MANISTEE CITY COUNCIL
WORK SESSION AGENDA

Tuesday, June 14, 2016 - 7:00 p.m. - Council Chambers, City Hall

I. Call to Order.

II. Work Session Items.

a.) PUBLIC COMMENTS ON WORK SESSION RELATED ITEMS.

b.) DISCUSSION ON DOWNTOWN DEVELOPMENT AUTHORITY – City Manager Thad N. Taylor.

c.) UPDATE ON CSO DISCUSSIONS – City Manager Thad N. Taylor.

III. Adjourn.

TNT:cl

May 24, 2016

Thad Taylor, City Manager
Jeff Mikula, DPW Director
City of Manistee
70 Maple St.
Manistee, MI 49660

RE: Combined Sewer Overflow Elimination/ Sanitary Sewer Improvements
Required Data Collection and Analysis to Prepare a Project Plan to Eliminate CSO 018
Draft - Preliminary Work Plan / Scope of Work/ Preliminary Estimate of Costs

Thad, Jeff:

As requested, we have evaluated data collection and analysis needs to prepare a project plan to eliminate Combined Sewer Overflow 018 (CSO 018) as quickly as possible. This preliminary work plan is intended to assist the City in pursuing potential grant sources to assist with the elimination of CSO 018. The first step in this process is ensuring adequate data collection and analysis are completed to identify a project plan.

This data collection would include televising all of the City's stormwater and wastewater collection systems not televised as part of the SAW grant and televising all of the City's sanitary service leads and unknown connections. Additional field data collection and analysis of unknown connections, as they are identified, will also be required as part of this work plan. The collection, review, cataloging, and analysis of this data, hydraulic modeling, alternative analysis and preparation of project plan are also included in this scope of work.

This letter provides a brief background of the City's last remaining Combined Sewer Overflow (CSO 018), some of the past and current efforts being conducted by the City to address this CSO, and finally the scope of work needed to identify a project plan to eliminate CSO 018. This letter does not include the permitting, preliminary design, and final design work items to eliminate CSO 018 since the recommended solution is unknown at this time. The purpose of this work plan is to collect adequate data and perform the necessary analyses to identify the recommended solution so a CSO 018 elimination project can be designed, permitted, and ultimately constructed.

Background/ Problem Statement

The City of Manistee has worked with the MDEQ over the past thirty years to separate their extensive combined sanitary and storm sewer systems. During this time frame, the City has invested nearly $40 million dollars to achieve a system which no longer discharges raw sewage to the Manistee River when inundated during wet weather periods (rain) or snow melt events.

The City has been successful in separating all of its known combined sewer pipe systems and closing an estimated 18 Combined Sewer Overflows (CSO's) to date. To the best of everyone's knowledge, all of the Combined Sewer Overflow (CSO) regulators in the system have been removed or abandoned, with the exception of one, CSO 018. Please refer to the attached map showing historical CSO's installed as part of the City's 1932 interceptor sewer project.

Unfortunately, the City cannot abandon this last CSO regulator, as it serves as the only relief point upstream of the wastewater treatment plant. When wastewater flows, including I&I flows, exceeds the capacity of the wastewater collection system during wet weather periods overflows do occur at this CSO. In accordance with the City's NPDES permit for the Wastewater Treatment Plant (WWTP) these CSO's are reported to the MDEQ, Manistee County Health Department, and to the local media.

These overflows, although not desired, are necessary at the current time. If this relief point was removed, imminent basement flooding to residential and commercial structures would take place. In addition, the wastewater treatment plant would not be able to treat all of the wet weather influent coming into the plant, and ultimately a permit violation and Sanitary Sewer Overflow (SSO) would occur in the vicinity of the plant. Please refer to the attached Memo summarizing the impacts of immediately removing CSO 018 prior to reducing Infiltration and Inflow into the existing Sanitary Sewer System.

The City has recognized that simply separating the existing combined sewer system does not solve the largest remaining problem, Infiltration and Inflow (I&I). The majority of the City's sanitary sewer system, though separated from the storm sewer system is at or beyond its service life and still has many unknown storm water and groundwater connections. Due to the age of the sewer pipes, joints and manholes and the presence of unknown connections there is still significant infiltration and inflow (I&I) into the wastewater collection system.

Infiltration is the seepage of groundwater into the system through cracks and bad joints in the pipe. Infiltration is a large contributor to the flows that are treated on a daily basis at the plant. Infiltration accounts for close to 40% of the average daily flows seen at the plant today. The presence of nearby waterbodies creates high groundwater conditions which further exacerbates the infiltration problem.

Inflow is due to direct connections to storm water sources such as catch basins, footing drains, sump pump leads, etc. These sources are harder to find, but have a much greater impact on peak flows during wet weather conditions.

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The City's remaining CSO 018 needs to be eliminated. However, this CSO cannot be eliminated without putting City residents at risk of basement sewage flooding until the sources of infiltration and inflow can be mitigated at their source or the ability to store this excess I&I can be provided.

Current and Past Studies

Sanitary Sewer Studies

To further identify, analyze, and combat the presence of infiltration and inflow, the City has performed several Sanitary Sewer Evaluation Studies over the years. The results of these studied were based upon dye testing, smoke testing, field investigation efforts, document reviews, pump station evaluations, and the review of flows at the Wastewater Treatment Plant (WWTP). Subsequent to the findings of these studies, the City has corrected numerous source points of illicit storm water connections into the sanitary sewer. This has provided some relief to the sanitary sewer, but not nearly enough to eliminate the recurring CSO's at CSO 018.

CSO 018 Flow Monitoring (Transducer Data Collection)

After concluding the SSES studies and the system fixes identified during these studies, the City sought some additional data collection to analyze wastewater flows. In November of 2014 the City worked with Spicer Group to install electronic metering equipment in CSO 018 to more accurately measure CSO events occurring during significant rain events, and snow melts. This monitoring equipment collects depth and temperature readings within the sanitary sewer interceptor at CSO 018 every 3 hours during non-CSO periods and collects this same information every 3 minutes during CSO events. Data is stored on a data logger, collected after CSO events, and analyzed to determine CSO volumes and CSO flowrates over the CSO weir.

Since being installed this equipment has allowed for more accurate monitoring of all of the CSO events that occurred in 2015 and at the end of 2014. These CSO events have ranged in size from 100,000 Gallons to 12.4 Million Gallons during the overflow monitoring period. Please refer to the attached table summarizing the recorded CSO events and a sample of the data tables and graphs for the most recent CSO event which occurred on March 30th, 2016.

Based on these more accurate overflow monitoring results it was determined previous recommendations to install a 500,000 gallon Equalization (EQ) Basin and eliminate CSO 018 would not be feasible under the current NPDES CSO 018 elimination schedule without further data collection and analysis and would pose a high risk to City residents if implemented.

Therefore, the City has requested an extension from the MDEQ to collect more background data and look into means to store and/or reduce I&I as part of the City's NPDES permit renewal process. This request to extend the deadline for the removal of CSO 018 was made to include data collection with a flow monitoring program and data collected as part of the City's SAW grant. Please refer to the attached excerpts from the City's NPDES Application for reissuance.

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2015 Flow Monitoring Program
The City also developed and funded a sanitary sewer flow monitoring program, which took place during 2015, to further identify those areas in the City experiencing infiltration and inflow occurrences. The flow monitoring period took place for approximately 10 months (January 2015 to November 2015). A more limited flow monitoring program continues today using 3 flow meters as part of the SAW grant program for calibrating flow and modeling data.

