There is a cost associated with the “No Action” alternative, although it is difficult to quantify that cost currently.

The “No Action” alternative does not meet the project objectives and will not be evaluated further as a principal alternative.

Alternative 2 - Regional Alternative

EGLE SRF guidelines require a Regional Alternative be evaluated. Specifically, this alternative would include decommissioning the existing Portland WWTP and pumping the untreated wastewater to another regional treatment facility via proposed new pump stations and forcemain.

The nearest wastewater treatment facility is located in the City of Grand Ledge. Treated effluent from the Grand Ledge WWTP is discharged to the Grand River. Table 8 outlines nearby municipal wastewater treatment plants, the distance from Portland, and an estimated forcemain cost to transport wastewater

Table 8 - Nearby Municipal Wastewater Treatment Plants

Regional Treatment Facility	Distance (miles)	Estimated Forcemain Cost
City of Grand Ledge	13.4	$6,700,000
Ionia	16.1	$8,050,000
Southern Clinton County Municipal Utilities Authority (SCCMUA)	19.6	$9,800,000

These regional alternatives would still need to include I/I removal as well since the existing collection system infrastructure still needs to be used.

Figure 3 illustrates the potential forcemain route from the City of Portland WWTP to the Grand Ledge WWTP. The proposed route is approximately 13.4 miles long roughly following Grand River Ave, Benton Rd, and Grand Ledge Hwy.

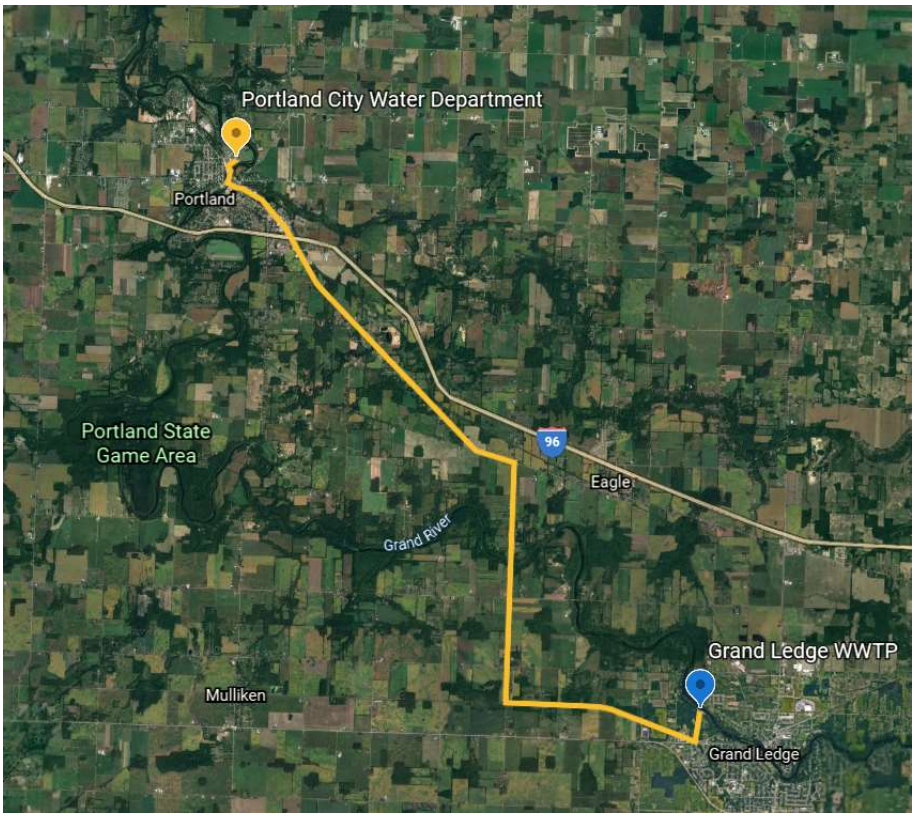

Figure 3 - Potential Forcemain Routing

This alternative has an estimated capital cost of $6.7 million, including construction of the conveyance forcemain needed to pump the wastewater to Grand Ledge. This does not include purchase of treatment service capacity from the City of Grand Ledge or any pump stations that may need to be constructed to overcome headloss through the forcemain. The difficulty in obtaining the necessary easements and acquiring property would also be challenging and could take years. Costs associated with this alternative would not be fully developed until agreements with the City of Grand Ledge were made. This alternative also assumes that the City of Grand Ledge would be willing and have the capacity to accept the additional flow from the City of Portland.

Pumping the wastewater to the Grand Ledge WWTP does not resolve the I/I problems; it only transfers them to another location. Therefore, the infiltration and inflow issues in the Portland wastewater system would also need to be addressed for this alternative which increases the capital costs.

The regional treatment alternative is not cost effective. Capital costs are much greater than the other alternatives evaluated. In addition, operating costs for this alternative are not anticipated to be lower than the other alternatives, despite the larger economy of scale. This alternative does not meet the financial project objectives and is not considered further as a principal alternative.

Alternative 3 - Optimize Existing Facilities with I/I Removal

Alternative 3 includes optimizing the existing facilities and making collection system improvements to remove I/I.

WWTP Improvements

Several improvements are required at the WWTP to extend the useful life of aging infrastructure and increase the biological capacity of the plant. To address issues with clogging of the raw sewage pumps, the pumps would be replaced with a non-clog type. In the raw sewage room, there are possible electrical issues that are being investigated. The raw sewage room would also be rehabilitated. The fine screen has bent rake stops and broken welds. Some of these screen issues have been addressed by WWTP staff but the screen should be inspected and have any repairs needed. It may also need to be replaced with a finer screen depending on the requirements of the new secondary treatment process.

The aeration blowers would be rebuilt or replaced to continue operation. The SCADA touchscreen in the blower building would be replaced as well. Alternate biological treatment methods are considered to expand the biological capacity. These alternates include mixed bed biofilm reactors (MBBRs) and integrated fixed-film activated sludge (IFAS). These alternates would utilize the existing basins after they undergo concrete repairs.

Clarification of the effluent would continue to be provided by the secondary clarifiers. Secondary Clarifier No. 1 is hydraulically limited by the 8” effluent pipe. The clarifiers experience algae issues in the summer and have had to be cleaned weekly. Improvements will be made to mitigate these issues.

The UV disinfection system needs some minor upgrades/repair. These improvements would be made during the project.

An effluent bypass pump connection would be installed to allow for effluent to be discharged during periods of high water in the river.

The existing polymer system is challenging to operate and maintain. The pumps are in poor condition and the non-potable water system clogs the pipes. There is no alternate system for water. The polymer system would be replaced and a water connection to the City water service would be made.

The Plant does not have sufficient biosolids storage. A 500,000-gallon tank would be added to allow sufficient storage capacity. The digesters also need improvements to optimize treatment. These improvements include a new digester mixing system, tank improvements/repairs, a new cover on the primary digester, new digester transfer pumps and piping, and new sludge recirculation pumps and piping.

The Laboratory/Administration Building does not have a sufficient HVAC system. A new system would be installed to adequately maintain building temperatures. The windows do not seal and would be replaced. Building renovations along with the addition of a break room, changing room, and shower will also be implemented.

A garage space is also needed to provide shelter for the City’s vactor truck and service vehicle along with areas to store and maintain equipment. A new ferrous chloride feed system could also be implemented in this building to protect the storage tanks from the elements and UV degradation.

Pump station Improvements

The pump stations need improvements to continue reliable operation. All pump stations have outdated electrical and controls that need to be updated. The Riverside pump station has a building that would be removed, and the pumps replaced with submersible pumps. The Canal St pump station is the only station that does not have a standby generator. A standby generator would be added. The Rindlehaven pump station has

issues with the pumps clogging. The addition of a strainer basket would help capture rags prior to the pumps and reduce the amount of clogging.

Collection System Improvements

Mass flow monitoring, manhole assessments, smoke testing, and closed-circuit televising all contributed to the development of several capital improvement plans (CIP) that aid the rehabilitation efforts to address I/I throughout the collection system. For the purpose of this project, the 1-2 year rehab recommendations will be included. These improvements will pinpoint the most severe areas of concern to reduce I/I.

Collection system improvements include lining, point repairs, and complete replacements of pipes and manholes in portions of the collection system. The specific areas are dispersed amongst the entire collection system, with heavy emphasis on the pipes and manholes along the Grand River, and near the WWTP. Each specific rehab measure and location can be seen in Figure A15 of Appendix A.

Alternative 4 – Build a New Treatment Plant

This alternative involves constructing a new treatment plant capable of treating the projected flows on the land located to the east of the existing WWTP site, across the river. This land is currently used for agriculture. The new treatment plant would require a new pump station at the current treatment plant site and 2,000 feet of new forcemain. The new facility would consist of a headworks building with a fine screen and vortex grit removal, a biological treatment system, secondary clarification, and UV disinfection prior to discharge to the Grand River. Residuals management would consist of digestion, thickening, and land application.

The estimated capital cost for this alternative, based on previous cost curves, is $17.25 million which makes it cost prohibitive. The I/I would also have to be addressed with this with this alternative, adding an additional $2.1 million. The OM&R costs would be greater than Alternative 3 because of the additional pumping required to reach the new plant. Alternative 4 – Build a New Plant does not meet the financial project objectives and is not considered further as a principal alternative.

B. Analysis of Principal Alternatives

One feasible alternative was developed that met the project objectives, identified as Alternative No. 3. This alternative was analyzed further and is summarized in the following sections.

The Monetary Evaluation

The monetary evaluation includes a present worth analysis. This analysis does not identify the source of funds but compares cost uniformly for each alternative over the 30-year planning period. The present worth is the sum which, if invested now at a given interest rate, would provide exactly the same funds required paying all present and future costs. The total present worth is the sum of the initial capital cost, plus the present worth of OM&R costs, minus the present worth of the salvage value at the end of the 30-year planning period. The discount rate used in computing the present worth cost is established by EGLE and has not yet been set for FY2022 SRF Projects. The discount rate of -0.5%, obtained from OMB Circular No. A-94 per SRF guidance, was used for the financial calculations.

The salvage value is calculated at the end of 30 years where portions of the project structures or equipment may have a salvage value, which is determined by using a straight-line depreciation. The present worth of the 30-year salvage value is then computed using the discount rate of -0.5%. The EGLE guidance document establishes the estimated life for the project structures and equipment to assess salvage values at 30-year

planning period. In general, concrete structures, earthwork basins, and piping have a useful life of 30-50 years and equipment has a useful life of 10-20 years.

The cost of labor, equipment and materials is not escalated over the 30-year life since it assumes any increase in these costs will apply equally to all alternatives. The interest charge during construction (capitalized interest) would not significantly influence the comparison of alternatives and was not included in the cost-effective analysis.

The following cost comparison details were specifically addressed and were applied in the present worth analysis as per the EGLE guidance.

- Capital costs were included for all identified improvements.
- Sunk costs were excluded from the present worth cost. Sunk costs for the project include existing land, existing waterworks facilities, and outstanding bond indebtedness.
- Operation, Maintenance, and Replacement, (OM&R) costs were included in the present worth cost.
- The economic comparison is based on a 30-year planning period and a discount rate of -0.5%.
- Salvage values were included in the present worth cost.
- Energy costs escalation was assumed equal between the alternatives and therefore are not adjusted over the 30-year period.
- Land purchase/acquisition costs were not applicable to the principal alternatives.
- Mitigation costs are included in the Project Costs and considered in the present worth cost.
- Total existing and projected user costs for the project are presented.

A detailed breakdown of all identified project costs is included in Appendix C. Table 9 shows the costs for breakdown for the principal Alternative. The net present worth of Alternative No. 3 is estimated at $17.8 million.

Table 9: Summary of Present Worth Cost Analysis

	Alternative 3
Capital Cost	$10,124,000
Annual OM & R	$457,130
Net Present Value of OM&R Cost	$9,640,700
Total Present Worth	$19,764,700
Salvage Value	$1,961,000
Present Worth of Salvage Value	$2,167,800
Net Present Worth	$17,803,700

The Environmental Evaluation

The major environmental impacts were analyzed for the principal alternative.

The principal alternative includes construction at the existing WWTP site. The alternative also includes construction throughout the collection system to reduce I/I. The mitigation measures will be designed and implemented as required for the construction phase of the project, including dust control and erosion control activities, and restoration. Table 10 evaluates the impacts on various environmental features for Alternatives No. 3.

Table 10: Environmental Evaluation for Alternative No. 3

Environmental Feature	Alternative No. 3
Agricultural and Open Space Lands	NSI
Air Quality	T
Archeological Historic Sites	NSI
Drinking Water Supply Source	NA
Endangered or Threatened Species	NSI
Fauna and Flora Communities/ habitat	NSI
Floodplains	NSI
Great Lakes Shoreline	NA
Lakes and Streams	B
Parks and Recreational Facilities	NSI
Unique Features	NA
Wetlands	NSI
Wild & Scenic Rivers	NSI

Explanation of Abbreviations:

NSI: No Significant Impact
L: Low, But Measurable Impact
SI: Significant Impact
T: Temporary Impact
B: Beneficial
NA: Not Applicable

No substantial indirect, direct, and cumulative impacts were identified.

Implementability and Public Participation

The draft Project Plan will be placed on display a minimum of 30 days prior to the scheduled Public Hearing, which will be held on May 17, 2021.

A Public Hearing will be held to discuss project alternatives in terms of effectiveness, implementability, project costs, anticipated user rates and environmental Impacts. A copy of the public notice was published in the Lansing State Journal and Portland Review & Observer. Public input provided either by written comment or presented at the Public Hearing will be considered during the review of the principal alternatives. A transcript of the Public Hearing will be included in Appendix E in the final Project Plan.

Technical and Other Considerations

Infiltration and Inflow Removal

F&V completed an initial evaluation of infiltration and inflow entering the wastewater collection system, administered under the Stormwater Asset Management, and Wastewater (SAW) Grant. This initial evaluation confirmed that an excessive amount of infiltration is entering the system during the spring months and when river levels were high. The project planning grant funded additional sewer system evaluation, including smoke testing and closed-circuit televising (CCTV) to identify I/I sources.

The MFM work confirmed that specific areas within the collection system require rehabilitation to not only reduce excessive infiltration compounded by inflow during spring rains, but also to correct identified structural problems. The MFM report is included as Appendix D for reference.

Sludge and Residuals

Alternative No. 3 would modify the existing sludge management system. The primary digester would have a new mixing system and cover, as well as new pumps. Additional biosolids storage is also proposed to allow the City to more effectively manage its biosolids.

Industrial Pretreatment Program

Based on a review of industrial users and wastewater sampling, the City should consider whether an Industrial Pretreatment Program is needed to protect the publicly owned treatment works (POTW).

Growth Capacity

All the feasible alternatives were designed to meet the existing and 20-year wastewater needs. The selected population City growth rate of 0.05% annually was estimated using the best available information, including Census data and regional planning agency projections. As discussed previously, the 20-year design wastewater flow rates are based on these projections.

Reliability

Alternative No. 3 would provide treatment reliability. The alternative provides improved reliability of the sanitary collection system and reduces the potential for backups and SSOs by reducing the amount of clean water entering the system. The WWTP would have an expanded biological capacity to continue to meet the permit limits as the City grows.

Alternative Sites and Routings

There are no alternative sites or routings within the Principal Alternative. The sewer rehabilitation and replacement work in Alternative 3 will be carried out in portions of the existing sanitary sewers located within utility rights-of-way and existing easements. All treatment site construction activities will be carried out at the existing WWTP site.

Contamination at the Project Site

A review of EGLE's Environmental Mapper website shows no sites of environmental contamination within the City of Portland.

IV. RECOMMENDED ALTERNATIVE

A. Description of the Recommended Alternative

The objectives of the wastewater collection and treatment system improvements project are identified as:

- Ensure reliable wastewater service (collection and treatment) to customers.
- Rehabilitate/repair high priority areas of existing wastewater infrastructure.
- Reduce infiltration and inflow in the collection system.
- Ensure facilities can provide consistent reliable services and continued compliance with the NPDES discharge permit limitations.
- Minimize financial burden to the sewer system users.
- Minimize environmental impact during construction of the improvements project.
- Minimize environmental impact of WWTP operations and discharge.

Each feasible alternative that met the project objectives was reviewed for effectiveness, reliability, implementability, environmental impacts, and cost effectiveness.

The present worth analysis determined that Alternative No. 3 has the lowest capital cost, lowest OM&R costs, and the lowest net present worth. Alternative No. 3 – Optimize Existing Facilities with I/I Removal is the Recommended Alternative.

Additional discussion of Recommended Alternative No. 3 is presented below.

B. Description of Improvements

Collection System Improvements

The recommended collection system improvements focus on removing I/I from the highest priority areas to reduce the overall wastewater flow to the WWTP.

The MFM Study conducted in 2019, and the follow up smoke testing, and CCTV found that the majority of the I/I is entering the system at the trunk sewer adjacent to Grand River, and near the WWTP. The Recommended Alternative includes rehabilitation measures to mitigate the I/I from these areas. Several segments of pipe along the river on Water Street, Bridge Street and Kent Street must be replaced. The improvements project will also require cured in place pipe (CIPP) lining on several segments of trunk sewer and adjacent sections on Water Street and Kent Street. Manholes located in these sewer segments will also be rehabilitated. Figure A15 in Appendix A shows the locations for the planned sewer and manhole rehabilitation.

Additional portions of the sewer on Center Street, Church Street, Grand River, and Bristie will be replaced to address broken pipes, holes, and other structural defects in the sewer found during sewer televising.

<u>Non-SRF, Longer-Term Capital Improvement Plans</u>

The City developed an Asset Management Plan, funded by the SAW Grant. Through this plan, additional Capital Improvement Plans were developed to aid the longer-term rehabilitation needed on the collection system. These improvements include but are not limited to:

- Manhole repair, cleaning, lining, and replacements throughout the City
- Additional point repairs, lining, and replacements throughout the City

The maps highlighting the collection system rehab for the 3–5-year CIP and the 6-20-year CIP are shown in Figures A16 and A17 in Appendix A.

WWTP Improvements

Improvements are also planned at the WWTP as part of the Recommended Alternative. These improvements will allow for more reliable operation and alleviate health and safety issues. Refer to Figure A14 for a conceptual site plan of the proposed improvements.

Many improvements are required at the WWTP to extend the useful life of aging infrastructure and increase the biological capacity of the plant. To address issues with clogging of the raw sewage pumps, the pumps will be replaced with a non-clog type. In the raw sewage room, there are electrical issues that are being investigated. The raw sewage room would also be rehabilitated. The fine screen has bent rake stops and broken welds. Some of these screen issues have been addressed by WWTP staff but the screen will be inspected and have any repairs needed. The screen may also need to be replaced with a finer screen depending on the requirements of the new secondary treatment process.

The aeration blowers will be rebuilt or replaced to continue operation. The SCADA touchscreen in the blower building will be replaced as well. Alternate biological treatment methods will be considered to expand the biological capacity. These alternates include mixed bed biofilm reactors (MBBRs) and integrated fixed-film activated sludge (IFAS). These systems are very similar except for the IFAS system incorporating the existing return activated sludge system. These alternates will utilize the existing basins after they undergo concrete repairs.

Clarification of the effluent would continue to be provided by the secondary clarifiers. Secondary Clarifier No. 1 is hydraulically limited by the 8” effluent pipe. The clarifiers experience algae issues in the summer and have had to be cleaned weekly. The existing concrete tanks will have the concrete cracks repaired. The effluent piping will be replaced as necessary to address the hydraulic limitations. Launder covers and/or weir brushes will be implemented to mitigate algae accumulation.

The UV disinfection system needs some minor upgrades/repair. These improvements will be made during the project.

An effluent bypass pump connection will be installed to allow for effluent to be discharged during periods of high water in the river. The bypass pump connection will allow the City to connect its bypass pump to the discharge of the WWTP and force effluent to the river which would mitigate hydraulic backups into the treatment systems.

The existing polymer system is challenging to operate and maintain. The pumps are in poor condition and the non-potable water system clogs the pipes. There is no alternate system for water. The polymer system will be replaced and a water connection to the City water service will be made with a backflow preventer.

The Plant does not have sufficient biosolids storage. A 500,000-gallon tank will be constructed to increase storage capacity. The digesters also need improvements to optimize treatment. These improvements include a new digester mixing system, tank improvements/repairs, a new cover on the primary digester, new digester transfer pumps and piping, and new sludge recirculation pumps and piping.

The Laboratory/Administration Building does not have a sufficient HVAC system. A new system will be installed to adequately maintain building temperatures. The windows do not seal and will be replaced. Building renovations along with the addition of a break room, changing room, and shower will also be implemented.

A garage space is also needed to provide shelter for the City's vactor truck and service vehicle along with areas to store and maintain equipment. A new ferrous chloride feed system will also be implemented in this building to protect the storage tanks and related equipment from the elements and UV degradation.

The capacity of the WWTP will continue to be rated for an average design flow of 0.5 MGD and a maximum flow of 1.5 MGD. This design is easily expandable if the mobile home park is added to the collection system in the future. This will also give the City time to determine the actual impacts of the I/I correction projects in its collection system.

Pump station Improvements

The pump stations have some improvements that are necessary to continue reliable operation. All pump stations have outdated electrical and controls that need to be updated. The Riverside pump station has a building that will be removed and the pumps replaced with submersible pumps. The Canal St pump station is the only station that does not have a standby generator. A standby generator will be added. The Rindlehaven pump station has issues with the pumps clogging. The addition of a strainer basket would help reduce the amount of clogging.

Non-SRF, Longer-Term Capital Improvements Project

The SRF Project intends to address the most critical items first. The City has developed a longer-term Asset Management Plan, funded through the SAW grant program. Many of the identified Capital Improvements Plans for the WWTP are being addressed by this project plan. Additional high priority needs throughout the collection system should be addressed as part of a 5–10-year Capital Improvements Plan.

Controlling Factors

Factors that control the design of the proposed project include:

- Footprint and quantity of process equipment
- Maintenance required
- Operation reliability
- Automation
- Efficiency

The service area population is anticipated to experience nominal growth during the next 20 years. Projected wastewater needs were estimated using available Census data and projections for the City.

It is anticipated that the surface water discharge permit requirements for the improved facility would be similar to the requirements of the existing system. The existing permit limitations are summarized below.

Table 11: Existing NPDES Permit Limitations

Parameter	Effluent Limit (Monthly Avg, unless noted)
Carbonaceous Biochemical Oxygen Demand	104 lbs/day 25 mg/L
Biological Oxygen Demand	30 mg/L
Total Suspended Solids	130 lbs/day 30 mg/L
Total Phosphorus	1.0 mg/L
Fecal Coliform	200 ct/100 mL 400 ct/100 mL (7-day avg)
pH	6.5 - 9.0 (daily)
Dissolved Oxygen	4.0 mg/L, min (daily)
Total Residual Chlorine	0.038 mg/L (daily)
CBOD or BOD % Removal	85% (minimum)
Total Suspended Solids % Removal	85% (minimum)

Project Maps

A Project Location Map showing the location of proposed improvements is included in Appendix A, Figure A14.

Sensitive Features and Mitigation

It is not anticipated that the Recommended Alternative will have permanent negative impacts to sensitive areas (wetlands, floodplains, or habitat for endangered species). Proposed construction is limited to existing WWTP and pump station sites, and existing sewer infrastructure is within rights-of-way and easement locations. All work will be performed in accordance with necessary permit requirements. Figure A7 shows locations of wetlands. Figure A8 illustrate the flood zones developed by FEMA for the City.

Project Delivery Method

The City is in the process of reviewing the various methods for delivering the construction of its project. EGLE has published the State Revolving Fund and Drinking Water Revolving Fund Project Delivery Methods Guidance Document in November 2015. The various delivery methods allowed include Design Bid Build (DBB), Construction Management at Risk (CMAR), Fixed-Price Design-Build (FPDB), and Progressive Design-Build (PDB).

The City is reviewing each of the available methods. A comparison/summary of each are outlined below.

Design-Bid-Build (DBB)

Many public infrastructure projects are delivered using the DBB method. In the DBB method, an engineer works closely with the City and prepares the project bidding documents including the construction drawings and specifications.

General contractors submit bids based on the plans and specifications, and the lowest, responsible bidder is awarded the project. The general contractor pricing includes their subcontractors, or trade contractors, to perform specialized work such as electrical/controls, mechanical work, concrete work, etc. Typically, the engineering firm that developed the design provides construction observation and construction administration services during the construction phase. In this alternative there are three parties – the Owner, the engineer, and the general contractor.

The following advantages are offered by the DBB method:

- Well understood and accepted.
- Independent oversight of Builder.
- Open to Owner involvement during design.

The following disadvantages are offered by the DBB method:

- Pricing is not known until the design process is complete.
- Contractor selected based on low bid not on value, knowledge, and experience brought to the team.

Construction Management At-Risk (CMAR)

CMAR is similar to DBB in that the engineering/design contract is separate from the construction contract. However, in the CMAR method, a construction management firm (CM) is hired independently by the City before or early on in the design process. An engineer works closely with the City and the CM during the entire design process. The CM provides input to the engineer and Owner through the entire design process. The engineer prepares the construction drawings and specifications while the CM prepares the bidding documents and obtains pricing from their subcontractors and suppliers.

The CM develops a Guaranteed Maximum Price (GMP). In this alternative there are three parties, the Owner, the engineer, and the independently contracted CM firm.

The following advantages are offered by the CMAR method:

- Open to Owner involvement during design.
- Early integration of Builder.
- Provides early and continuous constructability review.
- Provides early certainty of costs.
- Pricing and design may be conducted in parallel.
- Reduced likelihood of claims compared to the DBB alternative.

The following disadvantages are offered by the CMAR method:

- Not a single source of responsibility.
- No legal obligation linking Designer to Builder.
- Potential for disputes, claims and change orders.

Fixed Price Design Build (FPDB)

Fixed Price Design Build (FPDB) is a delivery method where the Owner designates one firm, a design-builder (DB), under one contract for the design and construction of the project. The DB provides a fixed price based on a defined scope, requirements, and schedule; but before complete and detailed design documents have been prepared.

Owner involvement during the design process is typically very limited after the fixed price is accepted. The "book is closed" on pricing around the 30% mark of the design process.

This particular project is a rehabilitation of an existing treatment facility and appropriate pricing will probably be too high considering the risk to the contractors until 70 to 90% plans are developed. The City staff want to be involved throughout the entire design and construction process. Therefore, FPDB was not considered further for this project.

Progressive Design Build (PDB)

The PDB delivery method is similar to the CMAR method with one major distinction – the design-builder (DB) is under one contract for design and construction of the project. Therefore, the City has one single firm responsible for the design, schedule, construction, and warranty of the project. If there are issues that arise during construction or after construction, the City has one firm to address the issues.

During the latter part of the design phase, the DB prepares the bidding documents and obtains pricing from their subcontractors and suppliers on an open book basis.

If an agreement is reached on the pricing, the City will move forward collaboratively to construction. With such flexibility, the PDB method allows the Owner to improve the project outcome by participating directly in design decisions. In this alternative there are two parties – the Owner and the DB firm.

The following advantages are offered by the PBD delivery method:

- The Owner can transfer more risk to the DB since there is a single point of responsibility for the design, permitting, construction, and performance warranty of the project.
- Owner has involvement during the entire design and construction.
- Early integration of Builder.
- Provides early and continuous constructability review.
- Provides early certainty of costs.
- Pricing and design may be conducted in parallel.

Project Delivery Selection

The City may contract with a third party to act as the Owner's Advisor or use its own staff.

The City and the engineering firm that developed the Project Plan will have discussions regarding the available project delivery methods and advantages and disadvantages offered by each method to develop the preferred method for the City. Based on preliminary discussions, it is anticipated that the City will proceed with the Progressive Design Build delivery method for the project.

Estimated Schedule for Design and Construction

Table 12 on the following page presents the proposed project schedule, which follows the SRF FY2022 Q4 milestone schedule for PBD projects.

Table 12: Proposed Schedule for Design and Construction

Anticipated Date	Activity
June 2021	Submit Final SRF Project Plan to EGLE
October 2021	Proceed with Survey, Project Development, and Preliminary Design
January 2022	Begin Detailed Design
April 2022	Finalize Design and Submit Permit Applications
May 2022	EGLE Approval of Plans & Specs
August 2022	SRF Loan Closing
October 2022	Begin Construction
November 2023	Complete Construction
December 2023	O&M Manual, Startup Assistance, and Record Drawings

Cost Summary

Table 13 summarizes the estimated costs for the recommended alternative. Appendix C shows the breakdown of the project costs.

Table 13: Cost Summary of the Recommended Alternative

Description	Capital Costs	OM&R Costs PW	Salvage Value PW	NPW
Alternative No. 3 – Optimize Existing Facilities with I/I Removal	$10.12 M	$9.64 M	$2.17 M	$17.8 M

C. Authority to Implement the Selected Alternative

Implementation of a selected alternative is the responsibility of the City of Portland. The City Council will select an alternative at the May 17, 2021 public hearing. A copy of the resolution will be included in the Final Project Plan.

D. User Costs

The City of Portland funds sewer and wastewater treatment operations entirely through user fees. Revenue is generated based on two types of charges: a monthly ready-to-serve fee, and a service charge per 1,000 gallons.

Table 14 compares the anticipated monthly Sewer Bill for a typical residential customer using 4,000 gallons per month before and after implementing the Recommended Alternative project.

Table 14: Comparison of Monthly Sewer Increase for a typical resident user
(First Year of Operation, City of Portland Fiscal Year Ending June 30, 2024)

	FYE 2022 W/O Project	FYE 2022 With Project
Ready-to-Serve Fee (monthly equivalent)*	$ 19.29	$ 38.79
Service Charge (per 1000 gallons)	$ 5.19	$ 5.19
Total Estimated Monthly Bill:	$ 40.05	$ 59.55

Assumptions:
$10.67 million SRF Loan, 30 years at 2.125% interest.
Ready to Serve Fee is charged on a monthly basis. It is currently $19.29 per month per user, the Recommended Alternative increases it to $38.79 per quarter per user

The Recommended Alternative is anticipated to increase the monthly user cost for a typical resident by approximately $19.50 over the anticipated FY2022 charges without the project, assuming the City tax revenues apportioned to the sewer fund are not increased. The City will be working with a certified Municipal Financial Advisor to determine the best approach to using existing City tax revenue to offset a portion of the SRF Project. The $19.50 increase stated in this Project Plan is a “worst-case” scenario.

If Green Project Reserve (GPR) principal forgiveness is offered through the SRF program for projects funded in FY2022, it is anticipated that many components in the Recommended Alternative, which incorporates I/I reduction, anaerobic digestion improvements, and secondary treatment improvements, would qualify for such a subsidy. Application of GPR principal forgiveness would allow the loan amount to be reduced. The savings would be passed on to the sewer customer through a proportional reduction in the readiness-to-serve charge increase necessary to support the Project. Additional GPR information is included in Appendix H.

E. Disadvantaged Community

Part 53, of the NREPA, provides for several benefits to municipalities who meet the state’s criteria for disadvantaged community status. Those benefits include additional priority points and extended loan terms. Regardless of their status as a disadvantaged community, the City of Portland intends to secure a 30-year SRF loan.

F. Useful Life

The City of Portland intends to secure a 30-year SRF loan for the construction of the recommended alternative. The weighted useful life for the Alternative 3 has been calculated to be 30 years, which is equal to the 30-year loan period. The weighted useful life is the total of all calculated life values (each asset’s dollar value times its estimated useful life) divided by the total estimate of all the project dollars spent on those assets. The Useful Life Calculations for Alternative 3 are included in Appendix C. This analysis verifies that the components of the recommended alternative will cost-effectively address treatment requirements for the term of the loan. It is not anticipated that all of the equipment will last the entirety of the planning period. The City will have to annually reserve funds to account for some equipment replacement.

V. Evaluation of Environmental Impacts

A. Description of the Impacts

The potential beneficial and detrimental environmental impacts of the selected alternative are evaluated in this section of the project plan. The analyses of impacts are divided into direct, indirect, and cumulative impacts. Direct environmental impacts are those that are directly attributable to the construction and operation of the project. Indirect impacts are caused by the project but are removed in time and/or distance, and are often considered secondary in nature. Cumulative impacts are those impacts which increase in magnitude over time, or which result from individually minor, but collectively significant actions.

Beneficial or Adverse Impacts

A discussion of the full range of potential impacts (i.e., direct, indirect and cumulative) must identify the nature of the impacts in terms of both beneficial and adverse impacts. The following section will describe the positive and negative impacts resulting from the selected alternative with special emphasis on cultural or environmentally sensitive resources.

Short-Term and Long-Term Imacts

The analysis includes trade-offs between short-term uses and the maintenance enhancement of long-term productivity and vice versa.

Irreversible or Irretrievable Resources

The analysis of the environmental impacts also includes any irreversible commitments or use of irretrievable resources, such as the commitment of construction materials, energy, and land to the proposed project.

B. Analysis of Impacts

Direct Impacts

Direct impacts are the environmental impacts directly attributive to the construction and operation of the project. The City must consider impacts resulting from construction in areas which have not been previously disturbed. The effects of the proposed project are considered for each of the following environmental factors:

Historic, Archaeological, Geological, Cutural, or Recreational Areas

Communication with the State Historic Preservation Office and the appropriate Tribal Historic Preservation Officers will be completed by EGLE. It is not anticipated that any historic properties or tribally important sites will be affected by the proposed improvemnts.

Two properties/areas within the City are registered as Historic places; however no impacts to these properties are anticipated as part of the proposed project.

The proposed project construction is limited to the existing WWTP property and existing utility rights-of-way and easements, therefore minimal disturbances to the surrounding landscape is anticipated.

Natural Settings and Sensitive Ecosystems

As discussed previously, the recommended alternative includes CIPP rehabilitation of existing collection sewer pipes. This is a non-intrusive construction technique. Relatively short lengths of sanitary sewer replacement is also planned, however, this will be performed in existing utility rights-of-way and easements. Excavation and building construction is planned at the existing WWTP site. No long-term impacts to the natural setting of Project Area is anticipated.

Existing and Future Quality of Surface Water and Groundwater

The primary goal of the project is to improve the reliability of the existing wastewater service. The proposed project is not anticipated to cause negative changes to the quality of nearby surface or groundwaters.

Consumption of Materials, Land, Energy, and Construction & Operation

Construction materials, public funds, energy and manpower will be consumed to construct and operate the proposed improvements. No known shortage of these items exist, nor is it expected that a shortage of these items will result from implementing this project.

The only chemicals used during the construction would be fertilizers used after the seeding and mulching of disturbed areas from the construction operations.

Energy (both electrical and fossil fuels) will be used during the construction of the improvements. Electrical usage may increase slightly due to the larger blowers utilized by the biological treatment system and the addition of the mixing system for the biosolids storage tank.

Human, Social, and Economic Impacts

There will be no dislocation of people during the construction. Minimal impact to residents is anticipated because a majority of the construction work would occur at the WWTP site. Work at various sections of the collection system will be coordinated with planned road reconstruction projects, where feasible, to minimize traffic impacts.

Employment of some residents by the contractor(s) is a possibility for certain construction operations.

Construction and Operational Impacts

A minor impact on local traffic may occur during the construction of the proposed wastewater system improvements. During construction, equipment will increase local noise and dust levels during operations. There will be a short-term adverse impact on air quality during the construction phase due to dust and construction equipment emissions generated during the excavation operations.

Indirect Impacts

Indirect impacts are those caused by the proposed project but removed in time and/or distance. Indirect impacts are often secondary in nature and are generally caused by residential and/or commercial development made possible by the project.

Examples of indirect impacts include undirected growth including additional traffic, over-extended police and fire protection, or heavy financial burden on existing and future residents for the cost of the water system

facilities. It is not expected that the proposed project would cause any significant undirected growth that would result in changes to zoning, population density, or types of developments found throughout the City, including residential, commercial and industrial areas.

Transportation and infrastructure is already in place within the service area, and the proposed wastewater system improvements will only serve to enhance the existing City infrastructure.

The proposed project will not result in any changes in anticipated land use.

There are no anticipated indirect impacts due to changes to the natural setting or sensitive ecosystems or jeopardy to any endangered species resulting from potential secondary growth.

There are no anticipated changes in air or water quality stemming from any primary or potential secondary development as a result of the improvements since any additional commercial/industrial development would be subject to the City's existing zoning or land use requirements.

There will be minimal additional groundwater consumption over the useful life of the facility due to the projected annual growth of the City. In addition, no additional generation of wastes is anticipated as a result of the proposed project.

Cumulative Impacts

There are no anticipated cumulative impacts that would increase in magnitude over time or result from individually minor, but collectively significant actions of the project. There is no anticipated new infrastructure proposed in conjunction with the proposed wastewater system improvements.

VI. MITIGATION

A. General

Structural and non-structural measures which avoid, eliminate, or mitigate adverse impacts on the environment need to be identified in the project plan. The cost of mitigation was considered during the financial analysis and is included in the unit costs and lump sum prices developed during the capital cost evaluation for the principal alternatives.

The structural measures involve the specific design and construction of the improvements while the non-structural measures involve regulatory, institutional, governmental or private plans, policies or regulations of the City. Mitigation of short-term, long-term, and indirect impacts must be considered in the project plan.

B. Short-Term Construction-Related Mitigation

Traffic and Safety Hazard Control

Traffic control and maintaining access to homes and businesses will be the responsibility of the Contractor. However, access to all homes and businesses will be maintained and emergency vehicle access will be ensured throughout construction. Residents will be notified when construction work is scheduled in their area. Traffic detour signs and flag control will be incorporated to provide non-local traffic with the information they need to navigate the construction site and to travel safely.

Construction site safety is the responsibility of the Contractor. The Contractor will be required to have only trained persons performing all phases of the work. The Contractor will also be required to comply with the Occupational Safety & Health Act (OSHA), including using back up alarms on all equipment, having employees trained in hazard control, and maintaining materials safety data sheets (SDS) for materials that may be used or handled by construction personnel.

Dust Control

Construction activities will result in increased dust in the vicinity of the construction sites during the length of the proposed construction. Mitigation measures to minimize the negative effect of dust on residents and construction workers will be defined in the project specifications. It is anticipated that dust control will be provided by the application of water and/or dust palliative during dry and dusty periods. The Contractor will be required to control dust in accordance with methods described in the project specifications.

Noise Control

Noise levels will increase temporarily during construction of the proposed project. Construction activities will only be allowed during the hours approved by the City, and would be subject to all local noise control ordinances. Construction workers and site visitors may be required to wear earplugs to minimize the effects of long-term noise during the construction operations.

Soil Erosion and Sedimentation Control

The Contractor will be required to obtain a soil erosion and sedimentation control permit from the local agency prior to the start of the work. It is anticipated that mitigation measures that may be utilized will include silt fence, straw bales, rip rap, geotextile fabric, and other such methods, as appropriate.

Restoration of Disturbed Areas

As previously stated, the project specifications will require the Contractor to provide and maintain access at all times to homes and businesses. Traffic control, including signage and flag persons must be provided. Restoration of disturbed areas will also be defined in the specifications. Restoring disturbed lawn areas, roadways, existing utilities, etc. will be completed in a timely fashion and in accordance with the project specifications.

C. Mitigation of Long-Term Impacts

General Construction

Mitigation measures would be developed to ensure that sensitive environments do not suffer permanent damage. Every effort will be made to avoid potential long-term or irreversible adverse impacts during the construction of the wastewater system improvements.

The construction work at the WWTP will incorporate “best management practice” methods for installing pipelines or disturbing the earth. Wetland, floodplain, and inland stream mitigation would be handled through the permit process. If impacts cannot be avoided, wetland mitigation measures will be used. The design and project specifications will include the proper use of physical measures to reduce soil erosion to a manageable level and any disturbed slope areas will be immediately seeded, mulched and/or sodded to prevent soil erosion and/or sedimentation.

Siting Decisions

All WWTP construction activities proposed by the Recommended Alternative are located within the existing WWTP site. Sewer replacement and rehabilitation is expected to be contained within existing utility right-of-way and easement areas. Where traffic must be re-routed for construction, the City will work closely with MDOT and state authorities to develop detours within urban areas.

Operational Impacts

The treatment site is located on Morse Drive, set back at least 1,100 feet from nearby residences and largely removed from the populated areas to provide both a visual buffer and dissipation of odors. The WWTP is located adjacent to the Bogue Flats Recreation Area baseball fields.

The potential impact of effluent discharge has been investigated, and permit limits have been issued by EGLE that must be met by the treatment process before discharge and are protective of the environment.

D. Mitigation of Indirect Impacts

Master Plan and Zoning

The most effective way of mitigating unrestricted growth in any community is proactive creation of zoning districts and effective enforcement of that zoning. The City has zoning in place, and officials have historically had a significant role in the development of the City. Unrestricted growth is not anticipated with or without the proposed project.

VII. PUBLIC PARTICIPATION

A. Public Meetings on Project Alternatives

A Public Hearing for the SRF Project Plan will be held on May 17, 2021 at the Portland City Hall to discuss the need for the project, principal alternatives, environmental impacts, description of the Recommended Alternative and associated cost estimates and user charge, and schedule of the proposed project.

A copy of the public hearing transcript and presentation will be included in the final Project Plan.

B. The Formal Public Hearing

A formal public hearing on project alternatives and user costs will be held on May 17, 2021 at the Portland City Hall.

Public Hearing Advertisement

The Public Hearing was advertised in a local newspaper on April 11, 2021, 36 days prior to the hearing date, in accordance with SRF guidelines. Copies of the Draft Project Plan detailing the proposed project were available for inspection on April 16, 2021 at the Portland City Offices. The public hearing advertisement is included in Appendix E.

Public Hearing Transcript

A verbatim transcript of the public hearing, recorded by a certified court reporter, will be included in Appendix E of the Final Project Plan.

Public Hearing Contents

The following items will be discussed at the public hearing:

- Project background.
- A description of the wastewater treatment and collection system needs and problem areas.
- A description of the principal alternatives considered.
- A breakdown of capital costs and OM&R costs for each of the principal alternatives.
- Proposed method of financing.
- Comparison of environmental impacts for the principal alternatives.
- Recommended Alternative.
- Proposed monthly user costs for the implementation of the Recommended Alternative for the average residential customer.

Public Hearing Comments Received and Answered

The comments received at the Public Hearing will be added in this section of the Final Project Plan.

C. Adoption of the Project Plan

The official period for receiving comments will be ended at the close of the formal public hearing. After the close of the public comment period, the recommended alternative will be selected for implementation by the City Council. A copy of the City's resolution to adopt the Project Plan and to implement the selected alternative will be included in Appendix E.

APPENDIX A
MAPS AND FIGURES

PREPARED FOR:

Portland Michigan
CITY OF TWO RIVERS

FLEIS&VANDENBRINK
DESIGN. BUILD. OPERATE.

Project No.: 848390

Wastewater Treatment Plant

Canal Street Lift Station

Riverside Lift Station

Rindlehaven Lift Station

FLEIS&VANDENBRINK
DESIGN. BUILD. OPERATE.

- Lift Station
- Manhole
- Pressurized Main
- Gravity Main

Sanitary System

City of Portland, Michigan

DRAWN BY	DATE
SWL	3/8/2021
PROJECT NO.	SCALE
816480	1:16,000

FILE LOCATION
S:\Client Info\Michigan\Ionia County\City of Portland\GIS Data - Project 816480\Maps\Pdf\SanitarySystemMap_11x17.pdf

SOURCES
F&V, MGDL, Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community

N

0 500 1,000
SCALE IN FEET

PAGE
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DRAFT

Map 3
Existing Land Use

City of Portland, Michigan

January 8, 2015

LEGEND

- Agricultural
- Single Family Residential
- Multiple Family Residential
- Manufactured Home Park
- Commercial
- Industrial
- Recreation/ Open Space
- Public/ Quasi-Public
- Vacant
- River
- RiverTrail
- City Boundary

Portland Township

Portland Township

Danby Township

STEFFES ST
SCHOOL DR
TIELIES AVE
GROSS ST
LYONS RD
IONIA ST
MAYNARD RD
GRAND RIVER
CARL ST
DETROIT ST
GRAPE ST
N WEST ST
CHURCH ST
PLANT ST
N WATER ST
MORSE DR
BLOSSOM DR
DONNA DR
BETHEL DR
CENTER ST
ALBRO ST
QUARTER LINE ST
PLEASANT ST
DIVINE HWY
W GRAND RIVER AVE
LOOKING GLASS AVE
LOOKING GLASS RIVER
GREEN ST
PARK ST
GROVE ST
W BRIDGE ST
BARR ST
UNION ST
MARSHALL AVE
CANAL ST
I ST
MARKET ST
MAPLE ST
ELM ST
SMITH ST
ACADEMY ST
S LINCOLN ST
E BRIDGE ST
N GRANT ST
JAMES ST
CAROLINE ST
REBECCA ST
NEWTON ST
E GRAND RIVER AVE
COLEMAN AVE
BRISTLE ST
ROWE AVE
RINDLE BLUFF DR
LILLIAN LN
JAMES ST
GLAND ST
E ORCHARD ST
HILL ST
BRUSH ST
S GRANT ST
KEARNEY ST
S EAST ST
VESSEY ST
RIVERSIDE DR
KENT ST
KNOX AVE
CRESCENT DR
S VIRGINIA AVE
SFORZA AVE
OAK ST
OKEMOS RD
96
PARKER DR
AMERICAN WAY
CUTLER RD
HIDDENWOOD LN
E GRAND RIVER AVE

FEET
0 1,000 2,000

N

McKenna Associates

Map Feature Source: Ionia County, 2014

DRAFT

Map 8
Future Land Use

City of Portland, Michigan

September 11, 2014

LEGEND

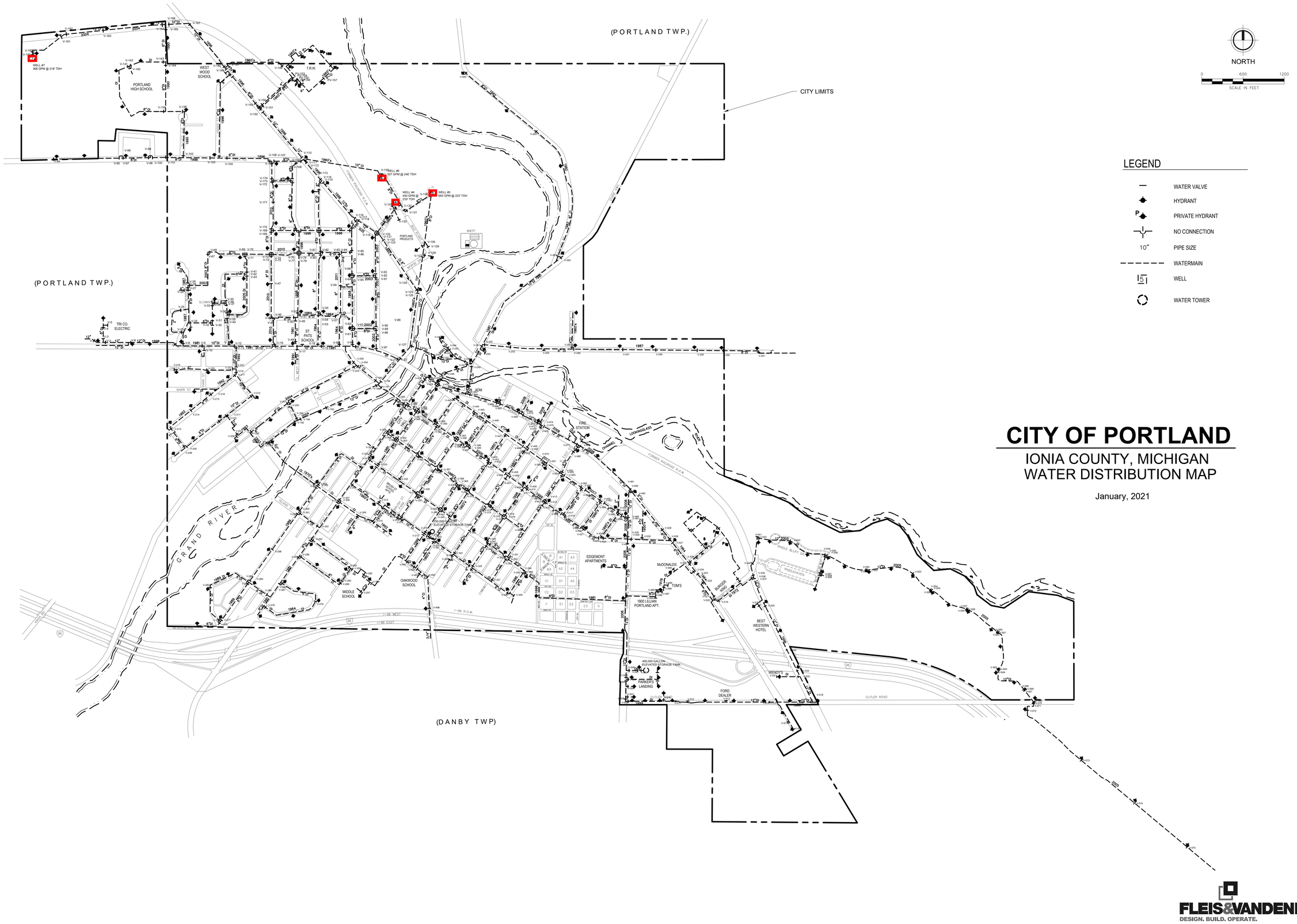
- Single Family Residential
- Flexible Residential
- Central Business District
- Convenience Commercial
- Neighborhood Commercial
- Mixed Use
- Public/ Quasi-Public
- Industrial
- Recreation/Open Space
- River
- RiverTrail
- City Boundary

FEET 0 1,000 2,000

N

McKenna ASSOCIATES

Map Feature Source: Iona County, 2014



LEGEND

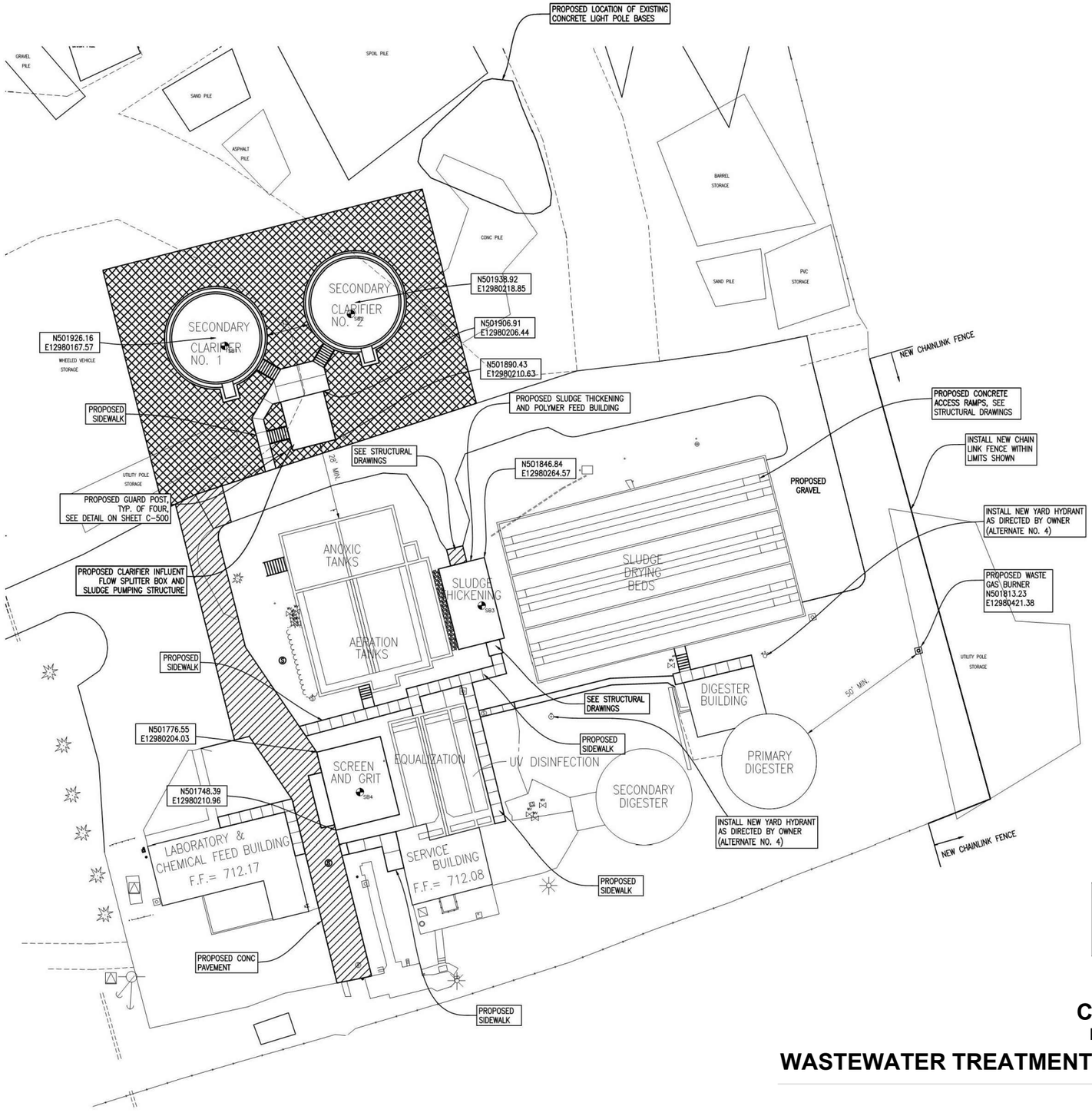
- WATER VALVE
- HYDRANT
- PRIVATE HYDRANT
- NO CONNECTION
- 10" PIPE SIZE
- WATERMAIN
- WELL
- WATER TOWER

CITY OF PORTLAND

IONIA COUNTY, MICHIGAN
WATER DISTRIBUTION MAP

January, 2021

FLEIS&VANDENBRINK
DESIGN. BUILD. OPERATE.



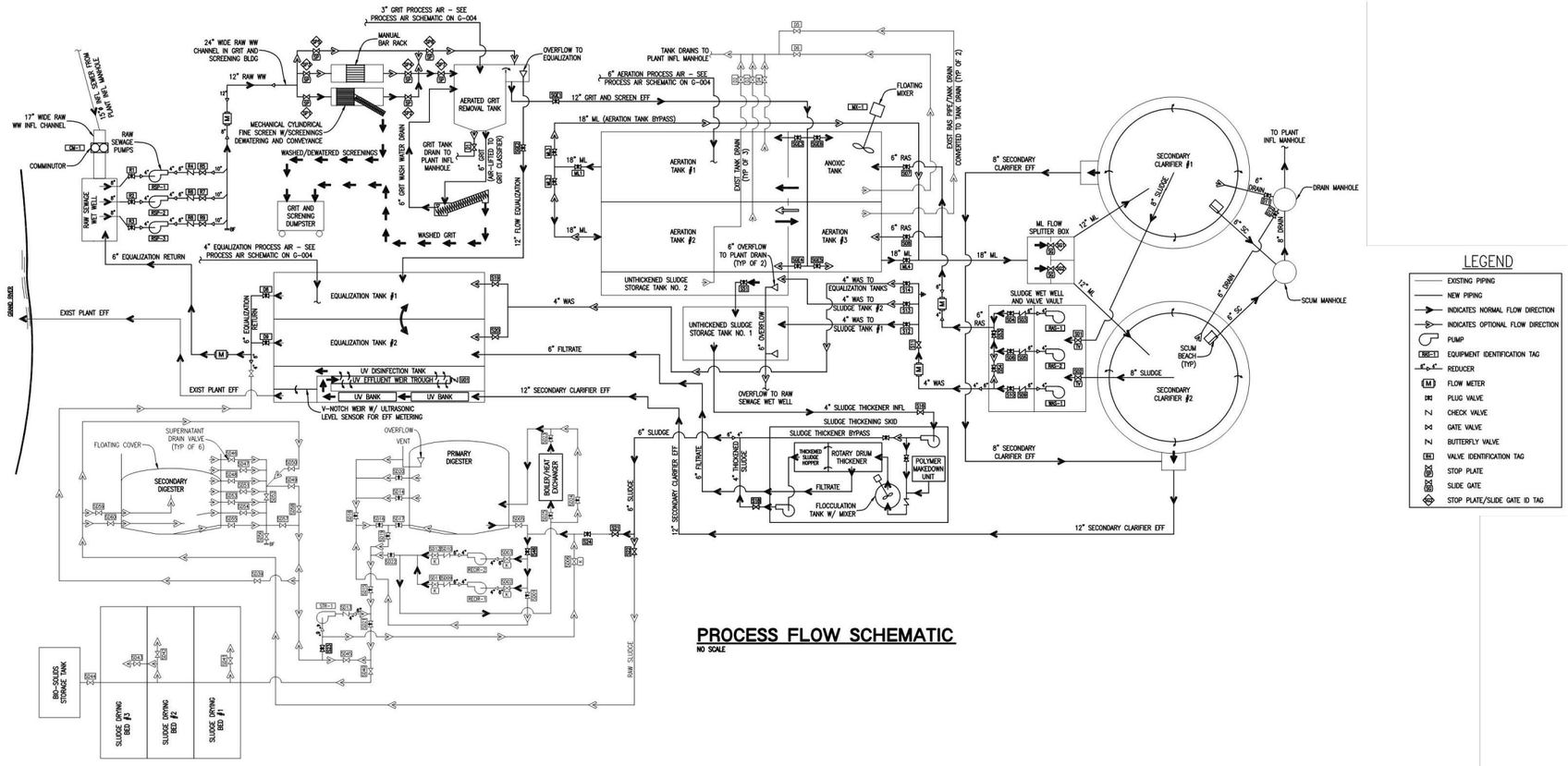
NORTH

THIS SITE PLAN DRAWING FOR REFERENCE PURPOSES ONLY, TAKEN FROM WASTEWATER TREATMENT PLANT IMPROVEMENTS, ENGINEER C2AE, DATED OCTOBER 2012.