As part of this flow monitoring program detailed records of flows at the WWTP, billing data, pumping data, CSO data, etc. was collected to estimate the overall I&I at the WWTP. This analysis estimates approximately 40% of the flows seen at the WWTP come from groundwater or storm water sources and are not municipal wastewater. Please refer to the attached table summarizing flows and estimated I&I at the WWTP over the last 4 years.

The flow monitoring program performed in 2015 divided the City into twelve (12) distinct districts. Based on existing REU's (residential equivalency units), historical and current water billing records, and the installed flow meters, each district could be analyzed for dry weather flow conditions as well as wet weather flow conditions. The purpose of installing these monitors was to assist the City in identifying which areas of the City were contributing the most I&I so a plan to reduce I&I for the greatest return on investment or cost/benefit ratio could be evaluated.

The results from the program were summarized to indicate those districts with relatively high volumes of inflow and infiltration. Please refer to the attached summary table and sanitary flow district map which show the general distribution of I&I across the City. As denoted by the Table and Figure, the district with the highest volume of infiltration and inflow is District 7. Any future studies, design, or project plans specific to I&I reduction should start with this district.

SAW Grant Program
The City is currently in the beginning stages of its recently awarded SAW Grant. This program will allow the City to perform much needed asset inventory, asset management, and condition assessment of the wastewater infrastructure (sewers, manholes, pump stations, WWTP, etc.). The scope of work eligible for the SAW program include: asset inventory, condition assessment, risk assessment, identification of capital improvement plan (CIP), and development of a financial plan (rate structure) to forecast the CIP projects. Tasks or items not eligible in the City of Manistee SAW program include; using grant funds for I&I studies, sewer design, and construction projects.

It should be noted that the grant amount for the SAW grant will not cover all of the costs associated with asset inventory of the system. Specifically, only a portion of the City's sanitary sewer system will be cleaned and televised, as doing so for the entire system was not financially feasible based on the SAW's grant maximum grant amount. Based on preliminary televising work completed in 2016 a significant portion of the wastewater collection system pipes will

require heavy cleaning.

The SAW grant will not reimburse for televising of pipes that are less than 20 years old and does not require all pipes in the system be televised. Based on the number of sewers within the system less than 20 years old and due to the cost of completing the heavy cleaning an estimated 20 miles of the 47 miles of sanitary sewer, and approximately 8 miles of the City's 23 miles of storm sewer will be cleaned and televised under the SAW grant program.

The SAW grant will only identify the location of leads within the televised portions of the system and will provide a condition assessment of the pipes within the system. The SAW grant will not determine where these leads originate from or quantify the amount of I&I from an identified potential source or from quantify infiltration from poor joints.

The remaining sanitary and storm sewer systems should be televised if the City is going to identify and adequately address its high rates of I&I. All of the system should be televised so a comprehensive inventory of all pipe connections and all leads is completed that can be reviewed and their sources identified. It is further recommended televising of all leads/ branch connections should be completed. Leads are often a significant contributor of I&I via deteriorated joints, footing connections, sump connections, etc. This Memo identifies the additional televising necessary to have a comprehensive database of all connections to the wastewater collection system so source identification and I&I quantification can be completed.

The SAW grant is intended for asset management, inventory, condition assessment, and risk assessment, and is not intended for I&I identification and analysis. However, the completion of this work is a still critical to assisting the City in addressing its I&I and CSO issue. The televising data and manhole scanning data collected will allow for a more comprehensive picture of the City's wastewater collection system, including identifying sanitary sewer service leads, potential illicit connections, and pipes with poor joints, cracks, etc... These findings will aid the City in identifying and eliminating sources of I&I.

Due to the critical value of this data a request to extend the schedule for the proposed planning, design, and construction of a Retention Treatment Basin (RTB), I&I reduction project, and removal of CSO 018 to handle peak wet weather flows has been requested as part of the City's NPDES renewal. Please refer to the attached excerpts from the City's NPDES Application for reissuance, which includes a request to extend the CSO removal schedule consistent with the completion of the SAW grant.

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Preliminary Recommendations to Store and Reduce I&I and Remove CSO 018

To ensure CSO 018 can safely be eliminated without causing wastewater backups within residential and commercial structures and to assist in accelerating the schedule for the elimination of CSO 018, a methodical and deliberate approach will need to be undertaken. This approach will have to address the short term goal of reducing CSO volumes and frequencies by providing in-system storage and the overall long-term goal of reducing the total I&I within the system to a point where in-system storage is significantly reduced or eliminated.

Based on the large volumes of I&I and CSO identified during flow monitoring at CSO 018 and within the wastewater collection system, it will be difficult and unlikely enough I&I can be removed from the system in a timely manner to remove CSO 018 without some form of Equalization (EQ) basin or Retention Treatment Basin (RTB) being constructed. To determine some of the specific details of this approach, additional data will need to be collected, especially if any grants or loans will be pursued through state or federal agencies.

Equalization (EQ) Basin

An EQ basin is a large wastewater storage system that would collect all of the excess wastewater during a wet weather event that the WWTP cannot adequately treat to meet NPDES water quality requirements. An EQ basin would need to be sized to store all of the excess wastewater and then return this wastewater at an acceptable rate to the WWTP.

Based on extrapolation of the data collected to date at CSO 018 and no further reduction in I&I it is estimated an EQ basin would need to be between 20 and 30 Million Gallons to fully contain the MDEQ's required 25 Year – 24 Hour Storm Event (Atlas 14 = 4.5 inches, Bulletin 71 = 3.9 Inches) if constructed today. The largest event recorded since installation of the CSO flow monitoring equipment to date is 12.4 Million Gallons, which occurred during a 1.4 inch rainfall event on March 30th, 2016. A 20 Million Gallon basin is equivalent to 61 acre-feet of water or 56 feet of water on a standard football field.

Retention Treatment Basin (RTB)

An RTB basin also collects excess wastewater during a wet weather event that the WWTP cannot adequately treat to meet NPDES water quality requirements. However, an RTB is designed to store a predetermined volume of excess wastewater that would be stored and returned to the plant at an acceptable rate. Any excess wastewater exceeding this predetermined volume would be discharged to the lake, but would go through primary treatment, which at a minimum would include screening, settling, and some form of disinfection such as chlorination or ultraviolet radiation before being discharged.

This option allows for a much smaller basin based on costs, regulatory requirements, and stakeholder input. Overflow frequency and volumes to the lake would be reduced proportionally to the size of the RTB basin constructed and no overflows would occur without primary treatment. The frequency of discharges from the RTB would be reduced as I&I within the system is removed. The size of this basin would need to be determined based on further data

collection and analysis and discussions with regulatory agencies.

The City of Manistee's wastewater collection system is currently considered a combined sewers system. However due to the separation work completed over the last 40 years may be considered a separated sewer system by the MDEQ in the future. RTB facilities are not typically allowed for a wastewater collection system that are considered separated. An EQ basin would typically be required for a separated wastewater collection system. Therefore, the use of an RTB to temporarily store and treat excess wastewater flows may have to be approved by regulating authorities. A smaller RTB is the preferred alternative due to constructability, cost concerns and the ability to provide some form of storage in the short term while excess I&I is identified and reduced.