CITY OF PORTLAND
IONIA COUNTY, MICHIGAN
WASTEWATER TREATMENT PLANT SITE PLAN

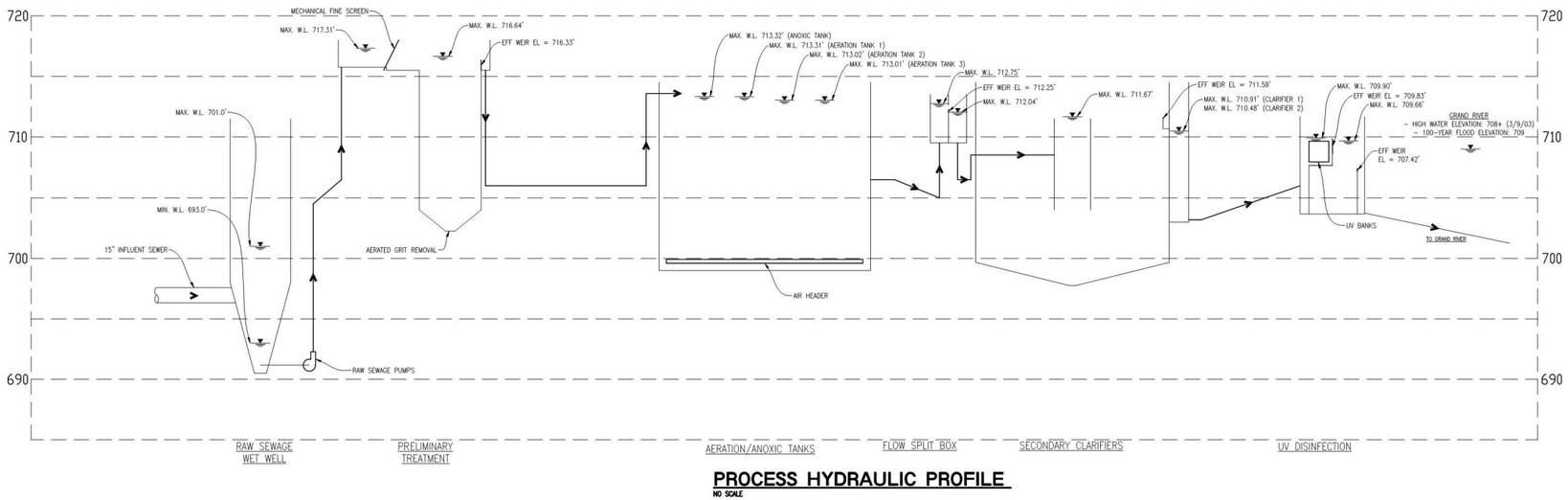
F&V PROJECT NO. 817404

F&V



PROCESS FLOW SCHEMATIC

NO SCALE



PROCESS HYDRAULIC PROFILE

NO SCALE

LEGEND

- EXISTING PIPING
- NEW PIPING
- INDICATES NORMAL FLOW DIRECTION
- INDICATES OPTIONAL FLOW DIRECTION
- PUMP
- EQUIPMENT IDENTIFICATION TAG
- REDUCER
- FLOW METER
- PLUG VALVE
- CHECK VALVE
- GATE VALVE
- BUTTERFLY VALVE
- VALVE IDENTIFICATION TAG
- STOP PLATE
- SLIDE GATE
- STOP PLATE/SLIDE GATE ID TAG

THIS PROCESS DRAWING FOR REFERENCE PURPOSES ONLY, TAKEN FROM WASTEWATER TREATMENT PLANT IMPROVEMENTS, ENGINEER C2AE, DATED OCTOBER 2012.

CITY OF PORTLAND

IONIA COUNTY, MICHIGAN

PROCESS FLOW SCHEMATIC & HYDRAULIC PROFILE

F&V PROJECT NO. 817404

F&V

M:\Proj\81500\81800\816480 Portland SAW\Cad\Fig\816480_FIG3.dwg, 3/30/2020 3:00:21 PM, davet, DWG To PDF.pc3

U.S. Fish and Wildlife Service
National Wetlands Inventory

City of Portland Wetlands

March 5, 2021

Wetlands

- Estuarine and Marine Deepwater
- Estuarine and Marine Wetland
- Freshwater Emergent Wetland
- Freshwater Forested/Shrub Wetland
- Freshwater Pond
- Lake
- Other
- Riverine

National Flood Hazard Layer FIRMette

84°54'27"W 42°52'45"N

84°53'49"W 42°52'19"N

Feet 1:6,000

0 250 500 1,000 1,500 2,000

Basemap: USGS National Map: Orthoimagery: Data refreshed October, 2020

Legend

SEE FIS REPORT FOR DETAILED LEGEND AND INDEX MAP FOR FIRM PANEL LAYOUT

SPECIAL FLOOD HAZARD AREAS
- Without Base Flood Elevation (BFE) *Zone A, V, A99*
- With BFE or Depth *Zone AE, AO, AH, VE, AR*
- Regulatory Floodway

OTHER AREAS OF FLOOD HAZARD
- 0.2% Annual Chance Flood Hazard, Areas of 1% annual chance flood with average depth less than one foot or with drainage areas of less than one square mile *Zone X*
- Future Conditions 1% Annual Chance Flood Hazard *Zone X*
- Area with Reduced Flood Risk due to Levee. See Notes. *Zone X*
- Area with Flood Risk due to Levee *Zone D*

OTHER AREAS
- NO SCREEN Area of Minimal Flood Hazard *Zone X*
- Effective LOMRs
- Area of Undetermined Flood Hazard *Zone D*

GENERAL STRUCTURES
- Channel, Culvert, or Storm Sewer
- Levee, Dike, or Floodwall

OTHER FEATURES
- 20.2 Cross Sections with 1% Annual Chance
- 17.5 Water Surface Elevation
- Coastal Transect
- 513 Base Flood Elevation Line (BFE)
- Limit of Study
- Jurisdiction Boundary
- Coastal Transect Baseline
- Profile Baseline
- Hydrographic Feature

MAP PANELS
- Digital Data Available
- No Digital Data Available
- Unmapped

N

The pin displayed on the map is an approximate point selected by the user and does not represent an authoritative property location.

This map complies with FEMA's standards for the use of digital flood maps if it is not void as described below. The basemap shown complies with FEMA's basemap accuracy standards

The flood hazard information is derived directly from the authoritative NFHL web services provided by FEMA. This map was exported on 3/5/2021 at 9:39 AM and does not reflect changes or amendments subsequent to this date and time. The NFHL and effective information may change or become superseded by new data over time.

This map image is void if the one or more of the following map elements do not appear: basemap imagery, flood zone labels, legend, scale bar, map creation date, community identifiers, FIRM panel number, and FIRM effective date. Map images for unmapped and unmodernized areas cannot be used for regulatory purposes.

UNITED STATES
DEPARTMENT OF THE INTERIOR
GEOLOGICAL SURVEY

MICHIGAN
STATE HIGHWAY DEPARTMENT
CHARLES M. ZIEGLER
STATE HIGHWAY COMMISSIONER

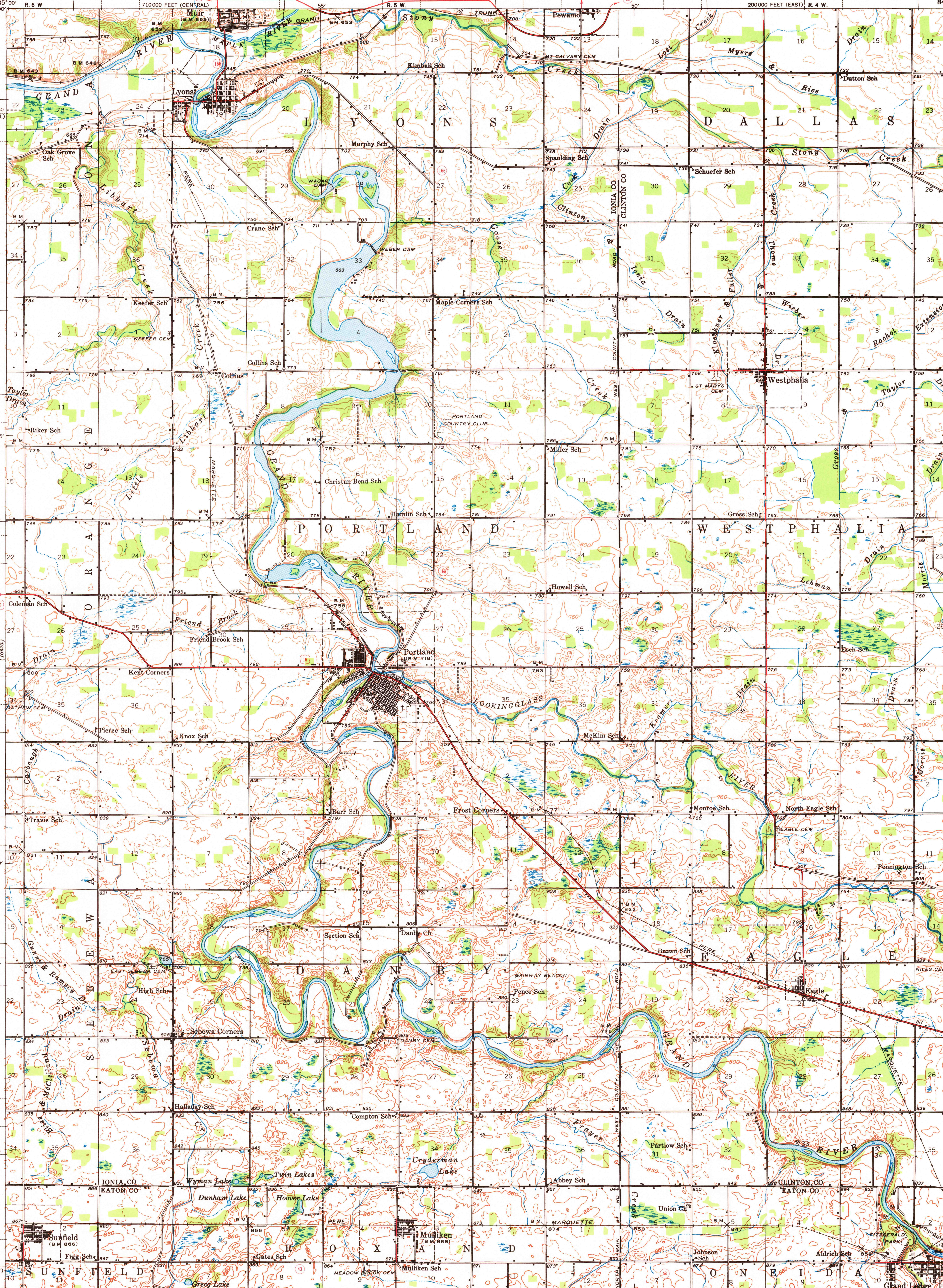
MICHIGAN
PORTLAND QUADRANGLE
15 MINUTE SERIES

LOWELL 22 MI.
IONIA 6.7 MI.

HUBBARDSTON 6.5 MI.

ST. JOHNS 14 MI.
FOWLER 5 MI.

(Perrinton)



GRAND RAPIDS 36 MI.
JUNC. STATE NO. 14 3.7 MI.

(Ionia)

(DeWitt)

JUNC. STATE NO. 100 9.5 MI.
LANSING 11.5 MI.

HASTINGS 22 MI.
JUNC. STATE NO. 50 2.6 MI.

GRESHAM 7.6 MI.

(Charlotte)

NEEDMORE 4.6 MI.
CHARLOTTE 13.8 MI.

(Lansing)

LANSING 11 MI.

Mapped by the Geological Survey
1945

JUNC. STATE NO. 50 2 MI.

ROAD CLASSIFICATION
Heavy-duty — Light-duty
Medium-duty — Unimproved dirt
U. S. Route — State Route

TRUE NORTH
MAGNETIC NORTH
1½°
APPROXIMATE MEAN DECLINATION, 1945

SCALE 1:62500
1 ½ 0 1 2 3 4 MILES
3000 0 3000 6000 9000 12000 15000 18000 21000 FEET
1 .5 0 1 2 3 4 5 KILOMETERS

Contour interval 20 feet
10 foot contours in dashed lines
Datum is mean sea level

INTERIOR—GEOLOGICAL SURVEY, WASHINGTON, D.C.

Polyconic projection. 1927 North American datum
5000 yard grid based on U. S. zone system, B
10000 foot grids based on Michigan (East) and
Michigan (Central) rectangular coordinate systems.

JUL 24 1973

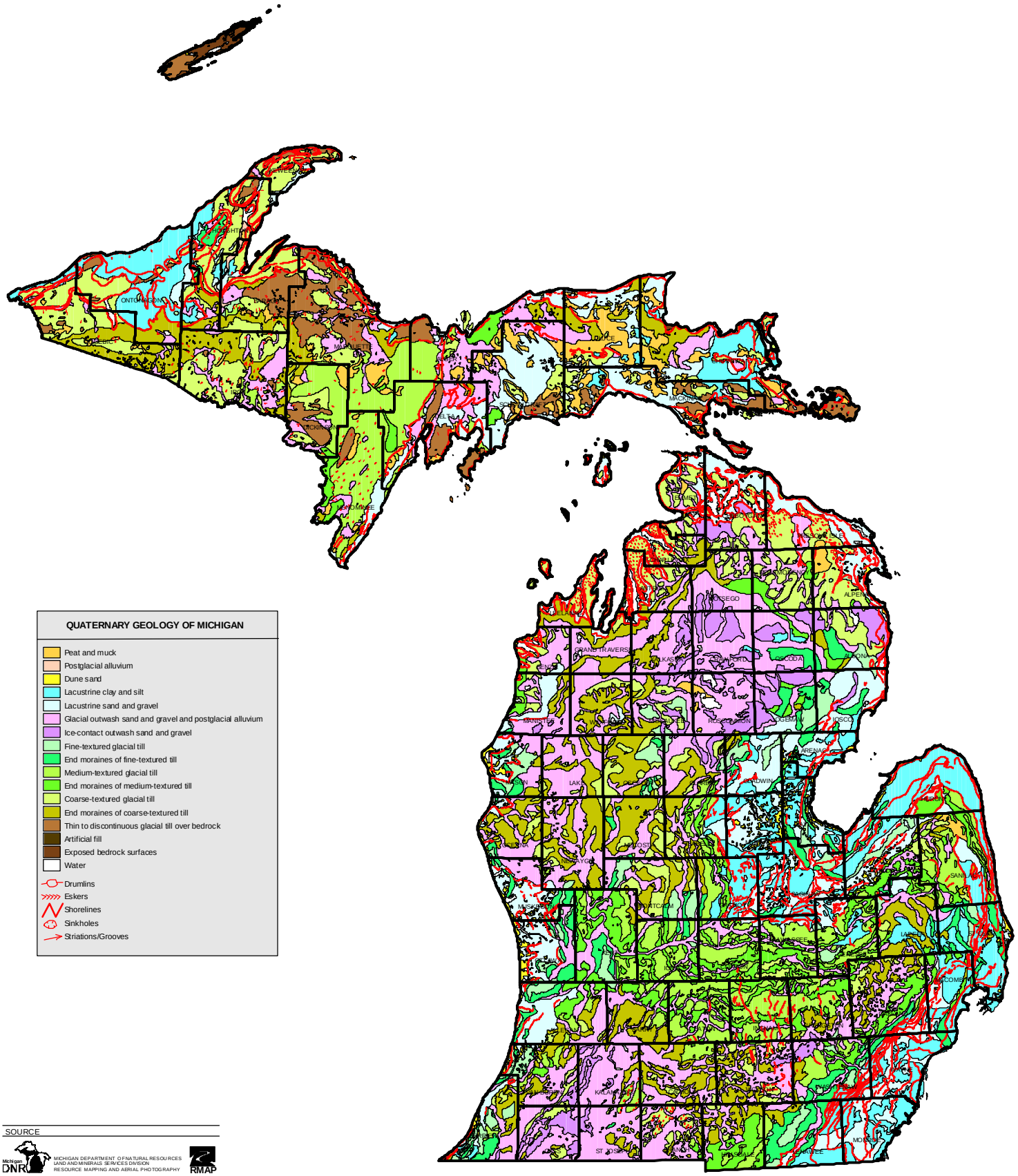
PORTLAND, MICH.
Edition of 1946

N4245—W8445/15

1/0

1080

1982 QUATERNARY GEOLOGY OF MICHIGAN



SOURCE

MICHIGAN DEPARTMENT OF NATURAL RESOURCES
LAND AND MINERALS SERVICES DIVISION
RESOURCE MAPPING AND AERIAL PHOTOGRAPHY

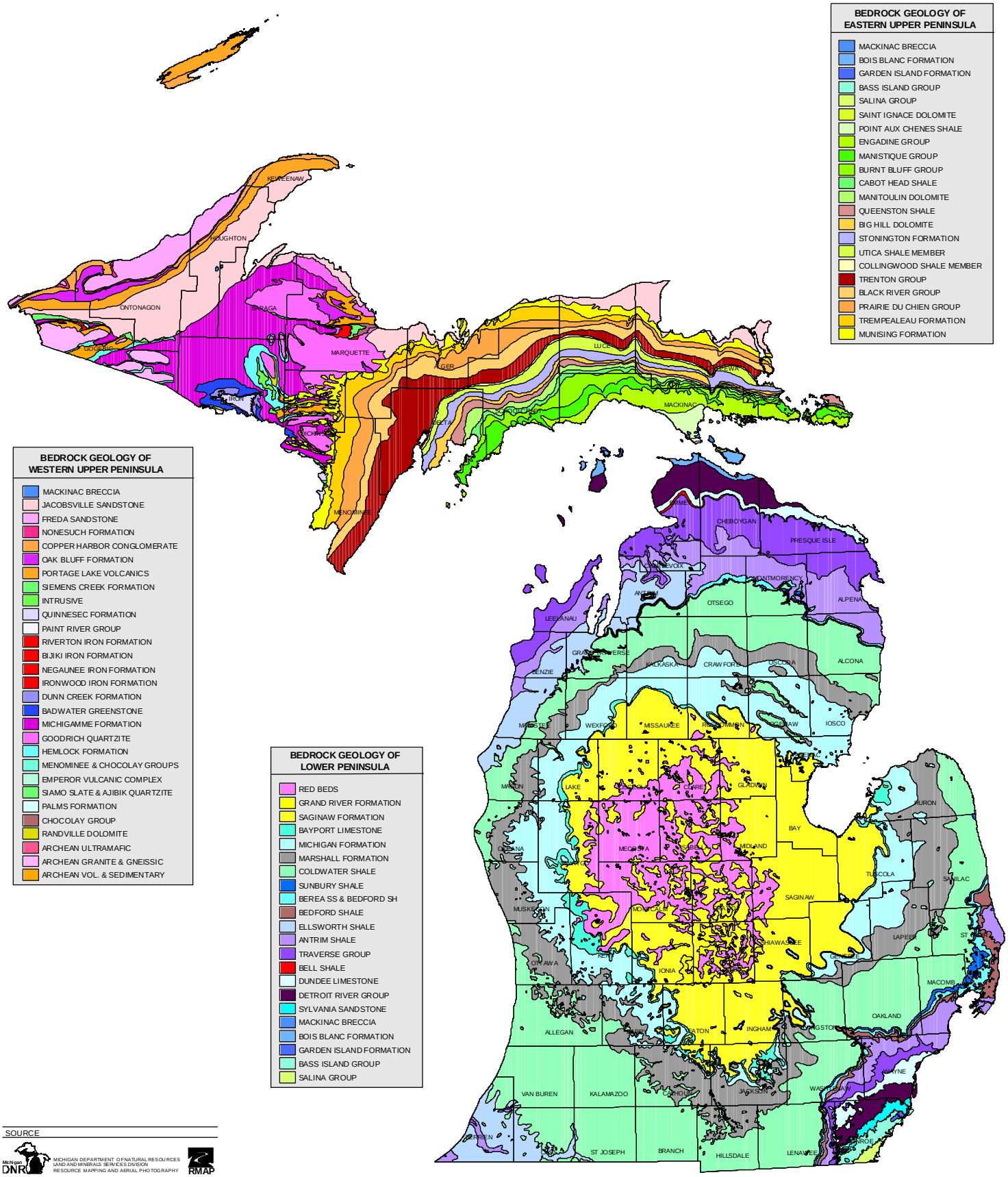
Michigan Resource Information System
Part 609, Resource Inventory, of the Natural Resources and Environmental Protection Act, 1994 PA 451, as amended.

Automated from "Quaternary Geology of Michigan", 1982, 1:500,000 scale, which was compiled by W. R. Farrand, University of Michigan and the Michigan Department of Environmental Quality, Geological Survey Division.

Date 11/12/99

0 20 40 Miles

1987 BEDROCK GEOLOGY OF MICHIGAN



BEDROCK GEOLOGY OF EASTERN UPPER PENINSULA

- MACKINAC BRECCIA
- BOIS BLANC FORMATION
- GARDEN ISLAND FORMATION
- BASS ISLAND GROUP
- SALINA GROUP
- SAINT IGNACE DOLOMITE
- POINT AUX CHENES SHALE
- ENGADINE GROUP
- MANISTIQUE GROUP
- BURNT BLUFF GROUP
- CABOT HEAD SHALE
- MANITOULIN DOLOMITE
- QUEENSTON SHALE
- BIG HILL DOLOMITE
- STONINGTON FORMATION
- UTICA SHALE MEMBER
- COLLINGWOOD SHALE MEMBER
- TRENTON GROUP
- BLACK RIVER GROUP
- PRAIRIE DU CHIEN GROUP
- TREMPEALEAU FORMATION
- MUNISING FORMATION

BEDROCK GEOLOGY OF WESTERN UPPER PENINSULA

- MACKINAC BRECCIA
- JACOBSVILLE SANDSTONE
- FREDA SANDSTONE
- NONESUCH FORMATION
- COPPER HARBOR CONGLOMERATE
- OAK BLUFF FORMATION
- PORTAGE LAKE VOLCANICS
- SIEMENS CREEK FORMATION
- INTRUSIVE
- QUINNESEC FORMATION
- PAINT RIVER GROUP
- RIVERTON IRON FORMATION
- BIJIKI IRON FORMATION
- NEGAUNEE IRON FORMATION
- IRONWOOD IRON FORMATION
- DUNN CREEK FORMATION
- BADWATER GREENSTONE
- MICHIGAMME FORMATION
- GOODRICH QUARTZITE
- HEMLOCK FORMATION
- MENOMINEE & CHOCOLAY GROUPS
- EMPEROR VULCANIC COMPLEX
- SIAMO SLATE & AJIBIK QUARTZITE
- PALMS FORMATION
- CHOCOLAY GROUP
- RANDVILLE DOLOMITE
- ARCHEAN ULTRAMAFIC
- ARCHEAN GRANITE & GNEISSIC
- ARCHEAN VOL. & SEDIMENTARY

BEDROCK GEOLOGY OF LOWER PENINSULA

- RED BEDS
- GRAND RIVER FORMATION
- SAGINAW FORMATION
- BAYPORT LIMESTONE
- MICHIGAN FORMATION
- MARSHALL FORMATION
- COLDWATER SHALE
- SUNBURY SHALE
- BEREA SS & BEDFORD SH
- BEDFORD SHALE
- ELLSWORTH SHALE
- ANTRIM SHALE
- TRAVERSE GROUP
- BELL SHALE
- DUNDEE LIMESTONE
- DETROIT RIVER GROUP
- SYLVANIA SANDSTONE
- MACKINAC BRECCIA
- BOIS BLANC FORMATION
- GARDEN ISLAND FORMATION
- BASS ISLAND GROUP
- SALINA GROUP

SOURCE

Michigan DNR — MICHIGAN DEPARTMENT OF NATURAL RESOURCES
LAND AND MINERALS SERVICES DIVISION
RESOURCE MAPPING AND AERIAL PHOTOGRAPHY
RMAP

Michigan Resource Information System
Part 609, Resource Inventory, of the Natural Resources and Environmental Petection Act, 1994 PA 451, as amended.

Automated from "Bedrock Geology of Michigan," 1987, 1:500,000 scale, which was compiled from a variety of sources by the Michigan Department of Environmental Quality, Geological Survey Division.

Date 11/12/99

0 20 40 Miles

Custom Soil Resource Report
Soil Map

MAP LEGEND

Area of Interest (AOI)
- Area of Interest (AOI)

Soils
- Soil Map Unit Polygons
- Soil Map Unit Lines
- Soil Map Unit Points

Special Point Features
- Blowout
- Borrow Pit
- Clay Spot
- Closed Depression
- Gravel Pit
- Gravelly Spot
- Landfill
- Lava Flow
- Marsh or swamp
- Mine or Quarry
- Miscellaneous Water
- Perennial Water
- Rock Outcrop
- Saline Spot
- Sandy Spot
- Severely Eroded Spot
- Sinkhole
- Slide or Slip
- Sodic Spot
- Spoil Area
- Stony Spot
- Very Stony Spot
- Wet Spot
- Other
- Special Line Features

Water Features
- Streams and Canals

Transportation
- Rails
- Interstate Highways
- US Routes
- Major Roads
- Local Roads

Background
- Aerial Photography

MAP INFORMATION

The soil surveys that comprise your AOI were mapped at 1:15,800.

Warning: Soil Map may not be valid at this scale.

Enlargement of maps beyond the scale of mapping can cause misunderstanding of the detail of mapping and accuracy of soil line placement. The maps do not show the small areas of contrasting soils that could have been shown at a more detailed scale.

Please rely on the bar scale on each map sheet for map measurements.

Source of Map: Natural Resources Conservation Service
Web Soil Survey URL:
Coordinate System: Web Mercator (EPSG:3857)

Maps from the Web Soil Survey are based on the Web Mercator projection, which preserves direction and shape but distorts distance and area. A projection that preserves area, such as the Albers equal-area conic projection, should be used if more accurate calculations of distance or area are required.

This product is generated from the USDA-NRCS certified data as of the version date(s) listed below.

Soil Survey Area: Ionia County, Michigan
Survey Area Data: Version 17, Jun 2, 2020

Soil map units are labeled (as space allows) for map scales 1:50,000 or larger.

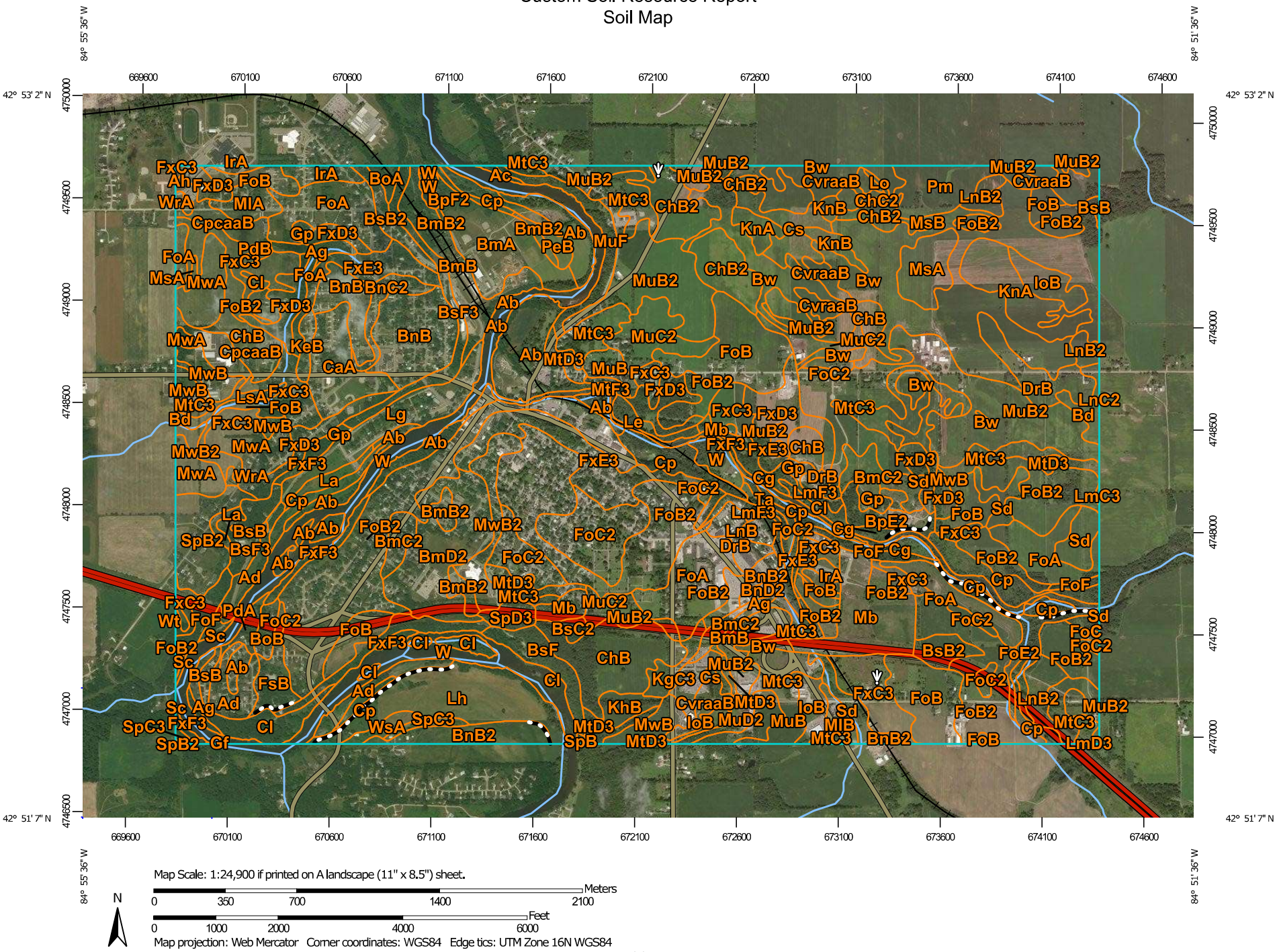
Date(s) aerial images were photographed: Jul 1, 2011—Mar 10, 2017

The orthophoto or other base map on which the soil lines were compiled and digitized probably differs from the background imagery displayed on these maps. As a result, some minor shifting of map unit boundaries may be evident.

Map Unit Legend

Map Unit Symbol	Map Unit Name	Acres in AOI	Percent of AOI
Ab	Abscota loamy sand	23.0	13.3%
BmA	Boyer loamy sand, 0 to 2 percent slopes	40.6	23.5%
BmB	Boyer loamy sand, 2 to 6 percent slopes	27.1	15.7%
BmB2	Boyer loamy sand, 2 to 6 percent slopes, moderately eroded	3.0	1.7%
BnB	Boyer sandy loam, 2 to 6 percent slopes	13.6	7.9%
BnC2	Boyer sandy loam, 6 to 12 percent slopes, moderately eroded	3.3	1.9%
BpF2	Boyer loamy sand, 25 to 40 percent slopes, moderately eroded	1.3	0.7%
BsB2	Boyer and Spinks loamy sands, 2 to 6 percent slopes, moderately eroded	4.2	2.4%
BsF3	Boyer and Spinks loamy sands, 25 to 40 percent slopes, severely eroded	7.2	4.1%
Cp	Cohoctah-Sloan loams	3.2	1.9%
FoA	Fox sandy loam, 0 to 2 percent slopes	0.0	0.0%
FxE3	Fox sandy clay loam, 18 to 25 percent slopes, severely eroded	6.3	3.7%
MtC3	Miami clay loam, 6 to 12 percent slopes, severely eroded	3.7	2.1%
MtD3	Miami clay loam, 12 to 18 percent slopes, severely eroded	0.0	0.0%
MuB2	Wawasee loam, 2 to 6 percent slopes, moderately eroded	5.5	3.2%
MuF	Miami loam, 25 to 40 percent slopes	11.6	6.7%
PeB	Perrin sandy loam, 2 to 6 percent slopes	4.2	2.4%
W	Water	14.7	8.5%
Totals for Area of Interest		**172.8**	**100.0%**

Custom Soil Resource Report
Soil Map



MAP LEGEND

Area of Interest (AOI)
- Area of Interest (AOI)

Soils
- Soil Map Unit Polygons
- Soil Map Unit Lines
- Soil Map Unit Points

Special Point Features
- Blowout
- Borrow Pit
- Clay Spot
- Closed Depression
- Gravel Pit
- Gravelly Spot
- Landfill
- Lava Flow
- Marsh or swamp
- Mine or Quarry
- Miscellaneous Water
- Perennial Water
- Rock Outcrop
- Saline Spot
- Sandy Spot
- Severely Eroded Spot
- Sinkhole
- Slide or Slip
- Sodic Spot
- Spoil Area
- Stony Spot
- Very Stony Spot
- Wet Spot
- Other
- Special Line Features

Water Features
- Streams and Canals

Transportation
- Rails
- Interstate Highways
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Map Unit Legend

Map Unit Symbol	Map Unit Name	Acres in AOI	Percent of AOI
Ab	Abscota loamy sand	82.0	2.6%
Ac	Abscota loam	1.4	0.0%
Ad	Abscota sandy loam	35.7	1.1%
Ag	Algansee loamy sand	19.6	0.6%
Ah	Algansee sandy loam	0.6	0.0%
Bd	Barry sandy loam	8.1	0.3%
BmA	Boyer loamy sand, 0 to 2 percent slopes	43.4	1.4%
BmB	Boyer loamy sand, 2 to 6 percent slopes	44.7	1.4%
BmB2	Boyer loamy sand, 2 to 6 percent slopes, moderately eroded	11.8	0.4%
BmC2	Boyer loamy sand, 6 to 12 percent slopes, moderately eroded	23.0	0.7%
BmD2	Boyer loamy sand, 12 to 18 percent slopes, moderately eroded	53.9	1.7%
BnB	Boyer sandy loam, 2 to 6 percent slopes	55.8	1.8%
BnB2	Boyer sandy loam, 2 to 6 percent slopes, moderately eroded	23.0	0.7%
BnC2	Boyer sandy loam, 6 to 12 percent slopes, moderately eroded	10.2	0.3%
BnD2	Boyer sandy loam, 12 to 18 percent slopes, moderately eroded	3.9	0.1%
BoA	Boyer very stony loamy sand, 0 to 2 percent slopes	3.6	0.1%
BoB	Boyer very stony loamy sand, 2 to 6 percent slopes	5.7	0.2%
BpE2	Boyer loamy sand, 18 to 25 percent slopes, moderately eroded	12.3	0.4%
BpF2	Boyer loamy sand, 25 to 40 percent slopes, moderately eroded	2.7	0.1%
BsB	Boyer and Spinks loamy sands, 2 to 6 percent slopes	6.8	0.2%
BsB2	Boyer and Spinks loamy sands, 2 to 6 percent slopes, moderately eroded	18.6	0.6%

Map Unit Symbol	Map Unit Name	Acres in AOI	Percent of AOI
BsC2	Boyer and Spinks loamy sands, 6 to 12 percent slopes, moderately eroded	3.1	0.1%
BsF	Boyer and Spinks loamy sands, 25 to 40 percent slopes	16.5	0.5%
BsF3	Boyer and Spinks loamy sands, 25 to 40 percent slopes, severely eroded	32.3	1.0%
Bw	Parkhill loam, non dense till subsoil, 0 to 2 percent slopes	189.9	6.0%
CaA	Cadmus loam, 0 to 2 percent slopes	29.8	0.9%
Cg	Carlisle muck, 0 to 2 percent slopes	14.1	0.4%
ChB	Celina loam, 2 to 6 percent slopes	74.6	2.3%
ChB2	Celina loam, 2 to 6 percent slopes, moderately eroded	50.3	1.6%
ChC2	Celina loam, 6 to 12 percent slopes, moderately eroded	1.8	0.1%
Cl	Ceresco-Shoals loams	38.6	1.2%
Cp	Cohoctah-Sloan loams	65.8	2.1%
CpcaaB	Capac loam, 0 to 4 percent slopes	23.2	0.7%
Cs	Colwood loam	27.6	0.9%
CvraaB	Conover loam, 0 to 4 percent slopes	37.7	1.2%
DrB	Dryden sandy loam, 2 to 6 percent slopes	34.9	1.1%
FoA	Fox sandy loam, 0 to 2 percent slopes	111.6	3.5%
FoB	Fox sandy loam, 2 to 6 percent slopes	121.1	3.8%
FoB2	Fox sandy loam, 2 to 6 percent slopes, moderately eroded	326.2	10.3%
FoC	Fox sandy loam, 6 to 12 percent slopes	2.2	0.1%
FoC2	Fox sandy loam, 6 to 12 percent slopes, moderately eroded	64.7	2.0%
FoE2	Fox sandy loam, 18 to 25 percent slopes, moderately eroded	16.7	0.5%
FoF	Fox sandy loam, 25 to 40 percent slopes	17.8	0.6%
FsB	Fox stony sandy loam, 2 to 6 percent slopes	12.0	0.4%
FxC3	Fox sandy clay loam, 6 to 12 percent slopes, severely eroded	89.7	2.8%

Map Unit Symbol	Map Unit Name	Acres in AOI	Percent of AOI
FxD3	Fox sandy clay loam, 12 to 18 percent slopes, severely eroded	80.0	2.5%
FxE3	Fox sandy clay loam, 18 to 25 percent slopes, severely eroded	66.5	2.1%
FxF3	Fox sandy clay loam, 25 to 40 percent slopes, severely eroded	30.0	0.9%
Gf	Gilford loamy sand	0.0	0.0%
Gp	Gravel pits	11.2	0.4%
IoB	Ionia loam, 2 to 6 percent slopes	25.9	0.8%
IrA	Ionia sandy loam, 0 to 2 percent slopes	13.3	0.4%
KeB	Kendallville loam, 2 to 6 percent slopes	4.9	0.2%
KgC3	Kendallville sandy clay loam, 6 to 12 percent slopes, severely eroded	8.3	0.3%
KhB	Kendallville sandy loam, 2 to 6 percent slopes	8.5	0.3%
KnA	Kibbie loam, 0 to 2 percent slopes	36.2	1.1%
KnB	Kibbie loam, 2 to 6 percent slopes	8.0	0.3%
La	Landes-Eel loams	8.7	0.3%
Le	Landes-Eel sandy loams	6.2	0.2%
Lg	Landes-Genesee loams	34.8	1.1%
Lh	Landes-Genesee sandy loams	57.4	1.8%
LmC3	Lapeer sandy clay loam, 6 to 12 percent slopes, severely eroded	0.3	0.0%
LmD3	Lapeer sandy clay loam, 12 to 18 percent slopes, severely eroded	0.0	0.0%
LmF3	Lapeer sandy clay loam, 18 to 40 percent slopes, severely eroded	9.5	0.3%
LnB	Lapeer sandy loam, 2 to 6 percent slopes	4.6	0.1%
LnB2	Lapeer sandy loam, 2 to 6 percent slopes, moderately eroded	23.8	0.8%
LnC2	Lapeer sandy loam, 6 to 12 percent slopes, moderately eroded	0.0	0.0%
Lo	Linwood muck	2.3	0.1%
LsA	Locke sandy loam, 0 to 2 percent slopes	7.1	0.2%

Map Unit Symbol	Map Unit Name	Acres in AOI	Percent of AOI
Mb	Made land	47.2	1.5%
MlA	Matherton loam, 0 to 2 percent slopes	10.3	0.3%
MlB	Matherton loam, 2 to 6 percent slopes	5.3	0.2%
MsA	Metamora sandy loam, 0 to 2 percent slopes	21.0	0.7%
MsB	Metamora sandy loam, 2 to 6 percent slopes	1.6	0.1%
MtC3	Miami clay loam, 6 to 12 percent slopes, severely eroded	103.6	3.3%
MtD3	Miami clay loam, 12 to 18 percent slopes, severely eroded	22.0	0.7%
MtF3	Miami clay loam, 25 to 40 percent slopes, severely eroded	2.0	0.1%
MuB	Wawasee loam, 2 to 6 percent slopes	17.9	0.6%
MuB2	Wawasee loam, 2 to 6 percent slopes, moderately eroded	194.3	6.1%
MuC2	Wawasee loam, 6 to 12 percent slopes, moderately eroded	42.7	1.3%
MuD2	Miami loam, 12 to 18 percent slopes, moderately eroded	6.6	0.2%
MuF	Miami loam, 25 to 40 percent slopes	16.8	0.5%
MwA	Miami-Owosso sandy loams, 0 to 2 percent slopes	50.1	1.6%
MwB	Miami-Owosso sandy loams, 2 to 6 percent slopes	30.2	1.0%
MwB2	Miami-Owosso sandy loams, 2 to 6 percent slopes, moderately eroded	26.3	0.8%
PdA	Perrin loamy sand, 0 to 2 percent slopes	5.9	0.2%
PdB	Perrin loamy sand, 2 to 6 percent slopes	1.4	0.0%
PeB	Perrin sandy loam, 2 to 6 percent slopes	4.2	0.1%
Pm	Pewamo clay loam	39.5	1.2%
Sc	Saranac silt loam	3.4	0.1%
Sd	Sebewa loam, 0 to 2 percent slopes	26.9	0.8%
SpB	Spinks loamy sand, 2 to 6 percent slopes	0.5	0.0%
SpB2	Spinks loamy sand, 2 to 6 percent slopes, moderately eroded	28.6	0.9%

Map Unit Symbol	Map Unit Name	Acres in AOI	Percent of AOI
SpC3	Spinks loamy sand, 6 to 12 percent slopes, severely eroded	4.5	0.1%
SpD3	Spinks loamy sand, 12 to 18 percent slopes, severely eroded	7.1	0.2%
Ta	Tawas muck	1.7	0.1%
W	Water	131.5	4.1%
WrA	Wasepi-Brady loamy sands, 0 to 2 percent slopes	1.9	0.1%
WsA	Wasepi-Brady sandy loams, 0 to 2 percent slopes	5.5	0.2%
Wt	Washtenaw soils	1.1	0.0%
Totals for Area of Interest		**3,178.4**	**100.0%**

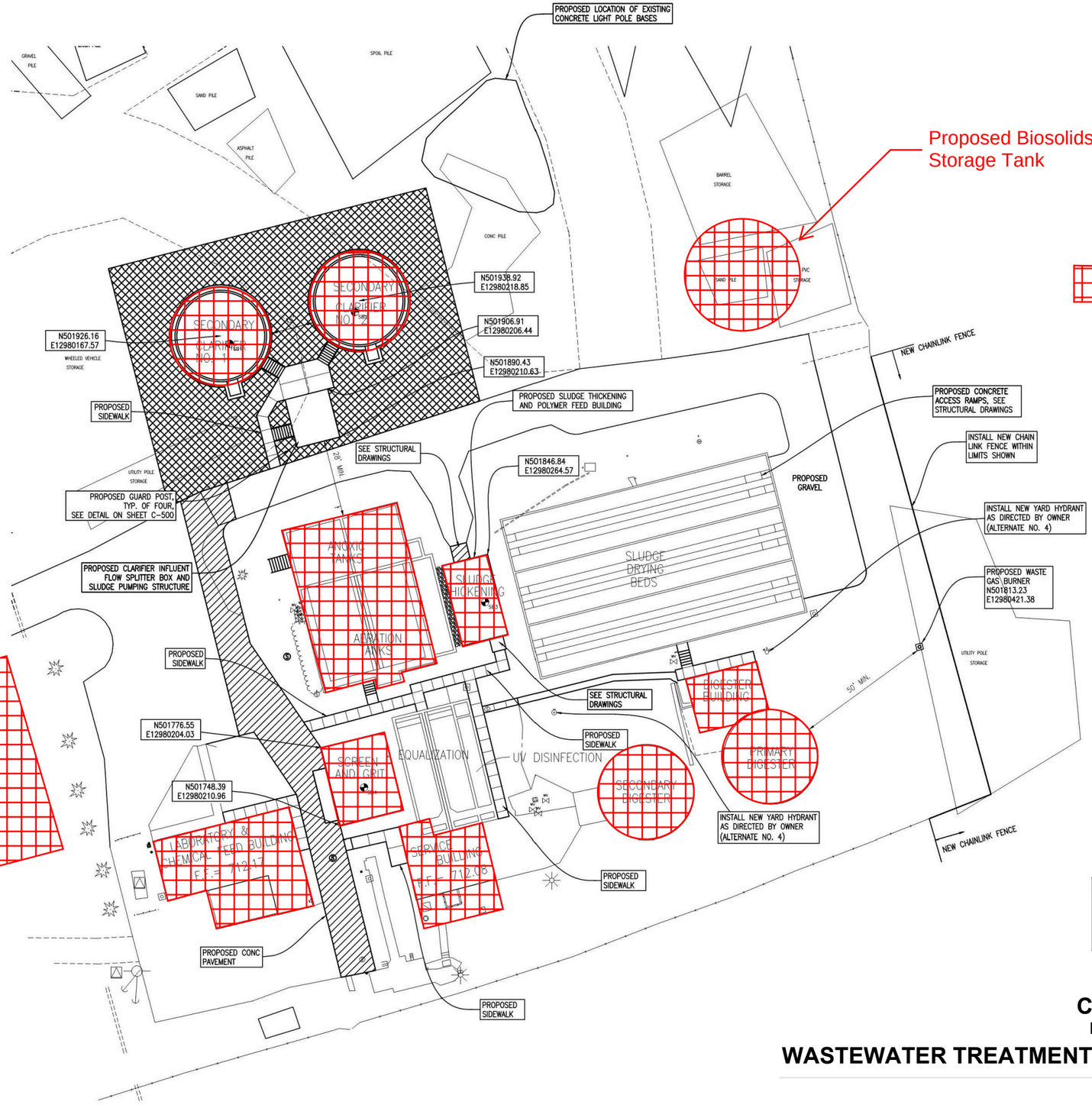
Map Unit Descriptions

The map units delineated on the detailed soil maps in a soil survey represent the soils or miscellaneous areas in the survey area. The map unit descriptions, along with the maps, can be used to determine the composition and properties of a unit.

A map unit delineation on a soil map represents an area dominated by one or more major kinds of soil or miscellaneous areas. A map unit is identified and named according to the taxonomic classification of the dominant soils. Within a taxonomic class there are precisely defined limits for the properties of the soils. On the landscape, however, the soils are natural phenomena, and they have the characteristic variability of all natural phenomena. Thus, the range of some observed properties may extend beyond the limits defined for a taxonomic class. Areas of soils of a single taxonomic class rarely, if ever, can be mapped without including areas of other taxonomic classes. Consequently, every map unit is made up of the soils or miscellaneous areas for which it is named and some minor components that belong to taxonomic classes other than those of the major soils.

Most minor soils have properties similar to those of the dominant soil or soils in the map unit, and thus they do not affect use and management. These are called noncontrasting, or similar, components. They may or may not be mentioned in a particular map unit description. Other minor components, however, have properties and behavioral characteristics divergent enough to affect use or to require different management. These are called contrasting, or dissimilar, components. They generally are in small areas and could not be mapped separately because of the scale used. Some small areas of strongly contrasting soils or miscellaneous areas are identified by a special symbol on the maps. If included in the database for a given area, the contrasting minor components are identified in the map unit descriptions along with some characteristics of each. A few areas of minor components may not have been observed, and consequently they are not mentioned in the descriptions, especially where the pattern was so complex that it was impractical to make enough observations to identify all the soils and miscellaneous areas on the landscape.

NORTH



Areas of Work

Proposed Garage Building

THIS SITE PLAN DRAWING FOR REFERENCE PURPOSES ONLY, TAKEN FROM WASTEWATER TREATMENT PLANT IMPROVEMENTS, ENGINEER C2AE, DATED OCTOBER 2012.

CITY OF PORTLAND
IONIA COUNTY, MICHIGAN
WASTEWATER TREATMENT PLANT SITE PLAN

F&V PROJECT NO. 817404

F&V

City of Portland
Sanitary Sewer Network

Manhole 1-2 Year Rehab Plan

- No Action
- MH Clean + Line + Repair
- MH Repair + Line
- MH Clean + Line

Gravity Main 1-2 Year Rehab Plan

- No Action
- Point Repair
- Point Repair & Lining
- Replacement
- Full Lining

FLEIS&VANDENBRINK
DESIGN. BUILD. OPERATE.

Capital Improvement Plan
1-2 Year Plan

City of Portland

DRAWN BY	DATE
BPN	3/16/2021
PROJECT NO.	SCALE
816480	1:15,000
FILE LOCATION	
SOURCES	

NORTH
0 625 1,250
SCALE IN FEET

FIGURE
A17

City of Portland
Sanitary Sewer Network

Manhole 3-5 Year Rehab Plan

- No Action
- MH Repair + Line
- MH Clean + Line
- MH Replace
- MH Clean + Line + Repair

Gravity Main 3-5 Year Rehab Plan

- No Action
- Point Repair
- Point Repair + Lining
- Full Lining
- Replacement

FLEIS&VANDENBRINK
DESIGN. BUILD. OPERATE.

Capital Improvement Plan
3-5 Year Plan

City of Portland

DRAWN BY	DATE
BPN	3/16/2021
PROJECT NO.	SCALE
816480	1:15,000
FILE LOCATION	
SOURCES	

NORTH
0 620 1,240
SCALE IN FEET

FIGURE
A18

City of Portland
Sanitary Sewer Network

Manhole 6-20 Year Rehab Plan

- No Action
- MH Clean + Line + Repair
- MH Repair + Line
- MH Replace
- MH Clean + Line

Gravity Main 6-20 Year Rehab Plan

- No Action
- Replacement
- Point Repair + Lining
- Point Repair
- Full Lining

FLEIS&VANDENBRINK
DESIGN. BUILD. OPERATE.

Capital Improvement Plan
6-20 Year Plan

City of Portland

DRAWN BY	DATE
BPN	3/16/2021
PROJECT NO.	SCALE
816480	1:15,000
FILE LOCATION	
SOURCES	

NORTH
0 620 1,240
SCALE IN FEET

FIGURE
A19

APPENDIX B
NPDES PERMIT

PREPARED FOR:

Portland
CITY OF TWO RIVERS Michigan

FLEIS&VANDENBRINK
DESIGN. BUILD. OPERATE.

Project No.: 848390

MICHIGAN DEPARTMENT OF ENVIRONMENTAL QUALITY
WATER RESOURCES DIVISION
NATIONAL POLLUTANT DISCHARGE ELIMINATION SYSTEM

Authorized by Part 31, Water Resources Protection, of the
Natural Resources and Environmental Protection Act, 1994 PA 451, as Amended

CERTIFICATE OF COVERAGE (COC)

Under General Permit No. MIG570000
Secondary Treatment Wastewater General Permit

COC NO.: MIG570220
DESIGNATED NAME: Portland WWTP
PERMITTEE: City of Portland
MAILING ADDRESS: 259 Kent Street
Portland, MI 48875

This Certificate of Coverage (COC) authorizes the permittee to discharge treated sanitary wastewater from the City of Portland Wastewater Treatment Plant located at 600 Morse Drive, Portland, Michigan 48875, in Ionia County. Consistent with the criteria and requirements established in General Permit No. MIG570000, the permittee is authorized to discharge the following:

0.5 MGD of treated sanitary wastewater from Monitoring Point 001A through Outfall 001. Outfall 001 discharges to the Grand River at Latitude 42.87526, Longitude -84.90014.

Sections of the General Permit applicable to this facility include: the cover page; Part I.A.1. **except** Part I.A.1.e. – Total Residual Chlorine; Part I.A.5. – Untreated or Partially Treated Sewage Discharge Reporting and Testing Requirements; Part I.A.6. – Facility Contact; Part I.A.7. – Monthly Operating Reports; Part I.A.9. – Residuals Management Program for Land Application of Biosolids; Part I.A.10. – Expiration and Reissuance; Part I.A.11. – Requirement to Obtain Individual Permit; and Part II. in its entirety.

This facility is subject to the $CBOD_5$ Maximum Monthly and Maximum 7-Day concentration limits set forth in Part I.A.1. of the General Permit, and the following Maximum Monthly and Maximum 7-Day loading rate limits for $CBOD_5$ and TSS:

	Maximum Limits for Quantity or Loading		
Parameter	**Monthly**	**7-Day**	**Units**
$CBOD_5$	104	170	lbs/day
Total Suspended Solids	130	190	lbs/day

This facility is subject to a $CBOD_5$ percent removal requirement of 85% and TSS percent removal requirements of 85%.

The permittee shall continue to implement the Residuals Management Program (RMP) approved on August 9, 2000, and modifications thereto, in accordance with Part I.A.9. of the General Permit The permittee shall certify that current residuals management practices are in accordance with the approved RMP, or propose modifications to the approved RMP. RMP-related submittals other than annual reports shall be submitted to the Department as defined in the COC. RMP annual reports shall be submitted electronically via the Department's MiWaters system at https://miwaters.deq.state.mi.us.

The permittee shall submit to the Department a facility treatment monitoring program on or before November 1, 2017.

References in the General Permit to the Department of Environmental Quality (Department) shall be defined as the Grand Rapids District Supervisor of the Water Resources Division. The Grand Rapids District Office is located at State Office Building, Fifth Floor, 350 Ottawa Ave NW, Unit 10, Grand Rapids, MI, 49503-2316; Telephone: 616-356-0500; Fax: 616-356-0202.

Any person who is aggrieved by this COC may file a sworn petition with the Michigan Administrative Hearing System within the Michigan Department of Licensing and Regulatory Affairs, c/o the Michigan Department of Environmental Quality, setting forth the conditions of the COC which are being challenged and specifying the grounds for the challenge. The Department of Licensing and Regulatory Affairs may reject any petition filed more than 60 days after issuance as being untimely.

The issuance of this COC does not authorize violation of any federal, state, or local laws or regulations, nor does it obviate the necessity of obtaining such permits, including any other Department permits, or approvals from other units of government as may be required by law.

This COC is based on a complete application received by the Department on October 30, 2015. The permittee is subject to all conditions specified in General Permit No. MIG570000, issued June 16, 2015 and modified (minor) on February 23, 2017, expiring April 1, 2020. This COC may be modified, terminated, reissued, or revoked as allowed for in General Permit No. MIG570000. On its effective date, this COC shall supersede COC No. MIG570220 (expiring April 1, 2015), which is hereby revoked.

This COC shall take effect on October 1, 2017.