Infiltration and Inflow (I&I) Reduction

Whether an EQ basin or RTB facility is constructed, I&I will continue to have to be identified, monitored, analyzed, and reduced over time. The frequency and volume of wastewater stored in an EQ basin or RTB facility over time would be reduced as I&I within the wastewater collection system is identified and mitigated. With an EQ basin the percentage of the basin being utilized would decrease over time. With an RTB basin the frequency and volume of overflows from the basin would decrease over time and eventually would be reduced to a point where no further treated outflows from the basin directly to the lake would occur and the basin would act as an EQ basin and all stored wastewater would be returned to the WWTP for full treatment.

It will be difficult to remove enough I&I in the next five years to safely remove CSO 018 without constructing some form of storage facility. The City has included a line item for I&I suppression in their current capital improvement plan for budget years 2 and 3 and a sewer main replacement line item for budget years 3, 4 and 5. Based upon the 2015 flow monitoring program we believe the area identified as District 7 and to some extent District 6 are the areas that have the largest contribution to the high I&I being observed at the plant and causing CSO events. Future I&I reduction projects should focus on these areas first.

These I&I reduction projects will allow for the identification and reduction of I&I in the system, but unless some very large inflow sources are identified and removed will likely not be adequate to eliminate enough I&I to be able to safely remove CSO 018 without some form of storage facility.

Pump CSO flows to LRBOI WWTP on Dontz Road

Another concept recently being discussed is to capture the combined sewer overflow at CSO 018 and directly pump it to the Little River Band of Ottawa Indians (LRBOI) WWTP located on Dontz Road approximately 5 miles away. This option would require the peak discharge over the CSO 018 weir to be immediately pumped away to ensure backups do not occur within residential or commercial structures located in the vicinity of CSO 018. Based on flow monitoring data collected at CSO 018 the two largest recorded discharge rates over the weir were 31,000 gpm during a 2.8 inch rainfall event and 10,000 gpm during a 1.8 inch rainfall event.

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Though this pump station and force main would only be used up to a dozen times a year it would need to be sized to immediately convey the largest flow over the weir for the 25 Year – 24 Hour design storm event of 4.5 inches. This would require a very large pump station and force main to be constructed and at the ready for CSO events. Based on recorded CSO flows recorded to date, we estimate this pump station and force main would have to convey in excess of 30,000 gpm to meet peak design discharges for a 25 Year – 24 Hour recurrence storm. This would be the equivalent of emptying a typical in-ground residential pool every minute.

This pump station and force main could be downsized by the construction of an EQ basin and/or RTB facility at or near CSO 018. An analysis of the EQ basin versus pump size would need to be completed. Additionally, the City would need to continuously pursue reduction in I&I sources and over time be able to decommission this pump station along with CSO 018.

Finally, this option, based on the current capacity the LRBOI treatment plant would require an EQ basin/ lagoon be constructed near the LRBOI treatment plant to temporarily store the CSO volume until it can be treated by the LRBOI WWTP plant. The size of this EQ basin/lagoon would be a function of available treatment plant capacity and the design CSO storm volume. As previously discussed this volume is estimated to be between 20 and 30 Million Gallons for the 25 Year- 24 Hour design storm without any I/I reduction.

<u>Preliminary Recommendation and Need for Additional Data Collection and Analysis</u>
Additional data collection and discussions with regulatory authorities will be necessary to move toward a specific project plan and design to remove CSO 018. At this time, a storage facility, likely an RTB basin, would be required before CSO 018 can be eliminated. The size and location of this RTB facility would need to be analyzed to determine the most practical, cost effective options. This RTB will need to be supplemented with a long term plan to continuously reduce I&I within the system and/or an option to pump excess I&I to another WWTP facility. This purpose of this work plan is to identify alternatives and provide a recommended solution.

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Data Collection and Analysis Needed to Develop a Project Plan to Eliminate CSO 018

As previously stated additional data collection and coordination with regulatory agencies and stakeholders will be necessary to identify a specific project plan to eliminate CSO 018 that would be used in acquiring state and federal grants and/or loans.

The following is a list of tasks that should be completed in addition to the SAW grant tasks to obtain an ideal level of information to adequately inventory, catalog, assess, and analyze the system and prepare a project plan that will be acceptable to regulatory and grant funding agencies. The data collected and analysis completed would be used to develop the project plan for a RTB facility and to develop the long term project plan for a reducing I&I.

1. **Televising and Inventory of Wastewater and Stormwater Collection Systems**

   a. Clean and televise additional sanitary sewers in the system not being completed as part of the SAW grant. Based on preliminary televising of the existing system an estimated 27 miles (140,000 feet) of sanitary sewer will need to be televised in addition to the sanitary sewer televised during the SAW grant work. This will allow for the entire system to be televised and all connections to the system documented. This televising, when accompanied with the SAW work, will allow for a complete inventory of all defects, branch connections, and lead connections within the wastewater collection system.

      Using an average televising and cleaning rate of $4.50/foot we estimate this cleaning and televising would be approximately $630,000 to televise all pipes within the City of Manistee's collection system not televised during the SAW Grant program. Accounting for planning, bidding, oversight, and other administrative items we would recommend a budget amount of $660,000 for planning purposes at this time.

      The actual costs to perform this work would have to be obtained from contractors through a bidding process. The extent of sewer to be cleaned and televised could be adjusted as necessary to meet budgetary and/or grant requirements and will depend on the amount of work completed during the SAW grant program.

   b. Clean and televise additional storm sewer in the system not being completed as part of the SAW grant. Up to 15 miles (80,000 feet) of storm sewer will need to be televised in addition to the storm sewer televised during the SAW grant work. This televising, when accompanied with the SAW work, will allow for a

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complete inventory of all defects, branch connections, and lead connections within the storm water collection system.

Using an average cleaning and televising rate of $5.00/foot we estimate this cleaning and televising would be approximately $400,000 to televise all pipes within the City of Manistee's collection system not televised during the SAW grant program. Accounting for planning, bidding, oversight, and other administrative items we would recommend a budget amount of $420,000 for planning purposes at this time.

The actual costs to perform this work would have to be obtained from contractors through a bidding process. The extent of sewer to be cleaned and televised could be adjusted as necessary to meet budgetary and/or grant requirements and will depend on the amount of work completed during the SAW grant program.

c. Incorporate all of the collected mainline stormwater and wastewater televising data into the City's GIS system and a televising database such as WinCan. Assuming an average televising run of 250 feet we estimate approximately 650 runs of televising data, in addition to the data collected with the SAW grant, will have to be incorporated into the City's GIS system and appropriate attribute fields populated.

Assuming 20 minutes of technician time to review and populate the appropriate fields in the GIS database and to provide for planning, QA/QC, and oversight we estimate the cost to update the GIS system to be approximately $60,000 for planning purposes at this time.

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2. Televising and Inventory of Wastewater Lead Connections

a. Televise leads connected to the sanitary sewer system. To further understand sources of I&I in the collection system televising of lateral sanitary service leads and branch connections should be completed. Televising sanitary service leads can help to identify their condition as they relate to seepage and infiltration and may also help to identify if other sources of groundwater such as footing drains and/or sump lead discharges are present.