September 27, 2017
Date Issued

Original Signed by Sylvia Heaton
Sylvia Heaton, Supervisor
Lakes Michigan & Superior Permits Unit

PERMIT NO. MIG570000

STATE OF MICHIGAN
DEPARTMENT OF ENVIRONMENTAL QUALITY

NATIONAL POLLUTANT DISCHARGE ELIMINATION SYSTEM
WASTEWATER DISCHARGE GENERAL PERMIT

SECONDARY TREATMENT WASTEWATER

In compliance with the provisions of the Federal Water Pollution Control Act (33 U.S.C. 1251 et seq., as amended; the "Federal Act"); Part 31, Water Resources Protection, of the Natural Resources and Environmental Protection Act, 1994 PA 451, as amended (NREPA); Part 41, Sewerage Systems, of the NREPA; and Michigan Executive Order 2011-1, secondary treatment wastewater is authorized to be discharged from facilities specified in individual "Certificates of Coverage" (COC) in accordance with effluent limitations, monitoring requirements, and other conditions set forth in this general National Pollutant Discharge Elimination System (NPDES) permit (the "permit").

The applicability of this permit shall be limited to discharges of treated sanitary wastewater that a) have been treated using secondary treatment processes that meet generally accepted design standards, as determined by the Michigan Department of Environmental Quality (the "Department"); b) comply with applicable secondary treatment regulations at 40 CFR 133.102; and c) have been determined by the Department not to need an individual NPDES permit. Discharges that may cause or contribute to a violation of a water quality standard are not authorized by this permit.

In order to constitute a valid authorization to discharge, this permit must be complemented by a COC issued by the Department.

Unless specified otherwise, all contact with the Department required by this permit shall be to the position indicated in the COC.

This general permit shall take effect **July 1, 2015**. The provisions of this permit are severable. After notice and opportunity for a hearing, this permit may be modified, suspended, or revoked in whole or in part during its term in accordance with applicable laws and rules.

This general permit shall expire at midnight, **April 1, 2020**.

Issued: June 16, 2015 .

Original Permit Signed by Philip Argiroff
Philip Argiroff, Chief
Permits Section
Water Resources Division

PERMIT FEE REQUIREMENTS

In accordance with Section 324.3120 of the NREPA, the permittee shall make payment of an annual permit fee to the Department for each October 1 the permit is in effect regardless of occurrence of discharge. The permittee shall submit the fee in response to the Department's annual notice. The fee shall be postmarked by January 15 for notices mailed by December 1. The fee is due no later than 45 days after receiving the notice for notices mailed after December 1.

In accordance with Section 324.3132 of the NREPA, the permittee shall make payment of an annual biosolids land application fee to the Department. In response to the Department's annual notice, the permittee shall submit the fee, which shall be postmarked no later than January 31 of each year.

CONTESTED CASE INFORMATION

The terms and conditions of this general permit shall apply to an individual facility on the effective date of a COC for the facility. The Department of Licensing and Regulatory Affairs may grant a contested case hearing on this general permit in accordance with the NREPA. Any person who is aggrieved by this permit may file a sworn petition with the Michigan Administrative Hearing System within the Michigan Department of Licensing and Regulatory Affairs, c/o the Michigan Department of Environmental Quality, setting forth the conditions of the permit which are being challenged and specifying the grounds for the challenge. The Department of Licensing and Regulatory Affairs may reject any petition filed more than 60 days after issuance as being untimely.

PART I

Section A. Effluent Limitations And Monitoring Requirements

1. Final Effluent Limitations

During the period beginning on the effective date of this permit and the effective date of an individual COC, and lasting until the expiration of this permit or termination of the individual COC, the permittee is authorized to discharge treated sanitary wastewater to the surface waters of the state of Michigan. Such discharge shall be limited and monitored by the permittee as specified below.

	Maximum Limits for Quantity or Loading				Maximum Limits for Quality or Concentration				Monitoring	Sample
Parameter	**Monthly**	**7-Day**	**Daily**	**Units**	**Monthly**	**7-Day**	**Daily**	**Units**	**Frequency**	**Type**
Flow	(report)	(report)	---	MGD	---	---	---	---	Daily	Report Total Daily Flow
Carbonaceous Biochemical Oxygen Demand ($CBOD_5$) (See I.A.1.d.)										
	(COC limit)	(COC limit)	---	lbs/day	25	40	---	mg/l	3 × Weekly	24-Hr Composite
Biochemical Oxygen Demand (BOD_5) (See I.A.1.d.)										
	(COC limit)	(COC limit)	---	lbs/day	30	45	---	mg/l	3 × Weekly	24-Hr Composite
Total Suspended Solids (TSS)										
	(COC limit)	(COC limit)	---	lbs/day	30	45	---	mg/l	3 × Weekly	24-Hr Composite
Ammonia Nitrogen (as N)										
May1 - September 30	---	---	(report)	lbs/day	---	---	(report)	mg/l	Monthly	24-Hr Composite
Total Phosphorus (as P)	---	---	---	---	1.0	---	---	mg/l	3 × Weekly	24-Hr Composite
Fecal Coliform Bacteria	---	---	---	---	200	400	---	cts/100 ml	3 × Weekly	Grab
Total Residual Chlorine (See I.A.1.e.)										
	---	---	---	---	---	---	0.038	mg/l	3 × Weekly	Grab
					Minimum Monthly					
$CBOD_5$ or BOD_5 Minimum % Removal (See I.A.1.g.)										
	---	---	---	---	85	---	---	%	Monthly	Calculation
Total Suspended Solids Minimum % Removal (See I.A.1.g.)										
	---	---	---	---	85	---	---	%	Monthly	Calculation
					Minimum Daily					
pH	---	---	---	---	6.5	---	9.0	S.U.	3 × Weekly	Grab
Dissolved Oxygen	---	---	---	---	4.0	---	---	mg/l	3 × Weekly	Grab
Outfall Observation	---	(report)	---	---	---	---	---	---	3 × Weekly	Visual

a. Narrative Standard
The receiving water shall contain no turbidity, color, oil films, floating solids, foams, settleable solids, or deposits as a result of this discharge in unnatural quantities that are or may become injurious to any designated use.

PART I

Section A. Effluent Limitations And Monitoring Requirements

b. Monitoring Location
If using gaseous chlorine or hypochlorite for disinfection, the samples for $CBOD_5$, (BOD_5 if applicable), Total Suspended Solids, Ammonia Nitrogen, and Total Phosphorus shall be taken prior to disinfection, and the samples for Dissolved Oxygen, Fecal Coliform Bacteria, Total Residual Chlorine, and pH shall be taken after disinfection. The Department may approve alternate sampling locations that are demonstrated by the permittee to be representative of the effluent.

c. Monitoring Frequency
Monitoring for all parameters except flow and percent removal shall be three times weekly.
Refer to the individual COC for the $CBOD_5$ and TSS final effluent maximum loading limitations that are applicable to this discharge. The permittee may request a reduction in monitoring frequency. This request shall be submitted to the Department. The request shall include a demonstration or explanation for why reduced monitoring is appropriate. Upon receipt of written approval and consistent with such approval, the permittee may reduce the monitoring frequency indicated in this permit. The Department may revoke its approval for reduced monitoring at any time upon notification to the permittee.

d. Alternate Monitoring
Monitoring and reporting of BOD_5 may be substituted for $CBOD_5$ upon approval by the Department as specified in the COC.

e. Total Residual Chlorine
Compliance with the Total Residual Chlorine limit shall be determined on the basis of one or more grab samples. If more than one (1) sample per day is taken, the additional samples shall be collected in near equal intervals over at least eight (8) hours. The samples shall be analyzed immediately upon collection and the average reported as the daily concentration. Samples shall be analyzed in accordance with Part II.B.2. of this permit.

f. Ultraviolet Disinfection
If ultraviolet light will be used to achieve compliance with the fecal coliform limitations, reporting of Total Residual Chlorine is not required, and the permittee shall notify the Department in accordance with Part II.C.12. - Changes in Facility Operations.

g. Percent Removal Requirements
Unless indicated in the COC, these requirements shall be calculated based on the monthly (30-day) effluent $CBOD_5$ (or BOD_5, if appropriate) and Total Suspended Solids concentrations and the monthly influent concentrations for approximately the same frequency and time period. This requirement is applicable unless a demonstration under 40 CFR 133.103(d) has been approved by the Department.

2. Additional Monitoring Requirements

This section applies to publicly-owned treatment works (POTWs) that are required to conduct Additional Monitoring as specified in the COC. The permittee shall monitor the discharge from the monitoring point identified in the COC for the constituents identified below, in accordance with 40 CFR 122.21(j), effective December 2, 1999. Testing shall be conducted in February 2016, April 2017, October 2018, and July 2019. Grab samples shall be taken for total mercury, available cyanide, total phenols, and the Volatile Organic Compounds listed below. For all other parameters, 24-hour composite samples shall be taken.

Chronic toxicity testing as described in this paragraph is required of all permittees with an annual average design flow equal to or greater than 1 MGD where the instream mix is less than 80 to 1. Test species for whole effluent toxicity monitoring shall include fathead minnow **and** *Ceriodaphnia dubia*. If the permittee has received Department approval to conduct chronic toxicity testing using the more sensitive species identified in the toxicity database, the first three (3) tests required above may be performed using the more sensitive species. The last (4^{th}) test shall be conducted using both species. Testing and reporting procedures shall follow procedures contained in EPA600/4-91/002, “Short-term Methods for Estimating the Chronic Toxicity of Effluents and Receiving Waters to Freshwater Organisms (Fourth Edition).” When the effluent ammonia nitrogen (as N) concentration is greater than 3 mg/l, the pH of the toxicity test shall be maintained at a pH of 8 Standard Units.

PART I

Section A. Effluent Limitations And Monitoring Requirements

Acute and chronic toxicity data shall be included in the reporting for the toxicity test results. Toxicity test data acceptability is contingent upon the validation of the test method by the testing laboratory. Such validation shall be submitted to the Department upon request.

Acute toxicity testing as described in this paragraph is required of all permittees with an annual average design flow equal to or greater than 1 MGD where the instream mix is greater than 80 to 1. Test species for whole effluent toxicity monitoring shall include fathead minnow **and** either *Daphnia magna, Daphnia pulex* or *Ceriodaphnia dubia*. If the permittee has received Department approval to conduct acute toxicity testing using the more sensitive species identified in the toxicity database, the first three (3) tests required above may be performed using the more sensitive species. The last (4^{th}) test shall be conducted using two (2) test species. Testing and reporting procedures shall follow procedures contained in EPA/600/4-90/027/F, "Methods for Measuring the Acute Toxicity of Effluents to Freshwater and Marine Organisms (Fifth Edition)." When the effluent ammonia nitrogen (as N) concentration is greater than 5 mg/l, the pH of the toxicity test shall be maintained at the pH of the effluent at the time of sample collection. Toxicity test data acceptability is contingent upon the validation of the test method by the testing laboratory. Such validation shall be submitted to the Department upon request.

The analytical protocol for total mercury shall be in accordance with EPA Method 1631, Revision E, "Mercury in Water by Oxidation, Purge and Trap, and Cold Vapor Atomic Fluorescence Spectrometry," EPA-821-R-02-019, August 2002. The quantification level for total mercury shall be 0.5 ng/l, unless a higher level is appropriate because of sample matrix interference. Justification for higher quantification levels shall be submitted to the Department within 30 days of such determination. The use of clean technique sampling procedures is required unless the permittee can demonstrate to the Department that an alternative sampling procedure is representative of the discharge. Guidance for clean technique sampling is contained in EPA Method 1669, "Sampling Ambient Water for Trace Metals at EPA Water Quality Criteria Levels," EPA-821-R96-001, July 1996. Information and data documenting the permittee's sampling and analytical protocols and data acceptability shall be submitted to the Department upon request.

The results of monitoring required in this section shall be submitted with the application for reissuance (see the cover page of this permit for the application due date). The permittee shall notify the Department within 14 days of completing the monitoring for each month specified above in accordance with Part II.C.5. Additional reporting requirements are specified in Part II.C.11. The permittee shall report to the Department any whole effluent toxicity test results greater than 1.0 TU_A or 1.0 TU_C within five (5) days of becoming aware of the result. If, upon review of the analysis, it is determined that additional requirements are needed to protect the receiving waters in accordance with applicable water quality standards, the permit may then be modified by the Department in accordance with applicable laws and rules.

Whole Effluent Toxicity

acute toxicity	chronic toxicity (if required in the COC)

Hardness

calcium carbonate

Metals (Total Recoverable), Cyanide and Total Phenols (Quantification levels in parentheses)

antimony (1 µg/l)	arsenic (1 µg/l)	available cyanide (2 µg/l) using Method OIA – 1677	
barium (5 µg/l)	beryllium (1 µg/l)	boron (20 µg/l)	cadmium (0.2 µg/l)
chromium (5 µg/l)	copper (1 µg/l)	lead (1 µg/l)	nickel (5 µg/l)
selenium (1 µg/l)	silver (0.5 µg/l)	thallium (1 µg/l)	zinc (5 µg/l)
mercury (0.5 ng/l) using Method 1631 Revision E		total phenolic compounds	

Volatile Organic Compounds

acrolein	acrylonitrile	benzene	bromoform
carbon tetrachloride	chlorobenzene	chlorodibromomethane	chloroethane
2-chloroethylvinyl ether	chloroform	dichlorobromomethane	1,1-dichloroethane
1,2-dichloroethane	trans-1,2-dichloroethylene	1,1-dichloroethylene	1,2-dichloropropane
1,3-dichloropropylene	ethylbenzene	methyl bromide	methyl chloride
methylene chloride	1,1,2,2,-tetrachloroethane	tetrachloroethylene	toluene
1,1,1-trichloroethane	1,1,2-trichloroethane	trichloroethylene	vinyl chloride

PART I

Section A. Effluent Limitations And Monitoring Requirements

Acid-Extractable Compounds

p-chloro-m-cresol	2-chlorophenol	2,4-dichlorophenol	2,4-dimethylphenol
4,6-dinitro-o-cresol	2,4-dinitrophenol	2-nitrophenol	4-nitrophenol
Pentachlorophenol	phenol	2,4,6-trichlorophenol	

Base/Neutral Compounds

acenaphthene	acenaphthylene	anthracene	benzidine
benzo(a)anthracene	benzo(a)pyrene	3,4-benzofluoranthene	benzo(ghi)perylene
benzo(k)fluoranthene	bis(2-chloroethoxy)methane	bis(2-chloroethyl)ether	bis(2-chloroisopropyl)ether
bis(2-ethylhexyl)phthalate	4-bromophenyl phenyl ether	butyl benzyl phthalate	2-chloronaphthalene
4-chlorophenyl phenyl ether	chrysene	di-n-butyl phthalate	di-n-octyl phthalate
dibenzo(a,h)anthracene	1,2-dichlorobenzene	1,3-dichlorobenzene	1,4-dichlorobenzene
3,3'-dichlorobenzidine	diethyl phthalate	dimethyl phthalate	2,4-dinitrotoluene
2,6-dinitrotoluene	1,2-diphenylhydrazine	fluoranthene	fluorene
Hexachlorobenzene	hexachlorobutadiene	hexachlorocyclo-pentadiene	hexachloroethane
indeno(1,2,3-cd)pyrene	isophorone	naphthalene	nitrobenzene
n-nitrosodi-n-propylamine	n-nitrosodimethylamine	n-nitrosodiphenylamine	phenanthrene
pyrene	1,2,4-trichlorobenzene		

3. Michigan Industrial Pretreatment Program

This section applies to POTWs required to implement the Michigan Industrial Pretreatment Program as specified in the COC. All individual Program modifications approved by the Department become enforceable requirements of this permit.

a. The permittee shall comply with R 323.2301 through R 323.2317 of the Michigan Administrative Code (Part 23 Rules) and the approved Michigan Industrial Pretreatment Program.

b. The permittee shall have the legal authority and necessary interjurisdictional agreements that provide the basis for the implementation and enforcement of the approved Michigan Industrial Pretreatment Program throughout the service area. The legal authority and necessary interjurisdictional agreements shall include, at a minimum, the authority to carry out the activities specified in R 323.2306(a).

c. The permittee shall develop procedures which describe, in sufficient detail, program commitments which enable implementation of the approved Michigan Industrial Pretreatment Program and the Part 23 Rules in accordance with R 323.2306(c).

d. The permittee shall establish an interjurisdictional agreement (or comparable document) with all tributary governmental jurisdictions. Each interjurisdictional agreement shall contain, at a minimum, the following:

1) identification of the agency responsible for the implementation and enforcement of the approved Michigan Industrial Pretreatment Program within the tributary governmental jurisdiction's boundaries; and

2) the provision of the legal authority which provides the basis for the implementation and enforcement of the approved Michigan Industrial Pretreatment Program within the tributary governmental jurisdiction's boundaries.

e. The permittee shall prohibit discharges that:

1) cause, in whole or in part, the permittee's failure to comply with any condition of this permit or the NREPA
2) restrict, in whole or in part, the permittee's management of biosolids;

PART I

Section A. Effluent Limitations And Monitoring Requirements

3) cause, in whole or in part, operational problems at the treatment facility or in its collection system;

4) violate any of the general or specific prohibitions identified in R 323.2303(1) and (2);

5) violate categorical standards identified in R 323.2311; and

6) violate local limits established in accordance with R 323.2303(4).

f. The permittee shall maintain a list of its nondomestic users that meet the criteria of a significant industrial user as identified in R 323.2302(cc).

g. The permittee shall develop an enforcement response plan which describes, in sufficient detail, program commitments which will enable the enforcement of the approved Michigan Industrial Pretreatment Program and the Part 23 Rules in accordance with R 323.2306(g).

h. The Department may require modifications to the approved Michigan Industrial Pretreatment Program which are necessary to ensure compliance with the Part 23 Rules in accordance with R 323.2309.

i. The permittee shall not implement changes or modifications to the approved Michigan Industrial Pretreatment Program without notification to the Department.

j. The permittee shall maintain an adequate revenue structure and staffing level for effective implementation of the approved Michigan Industrial Pretreatment Program.

k. The permittee shall develop and maintain, for a minimum of three (3) years, all records and information necessary to determine nondomestic user compliance with the Part 23 Rules and the approved Michigan Industrial Pretreatment Program. This period of retention shall be extended during the course of any unresolved enforcement action or litigation regarding a nondomestic user or when requested by the Department or the United States Environmental Protection Agency. All of the aforementioned records and information shall be made available upon request for inspection and copying by the Department and the United States Environmental Protection Agency.

l. The permittee shall evaluate the approved Michigan Industrial Pretreatment Program for compliance with the Part 23 Rules and the prohibitions stated in item e., above. Based upon this evaluation, the permittee shall propose to the Department all necessary changes or modifications to the approved Michigan Industrial Pretreatment Program no later than the next Industrial Pretreatment Program Annual Report due date (see item n., below).

m. The permittee shall develop and enforce local limits to implement the prohibitions listed in item e. above. Local limits shall be based upon data representative of actual conditions demonstrated in a maximum allowable headworks loading analysis.

n. On or before April 1 of each year, the permittee shall submit to the Department, as required by R 323.2310(8), an Industrial Pretreatment Program Annual Report on the status of program implementation and enforcement activities. The reporting period shall begin on January 1 and end on December 31. At a minimum, the Industrial Pretreatment Program Annual Report shall contain the following items:

1) additions, deletions, and any other modifications to the permittee's previously submitted nondomestic user inventory (R 323.2306(c)(i));

2) additions, deletions, and any other modifications to the permittee's approved Significant Industrial User List (R 323.2306(h));

PART I

Section A. Effluent Limitations And Monitoring Requirements

3) a listing of the names of Significant Industrial Users not inspected by the permittee at least once during the reporting period or at the frequency committed to in the approved Michigan Industrial Pretreatment Program;

4) a listing of the names of Significant Industrial Users not sampled for all required pollutants by the permittee at least once during the reporting period or at the frequency committed to in the approved Michigan Industrial Pretreatment Program;

5) a listing of the names of Significant Industrial Users without a permit at any time during the reporting period;

6) a listing of the names of categorical industrial users in significant noncompliance for each of the criteria defined in R 323.2302(dd)(i)-(viii);

7) proof of publication of all categorical industrial users in significant noncompliance in the largest daily newspaper in the municipality in which the permittee is located;

8) a summary of the enforcement activities by the permittee during the report period. This Summary shall include:

a) a listing of the names of nondomestic users which were the subject of an enforcement action;

b) the enforcement action taken and the date the action was taken; and

c) whether the nondomestic user returned to compliance by the end of the reporting period (include date nondomestic user returned to compliance).

9) a listing of the names of Significant Industrial Users who did not submit pretreatment reports in accordance with requirements specified in their permit during the reporting period;

10) a listing of the names of Significant Industrial Users who did not self-monitor in accordance with requirements specified in their permit during the reporting period;

11) a summary of results of all the sampling and analyses performed of the wastewater treatment plant's influent, effluent, and biosolids conducted in accordance with approved methods during the reporting period. The summary shall include the monthly average, daily maximum, quantification level, and number of samples analyzed for each pollutant. At a minimum, the results of analyses for all locally limited parameters for at least one monitoring event that tests influent, effluent and biosolids during the reporting period shall be submitted with each report, unless otherwise required by the Department. Sample collection shall be at intervals sufficient to provide pollutant removal rates, unless the pollutant is not measurable; and

12) any other relevant information as requested by the Department.

4. Untreated or Partially Treated Sewage Discharge Reporting and Testing Requirements

In accordance with Section 324.3112a of the NREPA, if untreated sewage, including sanitary sewer overflows (SSO) and combined sewer overflows (CSO), or partially treated sewage is directly or indirectly discharged from a sewer system onto land or into the waters of the state, the entity responsible for the sewer system shall immediately, but not more than 24 hours after the discharge begins, notify, by telephone, the Department, local health departments, a daily newspaper of general circulation in the county in which the permittee is located, and a daily newspaper of general circulation in the county or counties in which the municipalities whose waters may be affected by the discharge are located that the discharge is occurring.

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The permittee shall also annually contact municipalities, including the superintendent of a public drinking water supply with potentially affected intakes, whose waters may be affected by the permittee's discharge of combined sewage, and if those municipalities wish to be notified in the same manner as specified above, the permittee shall provide such notification. Such notification shall also include a daily newspaper in the county of the affected municipality.

At the conclusion of the discharge, written notification shall be submitted in accordance with and on the "Report of Discharge Form" available via the internet at: http://www.deq.state.mi.us/csosso/, or, alternatively for combined sewer overflow discharges, in accordance with notification procedures approved by the Department.

In addition, in accordance with Section 324.3112a of the NREPA, each time a discharge of untreated sewage or partially treated sewage occurs, the permittee shall test the affected waters for *Escherichia coli* to assess the risk to the public health as a result of the discharge and shall provide the test results to the affected local county health departments and to the Department. The testing shall be done at locations specified by each affected local county health department but shall not exceed 10 tests for each separate discharge event. The affected local county health department may waive this testing requirement, if it determines that such testing is not needed to assess the risk to the public health as a result of the discharge event. The results of this testing shall be submitted with the written notification required above, or, if the results are not yet available, submit them as soon as they become available. This testing is not required, if the testing has been waived by the local health department, or if the discharge(s) did not affect surface waters.

Permittees accepting sanitary or municipal sewage from other sewage collection systems are encouraged to notify the owners of those systems of the above reporting and testing requirements.

5. Facility Contact

The "Facility Contact" was specified in the application. The permittee may replace the facility contact at any time, and shall notify the Department in writing within 10 days after replacement (including the name, address, and telephone number of the new facility contact).

a. The facility contact shall be (or a duly authorized representative of this person):
- for a corporation, a principal executive officer of at least the level of vice president, or a designated representative, if the representative is responsible for the overall operation of the facility from which the discharge described in the permit application or other NPDES form originates,
- for a partnership, a general partner,
- for a sole proprietorship, the proprietor, or
- for a municipal, state, or other public facility, either a principal executive officer, the mayor, village president, city or village manager, or other duly authorized employee.

b. A person is a duly authorized representative only if:
- the authorization is made in writing to the Department by a person described in paragraph a. of this section; and
- the authorization specifies either an individual or a position having responsibility for the overall operation of the regulated facility or activity such as the position of plant manager, operator of a well or a well field, superintendent, position of equivalent responsibility, or an individual or position having overall responsibility for environmental matters for the facility (a duly authorized representative may thus be either a named individual or any individual occupying a named position).

Nothing in this section obviates the permittee from properly submitting reports and forms as required by law.

6. Monthly Operating Reports

For wastewater treatment facilities that serve the public, Part 41 of Act 451 of 1994 as amended, specifically Section 324.4106 and associated R 299.2953, requires that the permittee file with the Department, on forms prescribed by the Department, reports showing the effectiveness of the treatment facility operation and the

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Section A. Effluent Limitations And Monitoring Requirements

quantity and quality of liquid wastes discharged into waters of the state. If the Department has determined that this provision is applicable, it will be indicated in the COC.

FOR ALL **NEW** DISCHARGERS:
For new facilities: Sixty days prior to start-up of the treatment facility the permittee shall submit to the Department a treatment facility monitoring program to meet this requirement. Upon approval by the Department the permittee shall implement the treatment facility monitoring program. The report forms and guidance are available on the Department website at http://www.michigan.gov/deq/0,1607,7-135-3313_44117---,00.html. These forms shall be maintained on-site and shall be provided to the Department for review upon request. These treatment facility monitoring records shall be maintained for a minimum of three years.

FOR ALL **EXISTING** DISCHARGERS**:**
Within 30 days of the effective date of the COC the permittee shall submit to the Department a treatment facility monitoring program to meet this requirement. Upon approval by the Department the permittee shall implement the treatment facility monitoring program. The reporting forms and guidance are available on the Department website at http://www.michigan.gov/deq/0,1607,7-135-3313_44117---,00.html. These forms shall be maintained on-site and shall be provided to the Department for review upon request. These treatment facility monitoring records shall be maintained for a minimum of three years.

7. Residuals Management Program (RMP) for Land Application of Biosolids: First RMP, including new uses (The individual COC indicates if applicable.)

A permittee seeking authorization to land apply bulk biosolids or prepare bulk biosolids for land application shall develop and submit a Residuals Management Program (RMP) to the Department (see Part I.A.9.e. of this General Permit) for approval. Effective upon Department approval of the permittee's RMP, the permittee is authorized to land apply bulk biosolids or prepare bulk biosolids for land application in accordance with the requirements established in R 323.2401 through R 323.2418 of the Michigan Administrative Code (Part 24 Rules), which can be obtained via the internet (http://www.michigan.gov/deq/ and on the left side of the screen click on Water, Biosolids & Industrial Pretreatment, Biosolids, then click on Biosolids Laws and Rules Information, which is under the Laws & Rules banner in the center of the screen). The permittee's approved RMP, and any approved modifications thereto, are enforceable requirements of this General Permit. Incineration, landfilling, and other residual disposal activities shall be conducted in accordance with Part II.D.7. of this General Permit.

a. RMP Approval and Implementation
A permittee seeking approval of an RMP shall submit the RMP to the Department (see Part I.A.9.e. of this General Permit) at least 180 days prior to the land application of biosolids. The permittee may utilize the RMP Electronic Form that can be obtained via the internet (http://www.michigan.gov/deq/, and on the left side of the screen click on Water, Biosolids & Industrial Pretreatment, Biosolids; then click on RMP Electronic Form, which is under the Downloads banner in the center of the screen) or obtain detailed requirements from the Department. The RMP shall become effective and shall be implemented by the permittee upon written approval by the Department.

b. Annual Report
On or before October 30 of each year, the permittee shall submit an annual report to the Biosolids Program, Water Resources Division, Department of Environmental Quality, P.O. Box 30458, Lansing, Michigan 48909-7958, for the previous fiscal year of October 1 through September 30. At a minimum, the report shall contain:

1) a certification that current residuals management practices are in accordance with the approved RMP, or a proposal for modification to the approved RMP; and

2) a completed Biosolids Annual Report Form, which can be obtained via the internet (http:/www.michigan.gov/deq/, and on the left side of the screen click on Water, Biosolids &

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Section A. Effluent Limitations And Monitoring Requirements

Industrial Pretreatment, Biosolids; then click on Biosolids Annual Report Form, which is under the Downloads banner in the center of the screen) or from the Department.

c. Modifications to the Approved RMP
Prior to implementation of modifications to the RMP, the permittee shall submit proposed modifications to the Department (see Part I.A.9.e. of this General Permit) for approval. The approved modification shall become effective upon the date of approval. Upon written notification, the Department may impose additional requirements and/or limitations to the approved RMP as necessary to protect public health and the environment from any adverse effect of a pollutant in the biosolids.

d. Recordkeeping
Records required by the Part 24 Rules shall be kept for a minimum of five years. However, the records documenting cumulative loading for sites subject to cumulative pollutant loading rates shall be kept as long as the site receives biosolids.

e. Contact Information
RMP related submittals to the Department shall be to the address and telephone number listed in the COC.

8. Residuals Management Program for Land Application of Biosolids: APPROVED RMPs (The individual COC indicates if applicable.)

The permittee is authorized to land apply bulk biosolids or prepare bulk biosolids for land application in accordance with the permittee's approved RMP approved on the date specified in the COC and approved modifications thereto, in accordance with the requirements established in R 323.2401 through R 323.2418 of the Michigan Administrative Code (Part 24 Rules). The approved RMP, and any approved modifications thereto, are enforceable requirements of this General Permit. Incineration, landfilling, and other residual disposal activities shall be conducted in accordance with Part II.D.7. of this General Permit. The Part 24 Rules can be obtained via the internet (http://www.michigan.gov/deq/, and on the left side of the screen click on Water, Biosolids & Industrial Pretreatment, Biosolids; then click on Biosolids laws and Rules Information, which is under the Laws & Rules banner in the center of the screen).

a. Annual Report
On or before October 30 of each year, the permittee shall submit to the Biosolids Program, Water Resources Division, Department of Environmental Quality, P.O. Box 30458, Lansing, Michigan 48909-7958, for the previous fiscal year of October 1 through September 30. At a minimum, the report shall contain:

1) a certification that current residuals management practices are in accordance with the approved RMP, or a proposal for modification to the approved RMP; and

2) a completed Biosolids Annual Report Form, which can be obtained via the internet (http://www.michigan.gov/deq/ and on the left side of the screen click on Water, Biosolids & Industrial Pretreatment, Biosolids; then click on Biosolids Annual Report Form, which is under the Downloads banner in the center of the screen) or from the Department.

b. Modifications to the Approved RMP
Prior to implementation of modifications to the RMP, the permittee shall submit proposed modifications to the Department (see Part I.A.9.e. for this General Permit) for approval. The approved modification shall become effective upon the date of approval. Upon written notification, the Department may impose additional requirements and/or limitations to the approved RMP as necessary to protect public health and the environment from any adverse effect of a pollutant in the biosolids.

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Section A. Effluent Limitations And Monitoring Requirements

c. Record Retention
Records required by the Part 24 Rules shall be kept for a minimum of five years. However, the records documenting cumulative loading for sites subject to cumulative pollutant loading rates shall be kept as long as the site receives biosolids.

d. Contact Information
RMP related submittals to the Department shall be to the address and telephone number listed in the COC.

9. Expiration and Reissuance

On or before October 1, 2019, a permittee seeking continued authorization to discharge under this permit beyond the permit's expiration date shall submit to the Department a written request containing such information, forms and fees as required by the Department. Without an adequate request, a permittee's authorization to discharge will expire on April 1, 2020. With an adequate request, a permittee shall continue to be subject to the terms and conditions of the expired permit until the Department takes action on the request unless this permit is terminated or revoked.

If this permit is terminated or revoked, all authorizations to discharge under the permit shall expire on the date of termination or revocation.

If this permit is modified, the Department will notify the permittee of any required action. Without an adequate response, a permittee's authorization to discharge will terminate on the effective date of the modified permit. With an adequate response, a permittee shall be subject to the terms and conditions of the modified permit on the effective date of the modified permit unless the Department notifies the permittee otherwise.

If a discharge is terminated, the permittee shall request termination of discharge authorization.

10. Requirement to Obtain Individual Permit

The Department may require any person who is authorized to discharge by a certificate of coverage and this permit, to apply for and obtain an individual NPDES permit if any of the following circumstances apply:

a. the discharge is a significant contributor to pollution as determined by the Department on a case-by-case basis;

b. the discharger is not complying or has not complied with the conditions of the permit;

c. a change has occurred in the availability of demonstrated technology or practices for the control or abatement of waste applicable to the point source discharge;

d. effluent standards and limitations are promulgated for point source discharges subject to this permit; and

e. the Department determines that the criteria under which the permit was issued no longer apply.

Any person may request the Department to take action pursuant to the provisions of Rule 2191 (R 323.2191 of the Michigan Administrative Code).

PART II

Part II may include terms and /or conditions not applicable to discharges covered under this permit.

Section A. Definitions

Acute toxic unit (TU_A) means $100/LC_{50}$ where the LC_{50} is determined from a whole effluent toxicity (WET) test which produces a result that is statistically or graphically estimated to be lethal to 50% of the test organisms.

Annual monitoring frequency refers to a calendar year beginning on January 1 and ending on December 31. When required by this permit, an analytical result, reading, value or observation shall be reported for that period if a discharge occurs during that period.

Authorized public agency means a state, local, or county agency that is designated pursuant to the provisions of section 9110 of Part 91 of the NREPA to implement soil erosion and sedimentation control requirements with regard to construction activities undertaken by that agency.

Best management practices (BMPs) means structural devices or nonstructural practices that are designed to prevent pollutants from entering into storm water, to direct the flow of storm water, or to treat polluted storm water.

Bioaccumulative chemical of concern (BCC) means a chemical which, upon entering the surface waters, by itself or as its toxic transformation product, accumulates in aquatic organisms by a human health bioaccumulation factor of more than 1000 after considering metabolism and other physiochemical properties that might enhance or inhibit bioaccumulation. The human health bioaccumulation factor shall be derived according to R 323.1057(5). Chemicals with half-lives of less than 8 weeks in the water column, sediment, and biota are not BCCs. The minimum bioaccumulation concentration factor (BAF) information needed to define an organic chemical as a BCC is either a field-measured BAF or a BAF derived using the biota-sediment accumulation factor (BSAF) methodology. The minimum BAF information needed to define an inorganic chemical as a BCC, including an organometal, is either a field-measured BAF or a laboratory-measured bioconcentration factor (BCF). The BCCs to which these rules apply are identified in Table 5 of R 323.1057 of the Water Quality Standards.

Biosolids are the solid, semisolid, or liquid residues generated during the treatment of sanitary sewage or domestic sewage in a treatment works. This includes, but is not limited to, scum or solids removed in primary, secondary, or advanced wastewater treatment processes and a derivative of the removed scum or solids.

Bulk biosolids means biosolids that are not sold or given away in a bag or other container for application to a lawn or home garden.

Certificate of Coverage (COC) is a document, issued by the Department, which authorizes a discharge under a general permit.

Chronic toxic unit (TU_C) means $100/MATC$ or $100/IC_{25}$, where the maximum acceptable toxicant concentration (MATC) and IC_{25} are expressed as a percent effluent in the test medium.

Class B biosolids refers to material that has met the Class B pathogen reduction requirements or equivalent treatment by a Process to Significantly Reduce Pathogens (PSRP) in accordance with the Part 24 Rules. Processes include aerobic digestion, composting, anaerobic digestion, lime stabilization and air drying.

Combined sewer system is a sewer system in which storm water runoff is combined with sanitary wastes.

PART II

Section A. Definitions

Daily concentration is the sum of the concentrations of the individual samples of a parameter divided by the number of samples taken during any calendar day. If the parameter concentration in any sample is less than the quantification limit, regard that value as zero when calculating the daily concentration. The daily concentration will be used to determine compliance with any maximum and minimum daily concentration limitations (except for pH and dissolved oxygen). When required by the permit, report the maximum calculated daily concentration for the month in the "MAXIMUM" column under "QUALITY OR CONCENTRATION" on the Discharge Monitoring Reports (DMRs).

For pH, report the maximum value of any *individual* sample taken during the month in the "MAXIMUM" column under "QUALITY OR CONCENTRATION" on the DMRs and the minimum value of any *individual* sample taken during the month in the "MINIMUM" column under "QUALITY OR CONCENTRATION" on the DMRs. For dissolved oxygen, report the minimum concentration of any *individual* sample in the "MINIMUM" column under "QUALITY OR CONCENTRATION" on the DMRs.

Daily loading is the total discharge by weight of a parameter discharged during any calendar day. This value is calculated by multiplying the daily concentration by the total daily flow and by the appropriate conversion factor. The daily loading will be used to determine compliance with any maximum daily loading limitations. When required by the permit, report the maximum calculated daily loading for the month in the "MAXIMUM" column under "QUANTITY OR LOADING" on the DMRs.

Daily monitoring frequency refers to a 24-hour day. When required by this permit, an analytical result, reading, value or observation shall be reported for that period if a discharge occurs during that period.

Department means the Michigan Department of Environmental Quality.

Detection level means the lowest concentration or amount of the target analyte that can be determined to be different from zero by a single measurement at a stated level of probability.

Discharge means the addition of any waste, waste effluent, wastewater, pollutant, or any combination thereof to any surface water of the state.

Discharge point is the location where the point source discharge is directed to surface waters of the state or to a separate storm sewer. It includes the location of all point source discharges where storm water exits the facility, including *outfalls* which discharge directly to surface waters of the state, and *points of discharge* which discharge directly into separate storm sewer systems.

EC_{50} means a statistically or graphically estimated concentration that is expected to cause 1 or more specified effects in 50% of a group of organisms under specified conditions.

Fecal coliform bacteria monthly
FOR WWSLs THAT COLLECT AND STORE WASTEWATER AND ARE AUTHORIZED TO DISCHARGE ONLY IN THE SPRING AND/OR FALL ON AN INTERMITTENT BASIS – Fecal coliform bacteria monthly is the geometric mean of all daily concentrations determined during a discharge event. Days on which no daily concentration is determined shall not be used to determine the calculated monthly value. The calculated monthly value will be used to determine compliance with the maximum monthly fecal coliform bacteria limitations. When required by the permit, report the calculated monthly value in the "AVERAGE" column under "QUALITY OR CONCENTRATION" on the DMR. If the period in which the discharge event occurred was partially in each of two months, the calculated monthly value shall be reported on the DMR of the month in which the last day of discharge occurred.

FOR ALL OTHER DISCHARGES – Fecal coliform bacteria monthly is the geometric mean of all daily concentrations determined during a reporting month. Days on which no daily concentration is determined shall not be used to determine the calculated monthly value. The calculated monthly value will be used to determine compliance with the maximum monthly fecal coliform bacteria limitations. When required by the permit, report the calculated monthly value in the "AVERAGE" column under "QUALITY OR CONCENTRATION" on the DMR.

PART II

Section A. Definitions

Fecal coliform bacteria 7-day
FOR WWSLs THAT COLLECT AND STORE WASTEWATER AND ARE AUTHORIZED TO DISCHARGE ONLY IN THE SPRING AND/OR FALL ON AN INTERMITTENT BASIS – Fecal coliform bacteria 7-day is the geometric mean of the daily concentrations determined during any 7 consecutive days of discharge during a discharge event. If the number of daily concentrations determined during the discharge event is less than 7 days, the number of actual daily concentrations determined shall be used for the calculation. Days on which no daily concentration is determined shall not be used to determine the value. The calculated 7-day value will be used to determine compliance with the maximum 7-day fecal coliform bacteria limitations. When required by the permit, report the maximum calculated 7-day geometric mean value for the month in the "MAXIMUM" column under "QUALITY OR CONCENTRATION" on the DMRs. If the 7-day period was partially in each of two months, the value shall be reported on the DMR of the month in which the last day of discharge occurred.

FOR ALL OTHER DISCHARGES – Fecal coliform bacteria 7-day is the geometric mean of the daily concentrations determined during any 7 consecutive days in a reporting month. If the number of daily concentrations determined is less than 7, the actual number of daily concentrations determined shall be used for the calculation. Days on which no daily concentration is determined shall not be used to determine the value. The calculated 7-day value will be used to determine compliance with the maximum 7-day fecal coliform bacteria limitations. When required by the permit, report the maximum calculated 7-day geometric mean for the month in the "MAXIMUM" column under "QUALITY OR CONCENTRATION" on the DMRs. The first calculation shall be made on day 7 of the reporting month, and the last calculation shall be made on the last day of the reporting month.

Flow-proportioned sample is a composite sample with the sample volume proportional to the effluent flow.

General permit means a National Pollutant Discharge Elimination System permit issued authorizing a category of similar discharges.

Geometric mean is the average of the logarithmic values of a base 10 data set, converted back to a base 10 number.

Grab sample is a single sample taken at neither a set time nor flow.

IC_{25} means the toxicant concentration that would cause a 25% reduction in a nonquantal biological measurement for the test population.

Illicit connection means a physical connection to a municipal separate storm sewer system that primarily conveys non-storm water discharges other than uncontaminated groundwater into the storm sewer; or a physical connection not authorized or permitted by the local authority, where a local authority requires authorization or a permit for physical connections.

Illicit discharge means any discharge to, or seepage into, a municipal separate storm sewer system that is not composed entirely of storm water or uncontaminated groundwater. Illicit discharges include non-storm water discharges through pipes or other physical connections; dumping of motor vehicle fluids, household hazardous wastes, domestic animal wastes, or litter; collection and intentional dumping of grass clippings or leaf litter; or unauthorized discharges of sewage, industrial waste, restaurant wastes, or any other non-storm water waste directly into a separate storm sewer.

Individual permit means a site-specific NPDES permit.

Inlet means a catch basin, roof drain, conduit, drain tile, retention pond riser pipe, sump pump, or other point where storm water or wastewater enters into a closed conveyance system prior to discharge off site or into waters of the state.

PART II

Section A. Definitions

Interference is a discharge which, alone or in conjunction with a discharge or discharges from other sources, both: 1) inhibits or disrupts the POTW, its treatment processes or operations, or its sludge processes, use or disposal; and 2) therefore, is a cause of a violation of any requirement of the POTW's NPDES permit (including an increase in the magnitude or duration of a violation) or, of the prevention of sewage sludge use or disposal in compliance with the following statutory provisions and regulations or permits issued thereunder (or more stringent state or local regulations): Section 405 of the Clean Water Act, the Solid Waste Disposal Act (SWDA) (including Title II, more commonly referred to as the Resource Conservation and Recovery Act (RCRA), and including state regulations contained in any state sludge management plan prepared pursuant to Subtitle D of the SWDA), the Clean Air Act, the Toxic Substances Control Act, and the Marine Protection, Research and Sanctuaries Act. [This definition does not apply to sample matrix interference].

Land application means spraying or spreading biosolids or a biosolids derivative onto the land surface, injecting below the land surface, or incorporating into the soil so that the biosolids or biosolids derivative can either condition the soil or fertilize crops or vegetation grown in the soil.

LC_{50} means a statistically or graphically estimated concentration that is expected to be lethal to 50% of a group of organisms under specified conditions.

Maximum acceptable toxicant concentration (MATC) means the concentration obtained by calculating the geometric mean of the lower and upper chronic limits from a chronic test. A lower chronic limit is the highest tested concentration that did not cause the occurrence of a specific adverse effect. An upper chronic limit is the lowest tested concentration which did cause the occurrence of a specific adverse effect and above which all tested concentrations caused such an occurrence.

Maximum extent practicable means implementation of best management practices by a public body to comply with an approved storm water management program as required by a national permit for a municipal separate storm sewer system, in a manner that is environmentally beneficial, technically feasible, and within the public body's legal authority.

MGD means million gallons per day.

Monthly concentration is the sum of the daily concentrations determined during a reporting period divided by the number of daily concentrations determined. The calculated monthly concentration will be used to determine compliance with any maximum monthly concentration limitations. Days with no discharge shall not be used to determine the value. When required by the permit, report the calculated monthly concentration in the "AVERAGE" column under "QUALITY OR CONCENTRATION" on the DMR. If the seven day period was partially in each of two months, the monthly average shall be reported on the DMR of the month in which the last day of discharge occurred.

For minimum percent removal requirements, the monthly influent concentration and the monthly effluent concentration shall be determined. The calculated monthly percent removal, which is equal to 100 times the quantity [1 minus the quantity (monthly effluent concentration divided by the monthly influent concentration)], shall be reported in the "MINIMUM" column under "QUALITY OR CONCENTRATION" on the DMRs.

Monthly loading is the sum of the daily loadings of a parameter divided by the number of daily loadings determined during a reporting period. The calculated monthly loading will be used to determine compliance with any maximum monthly loading limitations. Days with no discharge shall not be used to determine the value. When required by the permit, report the calculated monthly loading in the "AVERAGE" column under "QUANTITY OR LOADING" on the DMR. If the seven day period was partially in each of two months, the monthly average shall be reported on the DMR of the month in which the last day of discharge occurred..

Monthly monitoring frequency refers to a calendar month. When required by this permit, an analytical result, reading, value or observation shall be reported for that period if a discharge occurs during that period.

Municipal separate storm sewer means a conveyance or system of conveyances designed or used for collecting or conveying storm water which is not a combined sewer and which is not part of a publicly-owned treatment works as defined in the Code of Federal Regulations at 40 CFR 122.2.

PART II

Section A. Definitions

Municipal separate storm sewer system (MS4) means all separate storm sewers that are owned or operated by the United States, a state, city, village, township, county, district, association, or other public body created by or pursuant to state law, having jurisdiction over disposal of sewage, industrial wastes, storm water, or other wastes, including special districts under state law, such as a sewer district, flood control district, or drainage district, or similar entity, or a designated or approved management agency under Section 208 of the Federal Act that discharges to the waters of the state. This term includes systems similar to separate storm sewer systems in municipalities, such as systems at military bases, large hospital or prison complexes, and highways and other thoroughfares. The term does not include separate storm sewers in very discrete areas, such as individual buildings.

National Pretreatment Standards are the regulations promulgated by or to be promulgated by the Federal Environmental Protection Agency pursuant to Section 307(b) and (c) of the Federal Act. The standards establish nationwide limits for specific industrial categories for discharge to a POTW.

No observed adverse effect level (NOAEL) means the highest tested dose or concentration of a substance which results in no observed adverse effect in exposed test organisms where higher doses or concentrations result in an adverse effect.

Noncontact cooling water is water used for cooling which does not come into direct contact with any raw material, intermediate product, by-product, waste product or finished product.

Nondomestic user is any discharger to a POTW that discharges wastes other than or in addition to water-carried wastes from toilet, kitchen, laundry, bathing or other facilities used for household purposes.

Outfall is the location at which a point source discharge enters the surface waters of the state.

Part 91 agency means an agency that is designated by a county board of commissioners pursuant to the provisions of section 9105 of Part 91 of the NREPA; an agency that is designated by a city, village, or township in accordance with the provisions of section 9106 of Part 91 of the NREPA; or the Department for soil erosion and sedimentation activities under Part 615, Part 631, or Part 632 pursuant to the provisions of section 9115 of Part 91 of the NREPA.

Part 91 permit means a soil erosion and sedimentation control permit issued by a Part 91 agency pursuant to the provisions of Part 91 of the NREPA.

Partially treated sewage is any sewage, sewage and storm water, or sewage and wastewater, from domestic or industrial sources that is treated to a level less than that required by the permittee's National Pollutant Discharge Elimination System permit, or that is not treated to national secondary treatment standards for wastewater, including discharges to surface waters from retention treatment facilities.

Point of discharge is the location of a point source discharge where storm water is discharged directly into a separate storm sewer system.

Point source discharge means a discharge from any discernible, confined, discrete conveyance, including but not limited to any pipe, ditch, channel, tunnel, conduit, well, discrete fissure, container, or rolling stock. Changing the surface of land or establishing grading patterns on land will result in a point source discharge where the runoff from the site is ultimately discharged to waters of the state.

Polluting material means any material, in solid or liquid form, identified as a polluting material under the Part 5 Rules (R 324.2001 through R 324.2009 of the Michigan Administrative Code).

POTW is a publicly owned treatment work.

Pretreatment is reducing the amount of pollutants, eliminating pollutants, or altering the nature of pollutant properties to a less harmful state prior to discharge into a public sewer. The reduction or alteration can be by physical, chemical, or biological processes, process changes, or by other means. Dilution is not considered pretreatment unless expressly authorized by an applicable National Pretreatment Standard for a particular industrial category.

PART II

Section A. Definitions

Public (as used in the MS4 individual permit) means all persons who potentially could affect the authorized storm water discharges, including, but not limited to, residents, visitors to the area, public employees, businesses, industries, and construction contractors and developers.

Public body means the United States; the state of Michigan; a city, village, township, county, school district, public college or university, or single-purpose governmental agency; or any other body which is created by federal or state statute or law.

Qualifying storm event means a storm event causing greater than 0.1 inch of rainfall and occurring at least 72 hours after the previous measurable storm event that also caused greater than 0.1 inch of rainfall.

Quantification level means the measurement of the concentration of a contaminant obtained by using a specified laboratory procedure calculated at a specified concentration above the detection level. It is considered the lowest concentration at which a particular contaminant can be quantitatively measured using a specified laboratory procedure for monitoring of the contaminant.

Quarterly monitoring frequency refers to a three month period, defined as January through March, April through June, July through September, and October through December. When required by this permit, an analytical result, reading, value or observation shall be reported for that period if a discharge occurs during that period.

Regional Administrator is the Region 5 Administrator, U.S. EPA, located at R-19J, 77 W. Jackson Blvd., Chicago, Illinois 60604.

Regulated area means the permittee's urbanized area, where urbanized area is defined as a place and its adjacent densely-populated territory that together have a minimum population of 50,000 people as defined by the United States Bureau of the Census and as determined by the latest available decennial census.

Secondary containment structure means a unit, other than the primary container, in which significant materials are packaged or held, which is required by State or Federal law to prevent the escape of significant materials by gravity into sewers, drains, or otherwise directly or indirectly into any sewer system or to the surface or ground waters of this state.

Separate storm sewer system means a system of drainage, including, but not limited to, roads, catch basins, curbs, gutters, parking lots, ditches, conduits, pumping devices, or man-made channels, which is not a combined sewer where storm water mixes with sanitary wastes, and is not part of a POTW.

Significant industrial user is a nondomestic user that: 1) is subject to Categorical Pretreatment Standards under 40 CFR 403.6 and 40 CFR Chapter I, Subchapter N; or 2) discharges an average of 25,000 gallons per day or more of process wastewater to a POTW (excluding sanitary, noncontact cooling and boiler blowdown wastewater); contributes a process waste stream which makes up five (5) percent or more of the average dry weather hydraulic or organic capacity of the POTW treatment plant; or is designated as such by the permittee as defined in 40 CFR 403.12(a) on the basis that the industrial user has a reasonable potential for adversely affecting the POTW's treatment plant operation or violating any pretreatment standard or requirement (in accordance with 40 CFR 403.8(f)(6)).

Significant materials Significant Materials means any material which could degrade or impair water quality, including but not limited to: raw materials; fuels; solvents, detergents, and plastic pellets; finished materials such as metallic products; hazardous substances designated under Section 101(14) of Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) (see 40 CFR 372.65); any chemical the facility is required to report pursuant to Section 313 of Emergency Planning and Community Right-to-Know Act (EPCRA); polluting materials as identified under the Part 5 Rules (R 324.2001 through R 324.2009 of the Michigan Administrative Code); Hazardous Wastes as defined in Part 111 of the NREPA; fertilizers; pesticides; and waste products such as ashes, slag, and sludge that have the potential to be released with storm water discharges.

Significant spills and significant leaks means any release of a polluting material reportable under the Part 5 Rules (R 324.2001 through R 324.2009 of the Michigan Administrative Code).

PART II

Section A. Definitions

Special-use area means secondary containment structures required by state or federal law; lands on Michigan's List of Sites of Environmental Contamination pursuant to Part 201, Environmental Remediation, of the NREPA; and/or areas with other activities that may contribute pollutants to the storm water for which the Department determines monitoring is needed.

Stoichiometric means the quantity of a reagent calculated to be necessary and sufficient for a given chemical reaction.

Storm water means storm water runoff, snow melt runoff, surface runoff and drainage, and non-storm water included under the conditions of this permit.

SWPPP means the Storm Water Pollution Prevention Plan prepared in accordance with this permit.

Tier I value means a value for aquatic life, human health or wildlife calculated under R 323.1057 of the Water Quality Standards using a tier I toxicity database.

Tier II value means a value for aquatic life, human health or wildlife calculated under R 323.1057 of the Water Quality Standards using a tier II toxicity database.

Total maximum daily loads (TMDLs) are required by the Federal Act for waterbodies that do not meet Water Quality Standards. TMDLs represent the maximum daily load of a pollutant that a waterbody can assimilate and meet Water Quality Standards, and an allocation of that load among point sources, nonpoint sources, and a margin of safety.

Toxicity reduction evaluation (TRE) means a site-specific study conducted in a stepwise process designed to identify the causative agents of effluent toxicity, isolate the sources of toxicity, evaluate the effectiveness of toxicity control options, and then confirm the reduction in effluent toxicity.

Water Quality Standards means the Part 4 Water Quality Standards promulgated pursuant to Part 31 of the NREPA, being R 323.1041 through R 323.1117 of the Michigan Administrative Code.

Weekly monitoring frequency refers to a calendar week which begins on Sunday and ends on Saturday. When required by this permit, an analytical result, reading, value or observation shall be reported for that period if a discharge occurs during that period.

WWSL is a wastewater stabilization lagoon.

WWSL discharge event is a discrete occurrence during which effluent is discharged to the surface water up to 10 days of a consecutive 14 day period.

3-portion composite sample is a sample consisting of three equal-volume grab samples collected at equal intervals over an 8-hour period.

PART II

Section A. Definitions

7-day concentration
FOR WWSLs THAT COLLECT AND STORE WASTEWATER AND ARE AUTHORIZED TO DISCHARGE ONLY IN THE SPRING AND/OR FALL ON AN INTERMITTENT BASIS – The 7-day concentration is the sum of the daily concentrations determined during any 7 consecutive days of discharge during a WWSL discharge event divided by the number of daily concentrations determined. If the number of daily concentrations determined during the WWSL discharge event is less than 7 days, the number of actual daily concentrations determined shall be used for the calculation. The calculated 7-day concentration will be used to determine compliance with any maximum 7-day concentration limitations. When required by the permit, report the maximum calculated 7-day concentration for the WWSL discharge event in the "MAXIMUM" column under "QUALITY OR CONCENTRATION" on the DMR. If the WWSL discharge event was partially in each of two months, the value shall be reported on the DMR of the month in which the last day of discharge occurred.

FOR ALL OTHER DISCHARGES – The 7-day concentration is the sum of the daily concentrations determined during any 7 consecutive days in a reporting month divided by the number of daily concentrations determined. If the number of daily concentrations determined is less than 7, the actual number of daily concentrations determined shall be used for the calculation. The calculated 7-day concentration will be used to determine compliance with any maximum 7-day concentration limitations in the reporting month. When required by the permit, report the maximum calculated 7-day concentration for the month in the "MAXIMUM" column under "QUALITY OR CONCENTRATION" on the DMR. The first 7-day calculation shall be made on day 7 of the reporting month, and the last calculation shall be made on the last day of the reporting month.

7-day loading
FOR WWSLs THAT COLLECT AND STORE WASTEWATER AND ARE AUTHORIZED TO DISCHARGE ONLY IN THE SPRING AND/OR FALL ON AN INTERMITTENT BASIS – The 7-day loading is the sum of the daily loadings determined during any 7 consecutive days of discharge during a WWSL discharge event divided by the number of daily loadings determined. If the number of daily loadings determined during the WWSL discharge event is less than 7 days, the number of actual daily loadings determined shall be used for the calculation. The calculated 7-day loading will be used to determine compliance with any maximum 7-day loading limitations. When required by the permit, report the maximum calculated 7-day loading for the WWSL discharge event in the "MAXIMUM" column under "QUANTITY OR LOADING" on the DMR. If the WWSL discharge event was partially in each of two months, the value shall be reported on the DMR of the month in which the last day of discharge occurred

FOR ALL OTHER DISCHARGES – The 7-day loading is the sum of the daily loadings determined during any 7 consecutive days in a reporting month divided by the number of daily loadings determined. If the number of daily loadings determined is less than 7, the actual number of daily loadings determined shall be used for the calculation. The calculated 7-day loading will be used to determine compliance with any maximum 7-day loading limitations in the reporting month. When required by the permit, report the maximum calculated 7-day loading for the month in the "MAXIMUM" column under "QUANTITY OR LOADING" on the DMR. The first 7-day calculation shall be made on day 7 of the reporting month, and the last calculation shall be made on the last day of the reporting month.