We estimate there is approximately 3,100 billed customers and therefore at least 3,100 service leads that could be televised. Additional connections beyond these services leads, such as abandoned leads, footing drains, etc. will also be present. These additional leads are difficult to estimate at this time, but are the most critical ones to investigate since they may be unknown contributors of I&I. Assuming 3,600 leads and an average length of 50 feet per lead there would be approximately 180,000 feet of service leads that could be televised.

Using an average televising cost of $250/ lateral we estimate cleaning and televising of all the leads would be approximately $900,000. Accounting for planning, bidding, oversight, and other administrative items we would recommend a budget amount of $950,000 for planning purposes at this time.

The actual costs to perform this work would have to be obtained from contractors through a bidding process. The extent of leads to be televised could be adjusted as necessary to meet budgetary and/or grant requirements.

b. Incorporate all of the collected wastewater lead televising data into the City's GIS system and a televising database such as WinCan. We estimate approximately 3,600 leads will have to be incorporated into the City's GIS system and the appropriate attribute fields populated.

Assuming 20 minutes of technician time per lead to review and populate the appropriate fields in the GIS database and to provide for planning, QA/QC, and oversight we estimate the cost to update the GIS system to be approximately $180,000 for planning purposes at this time.

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c. An option is available during the lead televising process to provide a location and depth of the sanitary sewer service lead. This would entail marking of the lead by the televising contractor using locaters on the camera head and then performing a survey of the marked locations. We estimate this locating service, survey, and location documentation would cost approximately $300 per lead. We do not anticipate needing this service for all of the service leads, but are assuming some of the leads may be worth tracing. For planning purposes we are assuming 200 sewer service leads may need to be traced, surveyed and documented.

Assuming 200 leads may need to be located and to provide for planning, QA/QC, and oversight we estimate the cost to locate, survey and document these service leads would be approximately $70,000 for planning purposes at this time.

The actual costs to perform this work would have to be obtained from contractors through a bidding process. The extent of sewer services to be located and surveyed can be adjusted as necessary to meet budgetary and/or grant requirements and will depend on the results of mainline and lead televising.

3. **I&I Identification and Preparation of a Sanitary Sewer Evaluation Study (SSES)**

a. Perform additional I&I field identification measures. The televising will likely result in additional branch connections, taps, and sanitary service leads being identified that have unknown sources. For these connections to be properly identified and to determine if storm or groundwater is actively entering the wastewater collection system at this point several field testing measures could be considered. These include, but are not limited to.

i. Dye testing and/or flow testing
ii. Smoke testing, if necessary
iii. Acoustic sounding of leads and manholes
iv. Onsite inspections of residential and commercial structures
v. Other measures…

It is difficult to estimate the amount of time and effort needed to determine the origin of an unknown connection, when these connections have not been identified yet. The means to determine the origin of these connection will also have an impact on the amount of time required to perform this work. For budgeting and planning purposes we would assume each unknown connection would take a minimum of 5 hours to perform field testing to identify the source, make a record of this source in GIS and to quantify the potential I&I flowrate and/or volume. We would estimate approximately $800 per Inflow source.

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Assuming there are 200 unknown connections in the system accounting for QA/AC, planning, and oversight time we estimated the cost to be $180,000 for planning purposes at this time.

b. Review televising and scanning data for I&I and illicit connections and to estimate the location, rates, and volumes of I&I sources entering the system. These sources include leaking joints, illicit connections, and leaking service leads. The rate of infiltration from leaking joints, leaking service leads, footing drains, sump leads, etc. along the sanitary sewer collection system should be identified and the rate of infiltration estimated. Additionally, the estimated storm water inflow from an illicit connection such as roof drains, storm cross connections, etc. will also need to be identified and estimated.

The location and quantity of infiltration and inflow will be utilized in the hydraulic model to more accurately reflect the specific location and rates of estimated I&I, beyond the current level of I&I estimation provided by the flow monitoring data. The known I&I in each flow district will be distributed in the district based upon televising reviews and I&I estimations within each district. This will be critical in performing cost benefit analysis, evaluating impacts, and to determine the best return on investment for various alternatives involving both I&I reduction techniques and I&I storage methods.

A review of all of the televising data collected as part of the SAW program and any additional televising data will be completed specific to identifying and estimating I&I. The identification and estimation of I&I is not part of the current SAW grant program. For planning purposes, we are assuming a review of 250,000 feet of mainline sanitary sewer and 3,600 sanitary leads will need to be completed.

Assuming 5 minutes of technician time to identify and estimate I&I rates from sanitary sewer runs and from service leads/ connections, provide QA/QC, and provide oversight we estimate the cost be $80,000 for planning purposes at this time.

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c. Complete an I&I study – Utilize flow monitoring data, I&I estimations, CSO monitoring data, WWTP flow data, televising data, manhole scanning data, etc. to prepare an I&I study in accordance with state and federal requirements. This analysis may be required as part of a project plan/grant application since calculated I/I at the WWTP exceed minimum dry weather flows per capita and exceed minimum wet weather flows per capita, and the City has an active CSO.

   Utilizing existing data collected in the past year, data gathered during the SAW grant process, and additional data collected as part of this work plan a report will be prepared summarizing the findings of our I/I analysis consistent with state and/or federal requirements. We estimate the cost to prepare this I/I analysis will be approximately $40,000. An I/I analysis is not funded as part of the SAW grant program.

d. Complete a Sanitary Sewer Evaluation Study (SSES) to summarize the findings of the I&I analysis. This evaluation will identify the recommend measures, projects and/or maintenance needed to mitigate the identified sources of I&I. The recommended I&I mitigation measures would be used in developing the overall project plan for eliminating CSO 018. This SSES study will leverage on the previous SSESS study started by the City's previous Engineer of Record and will be completed in accordance with state and federal requirements. We estimate the cost to prepare this SSES will be approximately $50,000. An I/I analysis is not funded as part of the SAW grant program.

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4. **Perform Hydraulic modeling and Prepare a Project Plan to Identify Alternatives and a Recommended Project to Eliminate CSO 018**

    a. Perform hydrologic and hydraulic modeling to determine RTB Sizing, I&I reduction options, and perform Cost Benefit analysis. The baseline hydraulic model prepared as part of the SAW grant will be used as a basis to evaluate alternatives identified as part of the planning process. This model will simulate various wastewater storage facilities along with I/I reduction scenarios within the collection system. The results of these simulations will be used to help weight the benefits of storage vs I/I reduction and to identify the most cost effective storage and I/I reduction project. We estimate the cost to update the base model created as part of the SAW grant and to simulate the various storage and I/I reduction scenarios will cost approximately $60,000.

    b. Prepare project plan or similar document summarizing the alternative analysis, cost benefit analysis and the recommended proposed project. A project plan will be required as part of any State Revolving Fund (SRF) grant or loan project. The following is a shortened outline of the information required in the project plan.

        i. Project Background
            1. Study Area and Characteristics
            2. Economic Characteristics
            3. Existing Facilities
            4. Need for the Project
            5. Population Data
            6. Environmental Setting
        ii. Analysis of Alternatives
            1. Identification of Potential Alternatives
            2. Analysis of Principal Alternatives
                a. Cost Benefit Analysis
                b. Lining vs RTB sizing, etc…
        iii. Selected Alternative
            1. Description of the Selected Alternative
            2. Authority to Implement the Selected Alternative
            3. User Costs
            4. Disadvantaged Community (SRF only)
            5. Useful Life
        iv. Evaluation of Environmental Impacts
            1. Analysis of the Impacts
        v. Mitigation
            1. General
            2. Short-Term Construction-Related Mitigation

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3. Mitigation of Long-Term Impacts
4. Mitigation of Indirect Impacts

vi. Public Participation
1. Public Meetings on Project Alternatives
2. The Formal Public Hearing
3. Adoption of the Project Plan

Other state and federal grant and loan programs will require similar information to identify alternatives, perform cost-benefit analyses, and recommend a proposed project.