24-hour composite sample is a flow-proportioned composite sample consisting of hourly or more frequent portions that are taken over a 24-hour period. A time-proportioned composite sample may be used upon approval of the Department if the permittee demonstrates it is representative of the discharge.

PART II

Section B. Monitoring Procedures

1. Representative Samples

Samples and measurements taken as required herein shall be representative of the volume and nature of the monitored discharge.

2. Test Procedures

Test procedures for the analysis of pollutants shall conform to regulations promulgated pursuant to Section 304(h) of the Federal Act (40 CFR Part 136 – Guidelines Establishing Test Procedures for the Analysis of Pollutants), unless specified otherwise in this permit. **Test procedures used shall be sufficiently sensitive to determine compliance with applicable effluent limitations**. Requests to use test procedures not promulgated under 40 CFR Part 136 for pollutant monitoring required by this permit shall be made in accordance with the Alternate Test Procedures regulations specified in 40 CFR 136.4. These requests shall be submitted to the Chief of the Permits Section, Water Resources Division, Michigan Department of Environmental Quality, P.O. Box 30458, Lansing, Michigan, 48909-7958. The permittee may use such procedures upon approval.

The permittee shall periodically calibrate and perform maintenance procedures on all analytical instrumentation at intervals to ensure accuracy of measurements. The calibration and maintenance shall be performed as part of the permittee's laboratory Quality Control/Quality Assurance program.

3. Instrumentation

The permittee shall periodically calibrate and perform maintenance procedures on all monitoring instrumentation at intervals to ensure accuracy of measurements.

4. Recording Results

For each measurement or sample taken pursuant to the requirements of this permit, the permittee shall record the following information: 1) the exact place, date, and time of measurement or sampling; 2) the person(s) who performed the measurement or sample collection; 3) the dates the analyses were performed; 4) the person(s) who performed the analyses; 5) the analytical techniques or methods used; 6) the date of and person responsible for equipment calibration; and 7) the results of all required analyses.

5. Records Retention

All records and information resulting from the monitoring activities required by this permit including all records of analyses performed and calibration and maintenance of instrumentation and recordings from continuous monitoring instrumentation shall be retained for a minimum of three (3) years, or longer if requested by the Regional Administrator or the Department.

PART II

Section C. Reporting Requirements

1. Start-up Notification

If the permittee will not discharge during the first 60 days following the effective date of this permit, the permittee shall notify the Department within 14 days following the effective date of this permit, and then 60 days prior to the commencement of the discharge.

2. Submittal Requirements for Self-Monitoring Data

Part 31 of the NREPA, specifically Section 324.3110(3) and R 323.2155(2) of Part 21, allows the Department to specify the forms to be utilized for reporting the required self-monitoring data. Unless instructed on the effluent limitations page to conduct "Retained Self-Monitoring" the permittee shall submit self-monitoring data via the Department's Electronic Environmental Discharge Monitoring Reporting (e2-DMR) system.

The permittee shall utilize the information provided on the e2-Reporting website at https://secure1.state.mi.us/e2rs/ to access and submit the electronic forms. Both monthly summary and daily data shall be submitted to the Department no later than the 20th day of the month following each month of the authorized discharge period(s). The permittee may be allowed to submit the electronic forms after this date if the Department has granted an extension to the submittal date.

3. Retained Self-Monitoring Requirements

If instructed on the effluent limits page (or otherwise authorized by the Department in accordance with the provisions of this permit) to conduct retained self-monitoring, the permittee shall maintain a year-to-date log of retained self-monitoring results and, upon request, provide such log for inspection to the staff of the Department. Retained self-monitoring results are public information and shall be promptly provided to the public upon request.

The permittee shall certify, in writing, to the Department, on or before January 10th (April 1st for animal feeding operation facilities) of each year, that: 1) all retained self-monitoring requirements have been complied with and a year-to-date log has been maintained; and 2) the application on which this permit is based still accurately describes the discharge. With this annual certification, the permittee shall submit a summary of the previous year's monitoring data. The summary shall include maximum values for samples to be reported as daily maximums and/or monthly maximums and minimum values for any daily minimum samples.

Retained self-monitoring may be denied to a permittee by notification in writing from the Department. In such cases, the permittee shall submit self-monitoring data in accordance with Part II.C.2., above. Such a denial may be rescinded by the Department upon written notification to the permittee. Reissuance or modification of this permit or reissuance or modification of an individual permittee's authorization to discharge shall not affect previous approval or denial for retained self-monitoring unless the Department provides notification in writing to the permittee.

4. Additional Monitoring by Permittee

If the permittee monitors any pollutant at the location(s) designated herein more frequently than required by this permit, using approved analytical methods as specified above, the results of such monitoring shall be included in the calculation and reporting of the values required in the Discharge Monitoring Report. Such increased frequency shall also be indicated.

Monitoring required pursuant to Part 41 of the NREPA or Rule 35 of the Mobile Home Park Commission Act (Act 96 of the Public Acts of 1987) for assurance of proper facility operation shall be submitted as required by the Department.

PART II

Section C. Reporting Requirements

5. Compliance Dates Notification

Within 14 days of every compliance date specified in this permit, the permittee shall submit a *written* notification to the Department indicating whether or not the particular requirement was accomplished. If the requirement was not accomplished, the notification shall include an explanation of the failure to accomplish the requirement, actions taken or planned by the permittee to correct the situation, and an estimate of when the requirement will be accomplished. If a written report is required to be submitted by a specified date and the permittee accomplishes this, a separate written notification is not required.

6. Noncompliance Notification

Compliance with all applicable requirements set forth in the Federal Act, Parts 31 and 41 of the NREPA, and related regulations and rules is required. All instances of noncompliance shall be reported as follows:

a. 24-Hour Reporting
Any noncompliance which may endanger health or the environment (including maximum and/or minimum daily concentration discharge limitation exceedances) shall be reported, verbally, within 24 hours from the time the permittee becomes aware of the noncompliance. A written submission shall also be provided within five (5) days.

b. Other Reporting
The permittee shall report, in writing, all other instances of noncompliance not described in a. above at the time monitoring reports are submitted; or, in the case of retained self-monitoring, within five (5) days from the time the permittee becomes aware of the noncompliance.

Written reporting shall include: 1) a description of the discharge and cause of noncompliance; and 2) the period of noncompliance, including exact dates and times, or, if not yet corrected, the anticipated time the noncompliance is expected to continue, and the steps taken to reduce, eliminate and prevent recurrence of the noncomplying discharge.

7. Spill Notification

The permittee shall immediately report any release of any polluting material which occurs to the surface waters or groundwaters of the state, unless the permittee has determined that the release is not in excess of the threshold reporting quantities specified in the Part 5 Rules (R 324.2001 through R 324.2009 of the Michigan Administrative Code), by calling the Department at the number indicated on the second page of this permit (or, if this is a general permit, on the COC); or, if the notice is provided after regular working hours, call the Department's 24-hour Pollution Emergency Alerting System telephone number, 1-800-292-4706 (calls from **out-of-state** dial 1-517-373-7660).

Within ten (10) days of the release, the permittee shall submit to the Department a full written explanation as to the cause of the release, the discovery of the release, response (clean-up and/or recovery) measures taken, and preventative measures taken or a schedule for completion of measures to be taken to prevent reoccurrence of similar releases.

PART II

Section C. Reporting Requirements

8. Upset Noncompliance Notification

If a process "upset" (defined as an exceptional incident in which there is unintentional and temporary noncompliance with technology based permit effluent limitations because of factors beyond the reasonable control of the permittee) has occurred, the permittee who wishes to establish the affirmative defense of upset, shall notify the Department by telephone within 24 hours of becoming aware of such conditions; and within five (5) days, provide in writing, the following information:

a. that an upset occurred and that the permittee can identify the specific cause(s) of the upset;

b. that the permitted wastewater treatment facility was, at the time, being properly operated and maintained (note that an upset does not include noncompliance to the extent caused by operational error, improperly designed treatment facilities, inadequate treatment facilities, lack of preventive maintenance, or careless or improper operation); and

c. that the permittee has specified and taken action on all responsible steps to minimize or correct any adverse impact in the environment resulting from noncompliance with this permit.

No determination made during administrative review of claims that noncompliance was caused by upset, and before an action for noncompliance, is final administrative action subject to judicial review.

In any enforcement proceedings, the permittee, seeking to establish the occurrence of an upset, has the burden of proof.

9. Bypass Prohibition and Notification

a. Bypass Prohibition
Bypass is prohibited, and the Department may take an enforcement action, unless:

1) bypass was unavoidable to prevent loss of life, personal injury, or severe property damage;

2) there were no feasible alternatives to the bypass, such as the use of auxiliary treatment facilities, retention of untreated wastes, or maintenance during normal periods of equipment downtime. This condition is not satisfied if adequate backup equipment should have been installed in the exercise of reasonable engineering judgment to prevent a bypass; and

3) the permittee submitted notices as required under 9.b. or 9.c. below.

b. Notice of Anticipated Bypass
If the permittee knows in advance of the need for a bypass, it shall submit prior notice to the Department, if possible at least ten (10) days before the date of the bypass, and provide information about the anticipated bypass as required by the Department. The Department may approve an anticipated bypass, after considering its adverse effects, if it will meet the three (3) conditions listed in 9.a. above.

c. Notice of Unanticipated Bypass
The permittee shall submit notice to the Department of an unanticipated bypass by calling the Department at the number indicated on the second page of this permit (if the notice is provided after regular working hours, use the following number: 1-800-292-4706) as soon as possible, but no later than 24 hours from the time the permittee becomes aware of the circumstances.

PART II

Section C. Reporting Requirements

d. Written Report of Bypass
A written submission shall be provided within five (5) working days of commencing any bypass to the Department, and at additional times as directed by the Department. The written submission shall contain a description of the bypass and its cause; the period of bypass, including exact dates and times, and if the bypass has not been corrected, the anticipated time it is expected to continue; steps taken or planned to reduce, eliminate, and prevent reoccurrence of the bypass; and other information as required by the Department.

e. Bypass Not Exceeding Limitations
The permittee may allow any bypass to occur which does not cause effluent limitations to be exceeded, but only if it also is for essential maintenance to ensure efficient operation. These bypasses are not subject to the provisions of 9.a., 9.b., 9.c., and 9.d., above. This provision does not relieve the permittee of any notification responsibilities under Part II.C.11. of this permit.

f. Definitions

1) Bypass means the intentional diversion of waste streams from any portion of a treatment facility.

2) Severe property damage means substantial physical damage to property, damage to the treatment facilities which causes them to become inoperable, or substantial and permanent loss of natural resources which can reasonably be expected to occur in the absence of a bypass. Severe property damage does not mean economic loss caused by delays in production.

10. Bioaccumulative Chemicals of Concern (BCC)

Consistent with the requirements of R 323.1098 and R 323.1215 of the Michigan Administrative Code, the permittee is prohibited from undertaking any action that would result in a lowering of water quality from an increased loading of a BCC unless an increased use request and antidegradation demonstration have been submitted and approved by the Department.

11. Notification of Changes in Discharge

The permittee shall notify the Department, in writing, as soon as possible but no later than 10 days of knowing, or having reason to believe, that any activity or change has occurred or will occur which would result in the discharge of: 1) detectable levels of chemicals on the current Michigan Critical Materials Register, priority pollutants or hazardous substances set forth in 40 CFR 122.21, Appendix D, or the Pollutants of Initial Focus in the Great Lakes Water Quality Initiative specified in 40 CFR 132.6, Table 6, which were not acknowledged in the application or listed in the application at less than detectable levels; 2) detectable levels of any other chemical not listed in the application or listed at less than detection, for which the application specifically requested information; or 3) any chemical at levels greater than five times the average level reported in the complete application (see the first page of this permit, for the date(s) the complete application was submitted). Any other monitoring results obtained as a requirement of this permit shall be reported in accordance with the compliance schedules.

PART II

Section C. Reporting Requirements

12. Changes in Facility Operations

Any anticipated action or activity, including but not limited to facility expansion, production increases, or process modification, which will result in new or increased loadings of pollutants to the receiving waters must be reported to the Department by a) submission of an increased use request (application) and all information required under R 323.1098 (Antidegradation) of the Water Quality Standards or b) by notice if the following conditions are met: 1) the action or activity will not result in a change in the types of wastewater discharged or result in a greater quantity of wastewater than currently authorized by this permit; 2) the action or activity will not result in violations of the effluent limitations specified in this permit; 3) the action or activity is not prohibited by the requirements of Part II.C.10.; and 4) the action or activity will not require notification pursuant to Part II.C.11. Following such notice, the permit or, if applicable, the facility's COC may be modified according to applicable laws and rules to specify and limit any pollutant not previously limited.

13. Transfer of Ownership or Control

In the event of any change in control or ownership of facilities from which the authorized discharge emanates, the permittee shall submit to the Department 30 days prior to the actual transfer of ownership or control a written agreement between the current permittee and the new permittee containing: 1) the legal name and address of the new owner; 2) a specific date for the effective transfer of permit responsibility, coverage and liability; and 3) a certification of the continuity of or any changes in operations, wastewater discharge, or wastewater treatment.

If the new permittee is proposing changes in operations, wastewater discharge, or wastewater treatment, the Department may propose modification of this permit in accordance with applicable laws and rules.

14. Operations and Maintenance Manual

For wastewater treatment facilities that serve the public (and are thus subject to Part 41 of the NREPA), Section 4104 of Part 41 and associated Rule 2957 of the Michigan Administrative Code allow the Department to require an Operations and Maintenance (O&M) Manual from the facility. An up-to-date copy of the O&M Manual shall be kept at the facility and shall be provided to the Department upon request. The Department may review the O&M Manual in whole or in part at its discretion and require modifications to it if portions are determined to be inadequate.

At a minimum, the O&M Manual shall include the following information: permit standards; descriptions and operation information for all equipment; staffing information; laboratory requirements; record keeping requirements; a maintenance plan for equipment; an emergency operating plan; safety program information; and copies of all pertinent forms, as-built plans, and manufacturer's manuals.

Certification of the existence and accuracy of the O&M Manual shall be submitted to the Department at least sixty days prior to start-up of a new wastewater treatment facility. Recertification shall be submitted sixty days prior to start-up of any substantial improvements or modifications made to an existing wastewater treatment facility.

PART II

Section C. Reporting Requirements

15. Signatory Requirements

All applications, reports, or information submitted to the Department in accordance with the conditions of this permit and that require a signature shall be signed and certified as described in the Federal Act and the NREPA.

The Federal Act provides that any person who knowingly makes any false statement, representation, or certification in any record or other document submitted or required to be maintained under this permit, including monitoring reports or reports of compliance or noncompliance, shall, upon conviction, be punished by a fine of not more than $10,000 per violation, or by imprisonment for not more than 6 months per violation, or by both.

The NREPA (Section 3115(2)) provides that a person who at the time of the violation knew or should have known that he or she discharged a substance contrary to this part, or contrary to a permit, COC, or order issued or rule promulgated under this part, or who intentionally makes a false statement, representation, or certification in an application for or form pertaining to a permit or COC or in a notice or report required by the terms and conditions of an issued permit or COC, or who intentionally renders inaccurate a monitoring device or record required to be maintained by the Department, is guilty of a felony and shall be fined not less than $2,500.00 or more than $25,000.00 for each violation. The court may impose an additional fine of not more than $25,000.00 for each day during which the unlawful discharge occurred. If the conviction is for a violation committed after a first conviction of the person under this subsection, the court shall impose a fine of not less than $25,000.00 per day and not more than $50,000.00 per day of violation. Upon conviction, in addition to a fine, the court in its discretion may sentence the defendant to imprisonment for not more than 2 years or impose probation upon a person for a violation of this part. With the exception of the issuance of criminal complaints, issuance of warrants, and the holding of an arraignment, the circuit court for the county in which the violation occurred has exclusive jurisdiction. However, the person shall not be subject to the penalties of this subsection if the discharge of the effluent is in conformance with and obedient to a rule, order, permit, or COC of the Department. In addition to a fine, the attorney general may file a civil suit in a court of competent jurisdiction to recover the full value of the injuries done to the natural resources of the state and the costs of surveillance and enforcement by the state resulting from the violation.

16. Electronic Reporting

Upon notice by the Department that electronic reporting tools are available for specific reports or notifications, the permittee shall submit electronically all such reports or notifications as required by this permit.

PART II

Section D. Management Responsibilities

1. Duty to Comply

All discharges authorized herein shall be consistent with the terms and conditions of this permit. The discharge of any pollutant identified in this permit, more frequently than, or at a level in excess of, that authorized, shall constitute a violation of the permit.

It is the duty of the permittee to comply with all the terms and conditions of this permit. Any noncompliance with the Effluent Limitations, Special Conditions, or terms of this permit constitutes a violation of the NREPA and/or the Federal Act and constitutes grounds for enforcement action; for permit or Certificate of Coverage (COC) termination, revocation and reissuance, or modification; or denial of an application for permit or COC renewal.

It shall not be a defense for a permittee in an enforcement action that it would have been necessary to halt or reduce the permitted activity in order to maintain compliance with the conditions of this permit.

2. Operator Certification

The permittee shall have the waste treatment facilities under direct supervision of an operator certified at the appropriate level for the facility certification by the Department, as required by Sections 3110 and 4104 of the NREPA. Permittees authorized to discharge storm water shall have the storm water treatment and/or control measures under direct supervision of a storm water operator certified by the Department, as required by Section 3110 of the NREPA.

3. Facilities Operation

The permittee shall, at all times, properly operate and maintain all treatment or control facilities or systems installed or used by the permittee to achieve compliance with the terms and conditions of this permit. Proper operation and maintenance includes adequate laboratory controls and appropriate quality assurance procedures.

4. Power Failures

In order to maintain compliance with the effluent limitations of this permit and prevent unauthorized discharges, the permittee shall either:

a. provide an alternative power source sufficient to operate facilities utilized by the permittee to maintain compliance with the effluent limitations and conditions of this permit; or

b. upon the reduction, loss, or failure of one or more of the primary sources of power to facilities utilized by the permittee to maintain compliance with the effluent limitations and conditions of this permit, the permittee shall halt, reduce or otherwise control production and/or all discharge in order to maintain compliance with the effluent limitations and conditions of this permit.

5. Adverse Impact

The permittee shall take all reasonable steps to minimize or prevent any adverse impact to the surface waters or groundwaters of the state resulting from noncompliance with any effluent limitation specified in this permit including, but not limited to, such accelerated or additional monitoring as necessary to determine the nature and impact of the discharge in noncompliance.

PART II

Section D. Management Responsibilities

6. Containment Facilities

The permittee shall provide facilities for containment of any accidental losses of polluting materials in accordance with the requirements of the Part 5 Rules (R 324.2001 through R 324.2009 of the Michigan Administrative Code). For a Publicly Owned Treatment Work (POTW), these facilities shall be approved under Part 41 of the NREPA.

7. Waste Treatment Residues

Residuals (i.e. solids, sludges, biosolids, filter backwash, scrubber water, ash, grit, or other pollutants or wastes) removed from or resulting from treatment or control of wastewaters, including those that are generated during treatment or left over after treatment or control has ceased, shall be disposed of in an environmentally compatible manner and according to applicable laws and rules. These laws may include, but are not limited to, the NREPA, Part 31 for protection of water resources, Part 55 for air pollution control, Part 111 for hazardous waste management, Part 115 for solid waste management, Part 121 for liquid industrial wastes, Part 301 for protection of inland lakes and streams, and Part 303 for wetlands protection. Such disposal shall not result in any unlawful pollution of the air, surface waters or groundwaters of the state.

8. Right of Entry

The permittee shall allow the Department, any agent appointed by the Department, or the Regional Administrator, upon the presentation of credentials and, for animal feeding operation facilities, following appropriate biosecurity protocols:

a. to enter upon the permittee's premises where an effluent source is located or any place in which records are required to be kept under the terms and conditions of this permit; and

b. at reasonable times to have access to and copy any records required to be kept under the terms and conditions of this permit; to inspect process facilities, treatment works, monitoring methods and equipment regulated or required under this permit; and to sample any discharge of pollutants.

9. Availability of Reports

Except for data determined to be confidential under Section 308 of the Federal Act and Rule 2128 (R 323.2128 of the Michigan Administrative Code), all reports prepared in accordance with the terms of this permit, shall be available for public inspection at the offices of the Department and the Regional Administrator. As required by the Federal Act, effluent data shall not be considered confidential. Knowingly making any false statement on any such report may result in the imposition of criminal penalties as provided for in Section 309 of the Federal Act and Sections 3112, 3115, 4106 and 4110 of the NREPA.

10. Duty to Provide Information

The permittee shall furnish to the Department, within a reasonable time, any information which the Department may request to determine whether cause exists for modifying, revoking and reissuing, or terminating this permit or the facility's COC, or to determine compliance with this permit. The permittee shall also furnish to the Department, upon request, copies of records required to be kept by this permit.

Where the permittee becomes aware that it failed to submit any relevant facts in a permit application, or submitted incorrect information in a permit application or in any report to the Department, it shall promptly submit such facts or information.

PART II

Section E. Activities Not Authorized by This Permit

1. Discharge to the Groundwaters

This permit does not authorize any discharge to the groundwaters. Such discharge may be authorized by a groundwater discharge permit issued pursuant to the NREPA.

2. POTW Construction

This permit does not authorize or approve the construction or modification of any physical structures or facilities at a POTW. Approval for the construction or modification of any physical structures or facilities at a POTW shall be by permit issued under Part 41 of the NREPA.

3. Civil and Criminal Liability

Except as provided in permit conditions on "Bypass" (Part II.C.9. pursuant to 40 CFR 122.41(m)), nothing in this permit shall be construed to relieve the permittee from civil or criminal penalties for noncompliance, whether or not such noncompliance is due to factors beyond the permittee's control, such as accidents, equipment breakdowns, or labor disputes.

4. Oil and Hazardous Substance Liability

Nothing in this permit shall be construed to preclude the institution of any legal action or relieve the permittee from any responsibilities, liabilities, or penalties to which the permittee may be subject under Section 311 of the Federal Act except as are exempted by federal regulations.

5. State Laws

Nothing in this permit shall be construed to preclude the institution of any legal action or relieve the permittee from any responsibilities, liabilities, or penalties established pursuant to any applicable state law or regulation under authority preserved by Section 510 of the Federal Act.

6. Property Rights

The issuance of this permit does not convey any property rights in either real or personal property, or any exclusive privileges, nor does it authorize violation of any federal, state or local laws or regulations, nor does it obviate the necessity of obtaining such permits, including any other Department of Environmental Quality permits, or approvals from other units of government as may be required by law.

APPENDIX C
COST ESTIMATES

PREPARED FOR:

Portland
CITY OF TWO RIVERS Michigan

FLEIS&VANDENBRINK
DESIGN. BUILD. OPERATE.

Project No.: 848390

FLEIS&VANDENBRINK
DESIGN. BUILD. OPERATE.

Engineer's Opinion of Probable Project Cost [1]

Project: City of Portland Project Plan
Basis for Estimate: [X] Conceptual [ ] Basis of Design [ ] Final
Work: **City of Portland WWTP**

Project No. 848390
Estimator:
Date: Apr-2021
Current ENR-CCI: 11,013

Item	Description	Unit	Qty.	Unit Price	Amount
Collection System Improvements					
1	Gravity Main and Manhole Improvements	LS	1	$1,981,000	$1,981,000
Wastewater Treatment Plant Improvements					
Raw Sewage Pumping					
2	Influent Pumping System Improvements	LS	1	$202,000	$202,000
Headworks					
3	Mechanical Screen Replacement	LS	1	$255,000	$255,000
Secondary Treatment					
4	Secondary Treatment Improvements	LS	1	$1,330,000	$1,330,000
5	Flow Splitter Improvements	LS	1	$18,000	$18,000
6	Secondary Clarifier Improvements	LS	1	$65,000	$65,000
Digester Improvements					
7	Anaerobic Digestion System	LS	1	$1,160,000	$1,160,000
Biosolids Storage					
8	Biosolids Storage	LS	1	$747,000	$747,000
Miscellaneous Improvements					
9	Garage Building	SF	1,200	$150	$180,000
10	Building Improvements	LS	1	$125,000	$125,000
11	Site Improvements/Restoration	LS	1	$75,000	$75,000
12	Effluent Bypass Pump Connection	LS	1	$30,000	$30,000
13	Chemical Feed Improvements	LS	1	$184,000	$184,000
Lift Station Improvements					
14	Rindlehaven LS Improvements	LS	1	$135,000	$135,000
15	Canal St LS Improvements	LS	1	$120,000	$120,000
16	Riverside LS Improvements	LS	1	$270,000	$270,000
17	Construction Subtotal:				$6,877,000
18	General conditions and OH&P		15%		$1,032,000
19	Construction Contingency		10%		$791,000
				Construction Cost:	**$8,700,000**
20	Engineering, Legal, Administration, & Financial				$1,424,000
				Total Project Cost:	**$10,124,000**

APPENDIX D
INFILTRATION AND INFLOW STUDY (MASS FLOW MONITORING REPORT)

PREPARED FOR:

Portland
CITY OF TWO RIVERS Michigan

FLEIS&VANDENBRINK
DESIGN. BUILD. OPERATE.

Project No.: 848390

INFILTRATION AND INFLOW
ANALYSIS REPORT

CITY OF PORTLAND
IONIA COUNTY, MI

WASTEWATER ASSET MANAGEMENT PLAN:
MASS FLOW MONITORING REPORT

December 2020
Project No. 816483

FLEIS&VANDENBRINK
DESIGN. BUILD. OPERATE.

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EXECUTIVE SUMMARY

The City of Portland retained Fleis & VandenBrink Engineering, Inc. (F&V) to evaluate their wastewater collection system as part of a Stormwater, Asset Management and Wastewater (SAW) grant-funded project. In general, SAW work involves an inventory and assessment of the condition of the assets in a wastewater collection system and the development of a long-term asset management plan (AMP). As with most aging wastewater collection systems, the flow rates in the sewers and the volume of wastewater collected tend to increase during and following wet weather events.

Study Scope and Approach

This report, ultimately an appendix to the full AMP, presents a hydraulic analysis of the underground sewers and manholes whose condition can be difficult to determine. The insights are derived from an analysis of stormwater and groundwater inflow and infiltration (I/I) into the wastewater collection system. The information in this report is intended to guide follow-up and maintenance efforts in discovering and correcting structural and other problems that are indicated by the presence and characteristics of I/I.

The identification of I/I in the sanitary sewer collection system relies on developing a comprehensive picture of dry and wet-weather flow patterns in the selected study areas. The approach to documenting system flows utilized for this study is referred to as mass flow monitoring (MFM). The MFM approach relies primarily on flow depth monitoring with compact and easily installed equipment, and spot checks of flow velocities and flow rates, which allows the development of high-resolution understanding of I/I distribution within systems for a relatively low cost, comparatively to other methods.

Data collection was completed from March 2019 to September 2019. Sewer flow depth and temperature were measured with Solinst® Leveloggers® (called LLs) at 16 manholes in the collection system. Daily system flow averages were recorded at the Wastewater Treatment Plant (WWTP). Precipitation and temperature data were collected using two tipping-bucket style rain gauges, one at the WWTP, and one at the Lift Station located on Riverside Street.

Results and Conclusions

In general, the results from this study will enable the City to pinpoint high priority I/I areas by increasing the spatial resolution of flow analyses in a target area. This allows for more efficient and cost-effective field investigation/rehabilitation efforts in addition to providing more comprehensive data to evaluate options for mitigation (i.e. sewer rehabilitation and/or source elimination).

The results from the flow monitoring and analysis efforts are presented in a prioritized manner that takes into consideration the effective population and quantity of underground structures (manholes and sewers) of the monitoring areas. This directs future investigation and rehabilitation into areas that will require the minimum effort to achieve the maximum return of I/I reduction.

The investigation priority was determined from an average of the priorities based on three I/I assessments:

- The average dry weather flow (normalized to the effective population of the service area) that highlights the best potential areas for addressing infiltration (groundwater as well as rainfall-induced infiltration); and
- The peak 24-hour wet weather design storm flow estimate (normalized to the effective population of the service area) that highlights the best potential areas for discovering and addressing inflow; and
- The estimated percent capture of design storm rainfall that highlights the most impactful service areas in terms of total rainfall entering the collection system.

The highest priority areas include:

- The aging vitrified clay pipe (VCP) trunk sewers along the banks of the Grand River (LL-04, LL-06 areas), as well as the aging residential service area near downtown (LL-11). Record drawings show that portions of the pipe were installed in the 1930's and is over half of its useful life. These areas experienced both groundwater infiltration and inflow.

A table of general findings is presented as Table ES-1. The priority ranking of monitoring areas is presented as Figure ES-1.

Table ES-1. General observations and analysis results.

Monitor	DWF		Wet Weather Flow (WWF)					RDII		
	Q (mgd) | (gpcd)		Peak Q (mgd) | (gpcd)					% Capture (MG/MG)		
	Event Average Dry Weather Flow	**Event Average DWF - normalized**	Maximum Observed	Design Storm Peak Hour Projection	Design Storm Peak Hour Projection - normalized	Design Storm Peak 24-hour Projection	**Design Storm Peak 24-hour Projection - normalized**	Maximum Observed	Weighted Average: Observed Capture %	**Design Storm Projection**
LL-01	0.037	***89***	0.08	0.10	*240*	0.10	***247***	1.1%	0.3%	**0.5%**
LL-02	0.020	***39***	0.06	0.10	*204*	0.09	***171***	1.2%	0.3%	**0.6%**
LL-03	0.014	***47***	0.05	0.08	*281*	0.07	***247***	2.1%	0.8%	**1.6%**
LL-04	0.043	***1,195***	0.59	0.69	*19,310*	0.57	***15,945***	1010.3%	37.4%	**42.5%**
LL-05	0.115	***62***	0.33	0.59	*323*	0.35	***191***	3.0%	1.0%	**0.6%**
LL-06	0.015	***154***	0.11	0.19	*1,895*	0.07	***733***	252.7%	3.2%	**3.0%**
LL-07	0.005	***13***	0.02	0.03	*89*	0.03	***77***	1.2%	0.4%	**0.7%**
LL-08	0.004	***21***	0.02	0.03	*150*	0.02	***100***	0.7%	0.2%	**0.4%**
LL-09	0.009	***38***	0.03	0.05	*192*	0.04	***182***	1.0%	0.4%	**0.8%**
LL-10	0.042	***31***	0.13	0.24	*177*	0.11	***82***	0.6%	0.3%	**0.7%**
LL-11	0.028	***100***	0.17	0.27	*163*	0.16	***574***	12%	5%	**6.6%**
LL-13	0.003	***29***	0.03	0.06	*568*	0.04	***341***	1.0%	0.4%	**0.6%**
LL-14	0.029	***39***	0.13	0.17	*232*	0.14	***192***	2.2%	0.7%	**1.4%**
LL-15	0.020	***26***	0.11	0.18	*236*	0.14	***178***	3.4%	0.8%	**1.0%**
LL-16	0.016	***31***	0.06	0.12	*234*	0.09	***176***	1.9%	0.5%	**0.8%**

Recommendations

Infiltration and inflow were characterized as low, medium, or high priority depending on the per capita flows calculated from the flow monitoring data for each study area. The priority rankings are shown in the color-coded sewer maps in Appendix A of this report.

Sewer cleaning, televising, and smoke testing were completed as a part of the condition assessment portion of the SAW grant project. Observations from these field investigations were reviewed considering the infiltration and inflow priorities identified through the flow monitoring task.

In general, specific defects that contribute to infiltration (such as cracks in the pipe, or leaking joints) or to inflow (illicit connections, broken cleanouts, defected or incorrect manhole covers, etc) were found in areas that were identified with medium or high priority I/I. The specific problem areas to address include:

Smoke Testing:

Upstream of LL-03 study area (Carl Street)

- Event #4-1: Smoke was observed rising from a yard drain in the lawn of 401 Carl Street.
- Event #4-2: Smoke was observed rising from an open sanitary cleanout in the yard of 415 Carl Street.

This area exhibited wet weather flows near the EGLE designation of 275 gpcd (247 gpcd).

Upstream of LL-11 study area (Bridge, Academy Street)

- Event #35-1: Smoke was observed rising from an open sanitary cleanout in the yard of 606 E Bridge Street.
- Event #36-1: Smoke was observed rising from an open sanitary cleanout in the yard of 422 Academy Street.

This area exhibited wet weather flows far exceeding the EGLE designation of 275 gpcd (574 gpcd).

Closed Circuit Televising:

Upstream of LL-01 study area (Lyons Street)

- There was an infiltration gusher (IG) and an infiltration runner (IR) observed in the 10” VCP along Lyons St between MHs A125 and A127.

Upstream of LL-05 study area (River Crossings, Water St)

- Televising crews were unable to dewater the river crossing siphon spanning from Manhole C1 to A10. After many attempts and truck loads of vacuuming, with the upstream flow bypassed, Manhole C1 maintained its surcharged high-water level, which is likely indicative of a break somewhere along the sewer line.

Upstream of LL-06 study area (Bridge Street)

- Thirteen observations of infiltration runners, as well as three infiltration gushers, and three infiltration weepers, were found in the 15” VCP along Bridge Street between MHs A11 and A12.
- Five infiltration runners were observed in the 15” VCP along Water Street between MHs A10 and A11.

Upstream of LL-11 study area (Smith, Bridge, Academy)

- Pipe fracture and cracking was observed between manholes C67A and C67. Several instances of root intrusion were also present, which provides a void for groundwater to seep into the sewer.
- A broken pipe, along with several fractures were observed between manholes C66 and C67.
- A broken pipe, along with a fracture were observed between manholes C65 and C66.
- Several fractured pipes and several cracks were observed between manholes C64 and C68

Upstream of LL-15 study area (Grant St.)

- There was an infiltration gusher (IG) and an infiltration runner (IR) observed in the 8” VCP along Grant St between MHs C48 and C8. Infiltration Gushers contribute the most volume of clean water infiltration amongst the infiltration defect codes.

All defects contributing to infiltration and inflow should be lined/rehabilitated in accordance with the Capital improvement plan (CIP) developed in the Asset Management Program.

Additional analyses, detailed conclusions, and complete recommendations can be found in the full report.

INTRODUCTION

The City of Portland is in Ionia County, approximately 23 miles west-northwest of Lansing. The City has a total land area of 2.63 square miles. The township population was 3,883 as of the 2010 U.S. Census. Fleis and VandenBrink Operations (FVOP) operates and maintains the wastewater treatment plant, with local Portland DPW managing the wastewater collection system, which serves approximately 1,601 customers, including: homes, businesses, schools, and industrial facilities. FVOP and City DPW staff have observed that the flow rates in the sewers and volume of plant inflow tend to increase during rainfall events, or during high river levels in the Grand River. Increased sanitary collection system flows during rainfall events are common among most aging wastewater collection systems. Rainfall may flow into the sanitary sewers through direct connections (e.g. from road catch basins or building roof drains) or may infiltrate into the pipes as groundwater through pipe defects. Adjacent waterbodies may also contribute to wastewater increases during certain conditions (e.g. flood events, ice jams).

Project Background

In 2013, The City of Portland, with assistance from Fleis & VandenBrink, applied to the Michigan Department of Environment, Great Lakes, and Energy (EGLE) stormwater, asset management, and wastewater (SAW) grant program. The SAW grant helps to fund the development of an asset management plan (AMP) for the Township's wastewater collection and treatment system was awarded. Work began in 2018 on a flow monitoring task[1] designed to characterize the performance of the collection system through monitoring and subsequent data analysis.

The field work and data collection related to flow monitoring ended in September 2019, and the primary analysis associated with this task has been completed. This report has been prepared to document the monitoring and analytical efforts. It will ultimately be an appendix to the final AMP which, when completed, will provide a more comprehensive picture of the entire wastewater system[2].

Existing Facilities

Collection System

The City of Portland's wastewater collection system serves approximately 2,100 residential equivalent users or (REUs), including homes, businesses, schools, and industrial facilities. First portions of the collection system were first constructed in the 1930s, with continuous additions and improvements occurring through present day. The collection system consists of approximately 25 miles of sanitary sewer, which all routes to Portland WWTP. The sewers range from 6 to 15 inches in diameter. Most of the pipe material is Vitrified Clay Pipe (VCP), with some of the newer portions being Polyvinyl Chloride Pipe (PVC). The system includes 3 lift stations to route the water from throughout the service area to the Portland WWTP. The entire Portland sanitary collection system was studied and was divided into 16 areas for flow monitoring purposes. An overview of the entire wastewater collection system can be found in Appendix A.

[1] SAW Scope of Work: Part B (Wastewater Asset Management Plan), Task 4 (Flow Metering / Analysis).
[2] Ultimately, this report will be an appendix to the Township's wastewater AMP (to be completed in 2019). It is intended to complement the condition assessment tasks in the subsequent estimation of long-term collection and treatment system performance. Additional analyses may be performed that refine aspects of this report. In such a case, the information presented in the final AMP will take precedence.

Pump/Lift Stations

There are 3 lift stations in operation throughout the system, Lift Station #1 (Canal Street), #2 (Riverside Drive), and #3 (near Cutler Road). The locations and collection areas of the lift stations are presented in Table 2.

Table 1. City of Portland lift stations, location description, and collection areas.

Lift Station	Within Study Area	Location	Collection Area	Pumps to
#1	LL 06	Canal Street	Market and Canal Street	MH A12
#2	LL 09	Riverside Drive	Riverside Drive	MH C82
#3	LL 16	North of Cutler Road	Eastern most part of the city collection system	MH C316

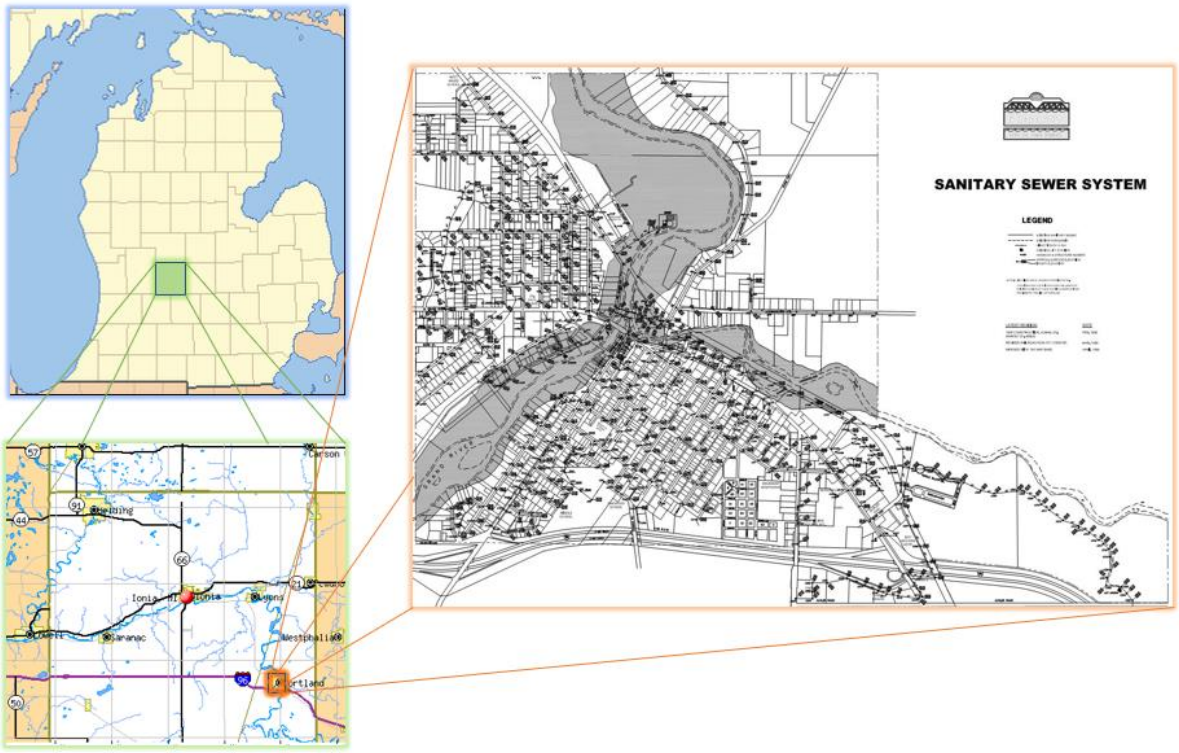

Figure 1. Overall location and the City of Portland collection system map.

Service Area

Land Use

Residential land, consisting of single-family homes, is dominant in terms of the number of parcels and total land area. The central commercial district of the City is composed of more developed land, consisting of businesses, churches, and a few schools. The City is surrounded entirely by agricultural land. Overall location of the service area can be seen in the maps in Figure 1.

Customers

There are approximately 1,408 parcels and 1,601 wastewater customers in the service area according to 2018 City billing data. As of the 2010 U.S. Census, there were 3,404 persons and 1,199 housing units in the City[3]. These numbers are used to predict and define wastewater characteristics of the system[4].

From the population and number of housing units, the persons per housing unit is estimated to be 2.83. As noted above, the service area includes some non-residential customers, and these were expressed in terms of residential equivalent units (REUs). These equivalencies were determined based on the table of unit factors presented in Appendix B1. Overall, the system is estimated to be servicing 2,107 REUs (which includes residential users), or an equivalent population of approximately 5,952 persons.

Wastewater Treatment Plant

The Portland WWTP has a capacity of treating a daily flow of up to 500,000 gallons per day. Currently, Michigan Department of Environment, Great Lakes, and Energy (EGLE) permit number MIG570220 authorizes the Portland WWTP to discharge treated effluent to the Grand River. The permit defines effluent limitations for several parameters and requires daily flows to be reported.

Terminology

Understanding the terminology of wastewater industry and inflow and infiltration phenomena is essential to the comprehension of this report. To that end, the report utilizes industry-standard flow-related terminology, including:

- Dry Weather Flow – flow during normal (i.e. 'dry') conditions including customer wastewater and the groundwater entering the system, usually estimated during high groundwater months. In the case of this study, dry weather flow was estimated as the 5-day average, before a significant rain event;
- Wet Weather Flow – the dry weather flow at the time plus any clean water entering the system during and after a rainfall/storm event (i.e. 'wet' conditions);
- Infiltration – "clean" water that enters the sewer indirectly (primarily through defects as the form of groundwater); and
- Inflow – "clean" water that enters the sewer directly (primarily through connected features).

Infiltration is generally a distributed problem; sources include defective pipes, leaky pipe joints and connections, and/or manhole barrel walls and chimneys. Inflow is generally a localized problem; sources include roof leaders, broken cleanouts, yard/area drains, manhole covers, storm sewer and catch basin connections, and waterbodies. Figure 2 visually presents this, and other, terminology along with common sources of I/I. Additional details and expansion of the discussion of I/I can be found in Appendix B2 – Water Migration Sources/Pathways

[3] A 'housing unit' is defined by the U.S. Census as "a house, an apartment, a mobile home, a group of rooms, or a single room that is occupied (or if vacant, is intended for occupancy) as separate living quarters.
[4] Housing units (with population density) can be used to predict wastewater generation while the number of parcels tends to be proportional to the number of sanitary sewer service leads (which tend to be primary sources of rainfall-related flow in the sewers).

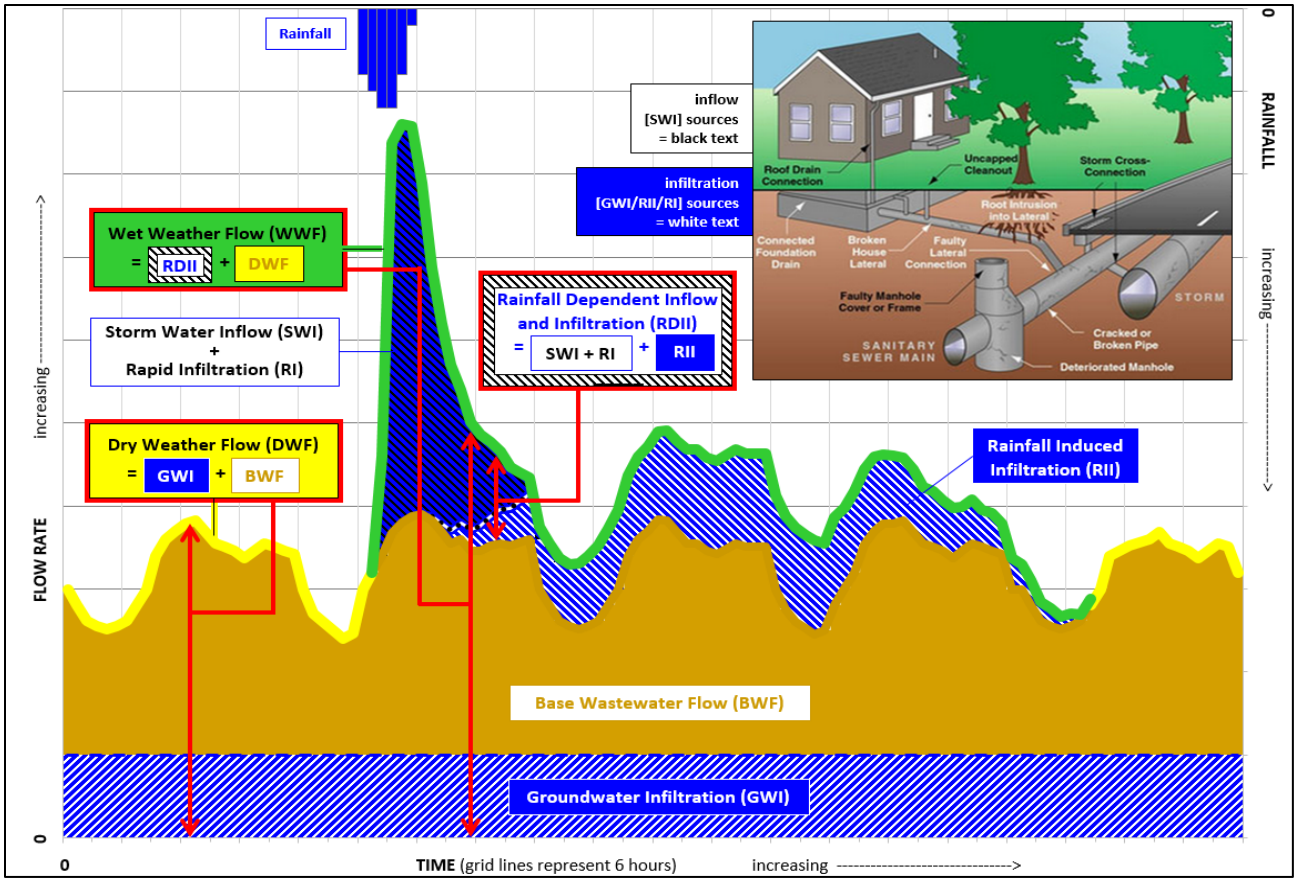

Figure 2. Standard flow terminology and inflow/infiltration sources.

Several regulatory terms are also important in the discussion of wastewater and I/I. EGLE assigns / defines:

- expected residential average flow[5] for planning is **70 gallons per capita per day (gpcd)**;
- excessive infiltration when the average flow[5] (for a given study area) exceeds **120 gpcd** during non-precipitation days and the elevated groundwater table season; and,
- excessive inflow to be occurring when the peak WWF during the 25-year/24-hour design storm (or any smaller event) exceeds **275 gpcd**[6].

EGLE also makes special note of problems such as sewer backups or overflows and hydraulic overloading (leading to reduced performance) at treatment facilities as important issues to consider in addressing I/I.[7]

Throughout the report, when discussing data from various metering locations, two categories are used:

- Total or cumulative – the data at a specific monitor (applicable to entire tributary area); and
- Incremental – the data between a specific monitor and any monitors that are upstream of it (thus defining a smaller area of interest within the total tributary area).

These categories apply primarily to discussions of flow rates, flow volumes, and area characteristics (e.g. service area population). The distinction between the two categories is important to understand the context of the data, particularly as it relates to comparison of data between various monitors.

[5] This flow refers to the total average over a long period of time and does not differentiate between dry and wet weather conditions.

[6] If flow monitoring data is not available for the design storm, then the design storm flow should be projected from at least the six largest storm events occurring between April 1 through October 31 [6] (using only those with normal antecedent soil moisture conditions, i.e. only those where the I/I from any previous storm has completely abated).

[7] Michigan Clean Water Revolving Funds (SRF & SWQIF) Project Plan Preparation Guidance

Additional terms used in the quantitative discussion of flow rates, regulatory assessment considerations, and the most important comparative metrics for quantifying flow and I/I are presented in Table 2.

Table 2. Flow and I/I discussion and assessment terms.

Term	Definition / Calculation	Time-line	Comments / Assessment Values	
Average Daily Flow (ADF)	The daily average flow rate over a given period of interest.	Long-term	ADF characteristics impacted by all of the variables impacting the various flow components presented below.	
Wet Weather Flow (WWF)	The actual flow rate at any instant during a wet weather flow event.	Event	*Primary variants: event total and peak 24-hour.* Assessment value[8]: 275 gallons per capita per day (gpcd) Comparative between areas of system to characterize WWF	
Peak Hour Flow (PHF)	The peak hourly flow rate during a wet weather event.	Event		
Flow Peak Factor (QPF)	A unitless measure of the intensity of peak flow rates. Calculated as: **QPF = PHF / ADW**	Event	Comparative between areas of system to characterize WWF	
Volume Peak Factor (VPF)	A unitless measure of the increase in wastewater volume over a given time period. Calculated as: **VPF = V_{WWF} / V_{DWF}**	Event	Comparative between areas of system to characterize WWF	
Average Dry Weather (ADW) Flow	The daily average flow rate for an extended period (7 to 14 days) of dry weather with no other I/I (within a given period of interest).	Long-term	DWF characteristics change based on groundwater season (impacting GWI); differences between weekday & weekend/holiday water use (affecting BSF); and population/business patterns throughout the year (affecting BSF).	Assessment value[8]: 120 gallons per capita per day (gpcd) (assessing groundwater infiltration)
Dry Weather Flow (DWF)	The actual dry weather flow rate at any instant. The dry weather flow during a wet weather event is projected based on the observed pattern and flow rates before and after the event.	Long-term & Event		
Peak Hour Dry (PHD) Weather Flow	The peak hourly flow rate during a 24-hour diurnal cycle.	Daily		Comparative between areas of the system to characterize DWF (PHD normalized to
Dry Peak Factor (DPF)	A unitless measure of the peak hourly flow rate during the 24-hour diurnal cycle. Calculated as: **DPF = PHD / ADW**	Daily		
Groundwater Infiltration (GWI)	The amount of groundwater infiltration. Daily value estimated as **GWI = 0.85 * DWF_{MIN}** (85% of minimum daily DWF) Then averaged over the period of interest.	Long-term	*Primary variants: high and low groundwater season.* Assessment value[8]: Deemed excessive if ADW is greater than 120 gpcd	
Base Sanitary Flow (BSF) water use data can provide better estimates of BSF	The portion of the daily average flow rate that is wastewater from customer usage. Calculated as: **BSF = ADW – GWI**	Long-term	*Primary variants: weekday and weekend/holiday; population/business patterns.* Assessment value[8]: 70 gallons per capita per day (residential water use estimate)	
Total I/I (TII)	The daily average I/I over a given period of interest. Calculated as: **TII = ADF - BSF**	Long-term	Total I/I characteristics depend on GWI and RDII.	
Rainfall Dependent I/I (RDII)	The daily average RDII over a given period of interest. Calculated as: **RDII = ADF – ADW = ADF – (BSF + GWI)** **RDII = WWF – DWF**	Long-term & Event	RDII / R% characteristics depend on SWI and RII.	Comparative between areas of system (flow and volume per structure served; flow and volume per acre served) to characterize RDII
Capture Percentage (R%)	A unitless measure of the amount of rainfall entering the system expressed as the percentage of rainfall volume that enters the sanitary sewer system compared to the total rainfall on the service area.	Long-term & Event		Comparative between areas of system to characterize RDII
Storm Water Inflow (SWI)	Estimated as a percentage of the RDII based on observed wet weather flow hydrograph. Calculated as: **SWI = % * RDII** Note: SWI occurs during or immediately after rainfall	Long-term & Event	*Primary variants: vegetation seasons – dormant and growing.* Comparative between areas of system (flow and volume per structure served) to characterize SWI	
Rainfall-Induced Infiltration (RII)	The portion of RDII that is not inflow. Calculated as: **RII = RDII – SWI** Note: RDII occurring hours to days after rainfall is all considered RII except under special conditions	Long-term & Event	*Primary variants: vegetation season – dormant/growing; high/low groundwater.* Comparative between areas of system (flow and volume per effective acre served) to characterize RII	

[8] *Michigan Clean Water Revolving Funds (SRF & SWQIF) Project Plan Preparation Guidance*. Michigan Department of Environmental Quality. 2016. Via: https://www.michigan.gov/documents/deq/deq-ess-mfs-formsguidance-SRFppsguide_249034_7.pdf

Historical / Baseline Data

It is useful to monitor the trends of increased plant flows over time to monitor the I/I severity from year to year. Figure 3 displays that the collection system has been moderately responsive to rainfall/storm events since the start of 2018. In February 2019, the City experienced and ice jam in the Grand River, causing surface water to flood the surrounding riverbanks and submerging wastewater structures, where inflow was observed in many manholes firsthand by FVOP staff.

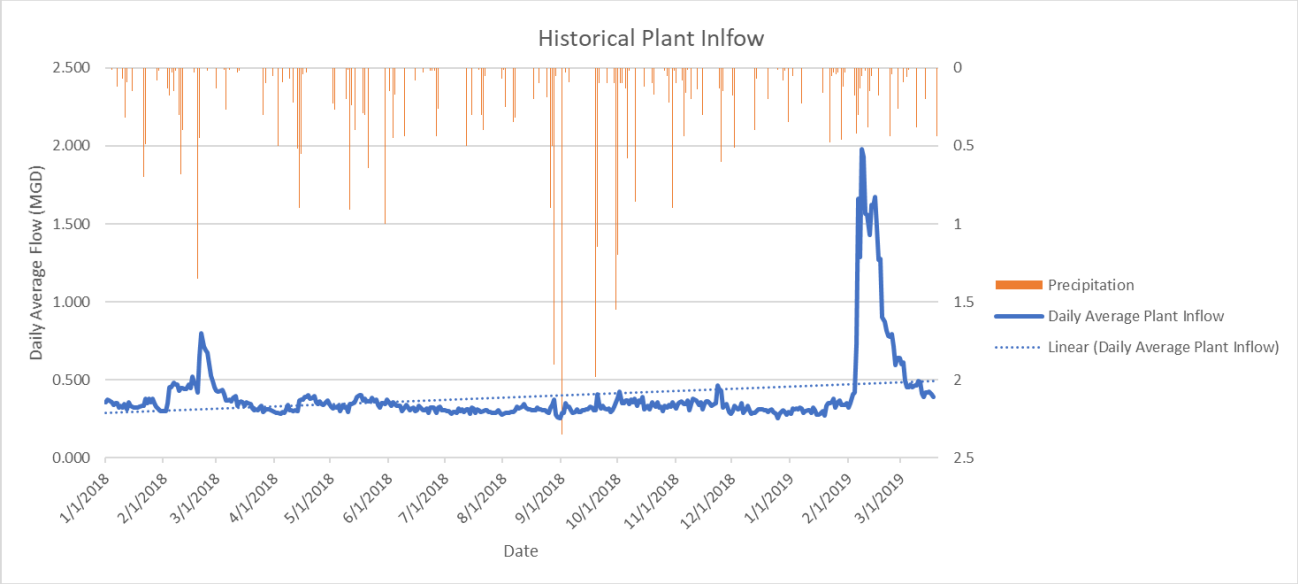

Figure 3. Daily average WWTP inflow from 1/1/2018 to 3/19/2019. The sharp spike in flow in February 2019 was a result of an ice jam, flooding many structures, with observed inflow and infiltration.