We anticipate this document or a similar report for other grant/loan submittal will be approximately $50,000 to prepare assuming all of the background data has been collected and is available.

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Summary of Key Task Work Items and Estimated Fees

1. **Cleaning, televising and inventory of Wastewater and Stormwater Collection Systems not Completed as Part of the SAW**

a. Clean & televise additional sanitary sewers in the system not completed as part of the SAW grant (27 Mi., 140,000 Ft +/-)	$660,000
b. Clean and televise additional storm sewer in the system not completed as part of he SAW grant (15Mi., 80,000 Ft +/-)	$420,000
c. Incorporate all of the collected mainline stormwater and wastewater televising data into the City's GIS system and/or a televising database such as WinCan (29 Mi., 154,000 Ft +/-)	$60,000
	$1,140,000

2. **Televising and Inventory of Wastewater Lead Connections**

a. Televise all sanitary service leads connected to the wastewater collection system (3,500 leads)	$950,000
b. Incorporate all of the collected wastewater service lead televising data into the City's GIS system and/or a televising database such as WinCan (3,500 leads +/-)	$180,000
c. Provide location and depth of the sanitary sewer service leads. This would entail marking of the lead by the televising contractor and then surveying the lead locations. Assume 200 leads to be located.	$70,000
	$1,200,000

DRAFT

3. **I&I Identification and Preparation of a Sanitary Sewer Evaluation Study (SSES)**

a. Perform additional I&I field identification measures. (Dye Testing, Smoke Testing, Soundings, Site Inspections, etc.) Assume 200 unknown leads or connections to be investigated.	$180,000
b. Review televising and scanning data for I&I and illicit connections to estimate the location, rates, and volumes of I&I sources entering the system.	$80,000
c. Complete an I&I study – Utilize flow monitoring data, CSO monitoring data, WWTP flow data, televising data, field Investigations, etc. to prepare an I&I study consistent with state and federal requirements to assist in developing a project plan.	$40,000
d. Complete a Sanitary Sewer Evaluation Study to summarize I&I sources and make recommendations mitigating identified I&I. The identified mitigation measures would be utilized in developing a project plan.	$50,000
	$350,000

4. **Perform Hydraulic modeling and Prepare a Project Plan to Identify Alternatives and a Recommended Project to Eliminate CSO 018**

e. Perform hydraulic modeling to determine RTB Sizing, I&I reduction planning, and perform Cost Benefit analysis.	$70,000
f. Prepare Project Plan or similar document summarizing the alternative analysis, cost benefit analysis and the recommended proposed project consistent with state and federal requirements. This plan will identify a recommended plan to eliminate CSO 018 utilizing a combination of in-system storage and I/I reduction.	$50,000
	$120,000

Estimated Total Costs to Fully Inventory and Analyze the system and Prepare a Project Plan to Eliminate CSO 018	**$2,810,000**

DRAFT

We have prepared this preliminary scope and estimated costs based upon information available to us today. Significant field work will be completed during the summer and fall of 2016, as part of the SAW grant, that may provide more insight and background for preparing a project plan to eliminate CSO 018. These preliminary estimates of cost are to assist the City in identifying and pursuing potential sources of funding. More detail breakdowns of work, quoted pricing, etc. can be provided as specific funding sources are identified.

If you have any questions or require additional information please contact me at any time.

Sincerely,

Shawn P. Middleton, P.E.
Spicer Group Inc.

Cell Phone (989) 928-8027

DRAFT

1932 Interceptor Sewer – CSOs Installed

Consequences of Removing

Combined Sewer Overflow (CSO) 018

Removing CSO 018 prior to mitigating or storing excess inflow and infiltration (I&I) or increasing the capacity at the wastewater treatment plant (WWTP) would have significant impacts on the wastewater collection and treatment system. These impacts include but are not limited to: sanitary sewer overflows, residential basement flooding, hydraulic overload at the WWTP, reduced wastewater treatment efficiency, and discharges to Manistee Lake exceeding NPDES permit standards.

The Wastewater Treatment Plant has a design capacity of 1.3 MGD. Flows are currently running about .900 MGD. Under normal operational conditions, the plant operates very well meeting all NPDES permit requirements. The plant can handle up to 1.8 MGD for up to a four day period. Beyond this period of time, the WWTP's ability to treat wastewater is significantly diminished. .

When the flow into the plant reaches a sustained flow of 1.8 MGD for 90 minutes, SCADA starts calling out an alarm condition of high flows. Observations are made of the treatment process and samples of the sludge blankets are taken to get an understanding of the sludge inventory. When the flows reach 2.0 to 2.1 MGD, the return sludge process is discontinued. At a flow of 2.3 MGD the blowers for the aeration process are shut down for up to a five hour period. These steps are taken to attempt to settle solids in the tanks and maintain the biological population. Washout or losing the biological population over the effluent weir is a great reality when high flows are maintained for long periods of time. If high flows continue for up to the four day period then it is likely the biological population could be washed out of the plant. , It is anticipated it would take up to two weeks for the biological population to recover once the flows returned to normal. During this recovery period, it is more than likely the plant would be operating outside of NPDES permit limits and therefore in non-compliance with the NPDES permit.

The City's current practice is to limit flow through the plant when the metered flow reaches 2.3 MGD to mitigate the potential loss of the biological population. To limit these flows, an influent slide gate, located at the head of the plant, is partially closed. The influent slide gate is typically throttled to maintain an influent flow of 1.8 MGD or whatever the plant can handle. Under this condition, the plant is experiencing hydraulic overload. The excess flows that are restricted upstream of the influent slide gate currently back up in the main collection interceptor and ultimately discharge over the weir located in CSO 018, and from there, discharge to Manistee Lake. If CSO 018 were eliminated, these excess flows would continue to back up in the interceptor, causing surcharging of existing manholes, resulting in sanitary sewer overflows

(SSO) along the interceptor and branch collection sewers from the plant up to CSO 018 and beyond.

The other impact of eliminating CSO 018 during these periods of high flows is basement flooding. As the system surcharges due to excess flow, and without a relief at CSO 018, the hydraulic gradient in the system will reach an elevation greater than basement floor elevations. Without adequate check valves at these properties sewage will surcharge into basements. A hydraulic grade line analysis to determine the impacts of a typical CSO event in 2015 was performed to estimate the number of structures impacted if CSO 018 was eliminated. The attached map shows the approximate limits of impact during a typical 2015 CSO event. This map shows approximately 65 structures that could be impacted by the removal of CSO 018. In 2015, six CSO events were recorded at CSO 018. Four of these events would have likely resulted in the flooding depicted on the attached map.

In conclusion, the removal of CSO 018 without mitigating or storing excess inflow and infiltration (I&I) or increasing the capacity at the wastewater treatment plant (WWTP) would have significant impacts on the wastewater collection and treatment system. The WWTP treatment capacity would be exceeded resulting in the plant not being able to meet NPDES permit parameters including, but not limited to: BOD, Suspended Solids, Phosphorus, Ammonia, Bacteria and high solids content in the effluent, having a detrimental effect on Manistee Lake. Additionally, not having CSO 018 as a relief on the wastewater collection system would result in basement flooding, surcharging of sanitary manholes and sanitary sewer overflows.

LEGEND

- Contours
- HGL
- Impacted Manholes
- Impacted Sewers
- Buildings Impacted
- Parcels

Sanitary Sewer

- Gravity
- Force Main
- Sanitary Pump Station
- Sanitary Manholes

NOTES:

1. Sanitary sewer shown on this map is a combination of surveyed structures and pipes from a previous GIS system build provided by Infogrphics and approximately located pipes and structures from a City sewer system CAD map provided by Abonmarche.

2. Contour elevations were generated from survey field data collected in 2015.

MANISTEE FLOW MONITORING
CITY OF MANISTEE, MICHIGAN

SANITARY SEWER MAP
CSO DISCONNECT IMPACTS

Spicer group ©2014
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DE. BY: RCE DR. BY: RCE	CH. BY: BOH APP. BY: BOH	PROJECT NO. 120924SG2013-26
STDS.	SHEET 01 OF 01	
DATE: 10/09/2015 SCALE : 1 " = 100 '	FILE NO.	

PLOTTED BY: ELLENARC 10/09/2015 11:29 AM FILE LOCATION: E:\Dropbox\12092413-008_NPDES Permitting\Assistance_CAD_GIS\GIS\CSO Backup Check\CSO Map.mxd

Summary of CSO Events - 2014 - 2016

Discharge Began (Date)	Discharge Duration (Hours)	Precipitation Amount Reported on MDEQ Website (Inches)	Precipitation Amount - Rainwise gaunge taken from website (Inches)	Total CSO Volume (MG)	CSO as % of Annual Wastewater Treated at the WWTP	Average Wastewater Flow at WWTP - from Water/ Sewer Billings (MGD)	Flow at WWTP During CSO Event - Assume Max Day Reading (MGD)	Flow per Capita per Day (GPCD)	Flow at WWTP During CSO Event - Assume Max Day Reading (GPM)	Volume of WW Conveyed to CSO 018 +WWTP during CSO Event using Water/Sewer Billing (MG)	Total Combined Flow at the WWTP During the CSO Event (MG)	Total Combined Flow CSO +WWTP Flow Volume (MG)	Estimated Inflow - CSO & Max Inflow Less Avg Day Flow (MG)	Inflow as a percent of Avg Daily Flow	Total Combined WWTP and CSO average Flowrate (GPM)	Total Combined WWTP and CSO Average Flowrate (CFS)	CSO Peak Flowrate (GPM)	Total Combined WWTP and CSO Peak Flowrate (GPM)	Total Combined WWTP and CSO Peak Flowrate (CFS)	Hydraulic Grade Line slope within 36" Sewer from CSO 018 to the WWTP for Peak Flow	Additional Head at CSO 018 resulting from Peak flow through 36" sewer flowing full	Estimated HGL if contained within pipe (Feet)	% of Wastewater in Combined Flows at CSO 018	Actual Wastewater Discharged to Lake Manistee over CSO 018 (MG)	CSO Wastewater as % of Annual Wastewater Treated at the WWTP	% of Raw Sewage in Combined Flows at CSO 018, Assume 35% of Wastewater is Sewage	Actual Sewage Discharged to Lake Manistee over CSO 018 (MG)	Sewage as % of Annual Wastewater Treated at the WWTP
								6300																				
1/31/2016	33.0	0.37	0.02	1.78	0.5%	1.226	**1.744**	277	1211	1.69	2.40	4.18	2.49	148%	2110	4.7	2083	3294	7.3	0.60%	19	602	40.3%	0.72	0.2%	14.1%	0.25	0.06%
2/20/2016	32.0	0.08	0.10	1.27	0.3%	1.226	**1.744**	277	1211	1.63	2.33	3.60	1.96	120%	1873	4.2	2178	3389	7.6	0.64%	20	603	45.5%	0.58	0.1%	15.9%	0.20	0.05%
3/27/2016	49.0	0.13	0.28	2.28	0.6%	1.226	**1.744**	277	1211	2.50	3.56	5.84	3.34	133%	1987	4.4	2250	3461	7.7	0.66%	21	604	42.9%	0.98	0.2%	15.0%	0.34	0.08%
3/30/2016	97.0	1.36	2.57	12.39	3.2%												6059											
		1.94	**2.97**	**17.72**	**4.6%**																							
					1.66	5	331283.422		575.572	**7.605220901**																		
12/16/2015	6.0	0.1	0.16	0.37	0.1%	1.226	**1.744**	**277**	1211	0.31	0.44	0.81	0.50	163%	2239	5.0	1870	3081	6.9	0.53%	17	600	38.0%	0.14	0.0%	13.3%	0.05	0.01%
12/14/2015	46.0	1.55	1.13	5.62	1.5%	1.226	**1.744**	**277**	1211	2.35	3.34	8.96	6.61	281%	3247	7.2	4400	5611	12.5	1.75%	56	639	26.2%	1.47	0.3%	9.2%	0.52	0.12%
11/24/2015	21.2	1.81	2.21	4.46	1.2%	0.992	1.703	**270**	1183	0.87	1.50	5.96	5.09	581%	4694	10.5	10000	11183	24.9	6.94%	222	805	14.7%	0.65	0.2%	5.1%	0.23	0.05%
8/2/2015	3.6	1.6	0.03	0.48	0.1%	0.831	1.03	**163**	715	0.12	0.15	0.63	0.51	409%	2937	6.5	5300	6015	13.4	2.01%	64	647	19.6%	0.09	0.0%	6.9%	0.03	0.01%
~~7/13/2015~~	23.6	2.82	0.00	3.80	1.0%	1.056	1.626	**258**	1129	1.04	1.60	5.40	4.36	420%	3813	8.5	31000	32129	71.6	57.27%	1833	2416	19.2%	0.73	0.2%	6.7%	0.26	0.06%
~~6/12/2015~~	79.8	2.28	2.24	3.76	1.0%	1.174	1.749	**278**	1215	3.90	5.82	9.58	5.67	145%	2000	4.5	4300	5515	12.3	1.69%	54	637	40.8%	1.53	0.4%	14.3%	0.54	0.12%
~~5/26/2015~~	1.4	0.99	1.02	0.15	0.0%	1.048	1.507	**239**	1047	0.06	0.09	0.24	0.18	289%	2832	6.3	2000	3047	6.8	0.51%	16	599	25.7%	0.04	0.0%	9.0%	0.01	0.00%
~~4/9/2015~~	27.5	0.96	1.29	2.43	0.6%	1.277	1.733	**275**	1203	1.46	1.99	4.42	2.95	202%	2676	6.0	3600	4803	10.7	1.28%	41	624	33.1%	0.81	0.2%	11.6%	0.28	0.07%
3/17/2015	58.5	0.01	0.01	1.11	0.3%	1.418	1.759	**279**	1222	3.46	4.29	5.40	1.94	56%	1538	3.4	1160	2382	5.3	0.31%	10	593	**64.0%**	0.71	0.2%	22.4%	0.25	0.06%
		12.12	**8.09**	**22.18**	**5.7%**	**1.139**	**1.622**	**257**	**1126**	**13.58**	**19.21**	**41.39**	**27.81**	**283%**	**2886**	**6.4**	**7070**	**8196**	**18.3**	**8.0%**			**32.8%**	**6.18**	**1.4%**	**11.5%**	**2.16**	**0.50%**
11/24/2014	186.00	1.89		11.51	2.7%	0.569	1.760	279	1222	4.41	13.64	25.15	20.74	470%	2254	5.0	4732			0.28%			17.5%	2.02	0.5%	6.1%	0.71	0.2%
10/14/2014	62.43	3.14		5.72	1.3%	0.663	1.778	282	1235	1.72	4.63	10.35	8.62	500%	2762	6.2				0.42%			16.7%	0.95	0.2%	5.8%	0.33	0.1%
10/3/2014	29.75	3.76		3.74	0.9%	0.663	1.778	282	1235	0.82	2.20	5.94	5.12	623%	3330	7.4				0.62%			13.8%	0.52	0.1%	4.8%	0.18	0.0%
9/5/2014	12.00	2.72		0.685	0.2%	0.621	1.555	247	1080	0.31	0.78	1.46	1.15	371%	2031	4.5				0.23%			21.2%	0.15	0.0%	7.4%	0.05	0.0%
6/17/2014	35.50	2.03		0.45	0.1%	0.657	1.605	255	1115	0.97	2.37	2.82	1.85	191%	1326	3.0				0.10%			34.4%	0.15	0.0%	12.0%	0.05	0.0%
5/9/2014	8.00	0.57		0.3	0.1%	0.673	1.698	270	1179	0.22	0.57	0.87	0.64	286%	1804	4.0				0.18%			25.9%	0.08	0.0%	9.1%	0.03	0.0%
4/11/2014	176.00	3.16		10.1	2.3%	1.325	1.735	275	1205	9.72	12.72	22.82	13.10	135%	2161	4.8				0.26%			42.6%	4.30	1.0%	14.9%	1.51	0.4%
3/27/2014	352.00	1.49		14	3.3%	0.696	1.727	274	1199	10.21	25.33	39.33	29.12	285%	1862	4.1				0.19%			26.0%	3.64	0.8%	9.1%	1.27	0.3%
3/20/2014	12.00	Snowmelt		0.25	0.1%	0.696	1.727	274	1199	0.35	0.86	1.11	0.77	220%	1547	3.4				0.13%			31.3%	0.08	0.0%	10.9%	0.03	0.0%
		18.76		**46.755**	**10.9%**	**0.729**	**1.707**	**271**	**1185**	**28.75**	**63.10**	**109.86**	**81.11**	**342%**	**2120**								**26.2%**	**11.88**	**2.8%**	**9.2%**	**4.16**	**1.0%**
	25Y-24H:	4.5		Inches																								