Figure 4 shows the daily flow averages for the WWTP and precipitation from 3/1/19 to 9/24/19, as well as EGLE designations. The plant flow values are the daily values provided by F&V operations staff, which have been calculated by subtracting filtrate and solids from daily influent.

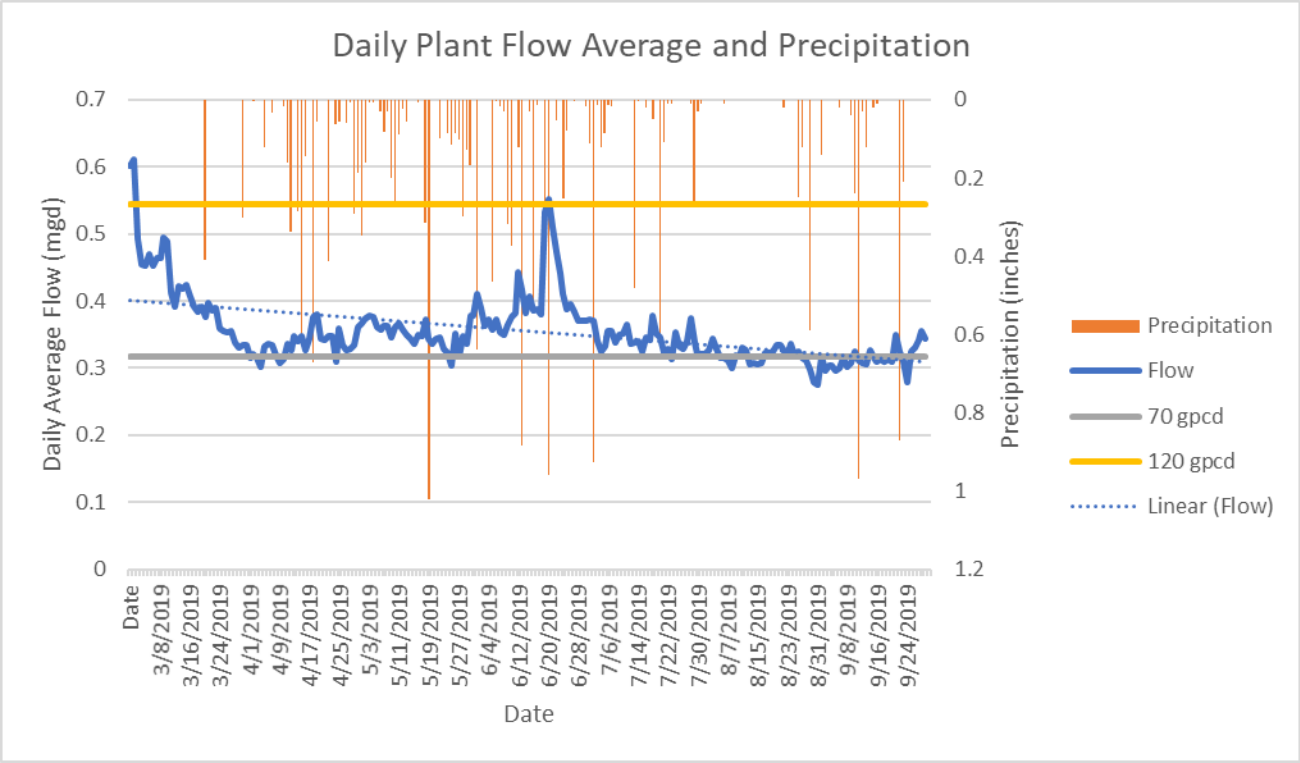

Figure 4. City of Portland WWTP flows, precipitation, and EGLE designations for expected DWF (70 gpcd) and excessive infiltration (120 gpcd).

As shown in Figure 4, daily dry weather flows are generally greater than 0.32 MGD (70 gallons per person per day (gpcd), gray line) but on average, less than 0.54 MGD (120 gpcd, yellow line). 70 gpcd is the EGLE standard for estimating the dry-weather sewage flow in a collection area with nominal I/I for planning purposes. By EGLE standards, a collection area is considered to receive excessive infiltration if its average flow, for days without rain during high groundwater months, is at least 120 gpcd. Since average flows are generally between these two thresholds, the City's overall collection system receives constant infiltration throughout the year but not in excessive amounts. Flows often increased immediately in response to precipitation, especially large precipitation events in Spring, or high groundwater months.

The identification of I/I in the sanitary sewer system relies on developing a comprehensive picture of dry- and wet-weather flow patterns in the system at an appropriate scale and for a reasonable cost. The process began, as described in the previous section, with analyses of 1) the system and its components, 2) appropriate terminology for the study, 3) existing data and observations about the system and flow rates, 4) known defects in the system, and 5) suspected I/I sources. This section describes the methodology used to collect data for analyses.

Potential Sources of Clean Water Intrusion

Infiltration

In general, sewers in the City are vulnerable to infiltration because most of the pipes in the system are close to 70 years old (i.e. over half their useful life). Portions of the collection system that consist of VCP tend to experience deterioration over time (e.g. cracks, pipe collapses) and can be sources of groundwater infiltration. Unlike other pipe materials, PVC doesn't typically deteriorate over time, however; infiltration can still occur at the pipe joints.

Critical portions of the sewer pipes and lower sections of manholes exist below the depth to water table as seen in Appendix B4, meaning they are likely surrounded by groundwater. This presents a significantly increased risk of consistent groundwater infiltration if the structures are deteriorated or otherwise inadequately watertight. The soils in the service area are mostly sandy loams with Hydrologic Soil Group Rating “A” meaning that they drain surface water effectively. The more water that can infiltrate into the ground, increases the probability of clean groundwater infiltrating into the sewer system.

Inflow

Much of the surface area is developed residential and commercial land containing compacted soil, shallow-root grasses, and impervious surfaces of developed land, which creates concentrated runoff. This concentrated runoff generally presents an opportunity for inflow sources to develop, entering the sanitary sewers through direct connections such as roof drains or broken/open sewer cleanouts. Storm sewers reduce this potential but also convey stormwater in proximity to sanitary sewers, thereby presenting opportunities for unintentional travel of stormwater from the storm to the sanitary sewers by means of undocumented cross connections or sewer defects. Much of the main trunk sewer that routes to the treatment plant fall within the FEMA 100-year floodplain (See Appendix B5). With higher water levels trending across the state, it is not uncommon for surface water to submerge manholes and other structures within the floodplain area, especially following significant storm events. When surface water bodies or overland drains rise high enough to submerge sanitary manhole covers, large quantities of clean water can enter manholes if their covers are not adequately watertight.

Observed I/I

On February 6, 2019 the City of Portland experienced an ice jam in the Grand River, which caused flooding conditions across the City’s downtown area. The ice jam caused a hydraulic overload at the WWTP, where the plant experienced flows approximately 1,750 percent above the dry weather flow of 0.2 MGD, which is expected for the plant at that time of year. During this time, DPW and FVOP Staff investigated manhole structures within the flood zone. Rapid infiltration, inflow, and surcharging were observed in multiple locations, which can be seen in Figures below.

Figure 5. Surcharged Manhole A6 - Water Street just before Morse Drive. (LL-04 Area).

Figure 6. Surcharged sewer pipe at Manhole A10 - Water St. - Point River Crossing (LL-05 Area)

Figure 7. Rapid Infiltration at Manhole A11- Grand River and Water Street (LL-06 Area)

Objectives

The purpose of this report is to document the findings of the flow monitoring and analyses done as part of developing the AMP for the City's sanitary sewer system. Ultimately, the objectives of the report are to present:

1) the technical approach and reasoning;
2) a summary of the collected data;
3) characterizations of DWF, WWF, and RDII in the system;
4) system problems in the context of I/I;
5) sufficient context to understand problems, observations, conclusions, and recommendations;
6) conclusions related to flow determination and the sources/impacts of I/I; and
7) recommendations for follow-up investigation/rehabilitation activities.

There is no specific I/I removal target defined for this project, rather the highest groundwater and/or wet-weather flow per system asset areas are prioritized.

The I/I volume removed can come from any source component: groundwater infiltration, rainfall-induced infiltration, directed infiltration, rapid infiltration, or storm water inflow. In general, addressing inflow is the most cost-effective approach to mitigating I/I and thus high inflow areas will generally be prioritized.

METHODOLOGY

The identification of I/I in the sanitary sewer system relies on developing a comprehensive picture of dry- and wet-weather flow patterns in the selected study areas. The approach to documenting system flows utilized for this study is referred to as mass flow monitoring (MFM), where mass takes the meaning of "massive" (referring to the amount of data generated).

Approach

The approach was pioneered by David Saylor and originally involved utilizing patented equipment and software. The MFM approach – which relies primarily on flow depth monitoring with compact and easily installed equipment – contrasts with traditional efforts that involve significant manpower in the field making spot measurements during dry and wet weather but generating only a small amount of useful data. MFM is also significantly more nimble than comprehensive flow monitoring efforts that rely on expensive flow metering and other equipment requiring specially trained and certified professionals.

Thus, the MFM approach employed for this study strikes a balance between these extremes by obtaining numerous sets of near-continuous, high-resolution data but utilizes a targeted and efficient deployment of a variety of cost-conscious monitoring devices and subsequent systematic analyses of the data to develop dry and wet weather flow estimates to be used in identifying I/I and its impact on wastewater facilities.

Monitoring Plan and Field Investigation

Once the project scope was identified, the preliminary monitoring locations were identified based on the most up-to-date documentation of the collection system. The preliminary monitoring locations were selected based on the potential for generating the best data (e.g. manholes on straight sewer sections, with no abrupt slope changes, with no significant drops in manhole, and with other minor considerations) and accessibility/safety. The manholes for each preliminary location were visited and assessed for monitoring potential, accessibility, and deployment practicality. If issues were noted, other nearby manholes were assessed. The selected location was then documented and physically marked. Ultimately, 16 locations in the sanitary sewer system were chosen for flow depth monitoring.

Primary Data Collection

The depth monitors were installed in the selected manholes during the third week in March 2018. Additionally, two temporary rain gauges were installed; one at the lift station on Riverside Drive, and one at the WWTP.

Every 6-8 weeks, field staff were on-site[9] to visit the locations of currently installed equipment to:

- download data from deployed equipment:
  - Leveloggers® (sewer flow depth[10] and temperature collected in 5-minute intervals);
  - Barologgers® (atmospheric pressure; in concert with Leveloggers); and

[9] Field visits occurred on 5/21, 7/2, 8/22, and 9/24.

[10] The Leveloggers® specifically measure absolute pressure. Two Barologgers® were deployed in the system during the project to measure atmospheric pressure. Proprietary software provided with the loggers was then utilized to determine the water pressure and to convert the pressure to a depth.

    - rain gauges (instantaneous rainfall at 0.01-inch increments and hourly air temperature);
- take live depth and velocity measurements from the Levelogger® locations (at a given manhole, data was collected as needed at the logger, sewer inlets, and/or sewer outlets);
- assess site flow and equipment performance (e.g. clogging/ragging, location consistency);
- perform equipment cleaning and maintenance and flow channel clearing as necessary; and
- adjust site hardware configurations.

Final Product

At the end of the project, the data from the entire project was comprehensively processed to provide a final analytical data set. The data processing approach is discussed in the remainder of this section. The findings of the analysis are presented in the following section.

The result of the MFM process is a comprehensive estimate of I/I flows and the locations of clean water intrusion. This information provides the basis for conclusions about wastewater flows throughout the system as well as for defining future study and investigative opportunities (e.g. additional monitoring, sewer televising, smoke testing) to further enhance discovery and characterization of I/I problems. In addition, corrective actions are proposed to provide guidance on future steps to address I/I. The precision of the I/I locations, estimates, and efficacy of corrective actions is dependent on the deployment scheme, the time monitored, the amount of rainfall during that period, and many other factors.

Equipment

For this study, four major types of data collection equipment were used: water pressure/temperature sensors (Leveloggers® with Barologger®), a portable velocity/flow meter, and a rain gauge. Details on this equipment are presented in Appendix C1.

Deployment

The monitoring equipment was installed March 19-21, 2019. There were two Barologgers® installed, one in the same manhole as LL-07, and one in the same manhole as LL-09 to measure atmospheric pressure, and the rain gauges were installed at the WWTP and Riverside Drive Lift Station. All equipment was removed on September 24, 2019.

The installation locations of the LLs were chosen to divide the collection system into logical and manageable sections for analysis. The LL locations and the area tributary to each are shown in Appendix A. The characteristics of the locations in which the LLs were installed are given in Table 3. A schematic of the relationship between the LLs and the collection system is shown in Figure 8.

Table 3. Characteristics of pipes where LLs were installed.

Sensor	Location	Sewer Diameter (inches)	Pipe Material	Roughness Coefficient (Manning's n)	Slope (ft/ft)
LL-01	Lyons Road north of Church St.	10	VCP	0.013	0.0123
LL-02	Grape Street north of Carl St.	10	PVC	0.013	0.0025
LL-03	Lyons Street east of Quarterline	15	VCP	0.013	Invert El. NA
LL-04	WWTP	15	VCP	0.013	0.0027
LL-05	Water Street north of Grand River	15	VCP	0.013	0.0021
LL-06	Water Street upstream of LL-05	15	VCP	0.013	0.0041
LL-07	Grand River and Pleasant St.	10	PVC	0.013	0.0442
LL-08	Grand River and Park St.	10	VCP	0.013	0.0124
LL-09	Riverside Lift Station	6	VCP	0.013	Invert El. NA
LL-10	Kent and Grand River	20	VCP	0.013	0.0367
LL-11	Kent and Grand River North of LL-10	15	VCP	0.013	0.0561
LL-12	Two Rivers Park	15	VCP	0.013	0.0067
LL-13	Divine Highway	8	VCP	0.013	0.0471
LL-14	N Warren	15	VCP	0.013	0.005
LL-15	Grand River and Grant	8	PVC	0.013	Invert El. NA
LL-16	Portland Riverwalk	10	PVC	0.013	0.0014

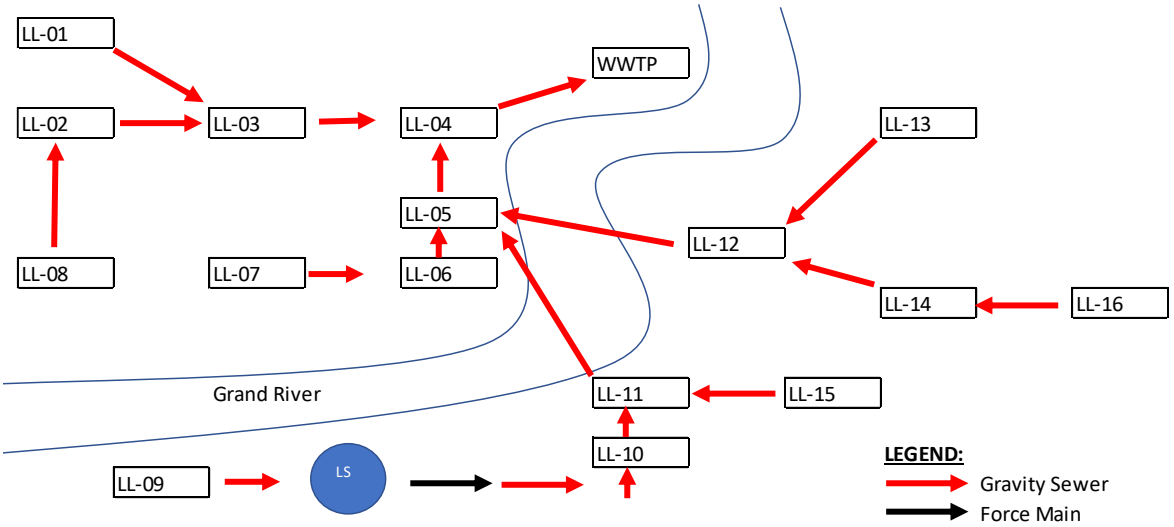

Figure 8. Flow Schematic of Level Logger locations.

Data Processing

A detailed description of the data processing methodology can be found in Appendix C2.

DATA ANALYSES: DEFINITIONS AND RESULTS

This section presents additional details about the analytical metrics utilized in the RDII analyses and a visualization of the elevated I/I areas based on design storm projections. Detailed analyses of the data for the LL monitoring areas and projections of the wet weather data to the design storm can be found in Appendix C3.

Flow Components and Comparison Metrics

The flows at each monitor location were assessed for total (cumulative) and incremental flows and volumes. These assessments look at total, dry weather (sanitary flow and groundwater infiltration), and RDII flows. The purpose of this analysis is to ensure the flow rates reported for each monitoring area are reasonable overall and that there are no obvious major flow subtraction issues for areas that are defined by the difference between two or more monitors. In some cases, certain flow data had to be omitted from analysis due to flow subtraction issues where LLs were placed too closely.

Total Flow/Volume

Total flow and volume are normalized to effective population. Metrics assessed include:

- Peak hourly flow rates (to gauge levels of inflow and/or rapid infiltration):
  - The maximum observed flow rate during the monitoring/deployment period (mgd);
  - The design storm projected flow rate (mgd);
  - The design storm projected flow rate normalized to equivalent population (gpcd);
- Peak 24-hour flow rates are used to gauge inflow against the EGLE-defined threshold of 275 gpcd to assess if an area is experiencing excess inflow;
- Flow peaking factor (to gauge levels of inflow and/or rapid infiltration above and beyond normal dry weather flow):
  - The maximum observed during the monitoring/deployment period;
  - The design storm projection;
- Volume peaking factor (to gauge levels of overall RDII versus average dry weather flow):
  - The maximum observed during the monitoring/deployment period; and
  - The design storm projection.

Dry Weather Flow Component

Dry weather flow and volume are calculated and are normalized to the effective population. The DWF rate is calculated by using only days not impacted by wet weather. In months where the influence of wet weather cannot be avoided (e.g. due to extremely long RDII responses during many successive storms such that no representative DWF days are available), the DWF has been adjusted to compensate, as discussed below. The dry weather flow is utilized as the reference for the calculation of wet weather peaking factors and as such the DWF prior to each analyzed event is documented. The summary table (Appendix C, Table C2) reports the average of the dry weather flows prior to each major rain event during the study period.

Dry weather flow is assessed for excessive infiltration based on the standard of 120 gpcd. This regulatory standard provides a means for highlighting areas where infiltration should be investigated.

Base Sanitary Flow Component

Base sanitary flow and volume are the difference between the dry weather flow and the estimated/calculated groundwater infiltration (GWI). On average, the BSF remains consistent (with a location-specific pattern over a 24-hour period and likely differences between weekdays and weekends/holidays) unless there are seasonal population shifts or changing non-residential water uses (e.g. industrial or business use).

In general, 70 gpcd is an accepted planning standard and thus the expected per capita wastewater generation rate.

Groundwater Infiltration Component

Groundwater infiltration flow and volume is assumed equal to 80% of the lowest hourly flow reported. The average monthly flow is normalized to the effective population.

Rainfall Dependent I/I Component

The RDII flow and volume are calculated as the difference between the total flow/volume and the dry weather flow/volume and is normalized to the effective population of each monitoring area. Groundwater conditions have an obvious impact on the seasonal levels of infiltration and thus the wet weather volume of events during the spring is generally much higher (high groundwater months tend to have higher soil saturation due to snowmelt and rain frequency). Metrics assessed include:

- Peak hourly flow rate (excluding dry weather flow):
  - The maximum observed during the monitoring/deployment period (mgd);
  - The design storm projection;
- Event volume details (excluding dry weather flow), including:
  - Peak 24-hour volume during RDII event (MG):
    - Maximum observed during project;
    - The design storm projection;
  - The average observed ratio of peak 24-hour RDII volume to total RDII volume;
  - The total volume during RDII event:
    - Maximum observed during project (MG);
    - The design storm total volume projection (MG)[11];
    - The design storm total volume projection normalized to the effective sewer acres in a monitoring area (in 1,000 gallons per acre);
- The capture percentage of rainfall;
  - The maximum observed during project;
  - The rainfall-weighted average for all events observed during the project; and
  - The design storm projection[12].

Summary of Findings

Detailed analysis results for the individual monitoring areas is presented as a table in Appendix C3. Appendix A presents a summarized visualization of these results for three I/I metrics:

- The average dry weather flow per capita, presented in Appendix A2;
- The design storm estimated peak 24-hour wet weather flow rate per capita, presented in Appendix A3; and
- The design storm estimated rainfall capture percentage, presented in Appendix A4.

[11] This is calculated as the peak 24-hour RDII volume for the design storm divided by the 24-hour vs. total volume ratio. Note that it is not possible to utilize a peaking factor with the total event volume because the response duration is not projected.
[12] This is calculated as the total RDII volume projected for the design storm divided by the rainfall volume for the effective sewer area.

CONCLUSIONS AND RECOMMENDATIONS

This section concentrates the flow analyses into a prioritized ranking for follow-up investigations and suggestions for investigative activities.

Investigation/Rehabilitation Priorities

The priority areas to be investigated are presented in Table 4 below, and visually in Appendix A5. The overall investigation priority was determined from an average of the priorities based on the three assessments presented in the previous section:

- The average dry weather flow (normalized to the effective population of the service area) that highlights the best potential areas for addressing infiltration (groundwater as well as rainfall-induced infiltration);
- The peak 24-hour wet weather design storm flow estimate (normalized to the effective population of the service area) that highlights the best potential areas for discovering and addressing inflow; and
- The estimated percent capture of design storm rainfall that highlights the most impactful service areas in terms of total rainfall entering the collection system.

Table 4. Overall investigation priorities with corresponding assessment values. Red = high priority; Yellow = medium priority; Green =low priority.

Monitor	DWF (gpcd)	WWF (gpcd)	% Capture	**Overall Priority**
LL-04	1,195	15,945	42.5%	**1**
LL-06	154	733	3.0%	**2**
LL-11	100	574	6.6%	**3**
LL-13	29	341	0.6%	**4**
LL-01	89	247	0.5%	**5**
LL-03	47	247	1.6%	**6**
LL-14	51	192	1.0%	**7**
LL-05	62	191	0.6%	**8**
LL-09	38	182	0.8%	**9**
LL-16	31	176	0.8%	**10**
LL-02	39	171	0.6%	**11**
LL-15	26	168	1.0%	**12**
LL-08	21	100	0.4%	**13**
LL-07	13	77	0.7%	**14**
LL-10	31	82	0.7%	**15**

Based on the prioritized service areas, City investigations and rehabilitation will be most effective when directed to the following areas:

- The 15-inch VCP main trunk sewer that runs along Water St and Morse Dr, which exhibits excessive inflow and infiltration; and
- The pipes within the downtown residential area on Smith, Academy and Bridge Street, which exhibit moderate inflow and infiltration.

Field Investigation Results

F&V performed two types of field investigation, as a part of the condition assessment portion of the SAW grant project. Smoke testing and closed-circuit televising (CCTV) were completed in 2020. Smoke testing is typically conducted as a means of pinpointing inflow sources, and CCTV is done as a means of pinpointing groundwater infiltration sources and other sewer defects. Several observations that coincide with high and medium priority levels are listed in the following sections.

Smoke Testing

Smoke testing was completed on the City of Portland sanitary sewer system in the late summer of 2020. Several observations were made in areas that have been identified as having excess inflow, summarized below. Additional details are included in the Smoke Testing Report.

Upstream of LL-03 study area (Carl Street)

- Event #4-1: Smoke was observed rising from a yard drain in the lawn of 401 Carl Street.
- Event #4-2: Smoke was observed rising from an open sanitary cleanout in the yard of 415 Carl Street.

This area exhibited wet weather flows near the EGLE designation of 275 gpcd (247 gpcd).

Upstream of LL-11 study area (Bridge, Academy Street)

- Event #35-1: Smoke was observed rising from an open sanitary cleanout in the yard of 606 E Bridge Street.
- Event #36-1: Smoke was observed rising from an open sanitary cleanout in the yard of 422 Academy Street.

This area exhibited wet weather flows far exceeding the EGLE designation of 275 gpcd (574 gpcd).

Closed-Circuit Televising (CCTV) Results

Televising inspection was performed in Portland sanitary sewer in the winter/spring/fall of 2020. Sewer defects were identified and added to the GIS map. Defects found that contribute to I/I throughout the system, especially in the highest priority areas, have been summarized below. Additional details regarding the CCTV results can be found in the Appendix of the Wastewater Collection AMP and the GIS database.

Upstream of LL-01 study area (Lyons Street)

- There was an infiltration gusher (IG) and an infiltration runner (IR) observed in the 10” VCP along Lyons St between MHs A125 and A127.

Upstream of LL-05 study area (River Crossings, Water St)

- Televising crews were unable to dewater the river crossing siphon spanning from Manhole C1 to A10, beneath the Grand River. After many attempts and truck loads of vacuuming, with the upstream flow bypassed, Manhole C1 maintained its surcharged high-water level, which is likely indicative of a break somewhere along the sewer line.

Upstream of LL-06 study area (Bridge Street)

- Thirteen observations of infiltration runners, as well as three infiltration gushers, and three infiltration weepers, were found in the 15” VCP along Bridge Street between MHs A11 and A12.
- Five infiltration runners were observed in the 15” VCP along Water Street between MHs A10 and A11.

Upstream of LL-11 study area (Smith, Bridge, Academy)

- Pipe fracture and cracking was observed between manholes C67A and C67. Several instances of root intrusion were also present, which provides a void for groundwater to seep into the sewer.
- A broken pipe, along with several fractures were observed between manholes C66 and C67.
- A broken pipe, along with a fracture were observed between manholes C65 and C66.
- A fractured pipes and several cracks were observed between manholes C64 and C68

Upstream of LL-15 study area (Grant St.)

- There was an infiltration gusher (IG) and an infiltration runner (IR) observed in the 8" VCP along Grant St between MHs C48 and C8. Infiltration Gushers contribute the most volume of clean water infiltration amongst the infiltration defect codes.

All defects contributing to infiltration and inflow should be lined/rehabilitated in accordance with the Capital improvement plan (CIP) developed in the Asset Management Program.

APPENDICES

APPENDIX A – EXHIBITS

A1 – Monitoring Locations and their Tributary Areas

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A2 – Dry Weather Flow

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A3 – Wet Weather Flow

Page 28

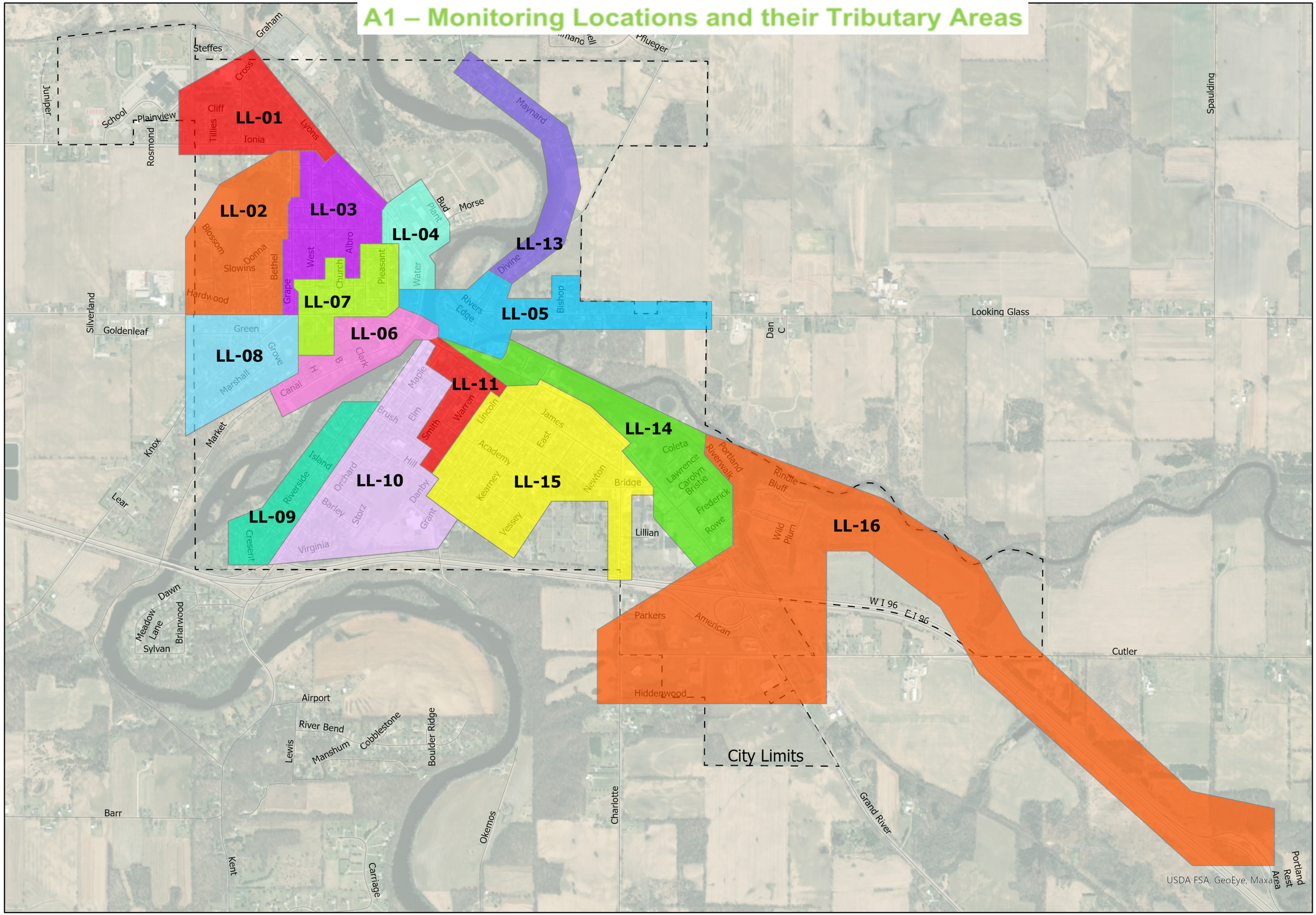
A4 – Percent Capture

Page 29

A5 – Investigation Priority

Page 30

A1 – Monitoring Locations and their Tributary Areas



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FLOW DISTRICTS

City of Portland, Michigan

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PROJECT NO.	SCALE
816483	1:16,000

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SOURCES
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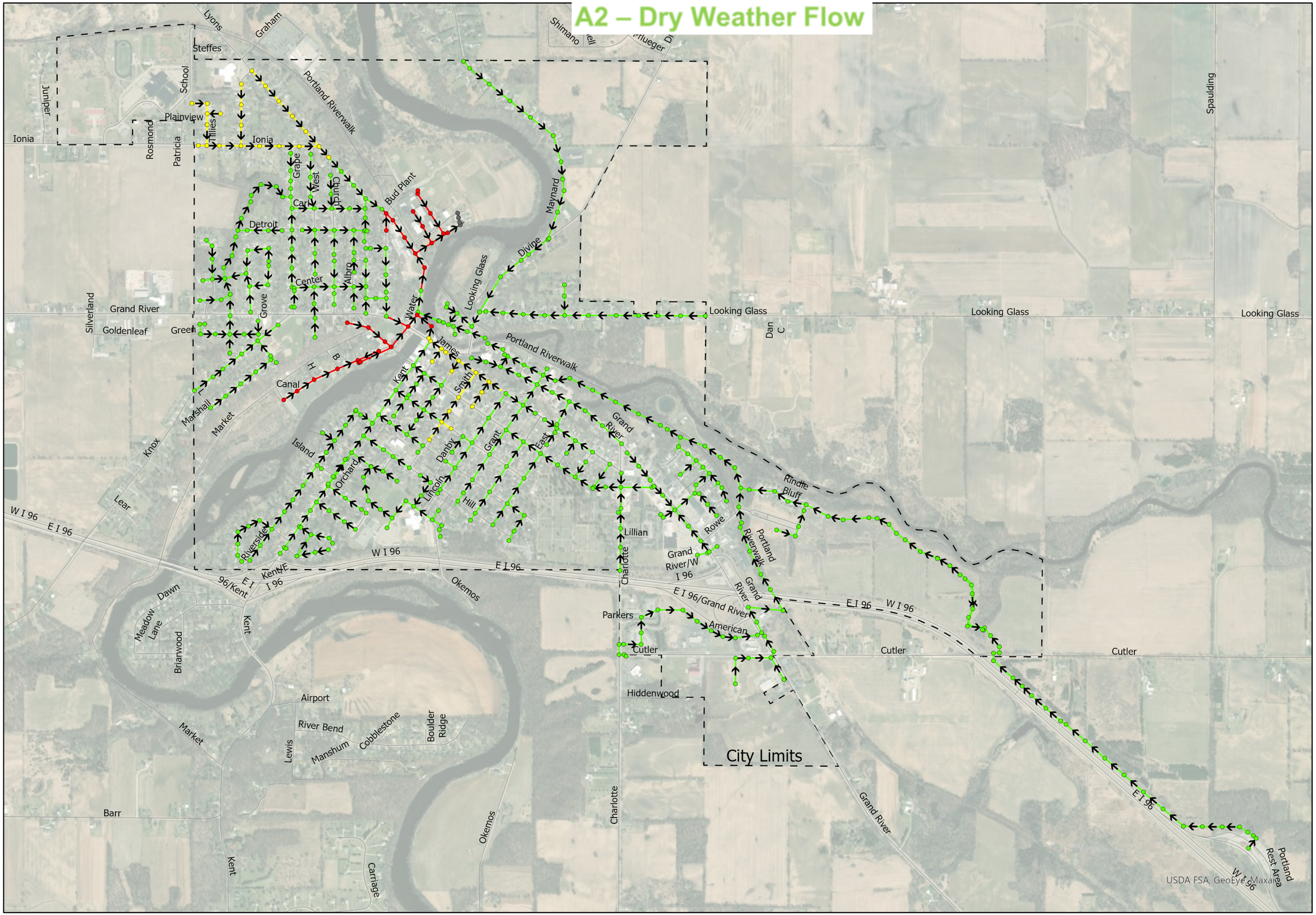
A2 – Dry Weather Flow



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Manhole Main GPCD

- No Data
- 0 - 75
- 75 - 120
- 120 +

DRY WEATHER FLOW

City of Portland, Michigan

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PROJECT NO.	SCALE
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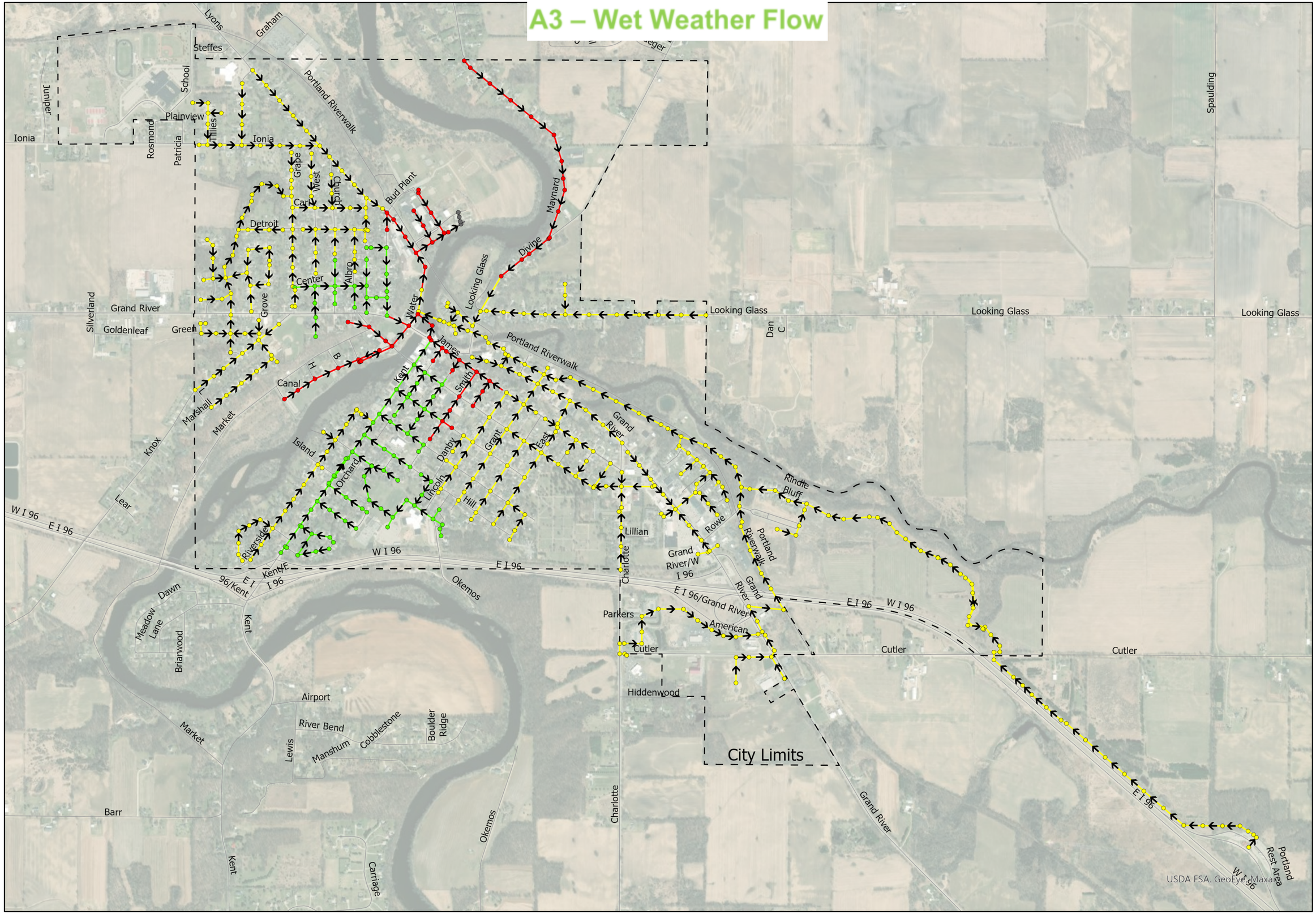
A3 – Wet Weather Flow



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Manhole Main GPCD

- No Data
- 0 - 90
- 90 - 275
- 275 +

WET WEATHER FLOW

City of Portland, Michigan

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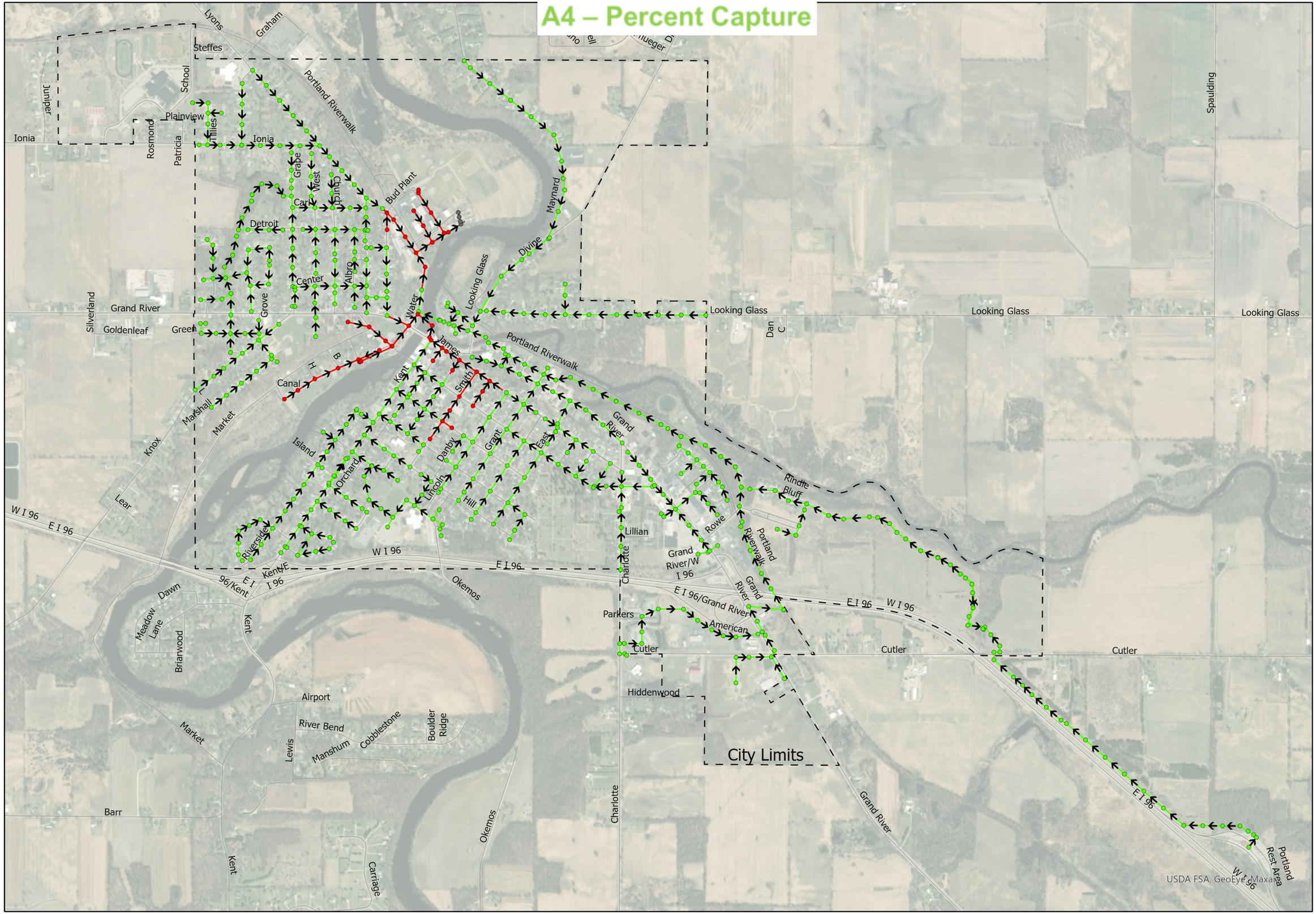
A4 – Percent Capture



FLEIS&VANDENBRINK
DESIGN. BUILD. OPERATE.

Manhole | Main | % Capture

- No Data
- 0 - 2
- 2 - 5
- 5 +

PERCENT CAPTURE

City of Portland, Michigan

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A5 – Investigation Priority

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DESIGN. BUILD. OPERATE.

Manhole | Main | Priority
- No Data
- Low
- Medium
- High

OVERALL PRIORITY

City of Portland, Michigan

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APPENDIX B – REFERENCE MATERIALS

This appendix includes outside information and conceptual discussions of topics included for reference.

B1 – Residential Equivalent Units

Non-residential facilities were converted to household equivalents based on the unit factors defined in Table B1. This allows for an assessment of flows in terms of an equivalent population that considers the impact of these locations on wastewater generation.

Table B1. Residential Equivalent Units.

Business/Category Use	Unit Factors		Business/Category Use	Unit Factors	
Single Family Residential	1.00	per dwelling	Service Providers		
Auto			Dry Cleaners	1.18	per 1,000 sq. ft.
Auto Service/Convenience Stations	0.21	per pump	Funeral Homes	0.15	per 1,000 sq. ft.
Auto Service/Repair	0.29	per employee	Hotels	0.38	per room
Auto Showroom/Dealership	0.37	per 1,000 sq. ft.	Motels	0.90	per 1,000 sq. ft.
Fully & Semi-Automatic Car Washes	6.95	per 1,000 sq. ft.	Pet Care Grooming	1.33	per 1,000 sq. ft.
Self-Serve Car Washes	2.89	per stall	Pet Care Kennels	0.63	per fixture
Food, Beverage & Retail			Self Service Laundry Facilities	0.71	per washer
Banquet Halls	0.23	per fixture	Medical/Wellness		
Convenience Store w/ Pharmacy	1.00	per facility	Dental Clinics	0.83	per dentist
Country Clubs	0.04	per member	Hospitals	1.22	per bed
Fraternal Organizations	0.04	per 1,000 sq. ft.	Medical Clinics	0.19	per 1,000 sq. ft.
Full Service Grocery Store (w/ florist, etc.)	0.26	per 1,000 sq. ft.	Retirement Homes/Assisted Living	0.39	per bed
Grocery Store w/o Full Service	0.19	per 1,000 sq. ft.	Office/General Use/Assembly		
Quick Service Restaurants w/ dining & restrooms	2.50	per 1,000 sq. ft.	Churches	0.11	per 1,000 sq. ft.
Quick Service Restaurants w/o dining & restrooms	1.00	per restaurant	Offices - General	0.40	per 1,000 sq. ft.
Restaurants w/ Liquor	4.50	per 1,000 sq. ft.	Public Institutions (other than hospitals, schools)	0.12	per fixture
Restaurants w/o Liquor	0.08	per seat	Warehouses & Storage	0.12	per fixture
Stores	0.04	per 1,000 sq. ft.	Government		
Personal Care			Daycare/Early Learning (13+ students)	4.28	per facility
Barber Shops	0.14	per fixture	Fire Stations	0.40	per employee
Beauty Salons	0.71	per 1,000 sq. ft.	Police Stations	0.09	per employee
Nail Salons	0.18	per employee	Schools, Elementary	0.02	per student
Entertainment/Health & Fitness			Schools, Junior or Middle	0.12	per 1,000 sq. ft.
Bowling Alleys	0.36	per 1,000 sq. ft.	Schools, Senior High	0.09	per 1,000 sq. ft.
Health Club/Fitness Center w/ Showers &/or Pool	1.29	per fixture	Manufacturing		
Health Club/Fitness Center w/o Showers &/or Pool	0.29	per 1,000 sq. ft.	Dry Process	1.38	per facility
Kids Indoor Play Centers	0.12	per 1,000 sq. ft.	Wet Process	0.29	per fixture
Swimming Pools	3.00	per 1,000 sq. ft.	Housing		
Theatres	0.27	per 1,000 sq. ft.	Convents & Seminaries	0.29	per employee
			Mobile Home Parks	0.41	per mobile home
			Multiple Family Residences	0.60	per residence

B2 – Water Migration Sources/Pathways

The presence of potential sources is largely a function of the condition of the system but the exposure of these sources to 'clean' water and the pathways this water takes to reach the sources is a function of many parameters, including sewer depth, groundwater depth, soils and geology, impervious cover, vegetative cover and plant species, topography, stormwater infrastructure, and proximity to waterbodies and floodplains. Many concepts of interest are presented in this section[1].

Infiltration Concepts

Collection systems can be impacted by groundwater year-round with the impact generally increasing during the spring when the groundwater is higher and is able to reach shallower parts of the system where the defects do not typically contribute infiltration (temporarily transforming potential sources into active sources). Those portions of a system that cross or are in proximity to waterbodies can experience even higher levels of infiltration when the waters rise and locally 'mound' the groundwater table and

[1] The figures and much of the conceptual material is drawn from the 1990 EPA Report to Congress entitled 'Rainfall Induced Infiltration into Sewer Systems'.

create a greater hydrostatic pressure on the sanitary sewers in the ground. Rainfall obviously exacerbates the level of infiltration into the collection system by directly influencing the groundwater table through percolation through the soil and as runoff as it increases water surface levels in adjacent waterbodies.

French Drain Effect

In areas of saturated soil, the sewer trench – which relies on a permeable aggregate to physically support the sewer – can act like a 'French drain' and draw water from the surrounding soil. This is shown in Figure B1.

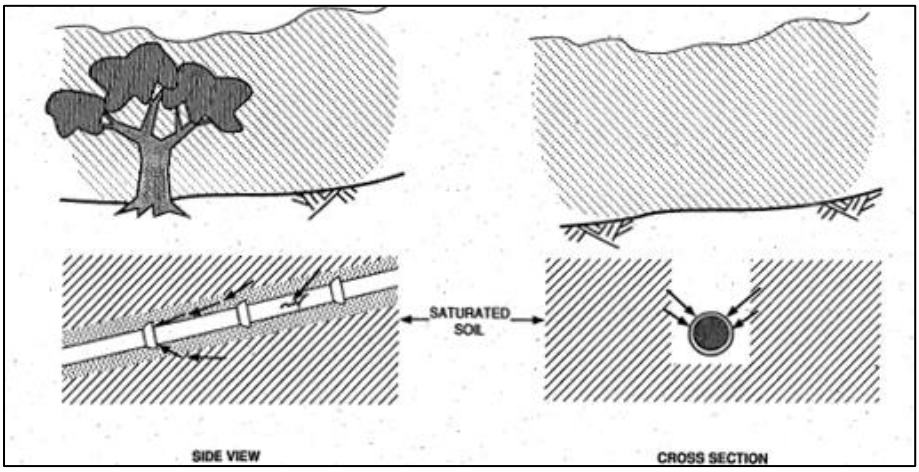


Figure B1. French drain effect in underground structures.

Thus, the water can easily enter the structures through any defects. This is a major reason that many rehabilitation efforts to deal with infiltration are less effective than predicted. If a source is corrected, the water simply migrates to another entry point downstream or the depth of water in the aggregate channel increases and causes previously less active (on inactive) sources to increase (or begin) infiltration.

Significant levels of rainfall-induced infiltration can occur when this effect extends above the groundwater table and significant portions of the collection system are exposed to transient increases in trench-water levels (as this causes many typically inactive defects to become active sources). The reason that this can happen is due to the low permeability of the native soils that essentially confine the water to the trench. If the surrounding soil were sufficiently permeable, the trench water would drain too rapidly to rise above the existing groundwater level.

Construction techniques often utilize porous bedding materials around the sewers to allow for movement and shifting without damaging of the pipe. Example trench details can be seen in Figure B2. An example of a trench can be seen in Figure B3.

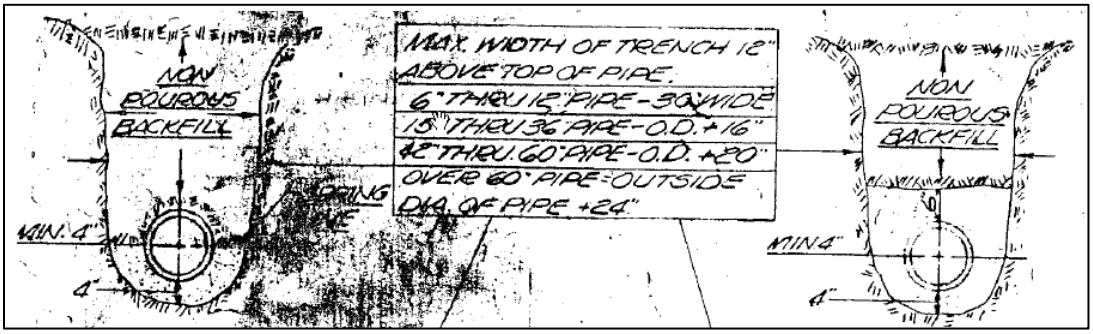


Figure B2. Example sewer construction drawing trench bedding details.

Figure B3. Example picture of a sewer trench.

The use of porous bedding materials indicates that the 'French drain effect' is a likely mechanism that enables groundwater to enter the sanitary sewer trench. The carrying capacity of the trench is impacted by the bedding configuration. Trench dams may be utilized to block the flow of water that is in the trench.

Surface – Trench Connectivity. The impact on trench-water levels in areas above the groundwater table is driven largely by the ease in which rainfall can enter the trenches before it can become surface runoff. As shown in Figure B4, examples of situations that ease the passage of rainfall into the sewer trench include: 1) the use of more permeable backfill; 2) the presence of additional utility trenches; and, 3) the proximity of watercourses (e.g. roadside ditches, creeks).

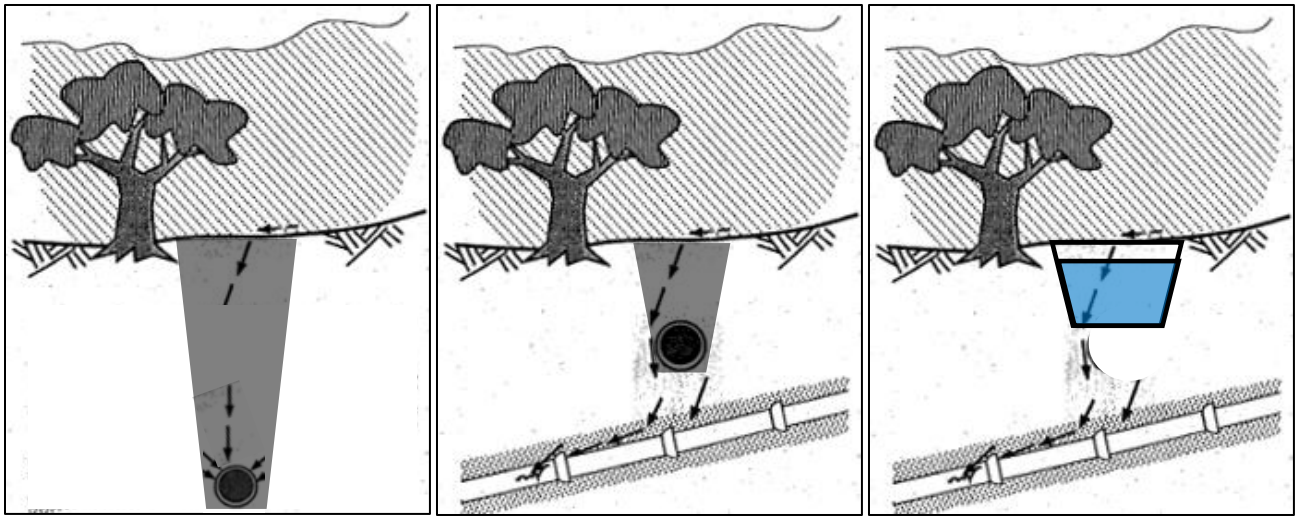


Figure B4. Examples of surface connections to sewer trench: left – permeable backfill channel (extending to or near surface); middle – channel formed by proximity of utilities; right – channel under watercourses.

Sanitary Sewer Trench Materials. Typically, the backfilling above the sewer trench is done with excavated materials that is generally compacted to densities equal to greater than undisturbed adjacent soils. Thus, the permeability above most of the trench is nominally equivalent to the native soil. However, ***soil channels*** can create paths for water movement to the trench from the surface or other subsurface features. Such channels are formed by plant root growth/death cycles, insect/animal activity, the shrink/swell cycles of clay in the soil, and the natural shifting of trench materials. Physical objects such as utility poles or signs can create 'shortcuts' for water to move deeper and make soil channel networks

more efficient. Areas where rainfall/runoff consistently ponds tend to be locations where soil channels form due to the frequent action of the water pressure on the soil. The channels can 'set' with the frequent passage of water and slowly increase in capacity as soil particles are eventually scoured away.

Under roads and shoulders, backfill is generally done with stone materials to support the paved surfaces. While road surfaces cover permeable trench materials and tend to create high levels of runoff (reducing levels of direct infiltration), poor road conditions (e.g. cracks, potholes) allow rainfall to seep through and create direct infiltration routes. These situations tend to more actively involve infiltration through shallower manhole defects.

Incidentally, manholes themselves can facilitate percolation down to the sewer along its exterior surface (especially if the casting is lower than the surrounding land and water can pond – see Figure B5). During these processes, materials that are scoured away into manhole or sewer defects can enlarge existing soil channels. And although it doesn't impact surface-to-sewer connectivity, soil channels that form along the sewer (as materials are carried with the infiltrating water) increase the trench carrying capacity, cause subsidence, and can eventually lead to trench and structure failure.

Figure B5. Example manhole surround deterioration and mild subsidence.

Utility Trench Crossings. Storm sewers tend to be the most problematic of the utility types that connect surface water to the sanitary sewer trench due to the added influence of exfiltration from the storm sewer. However, all underground utilities, including water and natural gas mains could lead to increased connectivity between the surface and the sanitary sewer trench. Because the sanitary sewer is typically the lowest utility, it has the potential to be affected by any utility trench above it.

A detail of the transfer of water between trenches is shown in Figure B6[2]. This type of problem has only been understood for a few decades and it creates a unique type of wet weather hydrograph spike in the sanitary sewer that looks very similar to inflow but is actually infiltration – referred to as 'rapid infiltration' – and can be extremely difficult to identify and much more complicated and expensive than inflow to address.