Volume calculated using data from Transducer measurements

Data used in SSOAP to estimate Inflow Volumes

ate/ Recurrence

City of Manistee CSO Estimate Worksheet - CSO #018 (5th St and Ramsdell St)

CSO Weir

Tansducer Weir Crest Height (Feet):	0.940		See Transducer Check Tab
Weir Length (Feet):	31		Estimated from Williams and Works Drawings circa 1938
Weir Coefficient:	3.087		Broad crested weir, not submerged
MH Rim at Transducer:	590.69	Feet	Survey (2016-2-3)
MH Rim at West MH:	590.78	Feet	Survey (2016-2-3)
West MH Wes edge Lip (Measurement Point)	590.65	Feet	Survey (2016-2-3)
Distance from MH Lip to Weir:	8.88	Feet	Survey (2016-2-3)
Distance from MH Lip to Weir:	106.56	Inches	Survey (2016-2-3)
Weir Crest Elevation:	581.77	Feet	Survey (2016-2-3)

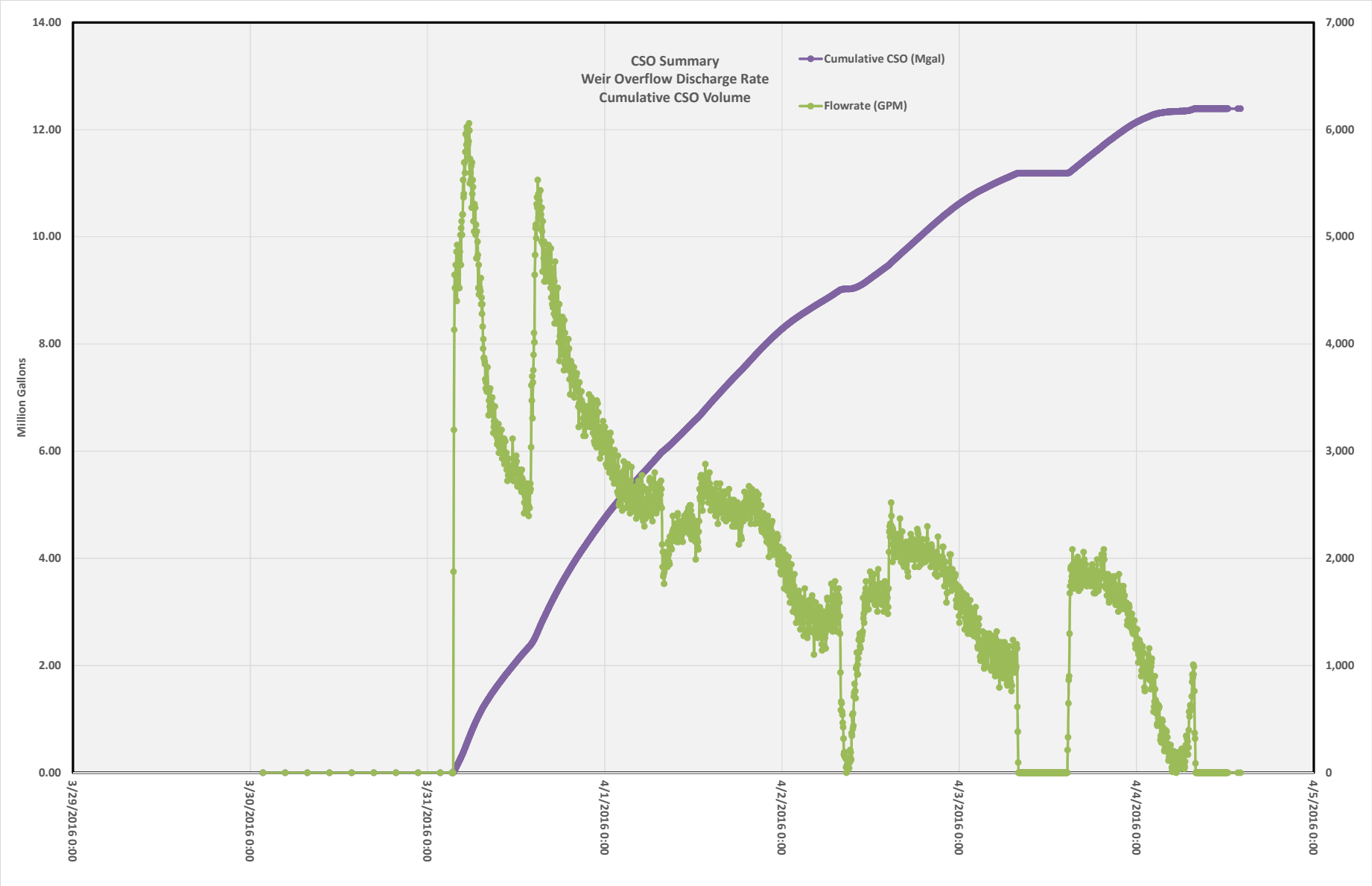
Outlet Pipe

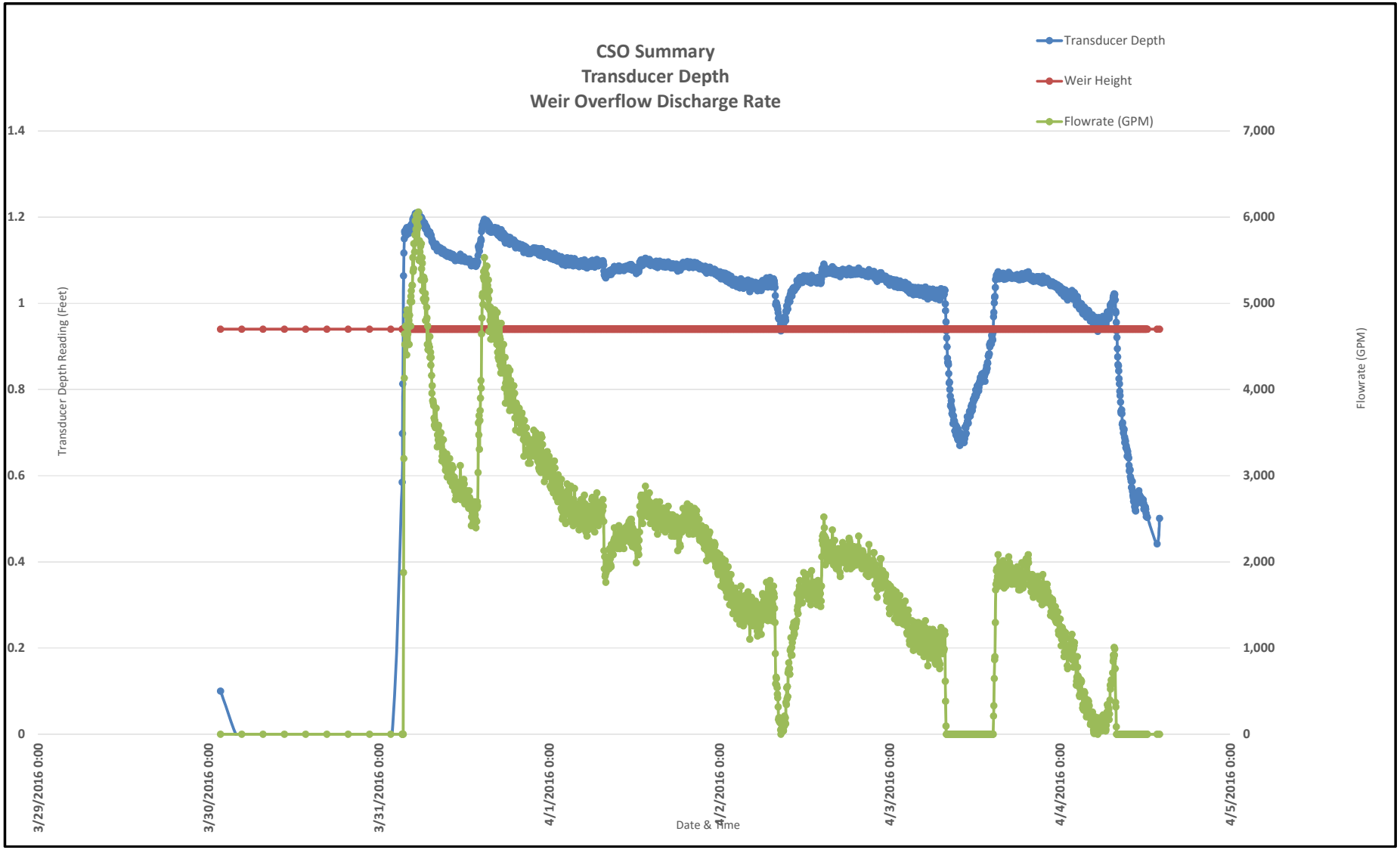
Storm Outlet Pipe Diameter from CSO Basin (Inches):	48.0	
Assumed Pipe/ Orifice Diameter based on Sediment in Pipe (Inches):	42.0	25% Sediment approxa 42" Diam.
Pipe/ Orifice Diameter (Feet):	3.5	
Orifice Coefficient:	0.6	
Manning's n Coefficient:	0.015	Concrete Pipe with Bottom covered in Sediment
Pipe Length (Feet)	440	CSO #018 to Lk = 440 ft -48", 310 ft -54", 360 ft - 66"x66" box , Assume 48" controls
48" Upstream Pipe Invert (Feet):	577.5	1988 Dwg = 577.5, 1938 Dwg = 581.75 (Confirm with Survey, scan?)
Weir Crest Elevation (Feet):	581.77	Surveyed MH Rim, 106" measured down to Rim, 1988 Dwg = 583.5 Feet, 1938 Dwg =585.15
Downstream HGL (Feet):	580.0	Manistee Lake/ Lake Michigan Level - July 2015