Adjacent Watercourses and Crossings. Situations such as when a sewer passes under a waterbody or watercourse or when the sewer is laid adjacent to such provide significant opportunity for water to enter the collection system. Sewers may be laid within cradles to prevent direct inflow/infiltration, but the trench

[2] The figure is based on a storm sewer crossing and shows water in the upper pipe, but the trench water transfer can occur between any utilities where the structures are bedded in porous materials.

is often the point where water enters and then flows to more downstream points past the casing where it then enters the sewer. Manhole defects also tend to be contributing sources near waterbodies due to the saturated nature of the soil. In addition, elevated water surface elevations (such as during flooding) may temporarily allow for I/I through numerous defects that may be present but not active during normal conditions.

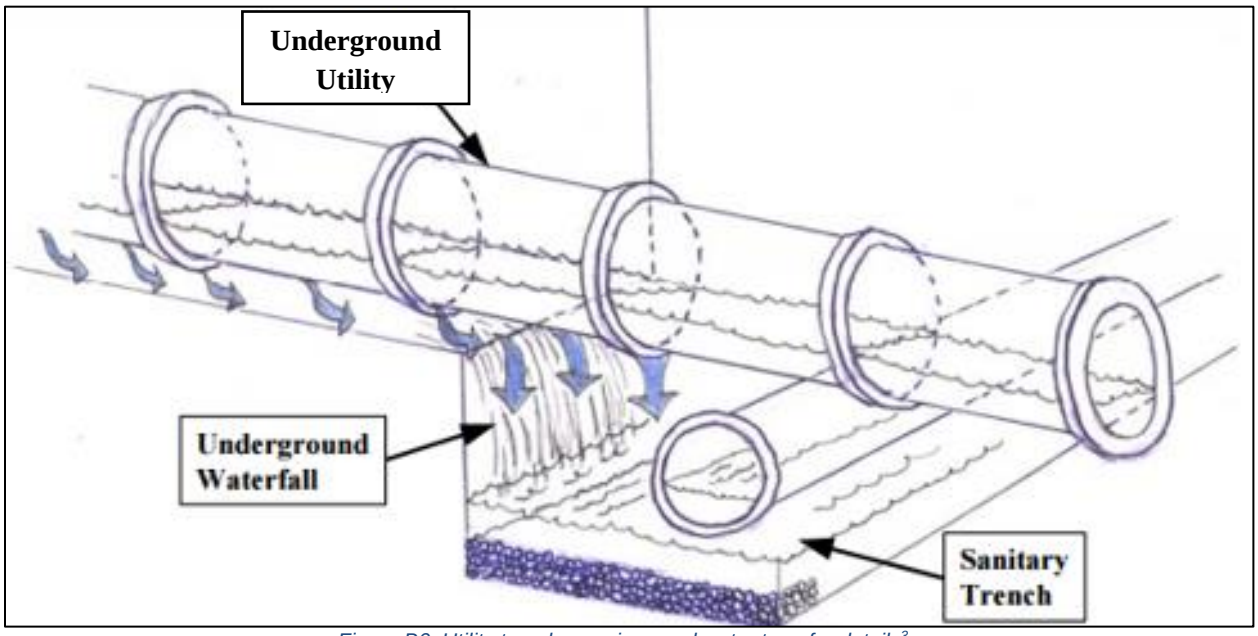


Figure B6. Utility trench crossings and water transfer details[3].

Foundation/Footing Drains. Footing drains exist to drain water away from foundations but prior to the recognition of significant I/I problems in sanitary sewers during the 1970s, most structures were built with their footing drains connected to the sanitary sewer system. Modern foundation drains (typically connected to a sump pump that routes water to surface drainage paths) are generally not problems for the sanitary system (but they can be if they are pumping water to areas that in turn contribute to I/I). Major infiltration flows can exist in older areas where a high percentage of structures have sanitary-connected footing drains. The flow characteristics are difficult to distinguish from the other pathways described above (as similar mechanisms are involved). Because these are intentionally connected pipe structures, the flows from these sources are sometimes considered inflow. Due to the delayed nature of the flows (as the water was first infiltrate into the ground), foundation/footing drains can be classified as 'Delayed Inflow'.

Inflow Concepts

Inflow is generally defined as rainfall/runoff/surface water that is routed (either intentionally or unintentionally) into the sanitary sewer system. Sanitary sewer systems are primarily impacted by inflow during rain events although assets near waterbodies may be susceptible to inflow during high water (flooding) conditions. Assets directly connected to the sanitary sewer (e.g. roof drains, improperly connected catch basins) will contribute inflow that is highly reactive to the timing of the rainfall. Cross-connected assets (e.g. storm sewer with high level connection with the sanitary system) may exhibit unique flow patterns such as only flowing into the sanitary sewer once a certain event occurs (e.g. the water depth becomes high enough to allow flow to divert to the sanitary sewer).

[3] http://www.adsenv.com/sites/adsenv.com/files/repository/white%20papers/keefe%20underground%20waterfalls%20abstract.pdf

Hydrograph Interpretation

The interpretation of wet weather hydrographs – given the understanding that rapid infiltration and inflow tend to 'look' similar – can yield different conclusions about the I/I sources despite similarities in hydrograph shape. Because the sources are generally not known before a study, well-reasoned assumptions are used to partition I/I into potential source candidates. An example of this is shown in Figure B7.

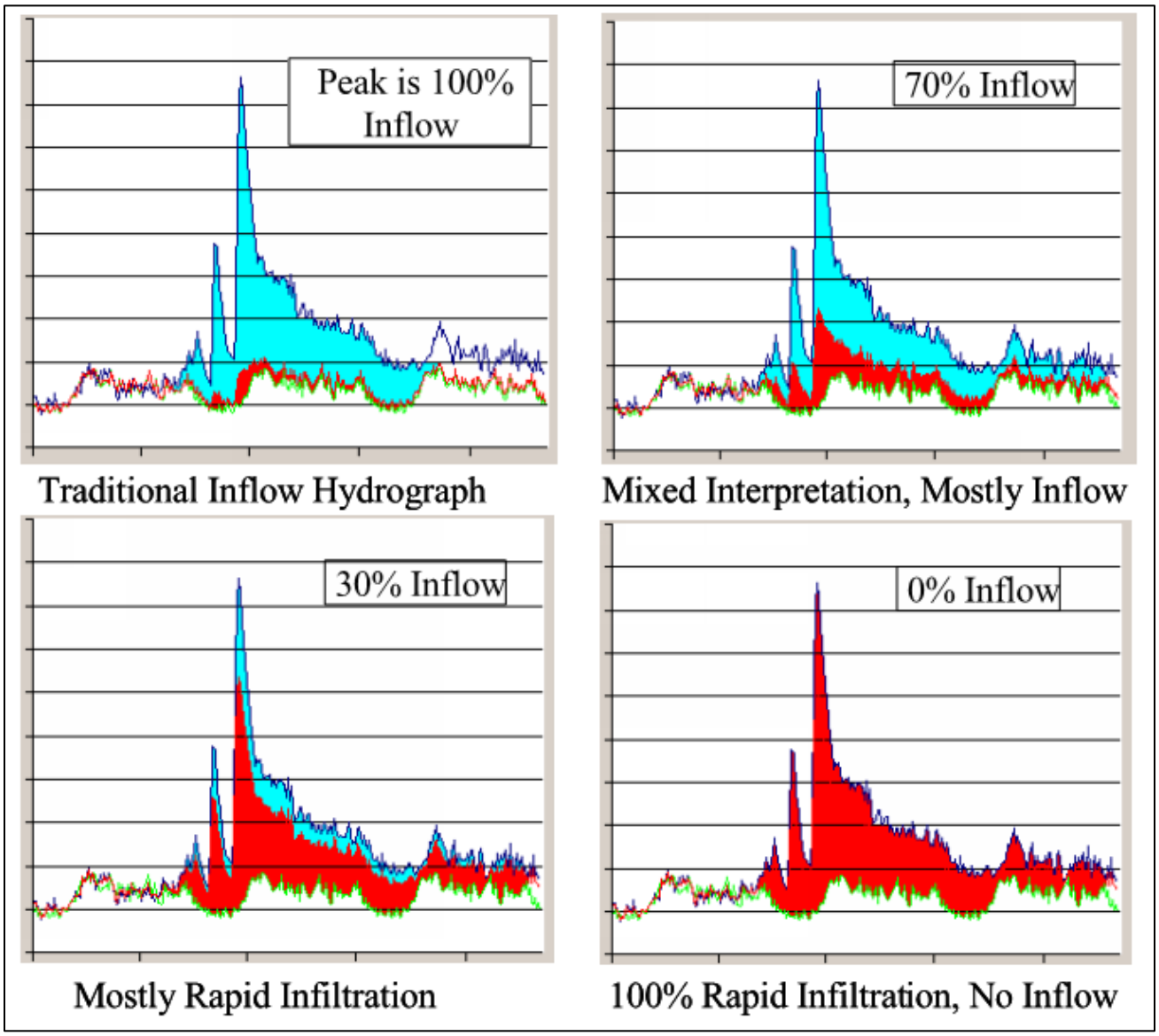


Figure B7. Rainwater infiltration and surface runoff.

The recommended mitigation actions will differ significantly between the case that is 100% inflow and 0% inflow (e.g. inflow mitigation requires generally low-cost efforts such as smoke testing and roof drain disconnection while rapid infiltration requires the use of pipe lining and trench dam barrier technologies). Generally, the reality of a situation will lie somewhere on the continuum between the extremes and therefore it is generally proposed that inflow investigation and mitigation should be the first steps. Follow-up monitoring can then determine is the contributing sources were addressed and if the more costly efforts to mitigate rapid infiltration should be considered.

Rainfall Partitioning

The land cover and development conditions in a given area will significantly impact the levels of infiltration and inflow. For example: impervious surfaces, turf grass, and compacted soils will greatly reduce rainwater infiltration into the ground and increase surface runoff (see Figure B8). The presence of storm sewers to route this water further impacts the infiltration/runoff relationship.

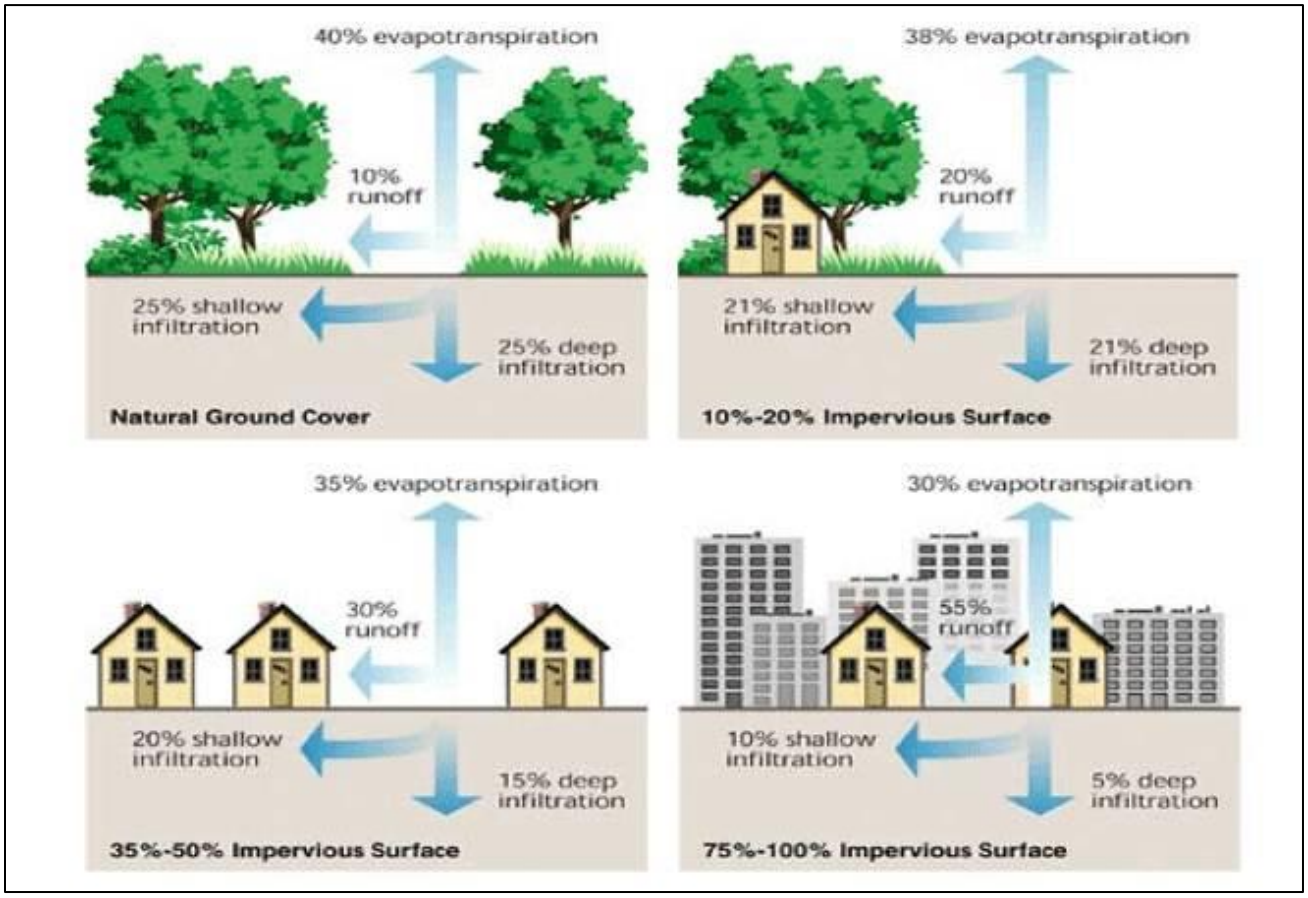


Figure B8. Rainwater infiltration and surface runoff.

The impacts of the various changes to surface hydrology and runoff routing can have marked complex effects on the I/I impacting sanitary sewers in the area. For example, while developed areas may reduce local infiltration and thus the potential for rainwater to infiltrate into the sanitary sewer, the presence of storm sewers can increase the potential for movement of water in subsurface utility trenches (i.e. rapid infiltration) and exacerbate existing storm/sanitary cross-connection problems.

A detailed discussion of these phenomena are not warranted in this report; however, such impacts should be considered when addressing sanitary sewer I/I and/or considering changes to surface hydrology in areas served by sanitary sewer systems.

B3 – Flow Rate Estimation

The Manning Equation is an empirical equation commonly used to design sewer systems and can be used to estimate velocities/flows in sewers when the pipe characteristics (i.e. diameter, slope, and roughness) and depth are known. The following equation shows a common representation of the formula.

$$v = \frac{1.486}{n} R^{2/3} S^{1/2}$$

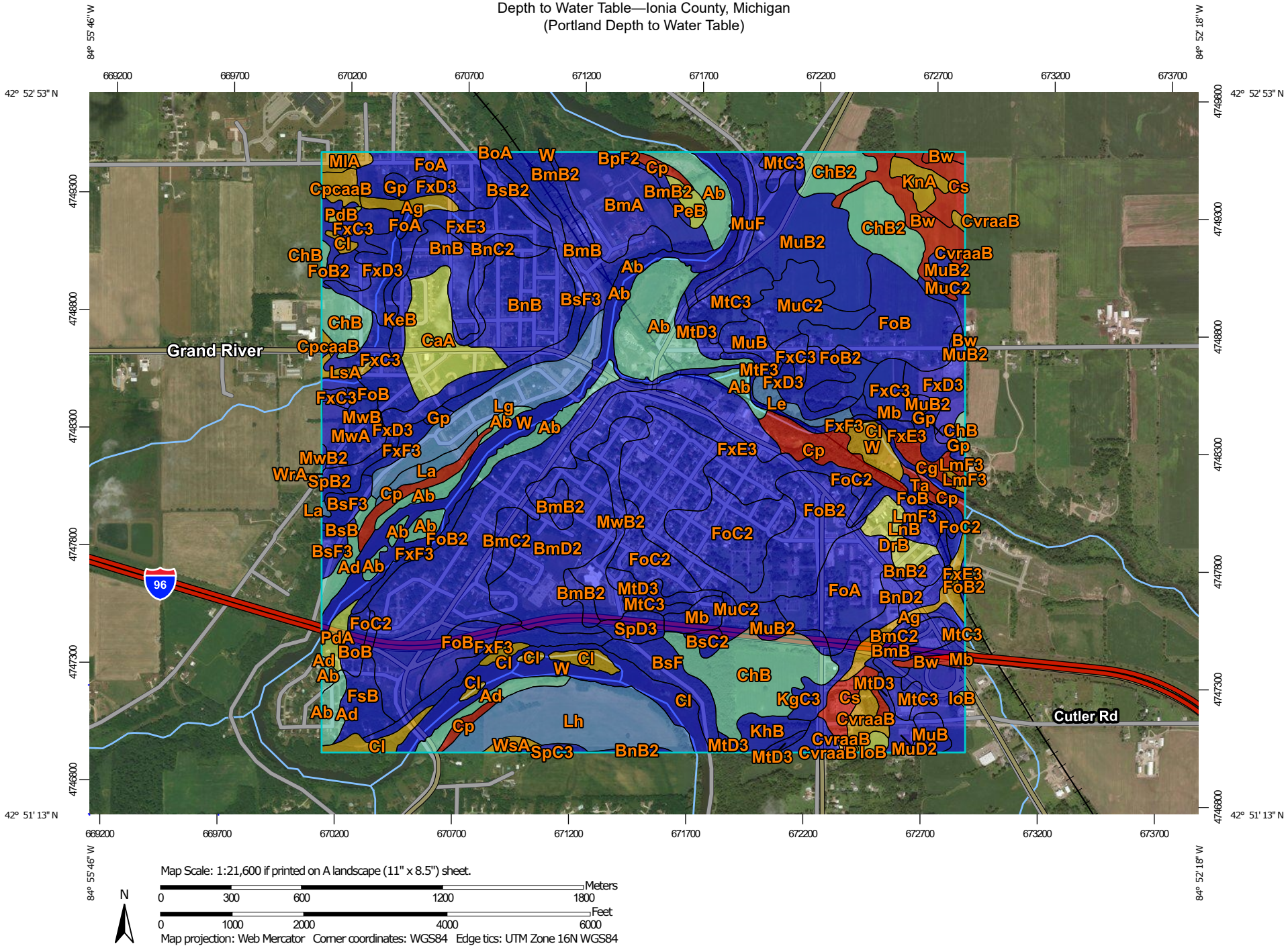
where:
- v = flow velocity, ft/s
- n = roughness coefficient
- R = hydraulic radius, ft
- S = slope of the energy gradient

Extensive practice has shown that observed velocities/flows measured in the field can deviate significantly from those estimated using this equation. Incorrect pipe characteristics, obstructions, and unique hydraulic conditions are contributing factors.

To account for these issues and provide the most accurate flow estimates based on observed depths at monitoring locations, two alternate methods are utilized: the Lanfear-Coll method (a curve-fitting technique for nominal conditions) and the Stevens-Schutzbach method (an iterative curve-fitting technique for conditions with suspected blockage downstream).

B4 – Depth to Water Table and Hydrologic Soil Group

Depth to Water Table—Ionia County, Michigan
(Portland Depth to Water Table)



Map Scale: 1:21,600 if printed on A landscape (11" x 8.5") sheet.

N

Meters: 0 300 600 1200 1800

Feet: 0 1000 2000 4000 6000

Map projection: Web Mercator Corner coordinates: WGS84 Edge tics: UTM Zone 16N WGS84

MAP LEGEND

Area of Interest (AOI)

Area of Interest (AOI)

Soils

Soil Rating Polygons

- 0 - 25
- 25 - 50
- 50 - 100
- 100 - 150
- 150 - 200
- > 200
- Not rated or not available

Soil Rating Lines

- 0 - 25
- 25 - 50
- 50 - 100
- 100 - 150
- 150 - 200
- > 200
- Not rated or not available

Soil Rating Points

- 0 - 25
- 25 - 50
- 50 - 100
- 100 - 150
- 150 - 200
- > 200
- Not rated or not available

Water Features

- Streams and Canals

Transportation

- Rails
- Interstate Highways
- US Routes
- Major Roads
- Local Roads

Background

- Aerial Photography

MAP INFORMATION

The soil surveys that comprise your AOI were mapped at 1:15,800.

Please rely on the bar scale on each map sheet for map measurements.

Source of Map: Natural Resources Conservation Service
Web Soil Survey URL:
Coordinate System: Web Mercator (EPSG:3857)

Maps from the Web Soil Survey are based on the Web Mercator projection, which preserves direction and shape but distorts distance and area. A projection that preserves area, such as the Albers equal-area conic projection, should be used if more accurate calculations of distance or area are required.

This product is generated from the USDA-NRCS certified data as of the version date(s) listed below.

Soil Survey Area: Ionia County, Michigan
Survey Area Data: Version 16, Sep 16, 2019

Soil map units are labeled (as space allows) for map scales 1:50,000 or larger.

Date(s) aerial images were photographed: Jul 1, 2011—Mar 10, 2017

The orthophoto or other base map on which the soil lines were compiled and digitized probably differs from the background imagery displayed on these maps. As a result, some minor shifting of map unit boundaries may be evident.

Depth to Water Table

Map unit symbol	Map unit name	Rating (centimeters)	Acres in AOI	Percent of AOI
Ab	Abscota loamy sand	114	77.5	4.5%
Ad	Abscota sandy loam	114	21.1	1.2%
Ag	Algansee loamy sand	46	15.9	0.9%
BmA	Boyer loamy sand, 0 to 2 percent slopes	>200	39.9	2.3%
BmB	Boyer loamy sand, 2 to 6 percent slopes	>200	39.3	2.3%
BmB2	Boyer loamy sand, 2 to 6 percent slopes, moderately eroded	>200	11.5	0.7%
BmC2	Boyer loamy sand, 6 to 12 percent slopes, moderately eroded	>200	10.7	0.6%
BmD2	Boyer loamy sand, 12 to 18 percent slopes, moderately eroded	>200	53.9	3.1%
BnB	Boyer sandy loam, 2 to 6 percent slopes	>200	55.8	3.2%
BnB2	Boyer sandy loam, 2 to 6 percent slopes, moderately eroded	>200	4.4	0.3%
BnC2	Boyer sandy loam, 6 to 12 percent slopes, moderately eroded	>200	10.2	0.6%
BnD2	Boyer sandy loam, 12 to 18 percent slopes, moderately eroded	>200	3.9	0.2%
BoA	Boyer very stony loamy sand, 0 to 2 percent slopes	>200	0.0	0.0%
BoB	Boyer very stony loamy sand, 2 to 6 percent slopes	>200	5.7	0.3%
BpF2	Boyer loamy sand, 25 to 40 percent slopes, moderately eroded	>200	1.0	0.1%
BsB	Boyer and Spinks loamy sands, 2 to 6 percent slopes	>200	1.3	0.1%
BsB2	Boyer and Spinks loamy sands, 2 to 6 percent slopes, moderately eroded	>200	6.7	0.4%

Map unit symbol	Map unit name	Rating (centimeters)	Acres in AOI	Percent of AOI
BsC2	Boyer and Spinks loamy sands, 6 to 12 percent slopes, moderately eroded	>200	3.1	0.2%
BsF	Boyer and Spinks loamy sands, 25 to 40 percent slopes	>200	16.0	0.9%
BsF3	Boyer and Spinks loamy sands, 25 to 40 percent slopes, severely eroded	>200	26.4	1.5%
Bw	Parkhill loam, non dense till subsoil, 0 to 2 percent slopes	0	21.0	1.2%
CaA	Cadmus loam, 0 to 2 percent slopes	76	29.8	1.7%
Cg	Carlisle muck, 0 to 2 percent slopes	0	6.9	0.4%
ChB	Celina loam, 2 to 6 percent slopes	130	56.6	3.3%
ChB2	Celina loam, 2 to 6 percent slopes, moderately eroded	130	32.0	1.8%
Cl	Ceresco-Shoals loams	46	25.9	1.5%
Cp	Cohoctah-Sloan loams	15	31.6	1.8%
CpcaaB	Capac loam, 0 to 4 percent slopes	30	6.0	0.3%
Cs	Colwood loam	0	18.8	1.1%
CvraaB	Conover loam, 0 to 4 percent slopes	30	8.0	0.5%
DrB	Dryden sandy loam, 2 to 6 percent slopes	76	11.0	0.6%
FoA	Fox sandy loam, 0 to 2 percent slopes	>200	56.6	3.3%
FoB	Fox sandy loam, 2 to 6 percent slopes	>200	57.6	3.3%
FoB2	Fox sandy loam, 2 to 6 percent slopes, moderately eroded	>200	207.4	11.9%
FoC2	Fox sandy loam, 6 to 12 percent slopes, moderately eroded	>200	55.3	3.2%
FsB	Fox stony sandy loam, 2 to 6 percent slopes	>200	12.0	0.7%
FxC3	Fox sandy clay loam, 6 to 12 percent slopes, severely eroded	>200	43.8	2.5%
FxD3	Fox sandy clay loam, 12 to 18 percent slopes, severely eroded	>200	57.2	3.3%

Map unit symbol	Map unit name	Rating (centimeters)	Acres in AOI	Percent of AOI
FxE3	Fox sandy clay loam, 18 to 25 percent slopes, severely eroded	>200	65.6	3.8%
FxF3	Fox sandy clay loam, 25 to 40 percent slopes, severely eroded	>200	28.3	1.6%
Gp	Gravel pits	>200	5.2	0.3%
IoB	Ionia loam, 2 to 6 percent slopes	76	2.8	0.2%
IrA	Ionia sandy loam, 0 to 2 percent slopes	76	0.0	0.0%
KeB	Kendallville loam, 2 to 6 percent slopes	>200	4.9	0.3%
KgC3	Kendallville sandy clay loam, 6 to 12 percent slopes, severely eroded	>200	8.3	0.5%
KhB	Kendallville sandy loam, 2 to 6 percent slopes	>200	8.3	0.5%
KnA	Kibbie loam, 0 to 2 percent slopes	46	7.2	0.4%
La	Landes-Eel loams	153	6.2	0.4%
Le	Landes-Eel sandy loams	153	6.2	0.4%
Lg	Landes-Genesee loams	153	34.8	2.0%
Lh	Landes-Genesee sandy loams	153	52.0	3.0%
LmF3	Lapeer sandy clay loam, 18 to 40 percent slopes, severely eroded	>200	6.3	0.4%
LnB	Lapeer sandy loam, 2 to 6 percent slopes	>200	4.6	0.3%
LsA	Locke sandy loam, 0 to 2 percent slopes	46	2.5	0.1%
Mb	Made land	>200	7.9	0.5%
MlA	Matherton loam, 0 to 2 percent slopes	46	4.0	0.2%
MtC3	Miami clay loam, 6 to 12 percent slopes, severely eroded	>200	40.0	2.3%
MtD3	Miami clay loam, 12 to 18 percent slopes, severely eroded	>200	16.0	0.9%
MtF3	Miami clay loam, 25 to 40 percent slopes, severely eroded	>200	2.0	0.1%
MuB	Wawasee loam, 2 to 6 percent slopes	>200	13.5	0.8%

Map unit symbol	Map unit name	Rating (centimeters)	Acres in AOI	Percent of AOI
MuB2	Wawasee loam, 2 to 6 percent slopes, moderately eroded	>200	65.8	3.8%
MuC2	Wawasee loam, 6 to 12 percent slopes, moderately eroded	>200	31.6	1.8%
MuD2	Miami loam, 12 to 18 percent slopes, moderately eroded	>200	3.9	0.2%
MuF	Miami loam, 25 to 40 percent slopes	>200	11.7	0.7%
MwA	Miami-Owosso sandy loams, 0 to 2 percent slopes	>200	13.9	0.8%
MwB	Miami-Owosso sandy loams, 2 to 6 percent slopes	>200	7.4	0.4%
MwB2	Miami-Owosso sandy loams, 2 to 6 percent slopes, moderately eroded	>200	20.0	1.2%
PdA	Perrin loamy sand, 0 to 2 percent slopes	84	4.6	0.3%
PdB	Perrin loamy sand, 2 to 6 percent slopes	84	1.4	0.1%
PeB	Perrin sandy loam, 2 to 6 percent slopes	84	4.2	0.2%
SpB2	Spinks loamy sand, 2 to 6 percent slopes, moderately eroded	>200	0.9	0.1%
SpC3	Spinks loamy sand, 6 to 12 percent slopes, severely eroded	>200	2.1	0.1%
SpD3	Spinks loamy sand, 12 to 18 percent slopes, severely eroded	>200	7.1	0.4%
Ta	Tawas muck	0	1.7	0.1%
W	Water	>200	92.4	5.3%
WrA	Wasepi-Brady loamy sands, 0 to 2 percent slopes	46	0.0	0.0%
WsA	Wasepi-Brady sandy loams, 0 to 2 percent slopes	46	2.6	0.1%
Totals for Area of Interest			**1,739.6**	**100.0%**

Description

"Water table" refers to a saturated zone in the soil. It occurs during specified months. Estimates of the upper limit are based mainly on observations of the water table at selected sites and on evidence of a saturated zone, namely grayish colors (redoximorphic features) in the soil. A saturated zone that lasts for less than a month is not considered a water table.

This attribute is actually recorded as three separate values in the database. A low value and a high value indicate the range of this attribute for the soil component. A "representative" value indicates the expected value of this attribute for the component. For this soil property, only the representative value is used.

Rating Options

Units of Measure: centimeters

Aggregation Method: Dominant Component

Component Percent Cutoff: None Specified

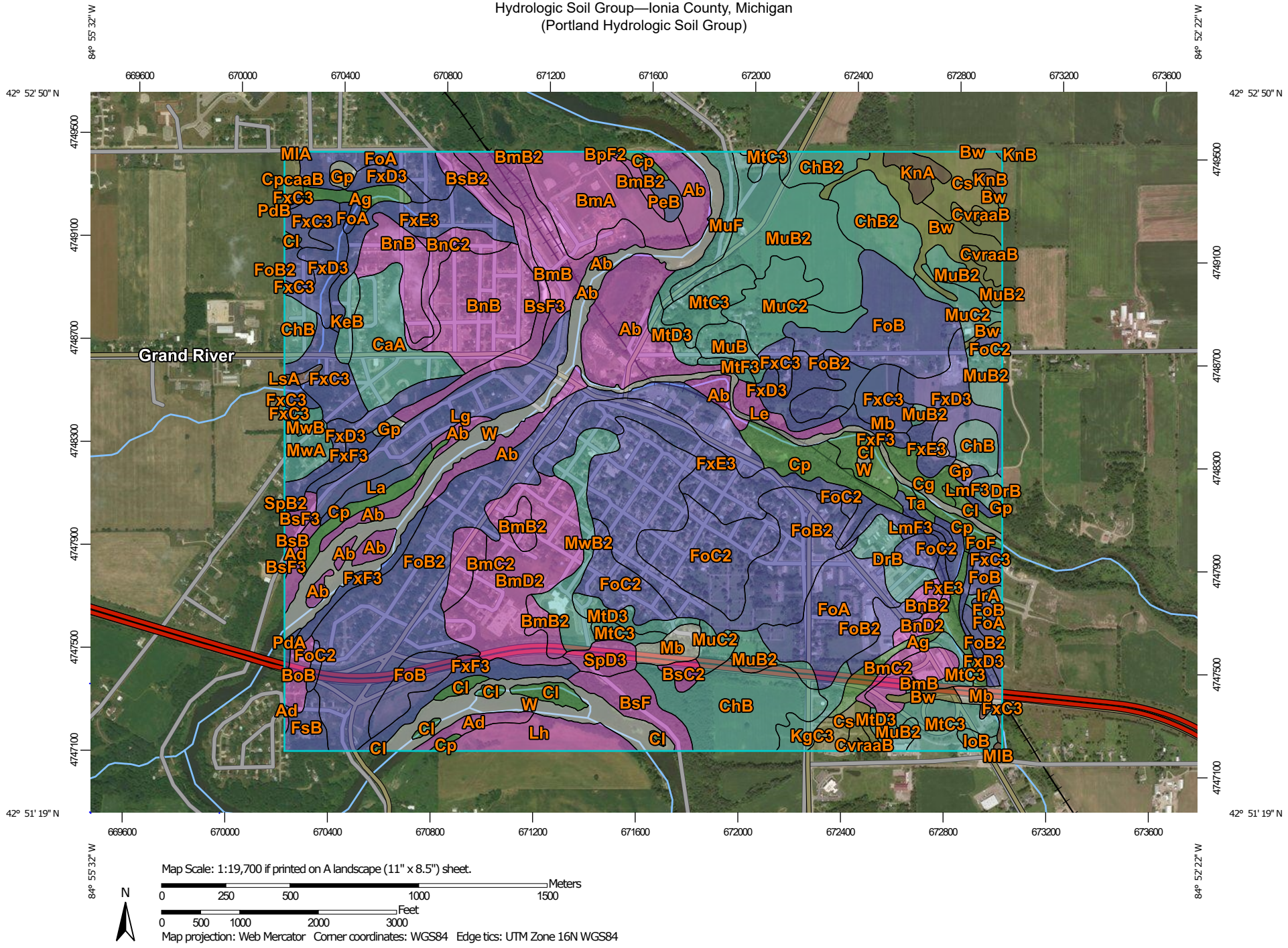
Tie-break Rule: Lower

Interpret Nulls as Zero: No

Beginning Month: January

Ending Month: December

Hydrologic Soil Group—Ionia County, Michigan
(Portland Hydrologic Soil Group)



Map Scale: 1:19,700 if printed on A landscape (11" x 8.5") sheet.

N

Meters: 0 250 500 1000 1500

Feet: 0 500 1000 2000 3000

Map projection: Web Mercator Corner coordinates: WGS84 Edge tics: UTM Zone 16N WGS84

MAP LEGEND

Area of Interest (AOI)

Area of Interest (AOI)

Soils

Soil Rating Polygons

A

A/D

B

B/D

C

C/D

D

Not rated or not available

Soil Rating Lines

A

A/D

B

B/D

C

C/D

D

Not rated or not available

Soil Rating Points

A

A/D

B

B/D

C

C/D

D

Not rated or not available

Water Features

Streams and Canals

Transportation

Rails

Interstate Highways

US Routes

Major Roads

Local Roads

Background

Aerial Photography

MAP INFORMATION

The soil surveys that comprise your AOI were mapped at 1:15,800.

Please rely on the bar scale on each map sheet for map measurements.

Source of Map: Natural Resources Conservation Service
Web Soil Survey URL:
Coordinate System: Web Mercator (EPSG:3857)

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Hydrologic Soil Group

Map unit symbol	Map unit name	Rating	Acres in AOI	Percent of AOI
Ab	Abscota loamy sand	A	73.5	4.5%
Ad	Abscota sandy loam	A	9.4	0.6%
Ag	Algansee loamy sand	A/D	17.6	1.1%
BmA	Boyer loamy sand, 0 to 2 percent slopes	A	36.7	2.3%
BmB	Boyer loamy sand, 2 to 6 percent slopes	A	37.2	2.3%
BmB2	Boyer loamy sand, 2 to 6 percent slopes, moderately eroded	A	11.3	0.7%
BmC2	Boyer loamy sand, 6 to 12 percent slopes, moderately eroded	A	10.7	0.7%
BmD2	Boyer loamy sand, 12 to 18 percent slopes, moderately eroded	A	53.9	3.3%
BnB	Boyer sandy loam, 2 to 6 percent slopes	A	55.8	3.5%
BnB2	Boyer sandy loam, 2 to 6 percent slopes, moderately eroded	A	3.1	0.2%
BnC2	Boyer sandy loam, 6 to 12 percent slopes, moderately eroded	A	10.2	0.6%
BnD2	Boyer sandy loam, 12 to 18 percent slopes, moderately eroded	A	3.9	0.2%
BoB	Boyer very stony loamy sand, 2 to 6 percent slopes	A	5.6	0.3%
BpF2	Boyer loamy sand, 25 to 40 percent slopes, moderately eroded	A	0.0	0.0%
BsB	Boyer and Spinks loamy sands, 2 to 6 percent slopes	A	0.7	0.0%
BsB2	Boyer and Spinks loamy sands, 2 to 6 percent slopes, moderately eroded	A	5.8	0.4%
BsC2	Boyer and Spinks loamy sands, 6 to 12 percent slopes, moderately eroded	A	3.1	0.2%

Map unit symbol	Map unit name	Rating	Acres in AOI	Percent of AOI
BsF	Boyer and Spinks loamy sands, 25 to 40 percent slopes	A	13.3	0.8%
BsF3	Boyer and Spinks loamy sands, 25 to 40 percent slopes, severely eroded	A	19.6	1.2%
Bw	Parkhill loam, non dense till subsoil, 0 to 2 percent slopes	C/D	24.7	1.5%
CaA	Cadmus loam, 0 to 2 percent slopes	C	29.8	1.8%
Cg	Carlisle muck, 0 to 2 percent slopes	A/D	6.9	0.4%
ChB	Celina loam, 2 to 6 percent slopes	C	52.6	3.3%
ChB2	Celina loam, 2 to 6 percent slopes, moderately eroded	C	27.9	1.7%
Cl	Ceresco-Shoals loams	A/D	20.7	1.3%
Cp	Cohoctah-Sloan loams	A/D	30.5	1.9%
CpcaaB	Capac loam, 0 to 4 percent slopes	C/D	2.3	0.1%
Cs	Colwood loam	C/D	19.6	1.2%
CvraaB	Conover loam, 0 to 4 percent slopes	C/D	8.7	0.5%
DrB	Dryden sandy loam, 2 to 6 percent slopes	C	14.3	0.9%
FoA	Fox sandy loam, 0 to 2 percent slopes	B	52.0	3.2%
FoB	Fox sandy loam, 2 to 6 percent slopes	B	61.2	3.8%
FoB2	Fox sandy loam, 2 to 6 percent slopes, moderately eroded	B	209.3	13.0%
FoC2	Fox sandy loam, 6 to 12 percent slopes, moderately eroded	B	56.4	3.5%
FoF	Fox sandy loam, 25 to 40 percent slopes	B	1.0	0.1%
FsB	Fox stony sandy loam, 2 to 6 percent slopes	B	6.9	0.4%
FxC3	Fox sandy clay loam, 6 to 12 percent slopes, severely eroded	B	37.8	2.3%
FxD3	Fox sandy clay loam, 12 to 18 percent slopes, severely eroded	B	60.7	3.8%

Map unit symbol	Map unit name	Rating	Acres in AOI	Percent of AOI
FxE3	Fox sandy clay loam, 18 to 25 percent slopes, severely eroded	B	66.5	4.1%
FxF3	Fox sandy clay loam, 25 to 40 percent slopes, severely eroded	B	26.3	1.6%
Gp	Gravel pits		5.5	0.3%
IoB	Ionia loam, 2 to 6 percent slopes	C	2.4	0.1%
IrA	Ionia sandy loam, 0 to 2 percent slopes	C	2.5	0.2%
KeB	Kendallville loam, 2 to 6 percent slopes	C	4.9	0.3%
KgC3	Kendallville sandy clay loam, 6 to 12 percent slopes, severely eroded	C	7.3	0.4%
KnA	Kibbie loam, 0 to 2 percent slopes	B/D	6.5	0.4%
KnB	Kibbie loam, 2 to 6 percent slopes	B/D	1.9	0.1%
La	Landes-Eel loams	B	5.7	0.4%
Le	Landes-Eel sandy loams	A	6.2	0.4%
Lg	Landes-Genesee loams	B	34.8	2.2%
Lh	Landes-Genesee sandy loams	A	17.6	1.1%
LmF3	Lapeer sandy clay loam, 18 to 40 percent slopes, severely eroded	B	8.4	0.5%
LnB	Lapeer sandy loam, 2 to 6 percent slopes	B	4.6	0.3%
LsA	Locke sandy loam, 0 to 2 percent slopes	B/D	1.4	0.1%
Mb	Made land		10.5	0.7%
MlA	Matherton loam, 0 to 2 percent slopes	B/D	0.4	0.0%
MlB	Matherton loam, 2 to 6 percent slopes	B/D	0.2	0.0%
MtC3	Miami clay loam, 6 to 12 percent slopes, severely eroded	C	37.6	2.3%
MtD3	Miami clay loam, 12 to 18 percent slopes, severely eroded	C	13.2	0.8%
MtF3	Miami clay loam, 25 to 40 percent slopes, severely eroded	C	2.0	0.1%

Map unit symbol	Map unit name	Rating	Acres in AOI	Percent of AOI
MuB	Wawasee loam, 2 to 6 percent slopes	C	7.9	0.5%
MuB2	Wawasee loam, 2 to 6 percent slopes, moderately eroded	C	74.0	4.6%
MuC2	Wawasee loam, 6 to 12 percent slopes, moderately eroded	C	35.4	2.2%
MuF	Miami loam, 25 to 40 percent slopes	C	10.2	0.6%
MwA	Miami-Owosso sandy loams, 0 to 2 percent slopes	C	8.3	0.5%
MwB	Miami-Owosso sandy loams, 2 to 6 percent slopes	C	2.2	0.1%
MwB2	Miami-Owosso sandy loams, 2 to 6 percent slopes, moderately eroded	C	19.5	1.2%
PdA	Perrin loamy sand, 0 to 2 percent slopes	B	1.0	0.1%
PdB	Perrin loamy sand, 2 to 6 percent slopes	B	0.6	0.0%
PeB	Perrin sandy loam, 2 to 6 percent slopes	B	4.2	0.3%
Sd	Sebewa loam, 0 to 2 percent slopes	B/D	1.2	0.1%
SpB2	Spinks loamy sand, 2 to 6 percent slopes, moderately eroded	A	0.0	0.0%
SpD3	Spinks loamy sand, 12 to 18 percent slopes, severely eroded	A	7.1	0.4%
Ta	Tawas muck	A/D	1.7	0.1%
W	Water		81.6	5.0%
Totals for Area of Interest			**1,615.7**	**100.0%**

Description

Hydrologic soil groups are based on estimates of runoff potential. Soils are assigned to one of four groups according to the rate of water infiltration when the soils are not protected by vegetation, are thoroughly wet, and receive precipitation from long-duration storms.

The soils in the United States are assigned to four groups (A, B, C, and D) and three dual classes (A/D, B/D, and C/D). The groups are defined as follows:

Group A. Soils having a high infiltration rate (low runoff potential) when thoroughly wet. These consist mainly of deep, well drained to excessively drained sands or gravelly sands. These soils have a high rate of water transmission.

Group B. Soils having a moderate infiltration rate when thoroughly wet. These consist chiefly of moderately deep or deep, moderately well drained or well drained soils that have moderately fine texture to moderately coarse texture. These soils have a moderate rate of water transmission.

Group C. Soils having a slow infiltration rate when thoroughly wet. These consist chiefly of soils having a layer that impedes the downward movement of water or soils of moderately fine texture or fine texture. These soils have a slow rate of water transmission.

Group D. Soils having a very slow infiltration rate (high runoff potential) when thoroughly wet. These consist chiefly of clays that have a high shrink-swell potential, soils that have a high water table, soils that have a claypan or clay layer at or near the surface, and soils that are shallow over nearly impervious material. These soils have a very slow rate of water transmission.

If a soil is assigned to a dual hydrologic group (A/D, B/D, or C/D), the first letter is for drained areas and the second is for undrained areas. Only the soils that in their natural condition are in group D are assigned to dual classes.

Rating Options

Aggregation Method: Dominant Condition

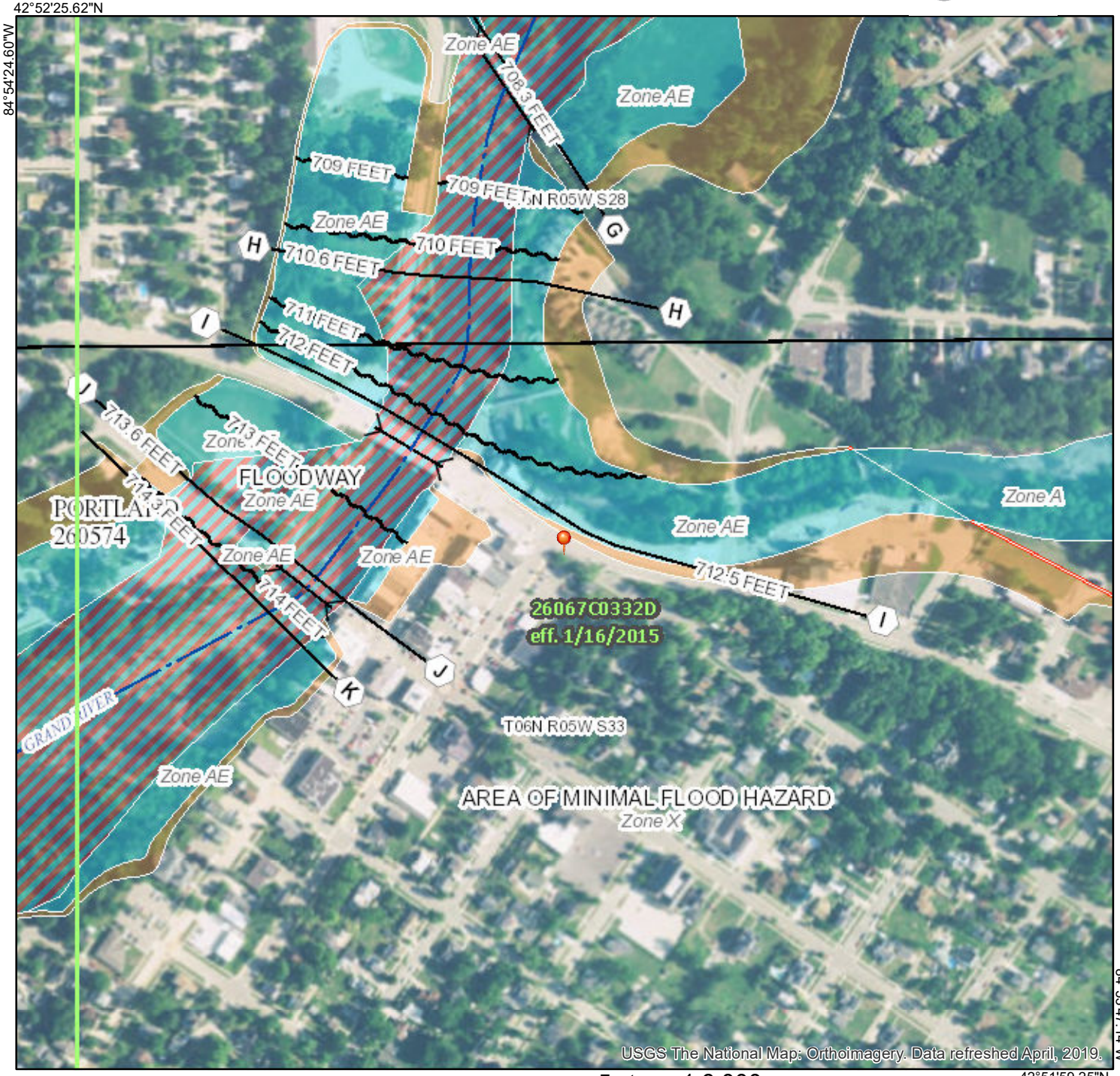
Component Percent Cutoff: None Specified

Tie-break Rule: Higher

B5 – FEMA 100 Year Floodplain

National Flood Hazard Layer FIRMette

FEMA



Legend

SEE FIS REPORT FOR DETAILED LEGEND AND INDEX MAP FOR FIRM PANEL LAYOUT

SPECIAL FLOOD HAZARD AREAS
- Without Base Flood Elevation (BFE) *Zone A, V, A99*
- With BFE or Depth *Zone AE, AO, AH, VE, AR*
- Regulatory Floodway

OTHER AREAS OF FLOOD HAZARD
- 0.2% Annual Chance Flood Hazard, Areas of 1% annual chance flood with average depth less than one foot or with drainage areas of less than one square mile *Zone X*
- Future Conditions 1% Annual Chance Flood Hazard *Zone X*
- Area with Reduced Flood Risk due to Levee. See Notes. *Zone X*
- Area with Flood Risk due to Levee *Zone D*

OTHER AREAS
- NO SCREEN — Area of Minimal Flood Hazard *Zone X*
- Effective LOMRs
- Area of Undetermined Flood Hazard *Zone D*

GENERAL STRUCTURES
- Channel, Culvert, or Storm Sewer
- Levee, Dike, or Floodwall

OTHER FEATURES
- 20.2 / 17.5 — Cross Sections with 1% Annual Chance Water Surface Elevation
- Coastal Transect
- 513 — Base Flood Elevation Line (BFE)
- Limit of Study
- Jurisdiction Boundary
- Coastal Transect Baseline
- Profile Baseline
- Hydrographic Feature

MAP PANELS
- Digital Data Available
- No Digital Data Available
- Unmapped

N

The pin displayed on the map is an approximate point selected by the user and does not represent an authoritative property location.

This map complies with FEMA's standards for the use of digital flood maps if it is not void as described below. The basemap shown complies with FEMA's basemap accuracy standards

The flood hazard information is derived directly from the authoritative NFHL web services provided by FEMA. This map was exported on 2/27/2020 at 8:35:20 AM and does not reflect changes or amendments subsequent to this date and time. The NFHL and effective information may change or become superseded by new data over time.

This map image is void if the one or more of the following map elements do not appear: basemap imagery, flood zone labels, legend, scale bar, map creation date, community identifiers, FIRM panel number, and FIRM effective date. Map images for unmapped and unmodernized areas cannot be used for regulatory purposes.

APPENDIX C – MONITORING PROGRAM

This appendix includes details about the monitoring program implemented for this project.

C1 – Monitoring Equipment Details

This study employed a number of different monitoring devices to collect data:

- Sewer depth/temperature sensors (collecting depth and temperature data at discrete intervals);
- Portable flow meter (measuring depth and velocity at discrete locations);
- Rain gauge (measuring instantaneous rainfall and hourly air temperature); and

Leveloggers – Measuring Wastewater Depth and Temperature

Solinst®[4] Leveloggers® (LLs) were utilized to measure and record wastewater depths and temperatures at 5-minute intervals at specific locations in the sanitary sewer system. The device measures the absolute pressure above the tip and therefore requires the use of a Solinst® Barologger® (BL) to measure the atmospheric pressure. Solinst® software is used to process the data stored in the LLs and the BL and generates data consisting of depth and temperature in 5-minute increments. The depth is derived from the difference in pressures measured by the LL and the BL. The software is capable of accounting for elevation-based pressure differences between the devices, in addition to many other factors, by automatically incorporating any provided correction factors into the final depth calculation. See Figure C1 for stock photos of the loggers.

Figure C1. Solinst® Levelogger® and Barologger® (stock photos).

The LLs were installed in the manholes in numerous ways depending on sewer and flow conditions with the primary objective being to keep the sensor in the flow while minimizing the potential for debris accumulation and minimizing sensor drift.

The LLs were installed inside a 1-inch diameter PVC casing pipe that helps to protect the LL and hold it in a stationary position in the flow channel. In some cases, modifications (such as a flexible section) were required to precisely place the sensor or if the requirement to allow debris to pass was necessary[5]. For this reason, most locations were deployed to the side of the flow channel and the sensor-measured depths were then corrected to the actual channel flow depth based on the in-situ measurements taken during field visits.

The PVC pipe was mounted to a spreader bar apparatus near the top of the manhole that allows all work to be done without the need for confined space entry procedure into the manhole, thus saving time and money and increasing safety. A typical manhole installation is shown in Figure C2. The BLs were

[4] Headquarters and manufacturing in Georgetown, Ontario, Canada.
[5] In some situations, loggers may accumulate debris during dry weather flow. In this situation, the data may skew over time as a clog builds up. However, the onset of wet weather flows will dislodge the clog, allowing for accurate capturing of wet weather data. The skewed data is then either corrected or ignored.

suspended from the mounting apparatus in two separate manholes near the center of the study area (LL-07, LL-09).

Figure C2. Levelogger® mounting apparatus – spreader bar and upper bracket at LL-07 (left) and drop pipe at LL-07 (right).

Portable Flow Meter – Measuring Flow Rates (via Depth and Velocity)

A Hach FH950 portable flow meter was utilized to obtain depth and velocity measurements at all locations where depth monitors were installed. Various techniques were used at each location depending on the circumstances of the location and the flow depth. Measurements were taken during each field visit to facilitate the development of a depth-velocity curve to be used to convert depths to flow rates. The Hach FH950 meter is shown in Figure C3.

Figure C3. Hach® FH950 Portable Flow Meter stock photos.

Rain Gauge – Measuring Precipitation

Two Texas Electronics tipping-bucket-type rain gauges were installed at the Riverside Dr. lift station and at the WWTP, which were used to record time-stamped precipitation data in 0.01-inch increments and hourly air temperature readings. The gauges include an integrated heating element to prevent freezing and convert snowfall into its rain equivalent, of which were not needed for the duration of this study.

Figure C4. Rain gauge installations at Riverside Dr Lift Station (left) and WWTP (right).

C2 – Data Processing

All data collected and provided was reviewed to identify problems, assess reliability, and apply corrections (if necessary and if possible). This section addresses the data collection, management, and processing procedures.

Rainfall Data

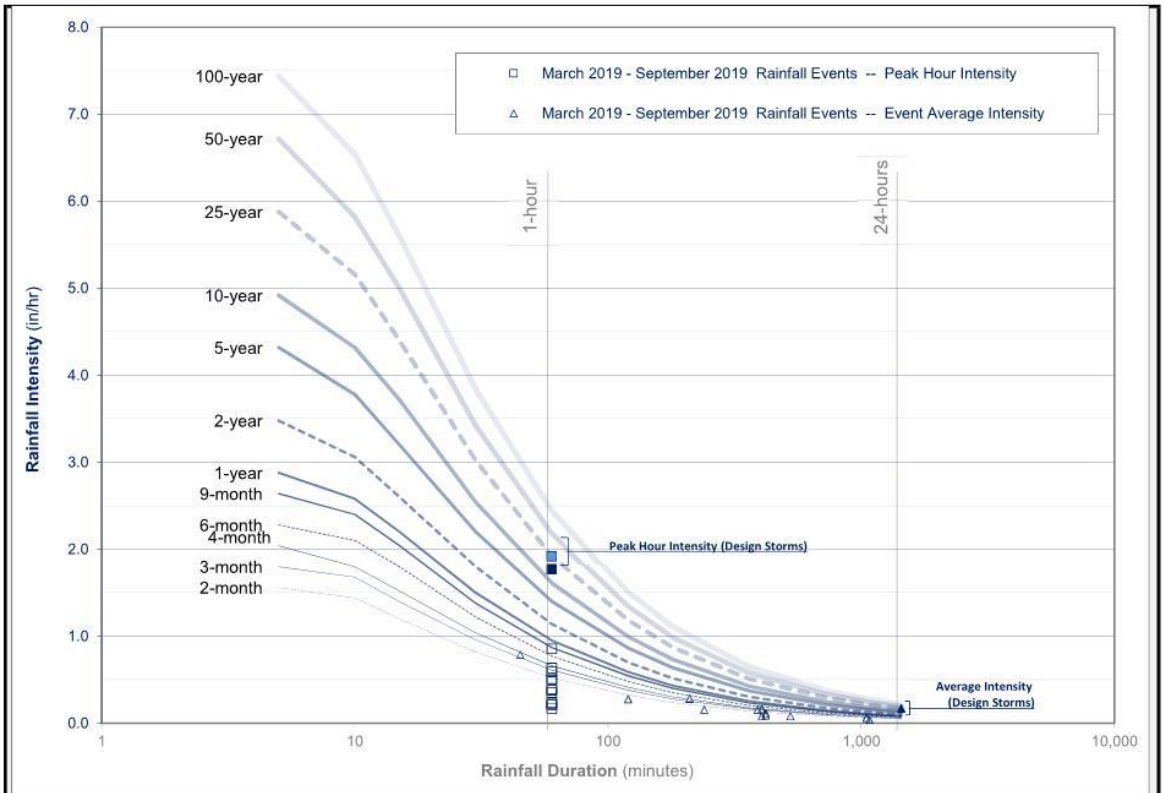
A wide range of wet weather events occurred during the monitoring period. Table C1 provides a summary of the largest rainfall events that were used in the RDII and statistical analyses. Many other smaller rainfall events occurred during the monitoring period; these smaller events were taken into consideration when necessary (e.g. establishing the DWF for a given location). Rainfall-dependent I/I generally occurred in response to precipitation events or a series of precipitation events with large total rainfalls. Two rain gauges were installed in the study region, to get a more accurate account of how much rainfall occurred at various locations throughout the City. A process called Inverse Distance Weighting (IDW) Interpolation was used to obtain the average recorded rainfall at each monitoring location. IDW is a process in which known rainfall at known locations (rain gauges) are used in a distance weighting formula to estimate the rainfall at an unknown location, in proximity to the two known points. Each monitoring area was designated a rainfall area, in which the centroid of that area was determined, and a measurement was made from each rainfall area centroid to each rain gauge location.

Table C1. Rainfall events used in the RDII analysis.

Event Start Date			Preceding week Rainfall (inches)	Total Precipitation Event Depth (inches)	Duration	Average Intensity (inches / hour)	Peak 15-minute Intensity (inches / hour)	Source
Year	Month	Date(s)						
2019	Apr	15	0.81	0.62	7h	0.09	0.26	IDW
2019	Apr	18	1.55	0.69	8h 45 min	0.08	0.32	IDW
2019	Apr	22	0.93	0.55	2h	0.27	1.02	IDW
2019	May	19	0.32	1.07	6h 45 min	0.16	2.3	IDW
2019	Jun	5	0.59	0.61	4h	0.15	0.83	IDW
2019	Jun	12	0.63	0.68	18h	0.04	0.67	IDW
2019	Jun	19	1.20	1.04	17h 30 min	0.06	0.85	IDW
2019	Jul	02	0.27	1.01	6h 30 min	0.15	1.19	IDW
2019	Jul	13	0.18	0.53	6h 45 min	0.08	0.49	IDW
2019	Aug	29	0.37	0.59	45 min	0.79	1.48	IDW
2019	Sep	11	0.30	0.98	3h 30 min	0.28	1.24	IDW
2019	Sep	22	0.30	0.80	7h	0.11	0.48	IDW
25y 24h -- DESIGN				**4.09**	**24h**	**0.17**	**-**	Huff & Angel[6]

It is common practice in this context to relate rainfall events to historical rainfall frequency data to determine what level of events were monitored. Figure C6 provides rainfall frequency information for the South Central Lower Peninsula of Michigan and a comparison of the study period rainfall events.

[6] "Rainfall Frequency Atlas of the Midwest." Bulletin 71. MCC – NAS – NWS – NOAA. Huff, F.A. & Angel, J.R. (1992).



Rainfall Volume	Section 09 of Michigan									from *Bulletin 71 Rainfall Frequency Atlas of the Midwest*		
Dura-tion	2-month (in)	3-month (in)	4-month (in)	6-month (in)	9-month (in)	1-year (in)	2-year (in)	5-year (in)	10-year (in)	25-year (in)	50-year (in)	100-year (in)
5-min	0.13	0.15	0.17	0.19	0.22	0.24	0.29	0.36	0.41	0.49	0.56	0.62
10-min	0.24	0.28	0.30	0.35	0.40	0.43	0.51	0.63	0.72	0.86	0.97	1.09
15-min	0.30	0.35	0.38	0.45	0.51	0.55	0.65	0.80	0.93	1.10	1.25	1.40
30-min	0.41	0.48	0.52	0.61	0.69	0.75	0.90	1.10	1.27	1.51	1.71	1.92
1-hour	0.52	0.61	0.66	0.77	0.87	0.95	1.14	1.40	1.61	**1.92**	2.18	2.44
2-hour	0.65	0.76	0.83	0.96	1.09	1.18	1.40	1.73	1.99	2.37	2.69	3.02
3-hour	0.71	0.83	0.91	1.05	1.20	1.30	1.55	1.91	2.20	2.62	2.96	3.33
6-hour	0.84	0.97	1.06	1.23	1.40	1.52	1.82	2.24	2.57	3.07	3.47	3.90
12-hour	0.97	1.13	1.24	1.43	1.63	1.77	2.11	2.59	2.98	3.56	4.03	4.52
18-hour	1.05	1.22	1.34	1.55	1.76	1.91	2.27	2.80	3.22	3.84	4.35	4.89
24-hour	1.12	1.30	1.42	1.64	1.87	2.03	2.42	2.98	3.43	**4.09**	4.63	5.20
Rainfall Volume from *Technical Paper No. 40 (TP-40): Rainfall Frequency Atlas of the U.S.*									--->	3.90	25-year, 24-hour	

Average Rainfall Intensity	Section 09 of Michigan									from *Bulletin 71 Rainfall Frequency Atlas of the Midwest*		
Dura-tion	2-month (in/hr)	3-month (in/hr)	4-month (in/hr)	6-month (in/hr)	9-month (in/hr)	1-year (in/hr)	2-year (in/hr)	5-year (in/hr)	10-year (in/hr)	25-year (in/hr)	50-year (in/hr)	100-year (in/hr)
5-min	1.56	1.80	2.04	2.28	2.64	2.88	3.48	4.32	4.92	5.88	6.72	7.44
10-min	1.44	1.68	1.80	2.10	2.40	2.58	3.06	3.78	4.32	5.16	5.82	6.54
15-min	1.20	1.40	1.52	1.80	2.04	2.20	2.60	3.20	3.72	4.40	5.00	5.60
30-min	0.82	0.96	1.04	1.22	1.38	1.50	1.80	2.20	2.54	3.02	3.42	3.84
1-hour	0.52	0.61	0.66	0.77	0.87	0.95	1.14	1.40	1.61	□ 1.92	2.18	2.44
2-hour	0.33	0.38	0.42	0.48	0.55	0.59	0.70	0.87	1.00	1.19	1.35	1.51
3-hour	0.24	0.28	0.30	0.35	0.40	0.43	0.52	0.64	0.73	0.87	0.99	1.11
6-hour	0.14	0.16	0.18	0.21	0.23	0.25	0.30	0.37	0.43	0.51	0.58	0.65
12-hour	0.08	0.09	0.10	0.12	0.14	0.15	0.18	0.22	0.25	0.30	0.34	0.38
18-hour	0.06	0.07	0.07	0.09	0.10	0.11	0.13	0.16	0.18	0.21	0.24	0.27
24-hour	0.05	0.05	0.06	0.07	0.08	0.08	0.10	0.12	0.14	△ 0.17	0.19	0.22
Average Rainfall Intensity from *Technical Papter No. 40 (TP-40): Rainfall Frequency Atlas of the U.S.*									--->	■ 0.16	25-year, 24-hour	

Figure C6. Historical rainfall intensity-duration-frequency (IDF) curves with study period rainfall events (top) and IDF tables with design storms highlighted (bottom).

Design Rainfall Event

The rainfall used for performance projection, also known as the 'design storm', is defined by the EGLE as the 25-year, 24-hour event of 4.09 inches[7] using an SCS Type II distribution. The characteristics of this event are presented in Figure C7.

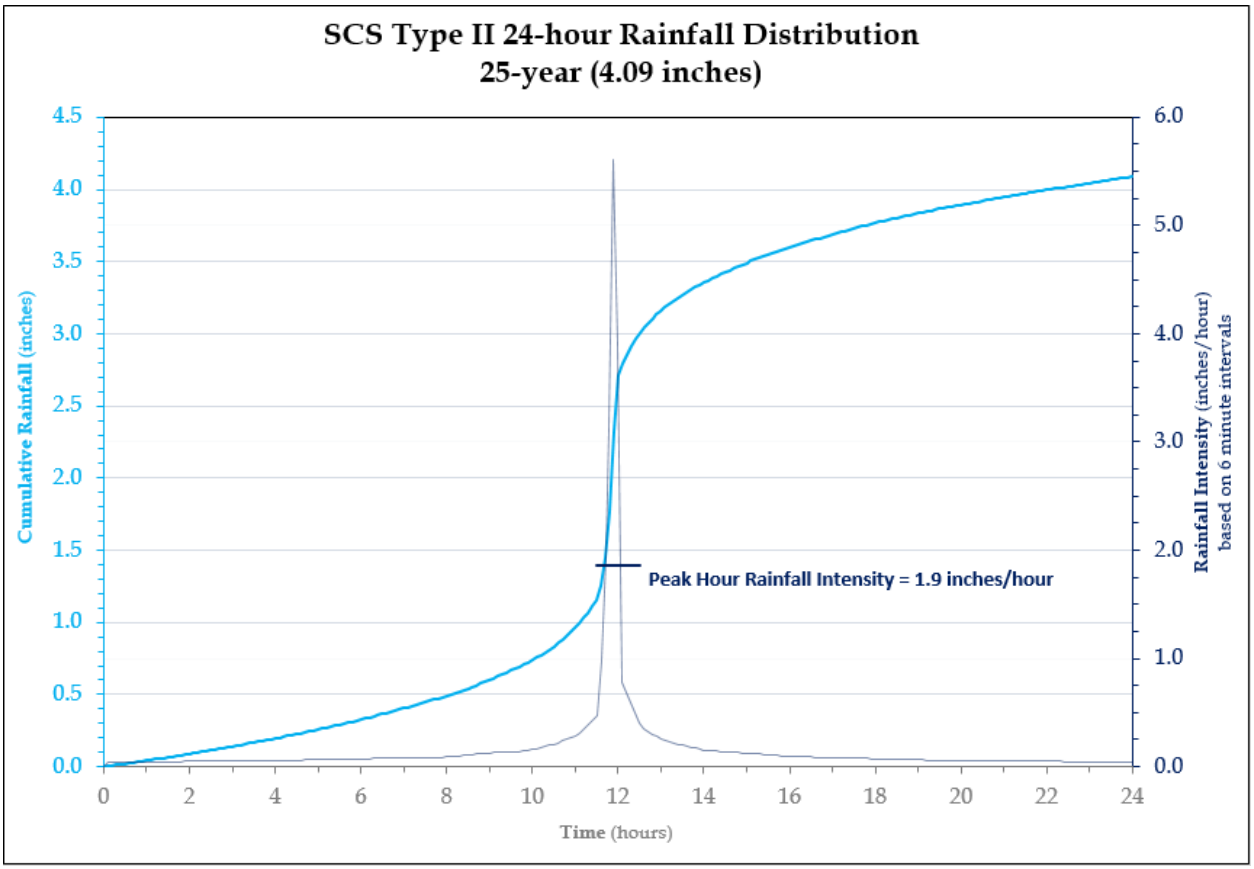


Figure C7. Design rainfall distribution.

Monitor Data QA/QC and Editing

All of the field data collected for the project went through quality control processes to assess data confidence, eliminate data errors, and provide corrections when possible. The QA/QC for different data types is discussed under the following headings.

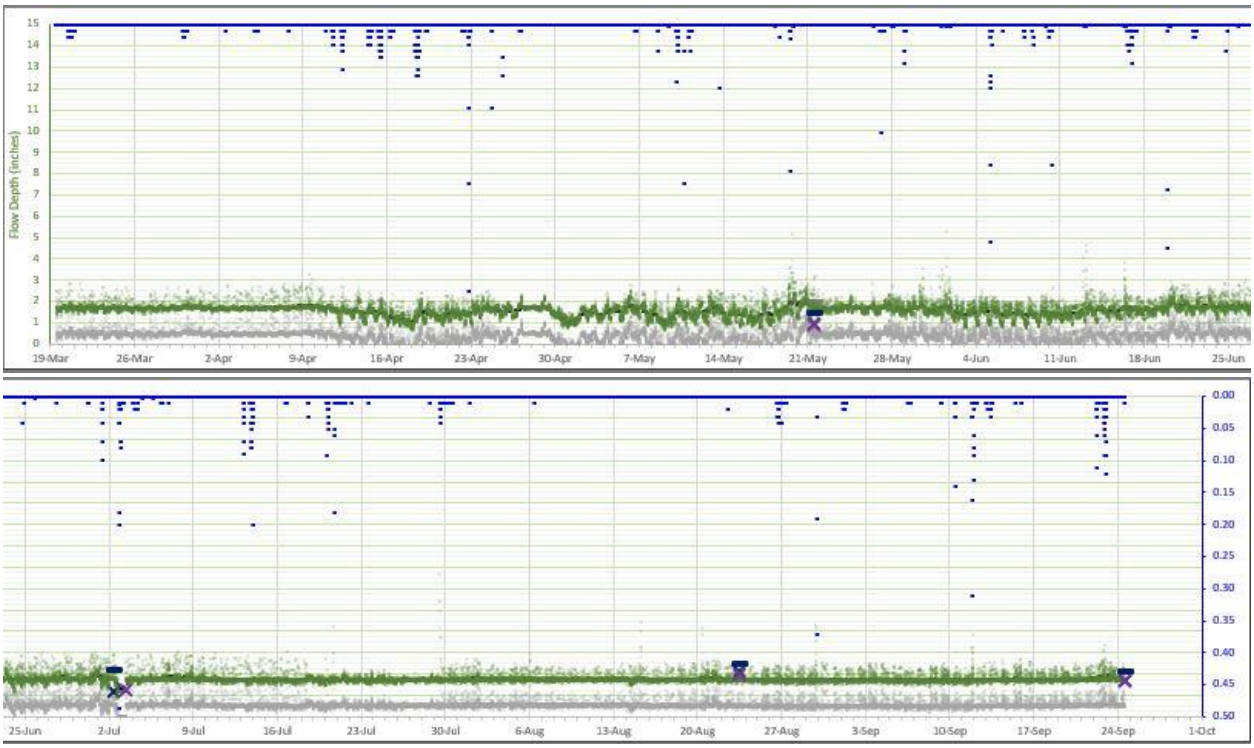
Logger Depth Data and Portable Flow Meter Usage

The depth loggers collected data at 5-minute intervals. This data has been reviewed and corrected to match real-time measurements (accounting for depth offset from bottom of channel) and to account for such things as deployment adjustments, clogging, momentum-displacement, or other issues. An example, for LL-11, is shown in Figure C8 where the entire data set is shifted up roughly 1.2 inches to match the data series to the in-situ depth measurements (i.e. the difference between the four (4) observed-in-the-field outlet depth measurements and logger-recorded depths was minimized).

Note that the data, at this point, has been edited to provide general accuracy on a day-to-day basis. The goal is large scale accuracy concerning the overall trend and RDII response to baseline conditions. The data was not reviewed at the 5-minute resolution, although corrections were applied at any scale as

[7] The source of 4.09 inches for the design rainfall depth is: Technical Paper No. 40, Weather Bureau, U.S. Department of Commerce. 1961, via: http://www.nws.noaa.gov/oh/hdsc/PF_documents/TechnicalPaper_No40.pdf

issues were encountered. Final corrections were made on an iterative basis when examining the flow output from this process. This is discussed further in the Flow Rate Calculation and Checking section below.



Gray line ---------- denotes barometrically compensated raw depth data from the Levelogger®. The barometric compensation is proprietary but requires knowing the deployment elevations of the Barologger® and the Levelogger®. Green line ---------- denotes the final depth data from which the flow rates were estimated (after being corrected to correspond to the depth measured during the field visits). The purple **X** represents the measured outlet depth and the dark blue **--** represents the depth at the sensor. The lighter blue at the top of the figure is rainfall in inches.

Figure C8. Example QA/QC adjustments for logged depth data (LL-11 shown).

Temperature data was collected and was used during the QA/QC process to determine if a change in depth shown in the logger data was associated with RDII flow patterns (where temperature changes generally track with RDII-induced flow changes) or if there was debris or other logger displacement issues that caused the logger to move with respect to the water surface (in which case the period of 'false' depth change was corrected as accurately as possible).

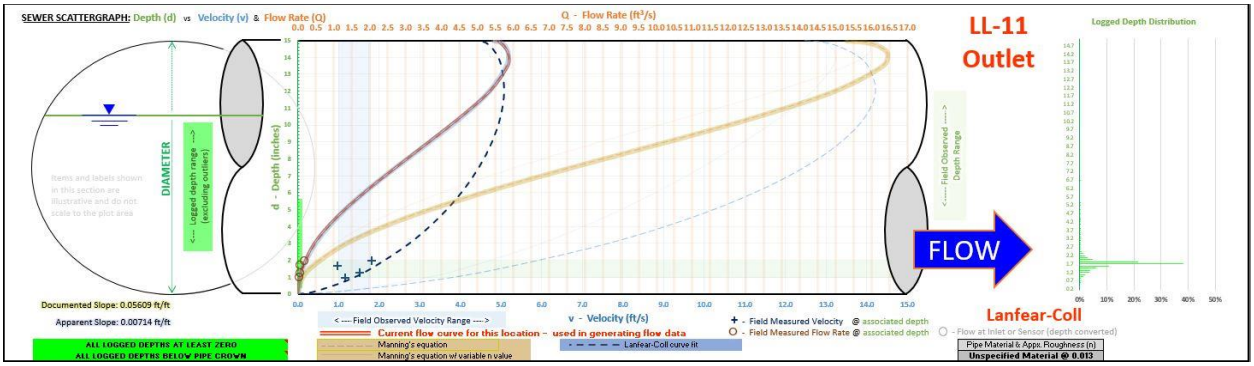
Field-observed depth/velocity/flow measurements were plotted against Manning's Equation to determine if the sewer at each location was performing according to theory. Figure C9 shows the data for LL-12.

Based on the diameter of the sewer, using the best available slope data, and estimating for the roughness coefficient, the sewer at the example location appears to have lower velocities/flow rates than would be predicted (Manning's equation flow rate is the yellow line). In cases like this, a curve-fitting approach known as the Lanfear-Coll[8] method was employed to develop a depth-flow relationship that represents the conditions observed. In some cases where an obstruction exists downstream, a curve is required that reflects a condition of no flow for depths below a specific point (e.g. an obstruction). In such situations, an iterative curve-fitting approach known as the Stevens-Schutzbach[8] method was employed. The right-hand side of the figure also displays a probability distribution of the depths observed during the

[8] These curve-fitting methodologies are presented in Appendix B3.

monitoring period for a quick-glance check of if the observed data and sensor-collected data are in agreement.

The best-fit curve generated through these methods expresses the flow rate as a function of depth. The curve for LL-11, generated using the Lanfear-Coll method is shown in Figure C10 (along with the associated equation).



O Dark orange circles denote observed flow rates **==** Dark red double line overlaying flow curve indicates which one was utilized
+ Dark blue crosses denote observed velocities **- - -** Lanfear-Coll velocity line **-- --** Manning's equation velocity line

Figure C9. In-situ depth-velocity-flow measurements compared to Manning's Equation relationship (LL-11 shown).

O Dark orange circles denote observed flow rates **==** Dark red double line overlaying flow curve indicates which one was utilized
+ Dark blue crosses denote observed velocities **- - -** Lanfear-Coll velocity line **-- --** Manning's equation velocity line

Figure C10. Example depth-velocity-flow curve (LL-11 shown).

Flow Rate Calculation and Checking

The logger depth data and the depth/flow relationship curves were combined to produce flow rate estimates at the logger locations for the period of deployment. After the preliminary flow rates were generated, the cumulative flow balance between the logger monitoring areas was reviewed as well as the continuity of the flow estimates immediately preceding, during, and after the major storm events (by visual inspection). The flow projections were validated by comparing to the field data.

Flow Rate Estimation Accuracy and 'Pain of Subtraction'

When properly calibrated, flow meters can produce values that are within +/- 5% of reality with reasonable scatter in the +/- 10% range. This potential error compounds as net (i.e. incremental) flows are calculated by subtracting the flows reported at upstream meters from the flows reported at the outlet meter for a given area. The closer the meters are together in terms of flow, the less accurate the net calculations are due to a phenomenon called the 'pain of subtraction'.

A few of the monitoring areas defined by the LLs required the subtraction of several upstream LLs to estimate the flows being generated in their incremental areas.

For areas where estimated flow rates could not be reliably balanced or if other 'pain of subtraction' issues were identified, the downstream logger was used to characterize the entire area and the upstream logger calculations applied only to prioritize within the larger immediate service area (i.e. the entire area defined by the downstream logger). This was the case for LL-12 data being rolled into LL-05 incremental data. The final logger flow estimates are presented in Table C2.

Service Area Characteristics

The monitor service boundaries were defined based on sanitary sewer system data with the boundaries drawn to generally coincide with parcel boundaries. For non-sewered areas along service area boundaries, the boundary was drawn based on likely future service connection to existing sewers. In some cases, parcels were split where logical. The effective sewered area within each of the overall service boundaries generally included the entire parcel for single-family residential service (except for larger lots where the backlot green space was typically excluded) while apartment buildings and non-residential structures were limited to the building footprint plus a small portion of additional area to maintain area continuity and pass over likely service lateral locations. This method thus excludes areas such as significant green space and large contiguous paved areas such as parking lots. For sewer runs through non-serviced area, a reasonable buffer around the pipe was included as part of the effective area. The 'serviced' area only includes actively connected parcels and structures.

Population data was estimated primarily by identifying the number of housing units through parcel data and aerial imagery and applying a persons per household multiplier.

For non-residential customers/buildings, equivalent 'populations' were estimated using the equivalency factors presented in Appendix B1. Other required data for equivalency estimation (e.g. square footage, number of units in an apartment) were obtained from appropriate sources such as aerial photography or online information.

C3 – RDII Comparative Analyses

Comparative analysis of RDII flows involves assessing the wet weather responses for selected events, projecting the responses to the selected design storm, and comparing the various areas by standard metrics. The process and metrics used are discussed in the remainder of this section.

WWF Event Hydrograph Decompositions

For each monitoring location, this process involves utilizing a spreadsheet-based visualization and calculation tool to extract the important values associated with a specific event. The tool interface is presented as Figure C11, with an example of the flows at LL-12 for the 9/30/2018 wet weather event.

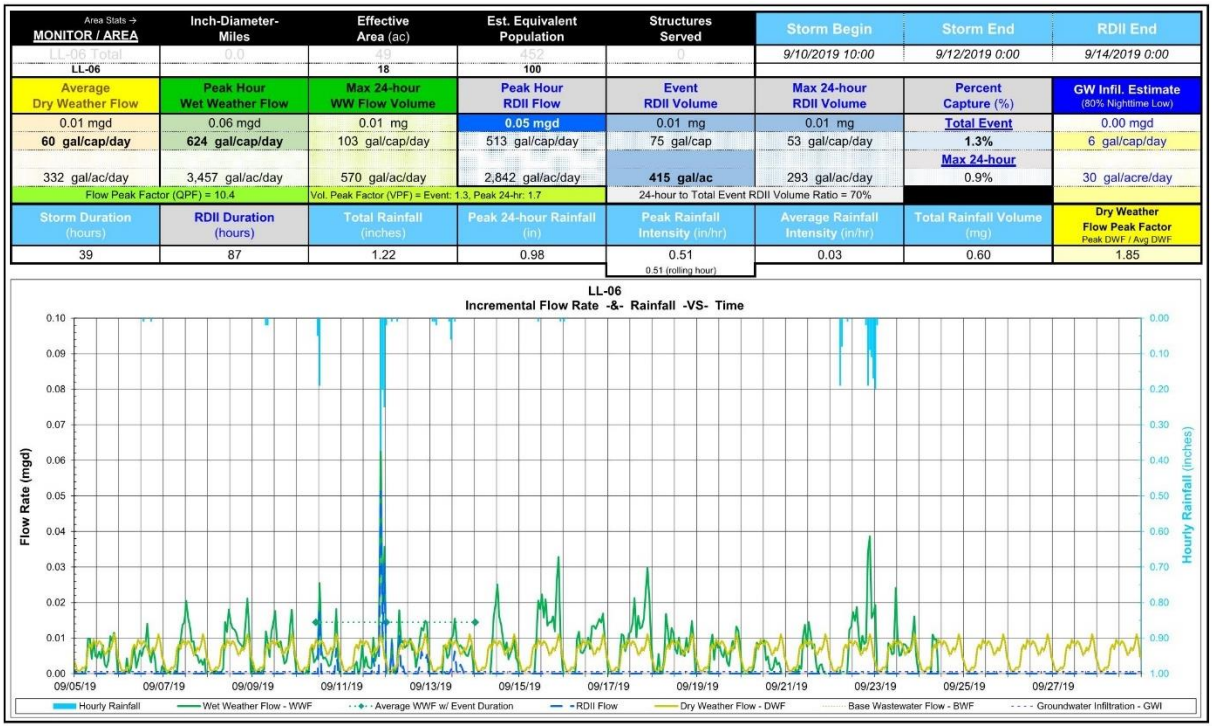


Figure C11. Wet weather flow event hydrograph decomposition tool (example for LL-06 Incremental).

Prior to analysis, the available flow area details are entered: effective sewered acreage and equivalent population. The interactive procedure of analysis is then: 1) define the storm beginning and end times; 2) define the RDII response end time; 3) define the dry weather flow pattern; and 4) if another event begins before the RDII response for the preceding event ends, the RDII response for the remaining duration is projected to zero at the defined RDII response end time.

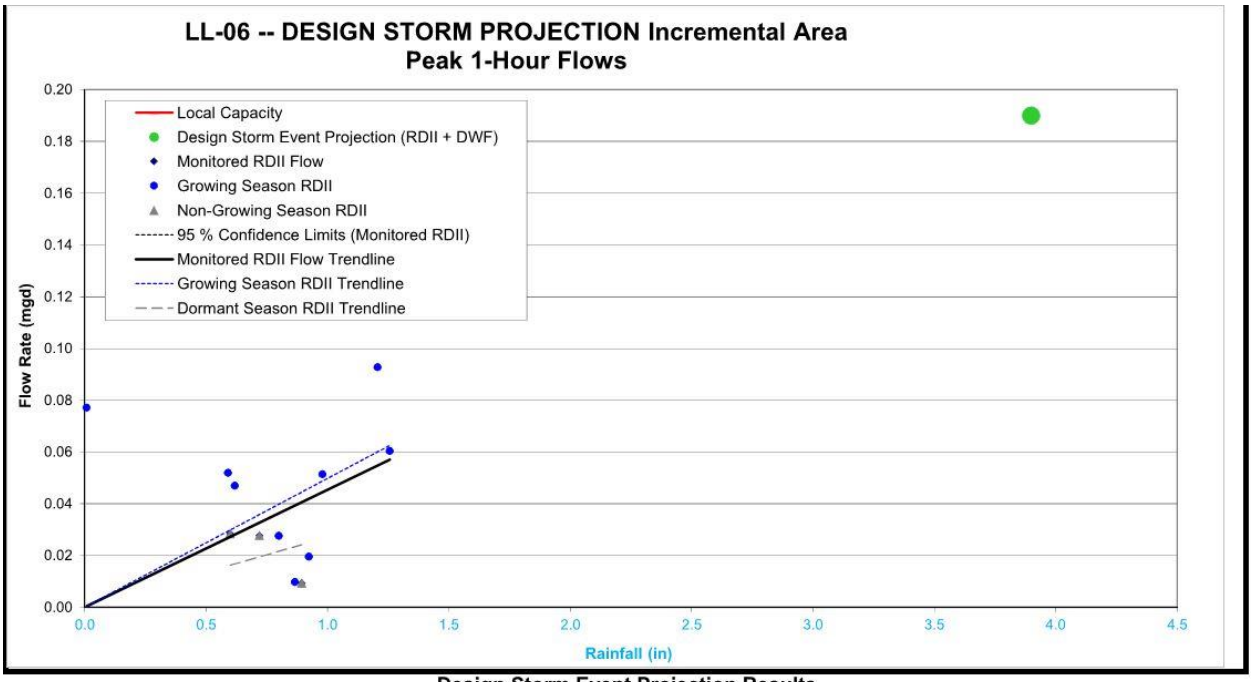
With this information defined, the tool calculates the following information (as well as the variants normalized to population and area): peak hour flow; maximum 24-hour volume; peak hour RDII flow; event RDII volume; maximum 24-hour RDII volume; total event and 24-hour percent captures; average DWF; infiltration rate; total rainfall; peak 24-hour rainfall; average rainfall intensity; total rainfall volume; and peaking factors (wet weather flow volume, WWF, and DWF).

Once all of the major design storms have been analyzed, the calculated event details for each are imported into a design storm estimation tool that uses a best-fit linear projection to estimate wet weather flow for a specified rainfall event (in this case 4.09 inches). The tool estimates: 1) the peak RDII/wet weather flow rate; 2) the 24-hour RDII/wet weather volume; and 3) the total event RDII/wet weather volume. Example output for the peak flow rate projection is presented as Figure C12.

The design storm comparisons for the monitoring areas are presented in Table C2.

Flow Monitoring Data Analysis Results

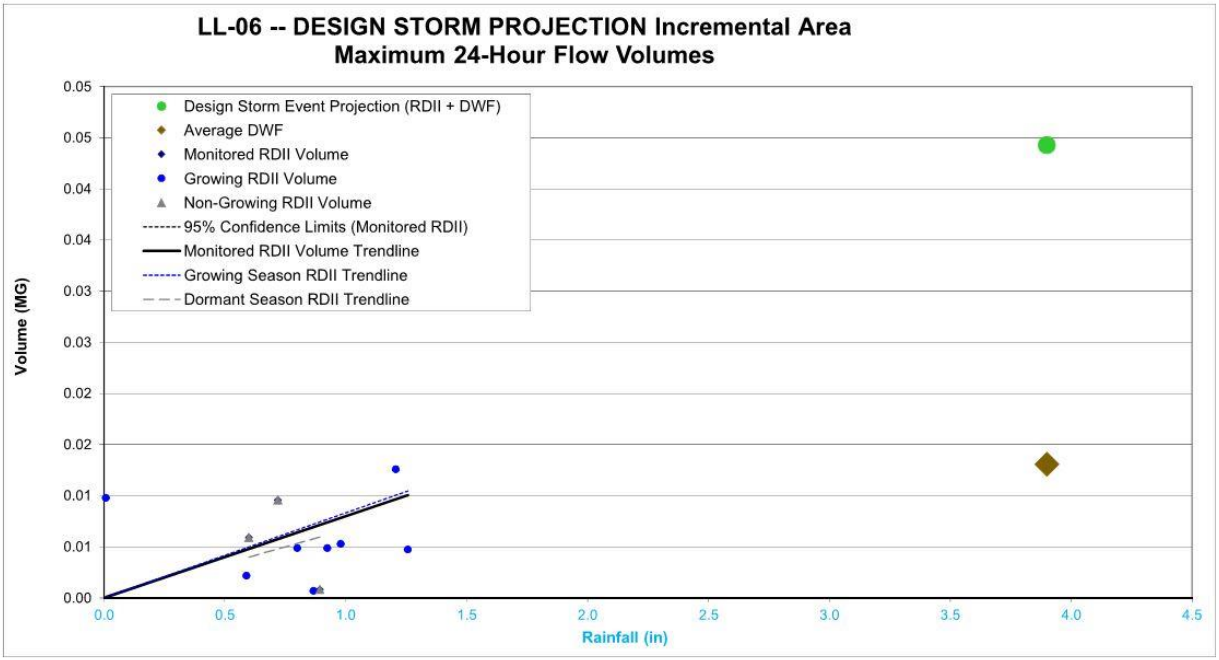
Rainfall Event	Total Rainfall (in)	Rainfall Duration (hr)	Peak Intensity (in/hr)	Average Intensity (in/hr)	Peak Hr. WWF (mgd)	DWF (mgd)	Peak Hr. RDII (mgd)	24-hour RDII Vol. (mg)	Percent Capture (gal/gal)	Peak Factor (mgd/mgd)
4/15/2019	0.60	9.0	0.18	0.07	0.06	0.02	0.03	0.01	2.5%	3.6
4/18/2019	0.72	11.0	0.20	0.07	0.05	0.01	0.03	0.01	4.6%	3.5
4/22/2019	0.89	4.0	0.79	0.22	0.03	0.01	0.01	0.00	0.3%	2.5
5/19/2019	1.21	8.0	1.18	0.15	0.11	0.02	0.09	0.01	2.8%	5.7
6/5/2019	0.92	5.0	0.64	0.18	0.04	0.02	0.02	0.00	1.7%	2.1
6/12/2019	0.01	19.0	0.01	0.00	0.09	0.02	0.08	0.01	252.7%	4.3
6/19/2019	0.62	19.0	0.36	0.03	0.06	0.01	0.05	0.03	22.1%	4.9
7/2/2019	1.26	8.0	0.72	0.16	0.08	0.01	0.06	0.00	1.2%	6.1
7/13/2019	0.87	8.0	0.26	0.11	0.02	0.01	0.01	0.00	0.2%	2.1
8/29/2019	0.59	2.0	0.40	0.29	0.06	0.01	0.05	0.00	0.8%	10.1
9/11/2019	0.98	5.0	0.51	0.20	0.06	0.01	0.05	0.01	1.3%	10.4
9/22/2019	0.80	9.0	0.20	0.09	0.04	0.01	0.03	0.00	1.4%	6.4



Design Storm Event Projection Results

25-yr 24-hr Rainfall (in)	Projected Peak Hour RDII Flow Rate (mgd)	DWF (mgd)	Projected Peak Hour Total Flow Rate (mgd)
3.9	0.18	0.01	0.19

Figure C12. Wet weather flow design storm projection tool (example for LL-06). (continued on next page)



Design Storm Event Projection Results

25-yr 24-hr Rainfall (in)	Projected 24-Hour RDII Volume (mg)	24-hour DWF (mg)	Project 24-hour Total Flow Volume (mg)	24-hour VPF
3.9	0.03	0.01	0.04	3.39

Figure C12. Wet weather flow design storm projection tool (example for LL-06). (continued from previous page)

Final Results

The table below presents the final estimated flows for each monitoring location, decomposed into the various DWF, WWF, and RDII metrics with 25-year, 24-hour design storm projections.

Table C2. RDII and design storm analysis summary table.

Monitor	DWF		Wet Weather Flow (WWF)								
	Q (mgd) | (gpcd)		Peak Q (mgd) | (gpcd)					Q Peak Factor		VPF (24-hour)	
	Dry Weather Flow High GW Season	*Spring DWF - normalized*	Maximum Observed	Design Storm Peak Hour Projection	***Design Storm Peak Hour Projection - normalized***	Design Storm Peak 24-hour Projection	***Design Storm Peak 24-hour Projection - normalized***	Maximum Observed	**Design Storm Projection**	Maximum Observed	**Design Storm Projection**
LL-01	0.037	*89*	0.08	0.10	*301*	0.10	***247***	2.1	3.6	1.9	1.8
LL-02	0.020	*39*	0.06	0.10	*204*	0.09	***171***	3.0	5.2	3.1	2.3
LL-03	0.014	*47*	0.05	0.08	*281*	0.07	***247***	3.1	3.4	2.8	1.8
LL-04	0.043	*1,195*	0.59	0.69	*19,310*	0.57	***15,945***	8.1	7.7	6.0	3.4
LL-05	0.115	*62*	0.33	0.59	*323*	0.35	***191***	8.3	7.2	4.5	2.9
LL-06	0.015	*154*	0.11	0.19	*1,895*	0.07	***733***	10.4	14.5	6.2	3.4
LL-07	0.005	*13*	0.02	0.03	*89*	0.03	***77***	6.0	4.7	4.0	2.2
LL-08	0.004	*21*	0.02	0.03	*150*	0.02	***100***	4.2	5.2	2.8	1.8
LL-09	0.009	*38*	0.03	0.04	*192*	0.04	***182***	4.3	4.0	3.1	1.8
LL-10	0.042	*31*	0.13	0.24	*177*	0.11	***82***	5.3	7.4	1.9	1.8
LL-11	0.028	*100*	0.17	0.27	*953*	0.16	***574***	4.2	5.8	3.4	2.9
LL-13	0.003	*29*	0.03	0.06	*568*	0.04	***341***	8.8	15.9	5.2	6.5
LL-14	0.029	*51*	0.13	0.17	*232*	0.14	***192***	3.4	4.4	2.9	1.9
LL-15	0.020	*26*	0.11	0.15	*271*	0.09	***168***	5.7	6.1	4.4	2.8
LL-16	0.016	*31*	0.06	0.12	*234*	0.09	***176***	2.7	5.7	2.4	2.4

Monitor	Rainfall Dependent Inflow and Infiltration (RDII)										
	Peak Q (mgd)		RDII Volume (MG) <or> (1000 gal/acre) ↓						% Capture (MG/MG)		
	Maximum Observed	**Design Storm Projection**	Greatest 24-hour V: Maximum Observed	Greatest 24-hour V: Design Storm Proj.	Average Vol. Ratio: 24-hour to Total	Maximum Observed Total Event Volume	Design Storm Projection: Total Event Volume	***Design Storm Projection - normalized***	Maximum Observed	Weighted Average: Observed Capture %	**Design Storm Projection**
LL-01	0.05	**0.07**	0.02	0.05	76%	0.03	0.07	*0.6*	1.1%	0.3%	**0.5%**
LL-02	0.04	**0.08**	0.02	0.05	68%	0.04	0.07	*1.0*	1.2%	0.3%	**0.6%**
LL-03	0.02	**0.08**	0.01	0.04	73%	0.02	0.06	*1.8*	2.1%	0.8%	**1.6%**
LL-04	0.47	**0.60**	0.17	0.31	58%	0.36	0.53	*45.0*	1010.3%	37.4%	**42.5%**
LL-05	0.31	**0.51**	0.10	0.24	83%	0.15	0.29	*0.9*	2.9%	0.6%	**0.6%**
LL-06	0.09	**0.18**	0.03	0.04	76%	0.07	0.06	*4.2*	252.7%	3.2%	**3.0%**
LL-07	0.02	**0.02**	0.01	0.01	65%	0.01	0.02	*0.8*	1.2%	0.4%	**0.7%**
LL-08	0.01	**0.02**	0.00	0.01	66%	0.01	0.02	*0.5*	0.7%	0.2%	**0.4%**
LL-09	0.02	**0.03**	0.01	0.02	62%	0.01	0.03	*0.9*	1.0%	0.4%	**0.9%**
LL-10	0.09	**0.21**	0.01	0.06	83%	0.02	0.07	*0.8*	0.6%	5.0%	**0.7%**
LL-11	0.13	**0.22**	0.04	0.13	59%	0.10	0.23	*7.7*	12.5%	1.0%	**6.6%**
LL-13	0.02	**0.06**	0.01	0.03	74%	0.01	0.03	*0.7*	0.1%	0.4%	**0.6%**
LL-14	0.04	**0.12**	0.01	0.07	78%	0.02	0.08	*1.3*	2.1%	1.0%	**1.0%**
LL-15	0.10	**0.15**	0.04	0.08	71%	0.07	0.12	*1.6*	3.4%	0.8%	**1.0%**
LL-16	0.04	**0.10**	0.01	0.05	69%	0.02	0.07	*1.0*	1.9%	5.0%	**0.8%**

APPENDIX E
PUBLIC PARTICIPATION DOCUMENTS

PREPARED FOR:

Portland Michigan
CITY OF TWO RIVERS

FLEIS&VANDENBRINK
DESIGN. BUILD. OPERATE.

Project No.: 848390

NOTICE OF PROJECT PLAN PUBLIC HEARING

The City of Portland will hold a public hearing on the proposed Wastewater Treatment Plant (WWTP) and Collection System Improvements project for the purpose of receiving comments from interested persons.

The City is pursuing subsidized financing through the Clean Water State Revolving Fund (CWSRF) to make necessary improvements to the wastewater collection system and WWTP. The improvements will focus on reducing inflow and infiltration and address identified deficiencies to ensure continued reliability and meet future planning needs. The City is also pursuing low-interest financing through the CWSRF program over a 30-year period and a principal forgiveness subsidy for qualifying Green Project components.

The hearing will be held at 7:00 p.m. on May 17, 2021 at the following location: City Council Chambers at City Hall, 259 Kent St, Portland, MI 48875.

Recommended improvements include the following:

- Various collection system repairs
- Lift station improvements
- Secondary treatment improvements
- Biosolids handling improvements and additional biosolids storage
- Building improvements
- Pump system replacement

Expected impacts of the proposed project include improved treatment efficiency and increased reliability of the wastewater treatment plant and reduction of inflow and infiltration in the collection system. Short-term construction related impacts include noise and dust during construction, as well as minor traffic disturbances.

The average cost to users to finance the proposed project entirely through the CWSRF Program is estimated at $15.00 to $19.50 per month per Residential Equivalent Unit (REU). Actual monthly costs will vary depending on financing terms, grant eligibility, individual usage, and community rate structures.

Copies of the plan detailing the proposed project will be available for review on April 17, 2021 at the following location(s):

- Portland City Hall 259 Kent St, Portland, MI 48875
- Online at the City of Portland website: https://www.portland-michigan.org/

Written comments received before the hearing record is closed on May 17, 2021, will receive responses in the final project plan. Written comments should be sent to:

City of Portland
Attn: Nikki Miller, City Clerk
259 Kent St
Portland, MI 48875
cityclerk@portland-michigan.org

APPENDIX F
SEWER TELEVISING REPORTS

PREPARED FOR:

Portland
CITY OF TWO RIVERS Michigan

FLEIS&VANDENBRINK
DESIGN. BUILD. OPERATE.

Project No.: 848390

ASSET MANAGEMENT PLAN

Pipeline Televising

Prepared for:

City of Portland

FINAL

March 2021

FLEIS&VANDENBRINK
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TABLE OF CONTENTS

Supplemental Attachments

BACKGROUND

Closed circuit television inspection (CCTV) is a process used to inspect storm and sanitary sewer pipe. CCTV inspections allow for visual inspection of pipes where the diameters are not large enough to allow for safe access. CCTV inspection is used to locate structural and operational (O&M) defects, evidence of Inflow & Infiltration (I&I), service laterals, obstructions such as roots, grease, debris, cross-bores, and identify pipe size and material.

The CCTV process involves placing a pan and tilt video camera into a sewer pipe at the manhole connection. The camera sits on a robotic vehicle referred to as a crawler. An operator is able to control the camera and crawler from a control center typically located inside the CCTV truck. As the camera moves through the pipe it records the distance traveled and sends back a video feed to the operator. The operator is able to record the video feed and produce a televising inspection for review.

As the operator controls the camera, they will also record each defect encountered in the pipe. Each defect is coded using the National Association of Sewer Service Companies (NASSCO) pipe assessment certification program. The NASSCO PACP identification and assessment is the industry standard used to provide consistent identification and assessment data.

METHOD

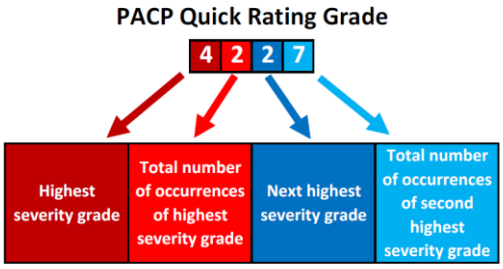
Fleis & VandenBrink (F&V) subcontracted with Monchilov Excavating to perform the CCTV inspection field work. Once the video field work was completed, the information was forwarded to F&V. F&V performed a review of the information looking for major issues, areas of grease concentration and locations of possible I&I.

Each defect encountered during the televising is categorized as structural or O&M. Structural defects are where the pipe has been physically damaged or otherwise defective. O&M defects describe various types of foreign objects located in the pipe interfering with the operation of the system, thus reducing reliable service to customers. I&I and grease defects are categorized under O&M as they are more of an operational concern than structural.

Structural defects were categorized into one of eleven categories and assigned a score of 5 to 1 as determined by PACP assessment guidelines. A structural defect of 5 is the most severe. A level of 5 indicates the pipe has failed or will fail soon and immediate attention is required. A score of 4 indicates the pipe is in poor shape and will become a 5 in the future. A score of 3 is fair and 2 is good. A score of 1 or 0 indicates the pipe is in excellent condition.

O&M defects were categorized into one of 9 obstruction concerns or evidence of I&I and assigned a level of 5 to 1. An O&M score of 5 indicates a severe obstruction which has or will completely stop the flow and cause a backup. A score of 4 indicates a significant obstruction which will soon become a 5. A score of 3 indicates a cause for concern but has yet to create an issue. A score of 2 or 1 is worth noting but is not of any great concern.

All the defects are combined into a quick rating grade for the pipe. Quick rating grades provide an overall summary of the pipe grade.



I&I defects are coded as infiltration or encrustations and rated 5 to 1 as determined by PACP. Infiltration is coded when ground water is seen entering the pipe. Encrustations are coded when mineral deposits are seen on the videos.

Grease defects are coded and assigned a score of 5 to 1 based on the percent of pipe area the grease occupies.

The CCTV pipe inspection data is analyzed by Innovyze Infomaster; a complete ArcGIS based asset integrity management and capital planning software. Infomaster uses a tree matrix of the available information reviewing the likelihood of failure and consequence of failure to calculate the total risk.

Infomaster is able to use the CCTV quick rating grades to create a GIS based map and assign a level to each pipe based on the most extreme grade rating encountered.

Once Infomaster calculates the total risk, each pipe is analyzed for the best rehabilitation or repair option and several budget scenarios are calculated. Each budget scenario is reviewed and a prioritized Capital Improvement Plan report is generated.

RESULTS

Sanitary Sewer System

198 sections of pipe were inspected totaling 37,988.7 feet. A summary of the information is shown in Table 1.

Table 1. Summary of the Sanitary Sewer Defects

Score	Number of O/M defects	Number of Structural Defects
5	28	226
4	155	298
3	188	335
2	297	287
1	757	18

1. Pipe A34 – A37 located on Lincoln St. This pipe is broken 4 feet from MH A34.
2. Pipe C48 – C8 located on Grant St. This pipe has holes at 33.3 feet and 86.3 feet from C48.
3. Pipe C50 – C49 located on Grant St. This pipe has two taps intruding at 125.6 feet and 185.4 feet from C50.

Infiltration & Inflow

49 noted cases of direct infiltration were noted in the CCTV videos. 6 were assigned a level of 5, 23 were assigned a level of 4, 13 were assigned a level of 3, 7 were assigned a score of 2, and 0 were assigned a level of 1. I&I locations are shown in D-5.

Grease

There are 3 noted cases of grease in the pipes. In each case the defect was observed to be less than 10% of the pipe capacity and was assigned a score of 2. Grease locations are shown in D-7.

City of Portland Sanitary Sewer Network

- Structures
- Lift Station

Structural Defects

- No Structual Defects
- Level 1 Structural Defects
- Level 2 Structural Defects
- Level 3 Structural Defects
- Level 4 Structural Defects
- Level 5 Structural Defects
- No CCTV

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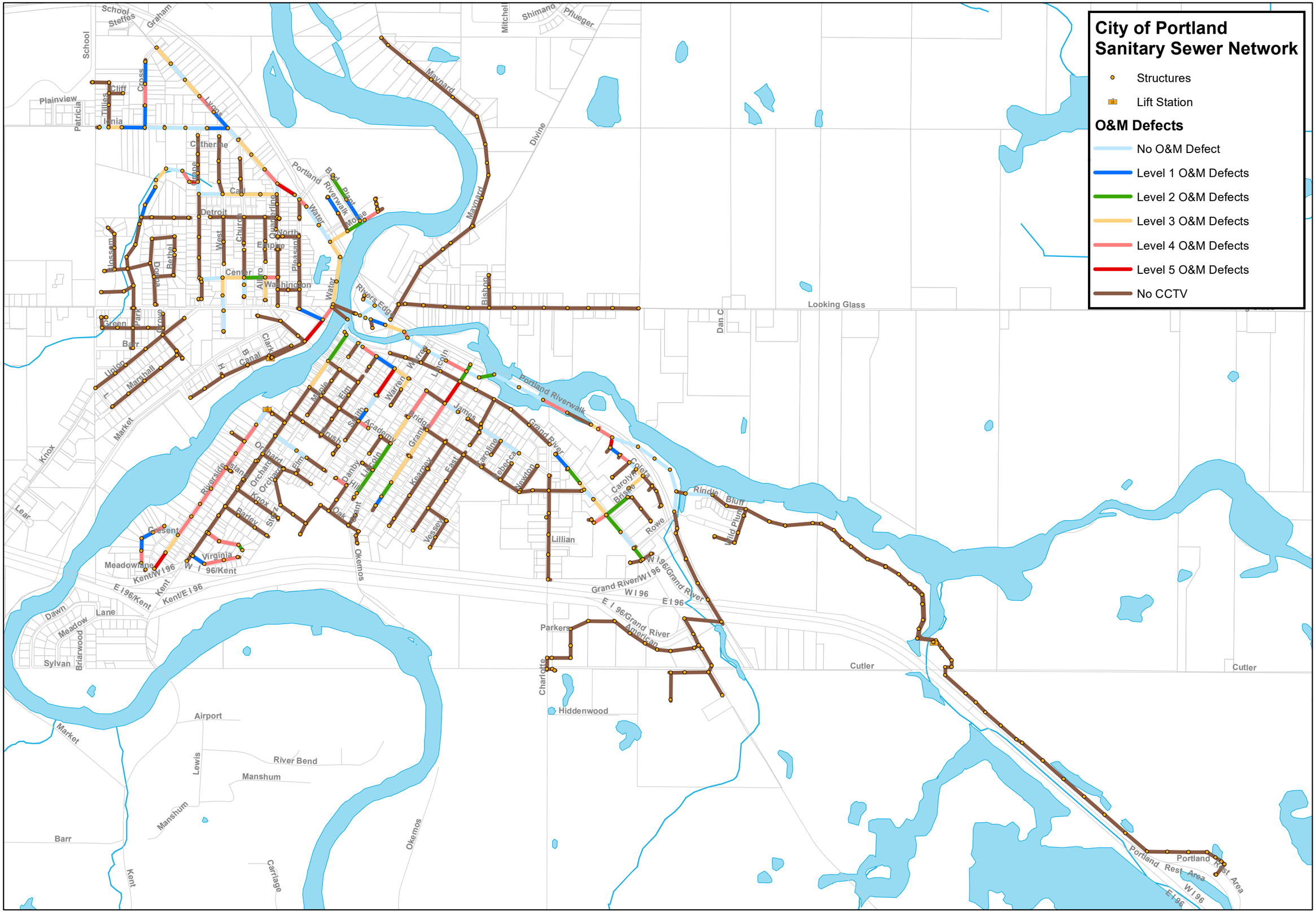
Sanitary Sewer AMP
CCTV Structural Defects

City of Portland

DRAWN BY	DATE
ESP	1/15/2021
PROJECT NO.	SCALE
816480	1:15,000
FILE LOCATION	
SOURCES	

NORTH
0 625 1,250
SCALE IN FEET

FIGURE
D-1



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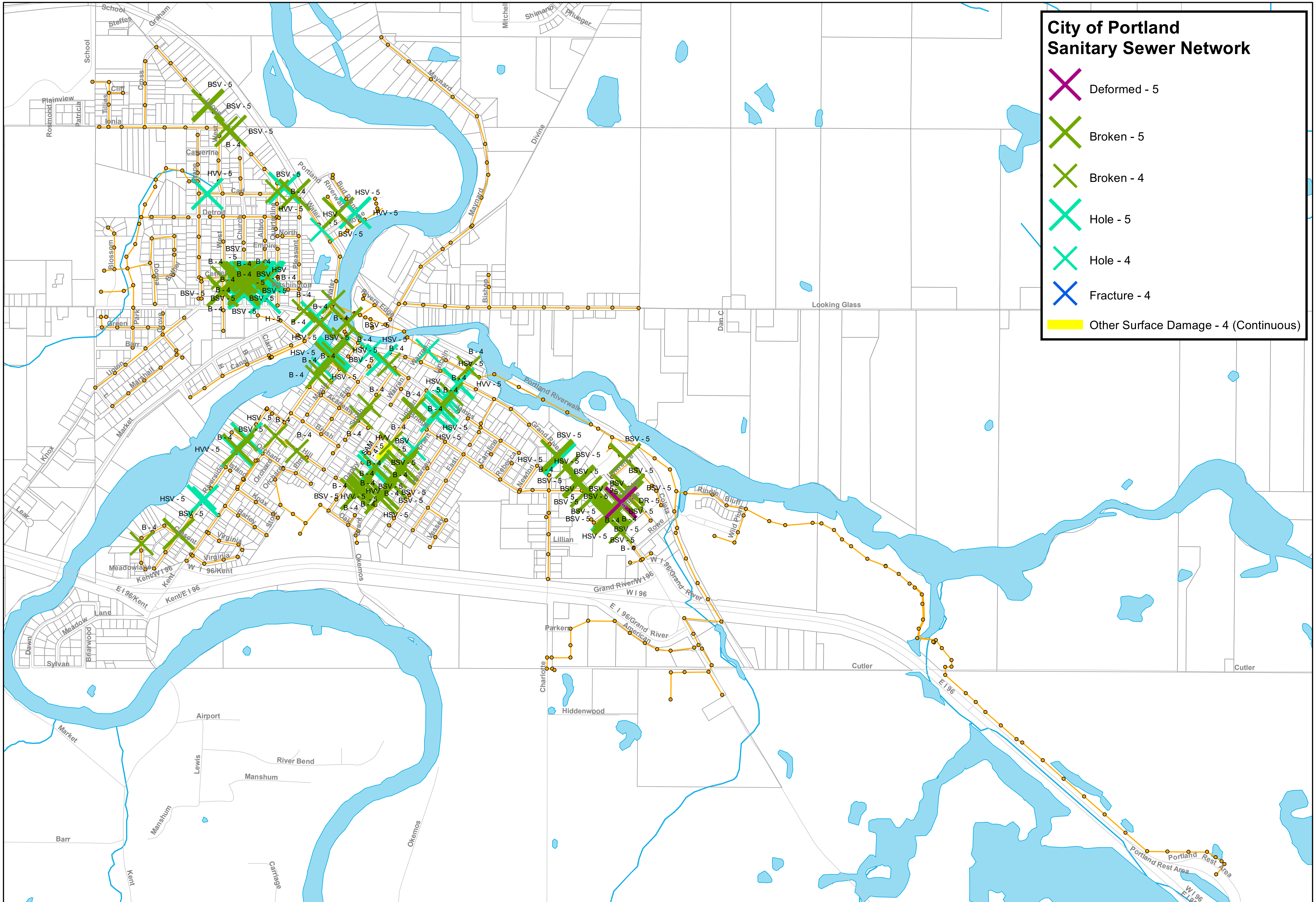
Sanitary Sewer AMP CCTV O&M Defects

City of Portland

DRAWN BY	DATE
ESP	1/15/2021
PROJECT NO.	SCALE
816840	1:15,000
FILE LOCATION	
SOURCES	

NORTH
0 625 1,250
SCALE IN FEET

FIGURE
D-2



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Sanitary Collection System
Major Structural Defects

City of Portland

DRAWN BY	DATE
ESP	1/5/2021
PROJECT NO.	SCALE
816480	1:15,000
FILE LOCATION	
SOURCES	

NORTH
0 625 1,250
SCALE IN FEET

FIGURE
D-3

City of Portland
Sanitary Sewer Network

FLEIS&VANDENBRINK
DESIGN. BUILD. OPERATE.

Sanitary Collection System
Sags (Structural)

City of Portland

DRAWN BY	DATE
ESP	1/5/2021
PROJECT NO.	SCALE
816480	1:15,000
FILE LOCATION	
SOURCES	

NORTH
0 625 1,250
SCALE IN FEET

FIGURE
D-4

City of Portland
Sanitary Sewer Network

- Infiltration Gusher - 5
- Infiltration Runner - 4
- Infiltration Dripper - 3
- Infiltration Weeper - 2
- Infiltration Stains - 0
- Encrustation Deposits - 3
- Encrustation Deposits - 2
- Encrustation Deposits - 2 (Continuous)

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Sanitary Collection System
Infiltration and Inflow

City of Portland

DRAWN BY	DATE
ESP	1/4/2021
PROJECT NO.	SCALE
816480	1:15,000
FILE LOCATION	
SOURCES	

NORTH
0 625 1,250
SCALE IN FEET

FIGURE
D-5

City of Portland Sanitary Sewer Network

- Root Ball - 5
- Root Ball - 4
- Medium Roots - 4 (Continuous)
- Medium Roots - 3
- Medium Roots - 3 (Continuous)
- Tap Roots - 3
- Tap Roots - 2
- Fine Roots - 2
- Fine Roots - 1
- Fine Roots - 1 (Continuous)

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Sanitary Collection System Roots

City of Portland

DRAWN BY	DATE
ESP	1/4/2021
PROJECT NO.	SCALE
816480	1:15,000
FILE LOCATION	
SOURCES	

NORTH
0 625 1,250
SCALE IN FEET

FIGURE
D-6

FLEIS&VANDENBRINK
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Sanitary Collection System Grease Deposits

City of Portland

DRAWN BY	DATE
ESP	1/4/2021
PROJECT NO.	SCALE
816480	1:15,000
FILE LOCATION	
SOURCES	

NORTH

0 625 1,250

SCALE IN FEET

FIGURE

D-7

City of Portland
Sanitary Sewer Network

- Obstruction Rocks - 5
- Obstruction Brick - 4
- Obstruction Rocks - 4
- Obstruction Brick - 3
- Obstruction Brick - 3 (Continuous)
- Object Wedged in Joint - 3
- Obstruction Rocks - 3
- Obstruction Brick - 2
- Obstruction Pipe Material - 2
- Object Wedged in Joint - 2
- Obstruction Construction Debris - 2
- Obstruction Rocks - 2
- Deposits Gravel - 3

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Sanitary Collection System Obstructions and Deposits

City of Portland

DRAWN BY	DATE
ESP	1/4/2021
PROJECT NO.	SCALE
816480	1:15,000
FILE LOCATION	
SOURCES	

NORTH
0 625 1,250
SCALE IN FEET

FIGURE
D-8

City of Portland

Attachment B: Photo Log of Typical Major Defects

Project #: 816480

Photo Log

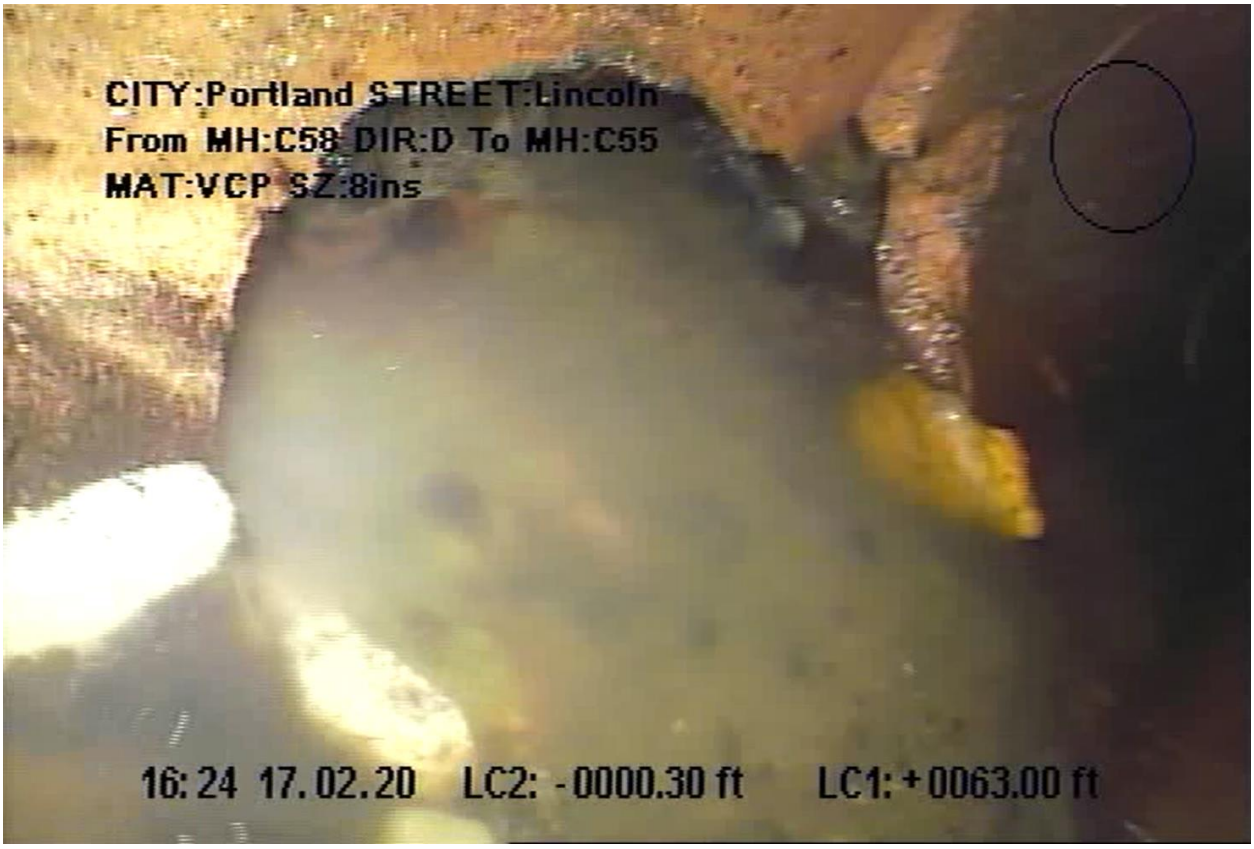

Photo 1: Shows a typical hole in the pipe with loss of surrounding soil. Loss of soil into pipes is the leading cause of sinkholes in the road. Typically, a hole can be repaired with a point repair patch and inserting grout into the void. This picture is pipe C58 – C55, 63 feet downstream of MH C58, from the 4:00 position to the 7:00 position (in reference to the pipe 360° around).

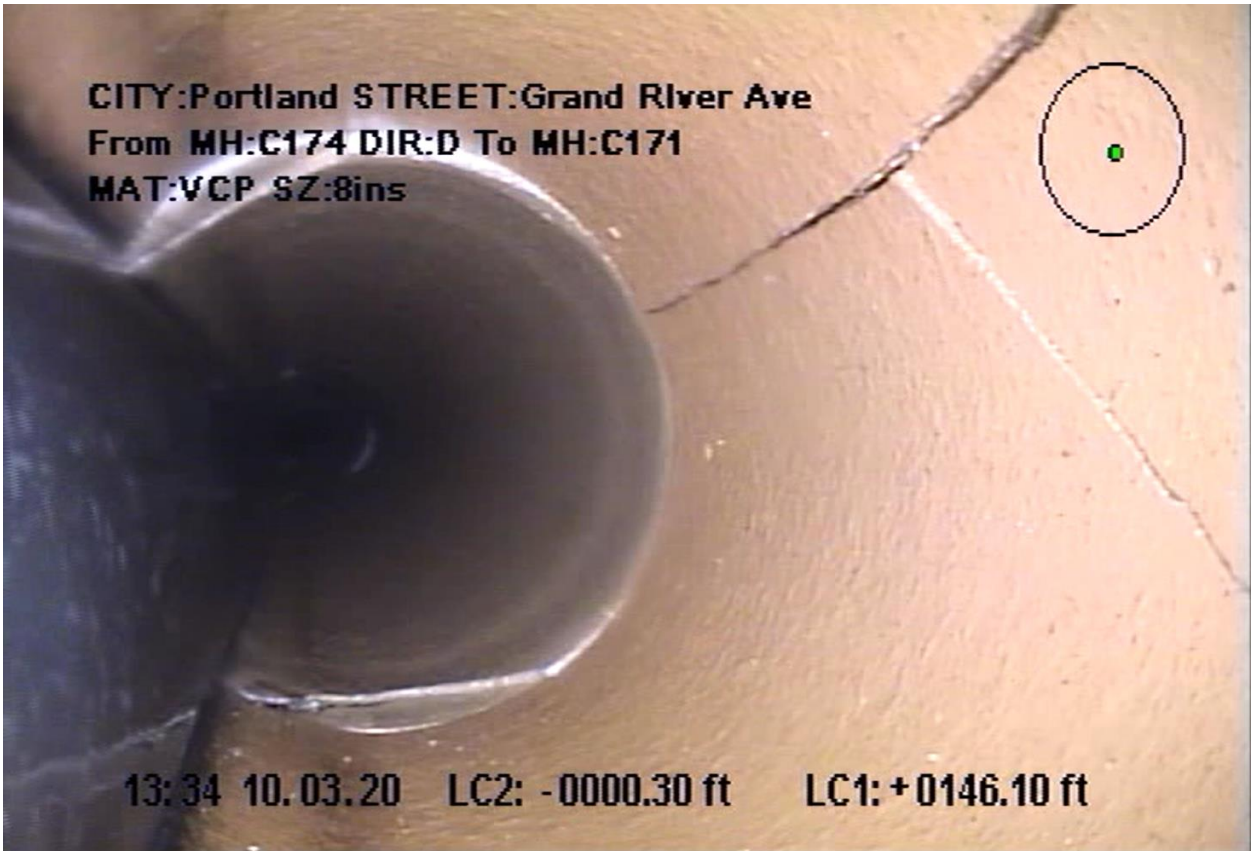

Photo 2: Shows a typical fracture in the pipe. Fractures reduce the integrity of the pipe and lead to deformations and collapses. When discovered early, fractures can be rehabilitated using point repair patches. This picture is pipe C174 – C171, 146.1 feet downstream of MH C174.

Photo 3: Shows a typical break in the pipe. Breaks can reduce the integrity of the pipe and lead to holes. Breaks can be repaired with a point repair patch. This picture is pipe C174 – C171, 148.2 feet downstream of MH C174.

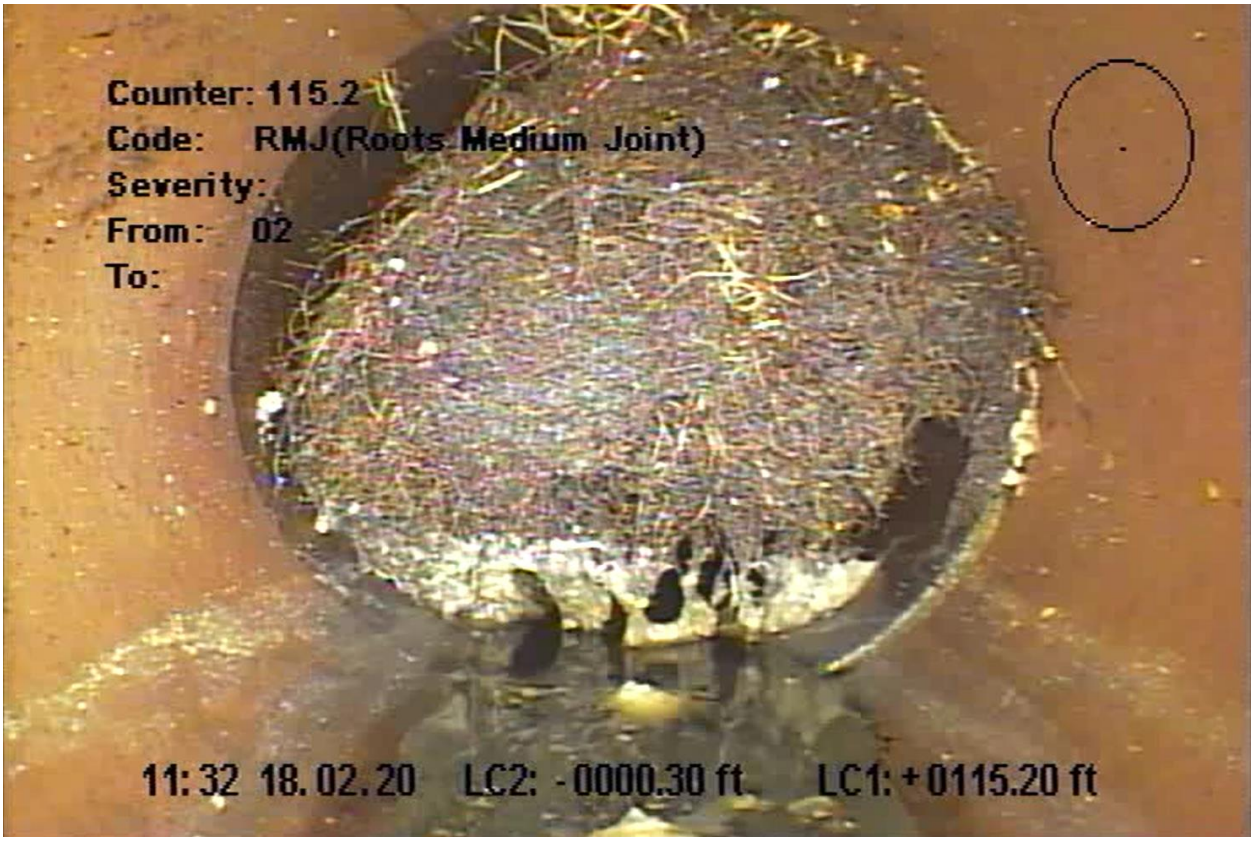

Photo 4: Shows a typical root intrusion at a joint. Roots will catch debris and eventually cause a backup. Roots can be cut from the main but they will need to be treated every year or they will grow back. A cured in place pipe will prevent roots from intruding in the pipe. This picture is pipe C66 – C65, 115.2 feet from MH C66.

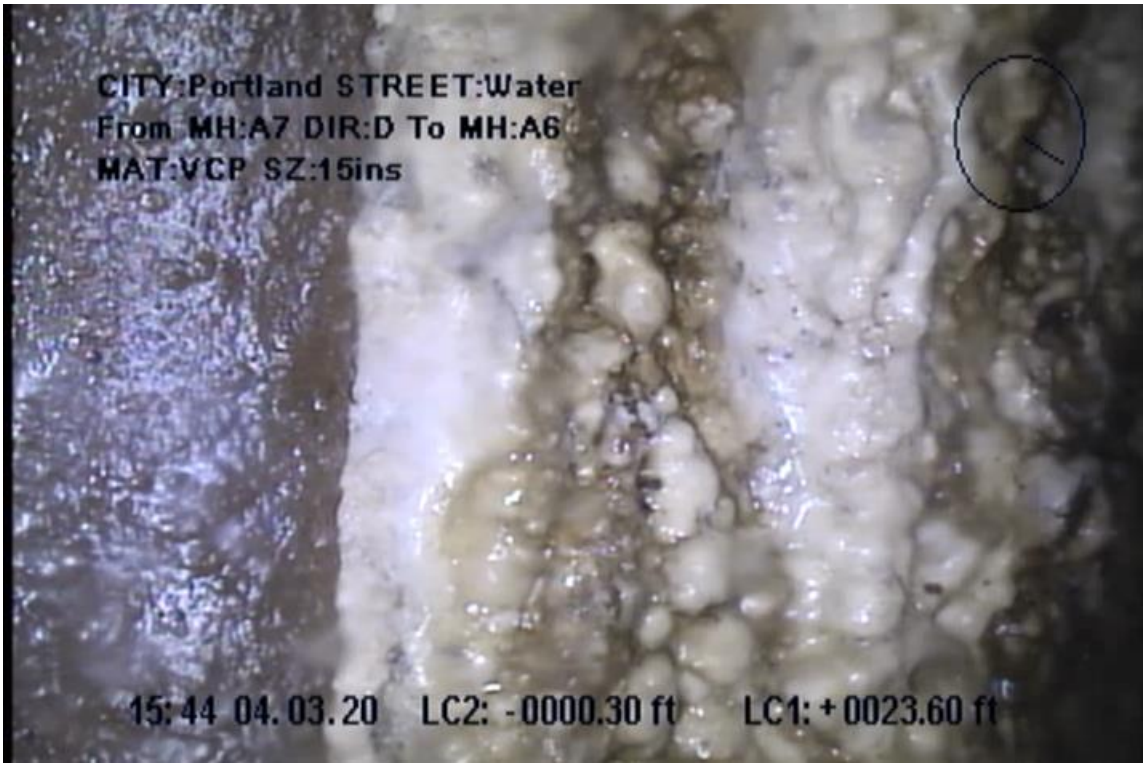

Photo 5: Shows a typical encrustation at a pipe joint. Encrustations are typically mineral deposits left behind from ground water flowing into pipe. Ground water is clean water that enters the system and is treated by the plant. Ground water will reduce the capacity of the system and treatment plant and generates no revenue requiring system uses to pay the cost of treatment. Ground water infiltration can quickly be reduced by injecting the joints with ground to seal off the leaks. The picture is pipe A7 – A6, 23.6 feet from A7.

Photo 6: Shows a typical offset joint. Offset joints can catch debris leading to blockages. The best repair of offset joints is to excavate and replace the pipe sections. This picture is pipe C51A – C51, 4.3 feet from MH C51.

Photo 7: Shows hydrogen sulfide damage in the pipe. Hydrogen Sulfide is created when the oxygen in the wastewater is low or absent. When the hydrogen sulfide gas is released it into the air it is converted to sulfuric acid by bacteria. The sulfuric acid will begin to dissolve the concrete reducing the structural integrity of the pipe. Depending on the damages, the sewer pipe can be lined with a cured in place pipe of will need to be replaced. This picture is pipe C58 – C55, 167 feet from MH C58.

City of Portland
Sanitary Sewer: CCTV Data Results

									Structural 5			O&M 5				Structural 4				O&M 4						Structural 3					O&M 3						Structural 2						O&M 2							Structural 1		O&M 1			Other Features						
Inspection ID	Pipe ID	Upstream MH	Downstream MH	Address	Diameter	Material	Surveyed Length	Survey Abandoned	Broken	Hole	Fracture	Roots	Infiltration	Intruding Tap >30%	Obstacle >30%	Broken	Hole	Fracture	H2S Damage	Camera Underwater	Roots	Infiltration	Intruding Tap 20% <	Obstacle 20% < 30%	Alignment Shift >20%	Fracture	Crack	H2S Damage	Defectective Tap	Sag >30%<=50%	Roots	Infiltration	Encrustation 10% < 20%	Deposits 10% < 20%	Intruding Tap 10% <	Obstacle 10% < 20%	Fracture	Crack	H2S Damage	Sag >30%	Defective Joint	Defective Tap	Roots	Infiltration	Encrustation < 10%	Grease < 10%	Intruding Tap <10%	Alignment Shift 10% <	Obstacle <10%	Crack	Defective Joint	Roots	Infiltration	Alignment Shift <10%	Manhole	End of Pipe	Material Change	Size Change	Tap	Tap Capped	Water Mark
1	C58 - C55_D	C58	C55	Lincoln	8	VCP	293.4	1		1				1		1			2																			2							1				1			1			1		2				1
2	C58 - C55_U	C58	C55	Lincoln	8	VCP	171.4	1						1					2																																	2			1						1
3	C55 - C54_D	C55	C54	Lincoln	8	VCP	462									1							2						1		1							1				3							1		1	1			2		2				2
4	C54 - C53_D	C54	C53	Lincoln	8	VCP	469							1		2				1			1			1												1							5				1						2						2
5	C60A - C60_U	C60A	C60	Lincoln	8	VCP	65		1																																1													2		1				1
6	Unknown 146 - C58_D	Unknown 146	C58	Linclon	8	VCP	17.3	1		1																																								1				1						3
7	C67A - C67_U	C67A	C67	Smith	8	VCP	215.9	1						1							1		1			2	1												1			7							1						1						1
8	C67 - C66_D	C67	C66	Smith	8	VCP	198									1										3												3														8			2						1
9	C66 - C65_D	C66	C65	Smith	8	VCP	126.7	2				2		1		1										1					2														1							2			2						4
10	C66 - C65_U	C66	C65	Smith	8	VCP	133.1	1				1																			2											2										11			3		1				2
11	C65 - C64_D	C65	C64	Smith	8	VCP	235.5	1						1									1			6					4							6				2										16			1		3				1
12	C65 - C64_U	C65	C64	Smith	8	VCP	203	1				1		1																	1											2			1							10			1						1
13	C67A - C67_D	C67A	C67	Smith	8	VCP	0	1													1										1												1									2			1						1
14	C52 - C51A_D	C52	C51A	Grant	6	VCP	52.7	1																																												3			1						1
15	C52 - C51A_U	C52	C51A	Grant	6	VCP	46.3	1	1					1												1																													1						1
16	C51A - C51_D	C51A	C51	Grant	8	PVC	45.9	1	1	2			1																										1							1					1					1		2				1
17	C51A - C51_U	C51A	C51	Grant	8	PVC	8.4	1	1																																1										1				1		2	1			1
18	C51 - C50_D	C51	C50	Grant	8	PVC	469		2					1		2							5			2			1		1							2							1							1			2		3				1
19	C50 - C49_D	C50	C49	Grant	8	VCP	186.7	1						3			1																					1														1			1						1
20	C50 - C49_U	C50	C49	Grant	8	VCP	111.1	1						1									2								4							1														4			1						1
21	C49 - C48_D	C49	C48	Grant	8	VCP	115.7	1						1									1			2												1														9			1						1
22	C49 - C48_U	C49	C48	Grant	8	VCP	236.7	1		3				2		1				2						1											1															1			1		1				5
23	C100 - C99_D	C100	C99	Hill	8	VCP	186													1																					1														2						3
24	C85 - C84_U	C85	C84	Hill	6	VCP	12.9	1								1										1											1		1																1						1
25	C84 - C83_D	C84	C83	Hill	6	VCP	5.4	1																		3												2																	1						1
26	C84 - C83_U	C84	C83	Hill	6	VCP	3.1	1								1																																							1						1
27	C64 - C68_D	C64	C68	James	12	VCP	100.3	1						1												1												1													1	4			1		2				1
28	C61 - C64_U	C61	C64	James	12	VCP	245																1			1	1				2				2																	1			2						1
29	C62 - C61_U	C62	C61	James	12	VCP	198.1	1															1			3					1																			1		5			1						1
30	C60 - C58_D	C60	C58	James	8	VCP	322							1		7	1																					3	2			1							4	1	3				2		5				1
31	C47 - C48_U	C47	C48	James	8	PVC	222.5																																																2						1
32	C48 - C8_D	C48	C8	Grant	8	PVC	347.1	1		2			1	1		1	2					1				2											1					1								1	1				1		7			2	1
33	C48 - C8_U	C48	C8	Grant	8	PVC	13																																																1	1					1
34	C155 - C8_U	C155	C8	Grant	10	PVC	170																1															1											1						2		1				1
35	C18 - C17_D	C18	C17	James	8	PVC	318																																																2						1
36	C17 - C14_D	C17	C14	James	8	PVC	345.5																																																2						1
37	A32 - A34_D	A32	A34	Center	6	PVC	85.9	1																		3												4			1														1		1				1
38	A32 - A34_U	A32	A34	Center	6	PVC	7.5	1																																	1														1						1
39	A35 - A34_U	A35	A34	West	8	VCP	262		1							1										5										1	1	1	1						1							6			2						2
40	A35A - A35_U	A35A	A35	West	8	PVC	223.1																																																2						1
41	A35B - A35A_D	A35B	A35A	West	8	PVC	300																																																2						1
42	A34 - A37_D	A34	A37	Center	6	VCP	11	1								1																						1																	1						1
43	A39 - A38_U	A39	A38	Church	8	VCP	7.7	1		3				1												1																									1				1						1
44	A38 - A37_D	A38	A37	Church	8	VCP	102.1			1						1							1			1												2													1				2						3
45	A34 - A37_U	A34	A37	Center	6	VCP	160	1	6	2						1										1											1	1	1			2							2			1			1						2
46	A37 - A40_D	A37	A40	Center	8	VCP	303		1	17				1		7	21									2												4	2										2		1	1			2						1
47	A40 - A21_D	A40	A21	Center	8	VCP	183			5						1	5								1	1												1			1											9			2						1
48	A41 - A40_D	A41	A40	Albro	6	VCP	105	1		1																																1										1			1						3
49	A39 - A38_D	A39	A38	Church	8	VCP	161.5	1	2	12				4		2	4									4											1																		1						2
50	C133 - C134_U	C133	C134	Cresent DR	8	VCP	110																																																2		2				2
51	C134 - C135_D	C134	C135	Cresent	8	VCP	175														2																					4										4			2						1
52	C135 - C136_D	C135	C136	Cresent	8	VCP	185									1																																				10			2						4
53	C136 - C137_D	C136	C137	Cresent	8	VCP	183																																													1			2		2				3
54	C137 - C138_D	C137	C138	Cresent	8	PVC	191														1					1																1										8			2		2				2
55	C138 - C141_U	C138	C141	Riverside Dr	8	VCP	233																																																2						3
56	C140 - C141_U	C140	C141	RiverSide DR	8	VCP	308																																			1										9			2		4				2
57	C139 - C140_U	C139	C140	Riverside Dr	8	VCP	181.3	1				1									1										2											1									1	5			1						1
58	C141 - C142_D	C141	C142	Riverside	8	VCP	332.5		1		1										2																2					2										16			2		2				3
59	C142 - C143_D	C142	C143	RiverSide Dr	8	VCP	223													1	2										3																					2			2						4
60	C143 - C144_U	C143	C144	Riverside Dr	8	VCP	272			1				1			2				1																					1										9			2						2
61	C144 - C145_D	C144	C145	Reiverside Dr	8	VCP	73.8	1						1							1					1																										10			1						1
62	C144 - C145_U	C144	C145	Reiverside Dr	8	VCP	181.6	1																							4					1			1			1							1			5			1					2	1
63	C139 - C140_D	C139	C140	Riverside Dr	8	VCP	105.8	1													2										2																					7			1						1
64	C145A - C146_U	C145A	C146	Riverside DR	6	VCP	167.7	1	1					2												3													2		1										1	6			1						2
65	C145 - C145A_D	C145	C145A	Riverside Dr	6	VCP	112.9	1																		1												4	1			2										7			1						1
66	C145 - C145A_U	C145	C145A	Riverside Dr	6	VCP	48.7	1						1							1																															4			1						2
67	C145A - C146_D	C145A	C146	Riverside Dr	6	VCP	42.1	1		1											1					3																1									1	1			1						1
68	C146 - C148_D	C146	C148	Riverside Dr	6	VCP	56	1		1				1		1					1																	2	1																1						1
69	C146 - C148_U	C146	C148	Riverside Dr	6	VCP	54.2	1																																											1				1						1
70	C148 - C149_D	C148	C149	Riverside Dr	6	VCP	8	1																																											1				1						1
71	C150 - C149_D	C150	C149	Riverside Dr	6	VCP	32.9	1													1										1											1						1				3			1						1
72	C121 - C122_D	C121	C122	Virginia Ave	6	VCP	207														4										2											2			2							2			2						1
73	C122 - C123_D	C122	C123	Virginia Ave	8	VCP	289														6										1							1				5										5			2						1
74	C123 - C125_D	C123	C125	Virginia Ave	8	VCP	395.5																																													10			2					1	3
75	C121A - C120_D	C121A	C120	Virginia Ave	8	VCP	94																			1																			1							3			2						1
76	C120 - C118_U	C120	C118	Virginia Ave	8	VCP	285														1																					1		1								5			2						1
77	C118 - C124_D	C118	C124	Virginia Ave	8	VCP	187.4													1																					1														2		1				2
78	A113 - A112_U	A113	A112	Cross	8	VCP	320																																													1			2		2				5
79	A112 - A111_D	A112	A111	Cross	8	VCP	315														1										2											1										1			2		2				1
80	A111 - A110_D	A111	A110	Cross	8	VCP	319																																													1			2						1

City of Portland
Sanitary Sewer: CCTV Data Results

Inspection ID	Pipe ID	Upstream MH	Downstream MH	Address	Diameter	Material	Surveyed Length	Survey Abandoned	Structural 5			O&M 5				Structural 4				O&M 4						Structural 3					O&M 3						Structural 2						O&M 2							Structural 1		O&M 1			Other Features						
									Broken	Hole	Fracture	Roots	Infiltration	Intruding Tap >30%	Obstacle >30%	Broken	Hole	Fracture	H2S Damage	Camera Underwater	Roots	Infiltration	Intruding Tap 20% <	Obstacle 20% < 30%	Alighment Shift >20%	Fracture	Crack	H2S Damage	Defectective Tap	Sag >30%<=50%	Roots	Infiltration	Encrustation 10% < 20%	Deposits 10% < 20%	Intruding Tap 10% <	Obstacle 10% < 20%	Fracture	Crack	H2S Damage	Sag >30%	Defective Joint	Defective Tap	Roots	Infiltration	Encrustation < 10%	Grease < 10%	Intruding Tap <10%	Alignment Shift 10% <	Obstacle <10%	Crack	Defective Joint	Roots	Infiltration	Alignment Shift <10%	Manhole	End of Pipe	Material Change	Size Change	Tap	Tap Capped	Water Mark
81	A107 - A108_D	A107	A108	Ionia	8	PVC	130																																																2		1				1
82	A108 - A109_D	A108	A109	Ionia	12	VCP	190																																			1							1						2						1
83	A109 - A110_D	A109	A110	Ionia	12	VCP	338.1							1																																						1			2		2				1
84	A110 - A114_D	A110	A114	Ionia	12	VCP	287							1																																									2						2
85	A114 - A115_U	A114	A115	Ionia	12	VCP	300																																																2						1
86	A115 - A116_D	A115	A116	Ionia	12	VCP	310																																																2						2
87	A116 - A122_D	A116	A122	Ionia	12	VCP	308									1										2																										2			2		2				3
88	A117 - A118_U	A117	A118	Lyons Rd	10	VCP	310.5																								1											1							1			3			2						1
89	A118 - A119_D	A118	A119	Lyons	10	VCP	41.1	1																																	1														1		1				1
90	A118 - A119_U	A118	A119	Lyons	10	VCP	264	1																		1															1														1						1
91	A119 - A120_D	A119	A120	Lyons	10	VCP	314.5																								1																					7			2						2
92	A120 - A121_D	A120	A121	Lyons	12	VCP	315		2		2									1						1											1	1																	2		2				6
93	A121 - A122_U	A121	A122	Lyons	10	VCP	310																																													2			2						5
94	A122 - A123_D	A122	A123	Lyons	10	VCP	224		1																												1																		2						1
95	A123 - A124_D	A123	A124	Lyons	10	VCP	287.5																								1							2											1			2			2						1
96	A124 - A125_D	A124	A125	Lyons	10	VCP	290																																			1										1			2						3
97	A125 - A126_U	A125	A126	Lyons	10	VCP	275															1																													1				2		1				1
98	A126 - A127_D	A126	A127	Lyons	10	VCP	299		1	1			1													2																													2		2				1
99	A127 - A127A_D	A127	A127A	Lyons	15	RCP	90																																																2						1
100	A127A - A128_D	A127A	A128	Lyons	15	RCP	147.5																	1																															2						1
101	A128 - A129_D	A128	A129	Lyons	15	RCP	320																																																2						2
102	A129 - A6_D	A129	A6	Water St	15	RCP	293										1																																						2			1			1
103	A4B - A4A_U	A4B	A4A	DoD Plant Dr	6	VCP	27.8	1																																															1						1
104	A4A - A4_D	A4A	A4	DOD Plant Dr	6	VCP	238	1		3				1																							1															10			1						1
105	A12 - A11_D	A12	A11	Bridge	10	VCP	406						3	1		2						13																2						3					3						2					5	2
106	A11 - A10_U	A11	A10	Water	10	VCP	104.8	1												1																																			1					2	1
107	A10 - A9_D	A10	A9	Water	15	VCP	38																															1																	2						2
108	A9 - A8_D	A9	A8	Water	15	VCP	337.3									1																						1				3			4										2					1	2
109	A8 - A7_D	A8	A7	Water	15	VCP	359																																			1			4										2					1	2
110	A7 - A6_D	A7	A6	Water	15	VCP	23.6	1																		1						9	2					5						1	14										3						3
111	A15 - A11_D	A15	A11	Pleasent	8	PVC	373			1						1										1											1	2													1	2			2		1				1
112	A11 - A10_D	A11	A10	Water	10	VCP	224															5																							1							1			2					3	1
113	C68 - C4B_U	C68	C4B	Grand River	10	PVC	240.2										1				2					1					1							8										1	1			3			2		3				1
114	C64 - C68_U	C64	C68	James	12	VCP	219.5	1		1				1		1																						6														3			1		1				1
115	C81 - C80_U	C81	C80	Kent	15	VCP	216.7	1						3		1	1						2			3											1	2											1						1						1
116	C80 - C3_D	C80	C3	Kent	24	VCP	353	1	2	3					2	2	1	1					2			13									5			7							3		6				1	1			3		4	4			4
117	A70 - A66_U	A70	A66	Grape	10	PVC	126	1				1									2								2																							2			3		2				2
118	A66 - A65_D	A66	A65	Grape	10	PVC	176																																																2						1
119	A65 - A59_D	A65	A59	Grape	10	PVC	345			1																											1																		2		1				2
120	A59 - A55_D	A59	A55	Carl	10	VCP	270																																			2													2						1
121	A55 - A54_D	A55	A54	Carl	10	VCP	275																			2																1										1			2						1
122	A54 - A53_U	A54	A53	Carl	10	VCP	236																																			3													2						4
123	A53 - A126_D	A53	A126	Quarterline	10	VCP	151.5							1		1																																			1				2		4				1
124	C80 - C3_U	C80	C3	Kent	24	RCP	105	1								1				1									1									1																	1						3
125	C185 - C172_D	C185	C172	Grand River Ave	8	RCP	208																																							2				1					2		2				3
126	C172 - C173_D	C172	C173	Grand River Ave	8	RCP	297																																																2						2
127	C173 - C174_D	C173	C174	Grand River Ave	8	VCP	330		3	1						3										4												1							1						1					2						1
128	C178 - C177_D	C178	C177	Grand River Ave	8	VCP	272		2	1				1		1																					1														1	2	1			2					2	1
129	C177 - C176_U	C177	C176	Grand River Ave	8	VCP	277		2	1	2															1												2												1						2						2
130	C176 - C175_D	C176	C175	Grand River Ave	8	VCP	110.1																																			1							1						2						1
131	C175 - C174A_D	C175	C174A	Grand River Ave	8	VCP	191		2																																														2						1
132	C174A - C174_D	C174A	C174	Grand River Ave	8	VCP	80.4	1																												1									1										1						1
133	C180 - C174_U	C180	C174	Grand River Ave	8	VCP	215.5	1																1																		1			1								1		1						1
134	C174 - C171_D	C174	C171	Grand RIver Ave	8	VCP	399.5		8		6					4										1											1	1							1					1					2						1
135	C171 - C170_D	C171	C170	Bristie	10	VCP	130		5					2												1												1																	2						2
136	C170 - C168_U	C170	C168	Trailer Park	10	VCP	267																																		1	1													2		2				1
137	C168 - C168A_D	C168	C168A	Trailer Park	10	VCP	136																																			1													2						1
138	C168A - C165_D	C168A	C165	Trailer Park	10	VCP	142																																																2						1
139	C165 - C164_D	C165	C164	Trailer Park	10	VCP	167		1											1																																			2						1
140	C164 - C163_D	C164	C163	trailer Park	10	VCP	176																																													1			2						1
141	A4B - A4A_D	A4B	A4A	DOB PLant Rd	6	VCP	362																																										1						2						1
142	A135 - A136_D	A135	A136	Parking Lot	6	VCP	89	1	1																																											4		2	3		1				2
143	A135 - A136_U	A135	A136	Parking Lot	6	VCP	185.5	1																																										1	3	5			1		3				1
145	C204 - C203_U	C204	C203	City Park	10	PVC	295																																																2						1
146	C203 - C202_D	C203	C202	City Park	10	PVC	325																																																2						1
147	C202 - C201_D	C202	C201	City Park	10	PVC	277																																																2						1
148	C201 - C200_D	C201	C200	City Park	10	PVC	295																																																2						1
149	C200 - C162_D	C200	C162	City Park	10	PVC	400																																																2						2
150	C155A - C155_D	C155A	C155	Grant	6	VCP	114									1																													1										2						1
151	C156 - C155_U	C156	C155	Grant	12	VCP	200																																																2						3
152	C155 - C154_D	C155	C154	Grant	15	RCP	336													1									1													1							1						2						1
153	C154 - C153_D	C154	C153	Lincoln	15	RCP	287																																																2						1
154	C153 - C152_D	C153	C152	Lincoln	15	RCP	49										1																																						4						2
156	C152 - C151_U	C152	C151	Parking Lot	15	RCP	253.1																																																2						2
157	C151 - B44_D	C151	B44	Parking Lot	12	CAS	3.5	1																	1																				1										1						1
158	B44 - B5_U	B44	B5	Park	12	CP	293.5																					2				1										1			2										2						3
159	C163 - C162_D	C163	C162	trailer Park	10	VCP	147.6						1									2																																	2		2				1
160	B5 - B4A_D	B5	B4A	City Park	18	RCP	224																																													1			2						3
161	B4A - B4_D	B4A	B4	City Park	18	RCP	82																																																2						2
162	B4 - B3_D	B4	B3	City Park	18	RCP	86.1																																																2						1

City of Portland
Sanitary Sewer: CCTV Data Results

									Structural 5			O&M 5				Structural 4				O&M 4						Structural 3					O&M 3						Structural 2						O&M 2							Structural 1		O&M 1			Other Features						
Inspection ID	Pipe ID	Upstream MH	Downstream MH	Address	Diameter	Material	Surveyed Length	Survey Abandoned	Broken	Hole	Fracture	Roots	Infiltration	Intruding Tap >30%	Obstacle >30%	Broken	Hole	Fracture	H2S Damage	Camera Underwater	Roots	Infiltration	Intruding Tap 20% <	Obstacle 20% < 30%	Alighment Shift >20%	Fracture	Crack	H2S Damage	Defectective Tap	Sag >30%<=50%	Roots	Infiltration	Encrustation 10% < 20%	Deposits 10% < 20%	Intruding Tap 10% <	Obstacle 10% < 20%	Fracture	Crack	H2S Damage	Sag >30%	Defective Joint	Defective Tap	Roots	Infiltration	Encrustation < 10%	Grease < 10%	Intruding Tap <10%	Alignment Shift 10% <	Obstacle <10%	Crack	Defective Joint	Roots	Infiltration	Alignment Shift <10%	Manhole	End of Pipe	Material Change	Size Change	Tap	Tap Capped	Water Mark
163	B3 - B2_D	B3	B2	City Park	18	RCP	65																																																2						1
164	B2 - B1_D	B2	B1	City Park	18	RCP	10.6																			1																													2						1
165	B4E - B4C_U	B4E	B4C	River Edge	8	PVC	186																																																2						1
166	B4C - B3_D	B4C	B3	River Edge	8	PVC	222																																																2						1
167	B6 - B4C_U	B6	B4C	River Edge	8	PVC	307																																																2						1
168	A6 - A5_D	A6	A5	Water St	15	VCP	165.5	2																														1							3	1									2						5
169	A6 - A5_U	A6	A5	Water St	15	VCP	127	1																								1	1					2							5										1						1
170	A5 - A2_D	A5	A2	Water Treatment Pla	15	VCP	293																															6						1	3										2						1
171	A2 - A1_D	A2	A1	Water Treatment Pla	15	VCP	233															1										1					1	2																	2						3
172	A4 - A2_D	A4	A2	Water Treatment Pla	15	VCP	25.8																																																2						1
173	C161A - C161_D	C161A	C161	Back In the woods	10	VCP	123																									1																							2						1
174	Unknown 171 - C161A_D	Unknown 171	C161A	Back In Woods	10	VCP	31	1												1																																			1						2
175	C162 - C161A_U	C162	C161A	Back In Woods	10	VCP	65	1												2																																			1						2
176	C160 - C159_D	C160	C159	Back IN woods	10	VCP	1	1																																															1						1
177	C160 - C159_U	C160	C159	Back IN woods	10	VCP	293	1												1																									2										1						7
178	C159 - C158_D	C159	C158	Back In woods	10	VCP	399																																																2						2
179	C158 - C157_D	C158	C157	Back IN woods	10	VCP	400																															1																	2						2
180	C157 - C156_D	C157	C156	Back IN woods	10	VCP	228																																							2									2						2
181	A71 - A70_D	A71	A70	Back IN woods	10	VCP	73	1												1																																			1						3
182	A72 - A71_U	A72	A71	Back IN woods	10	VCP	236																																																2						2
183	A73 - A72_U	A73	A72	Back IN woods	10	VCP	221																			1					1							1																	2						3
184	A74 - A73_U	A74	A73	Back In woods	10	VCP	5	2																										1																					2						2
186	A75 - A74_U	A75	A74	Back in Woods	10	VCP	67	1																																															1						2
187	A75 - A74_D	A75	A74	Back in woods	10	VCP	165	1																																												1			1						1
188	A76 - A75_U	A76	A75	Back in woods	10	VCP	53	1																																												4			1						1
192	C81 - C80_D	C81	C80	Kent	15	PVC	247.3	1						3		1										6			1									3					1									3			1		1				1
193	C3 - C2_U	C3	C2	Grand River AVE	12	VCP	47.3																			11											1											1							2						1
194	C2 - C1_D	C2	C1	Grand River AVE	12	VCP	180.9		1																												1	2																	2						2
195	C4B - C4_U	C4B	C4	Grand River AVe	8	PVC	83																																																2						1
196	C4 - C3_D	C4	C3	Grand River Ave	8	PVC	204																																																2						1
200	C302 - C301_D	C302	C301	Rindle Bluff Dr	10	PVC	177.3																																																1	1					1
1A	C151 EAST - B44 EAST_Downstream	C151 EAST	B44 EAST	Rivers Edge Ln.	12	Ductile Iron Pipe	7.6	1																	1																														1						1
2A	B1 NORTH SIPHON - A9 NORTH SIPHON_Upstream	B1 NORTH SIPHON	A9 NORTH SIPHON	Rivers Edge Ln.	10	Ductile Iron Pipe	71.7	1																																												2			1	1						1
3A	B1 SOUTH SIPHON - A9 SOUTH SIPHON_Downstream	B1 SOUTH SIPHON	A9 SOUTH SIPHON	Rivers Edge Ln.	8	Ductile Iron Pipe	356.7																																		2										16			5	2						1
4A	C151 EAST - B44 EAST_Upstream	C151 EAST	B44 EAST	Rivers Edge Ln.	6	Ductile Iron Pipe	87.5	1																	1															2						1								2	1						1
5A	C151 WEST - B44 WEST_Upstream	C151 WEST	B44 WEST	Rivers Edge Ln.	12	Ductile Iron Pipe	92.9	1																	1															2						3									1						1
6A	C151 WEST - B44 WEST_Downstream	C151 WEST	B44 WEST	Rivers Edge Ln.	12	Ductile Iron Pipe	7.4	1																	1																														1						1
7A	B1 NORTH SIPHON - A9 NORTH SIPHON_Downstream	B1 NORTH SIPHON	A9 NORTH SIPHON	Rivers Edge Ln.	10	Ductile Iron Pipe	284.9	1																	1					1										1	1										15		1	5	1				1		1

APPENDIX G
SMOKE TESTING REPORT

PREPARED FOR:

Portland
CITY OF TWO RIVERS Michigan

FLEIS&VANDENBRINK
DESIGN. BUILD. OPERATE.

Project No.: 848390

ASSET MANAGEMENT PLAN

Smoke Testing

Prepared for:

City of Portland

FINAL

March 2021

FLEIS&VANDENBRINK
DESIGN. BUILD. OPERATE.

TABLE OF CONTENTS

List of Attachments for Smoke Testing Report

EXECUTIVE SUMMARY

The City of Portland (City) retained Fleis & VandenBrink (F&V) to evaluate their wastewater collection system as part of a Stormwater, Asset Management and Wastewater (SAW) grant-funded project. In general, SAW work involves an inventory and assessment of the condition of the assets in a wastewater collection system and the development of a long-term asset management plan (AMP). This Smoke Testing report was commissioned as part of the SAW grant.

Study Details

This report, ultimately an appendix to the full AMP, presents the results of the smoke testing that occurred from September 10th to September 11, 2020. Smoke testing is a relatively fast, economical, and effective method of locating potential sources of inflow and infiltration (I&I) into the sanitary sewer collection system. The goal for this study was to complete smoke testing of high priority areas in town based on anecdotal evidence provided by the City and result from mass flow monitoring indicating areas of higher I&I. A map of the area tested and the locations of smoke observations can be found in Appendix A.

Conclusions

Sixteen instances of smoke exiting the wastewater collection system at inappropriate locations were found during smoke testing. The list below identifies each of these locations, their priority in fixing them and the recommended remediation.

<u>Storm Manhole - City to disconnect from sanitary sewer system (High Priority):</u>

- 745 Storz Ave – Middle School

<u>Miscellaneous – Property owner to disconnect from sanitary sewer system (Medium Priority):</u>

- 541 Looking Glass Ave – basement drain
- 291 Crescent Dr – roof gutters
- 308 Academy St – storm drain in driveway

<u>Open Sanitary Cleanout - Property owner to install new cleanout cap (Low Priority):</u>

- 415 Carl St
- 864 Riverside Dr
- 606 E Bridge St
- 422 Academy St
- 1534 E Grand River Ave

<u>Miscellaneous – (Low Priority):</u>

- 401 Carl St
- 801 Looking Glass Ave
- 541 Looking Glass Ave
- 841 Riverside Dr
- 775 Riverside Dr
- 234 Academy St
- 230 Elm St

INTRODUCTION

PROJECT BACKGROUND

In 2013, the City, with assistance from F&V, submitted an application to the Michigan Department of Environmental Quality's (MDEQ's) Stormwater, Asset Management, and Wastewater (SAW) grant program. A grant to fund the development of an asset management plan (AMP) for the City's wastewater collection and treatment system was awarded in 2017.

This smoke testing report is one of the tasks associated with the City's SAW project and will be included in an appendix of the AMP.

TERMINOLOGY

Infiltration and Inflow (I&I) is a broad term that is often defined differently by different people and organizations. For the purposes of this report, the below list of types of I&I with their accompanying definitions is used.

- **Groundwater Infiltration** – groundwater entering the sanitary sewer through structural defects (e.g. cracks or separated joints) on a constant basis, regardless of precipitation or surface water elevations.
- **Inflow** – surface runoff from precipitation entering the sanitary sewer through direct connections (e.g. storm sewer connections, roof drains, open sewer cleanouts). It is characterized by a flow spike immediately following precipitation, especially intense periods of precipitation.
- **Storm-Induced I&I** – an increase in sewer flow starting 1-2 days after a precipitation event and lasting 1-2 days. Sources of storm-induced tend to be temporary storages of precipitation, such as the soil (e.g. elevated groundwater levels) or basements.
- **River-Induced I&I** – elevated flows in response to elevated Flat River water surface levels. During the study, periods of elevated river stage lasted 4-7 days. This form of I&I can be attributed to a number of causes, the major ones being, in order of likelihood:
    - Elevated groundwater levels causing increased infiltration through structural defects.
    - Exfiltration from storm sewers or overland drains travelling through the ground and infiltrating the sanitary sewers.
    - Direct connections between storm sewers or overland drains and the sanitary sewers.
    - Surface flooding entering manholes not adequately watertight.

Due to the nature of smoke testing, it has a tendency to identify inflow sources, but usually does not identify any of the other sources of I&I listed above. For instance, smoke testing is more likely to identify a catch basin connected to the sanitary sewer or a broken sewer lateral clean-out cap than structural defects in the buried piping system.

OBJECTIVES

The objective of this study is to determine as many I&I sources as can be found by smoke testing as well as to present the findings in a manner in which each inflow point can be tracked for future confirmation of correction. The report also categorizes each inflow point into its relative priority based on the estimated volume of clean water inflow that might occur at that point. For instance, a catch basin connected to the sanitary sewer system will have a higher priority because it will discharge significantly more clean water into the sanitary sewer system than a broken cap on a sanitary lateral clean-out will.

TESTING METHODOLOGY

Smoke Testing involves blowing a non-toxic synthetic smoke like gas into the sanitary sewer system at strategically located manholes and recording observations of where the smoke emerges from the sewer system at inappropriate locations such as catch basins, uncapped sewer lateral clean-outs, roof drains, etc. Smoke from these inappropriate locations indicates potential pathways of I&I entering the sanitary sewer system.

Prior to testing, affected businesses and homeowners were notified by the City and Fleis & VandenBrink employees via printed notices on doors. The local police and fire department were informed of the testing, prior to testing, in the event that the artificial smoke might be interpreted as real smoke and reported to the authorities.

A portable blower specifically designed and built for use in smoke testing was utilized for the work. The smoke fluid used for the testing produces artificial smoke when pumped from a container onto the heating element of the blower manifold. The artificial smoke generated is white in color and leaves no residue. The smoke is non-toxic, non-explosive, and dissipates quickly once the blower is deactivated.

To perform the testing, the blower was positioned on a sanitary manhole and a visual inspection was conducted of the surrounding area as smoke was continuously introduced into the system. The effective area of coverage for each manhole set-up was defined by the observation of the smoke exiting home roof vents, sanitary manhole covers, and suspect locations of the sanitary sewer system noted in the field as potential sources of I&I.

Blower setup locations were selected to provide overlap within the coverage areas in order to facilitate testing of the entire target area of the sanitary collection system without gap. The operation of the collection system was not interrupted, nor was it necessary to plug the sewer pipes.

RESULTS & RECOMMENDATIONS

A total of 16 instances were noted where smoke exited the sanitary sewer system at an inappropriate location. Each of these instances were logged with a sketch of the area along with a written description of what was visually observed. Additionally, many instances were documented with pictures identifying the location where smoke was observed. The field logs and pictures are attached to this report in Attachment A.

Each instance where smoke was observed has been categorized into one of three categories based on how much clean water inflow it is felt likely to occur at that location. The priority classifications are identified by a visual inspection and are intended to help the City economically and efficiently prioritize correcting the problems. The three categories are:

- *Low Priority* – Small chance for inflow to occur due to natural runoff and infiltration of the area around the specified object.
- *Medium Priority* – Good chance for inflow to occur due to natural runoff and infiltration of the area around the specified object.
- *High Priority* – High chance for inflow to occur due to natural runoff and infiltration of the area around the specified object.

Recommended actions accompany each location where smoke was observed. Many of the locations are outside of the right-of-way and therefore privately owned by the property owner. The City is not responsible for either making repairs or the associated cost for problems found on private property as ownership and maintenance responsibilities of the sewer system end at the right-of-way. However, the City can enforce its sewer use ordinance and its rules and regulations of the sewer system. Therefore, it is recommended that the City notify each of the private property owners in writing of the I&I issues discovered and require that repairs be made by the property owner within a timely manner.

The table below identifies each of the instances where smoke exited the sanitary sewer system at an inappropriate location and identifies the priority and recommended action.

Table 1: Smoke Testing Observations

Event	Location	Observation	Priority	Remedy Recommendation
4-1	401 Carl St	Yard Drain	Low	Owner to repair
4-2	415 Carl St	Open Cleanout	Low	Owner to repair
21-1	801 Looking Glass Ave	Yard Drain	Low	Owner to repair
22-1	541 Looking Glass Ave	Basement Drain	Medium	Owner to repair
25-1	291 Crescent Dr	Roof Gutters	Medium	Owner to repair
25-2	864 Riverside Dr	Open Cleanout	Low	Owner to repair
25-3	841 Riverside Dr	Vented Manhole Cover	Low	City to replace w/ solid cover
25-4	775 Riverside Dr201 N Virginia Dr	Vented Manhole Cover	Low	City to replace w/ solid cover
27-1	201 N Virginia Dr	Yard Drain	Low	Owner to repair
31-1	234 Academy St	Vented Manhole Cover	Low	City to replace w/ solid cover
31-2	308 Academy St	Storm Drain in Private Drive	Medium	Owner to repair
32-1	230 Elm St	Vented Manhole Cover	Low	City to replace w/ solid cover
33-1	745 Storz Ave	Storm Manhole	High	City to disconnect
35-1	606 E Bridge	Open Cleanout	Low	Owner to repair
36-1	422 Academy	Open Cleanout	Low	Owner to repair
51-1	1534 E Grand River Ave	Open Cleanout	Low	Owner to repair

APPENDIX H
GREEN PROJECT RESERVE

PREPARED FOR:

Portland
CITY OF TWO RIVERS Michigan

FLEIS&VANDENBRINK
DESIGN. BUILD. OPERATE.

Project No.: 848390

PORTLAND GREEN PROJECT RESERVE BUSINESS CASE

Summary and Overview of the Project

Provisions of the *2012 Clean Water State Revolving Fund 10% Green Project Reserve: Guidance for Determining Project Eligibility Guidance*, indicate that some project components in the City of Portland Clean Water State Revolving Fund (SRF) Project Plan are eligible for "principal forgiveness", or a reduction in the loan capital amount.

As presented in the SRF Project Plan, the City of Portland has committed to implement necessary improvements in the collection system and at the Wastewater Treatment Plant (WWTP). The elements that qualify for Michigan's FY2022 Green Project Reserve (GPR) are described in this Business Case.

It is estimated that $6,599,000 of the project are eligible for GPR funding. The capital cost breakdown of the GPR eligible elements is attached.

I/I Reduction Improvements

The I/I Study (Mass Flow Monitoring Report), included as Appendix D to the Project Plan, demonstrated that reducing the infiltration and inflow (I/I) would reduce increased flows following periods of high ground water and excessive wet weather flows as well as high Grand River water levels. Reducing I/I will also realize operational benefits by reducing the operations and maintenance costs at the Canal Street Lift Station and WWTP.

The I/I reduction will reduce the amount of hours in pumping required at the Canal Street Lift station and raw sewage pumps, ultimately resulting in a reduction of energy costs. The I/I Study (Appendix D of the SRF Project Plan) documents the extent of the I/I issue in the City collection system.

The average influent from the year 2020's Monthly Operation Reports (MORs) submitted by the City's operator, Fleis & VandenBrink Operations, shows the average influent to be 0.365 MGD. The average billed sewage (based on water usage) for 2020 was approximately 0.303 MGD. Based on this comparison, annual I/I exceeds 20 MGY and accounts for just under 20% of the total flow treated at the plant.

In addition to the electrical savings benefit, other benefits will be realized, including reduced wear and tear on the pumps, and less treatment of clean water.

Anaerobic Digestion

The WWTP's anaerobic digester was originally designed to utilize biogas and natural gas in the heat exchanger / boiler for heating the primary digester. Planned treatment plant improvements will help to enhance biogas production and reduce natural gas usage for heating.

Poor mixing in the digesters is adversely impacting biogas production. The replacement of the mixing system will minimize this issue, reducing the amount of natural gas needed to supplement the biogas. The recirculation system will also be improved, also increasing the biogas production.

The project also includes better insulation for the digester tanks. This will reduce the overall heating demand. The pumping systems used throughout will be replaced with more efficient equipment, reducing energy demand as well.

Secondary Treatment

The proposed secondary treatment system would increase the efficiency of the WWTP. This system would upgrade the existing equipment with higher efficiency equipment, including more efficient blowers equipped with variable frequency drives. The aeration process would also be controlled by oxygen demanded, further increasing process efficiency. These upgrades will allow for reduced energy usage at the WWTP. The system would also expand the biological capacity of the plant, reducing the need for extended treatment time within the existing treatment system.

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Engineer's Opinion of Probable Project Cost [1]

Project:	City of Portland Project Plan	*Project No.*	848390
Basis for Estimate:	[X] Conceptual [ ] Basis of Design [ ] Final	*Estimator:*	
Work:	**City of Portland WWTP**	*Date:*	Apr-2021
	GPR Eligible Costs	*Current ENR-CCI:*	11,013

Item	Description	Unit	Qty.	Unit Price	Amount
Collection System Improvements					
1	Gravity Main and Manhole Improvements	LS	1	$1,981,000	$1,981,000
Wastewater Treatment Plant Improvements					
Secondary Treatment					
2	Secondary Treatment Improvements	LS	1	$1,330,000	$1,330,000
3	Flow Splitter Improvements	LS	1	$18,000	$18,000
4	Secondary Clarifier Improvements	LS	1	$65,000	$65,000
Digester Improvements					
5	Anaerobic Digestion System	LS	1	$1,160,000	$1,160,000
6	General conditions and OH&P		15%		$683,000
7	Construction Contingency		10.0%		$524,000
				Construction Cost:	**$5,761,000**
8	Engineering, Legal, Administration, & Financial		16%		$838,000
				Total Project Cost:	**$6,599,000**