Centerline of US End of Pipe(Feet):	579.3	
End Area of Outlet Pipe (Sq. Ft.):	9.62	76%
Hydraulic Radius (Ft):	0.88	of End Area of 48" for Sediment
Unrestricted Flowing full capacity of 30" and 20" Storm Inlet Sewers (CFS):	60.0	Flowing Free w/o TW(30"W@ 0.5%=47 CFS, 24"E@0.5%=16CFS), 30"Aband? 1988 Dwg
Assumed flow from 30" and 20" Storm Inlet Sewers during Event (CFS):	40.0	

Data from Tranducer Data Log

Calculated Values

Date and Time	Elapsed Time (Seconds)	Transducer Pressure Reading from Data Log (PSI)	Transducer Temperature Reading from Data Log (Degrees F)	Transducer Depth Reading from Data Log (Feet)	Water Height (Head) above Weir (Feet)	Water Height (Head) Above Weir (Inches)	Water Surface Elevation (Feet)	CSO Weir Flowrate/ Discharge (CFS)	48" Inlet Control Head on Inlet Orifice (Feet)	48" Inlet Control Inlet (Orifice) Flow (CFS)	48" Outlet Control Hydraulic Gradient (FT/FT)	48" Outlet Control Outlet (Mannings) Control Flow (CFS)	48"Controlling Flowrate Less 36" Inflow (CFS)	**Controlling Flowrate for CSO Estimatation (CFS)**	Flowrate/ Discharge (GPM)	Flowrate/ Discharge (MGD)	Incremental Volume (CFT)	Incremental Volume (Gallons)	Cumulative Volume (CFT)	Cumulative Volume (MGal)	Transducer Weir Crest (Feet)
MAX VALUES:		**0.524**	**49.2**	**1.211**	**0.271**	**3.25**	**582.04**	**13.5**	**2.79**	**77.39**	**0.00**	**59.39**	**19.39**	**13.50**	**6059**	**8.73**	**2430**	**18178**	**1656725**	**12.39**	**0.940**
0																					
3/30/2016 1:44	32726012.77	0.043	48.18	0.1	0.000	0.00	581.77	0.0	2.52	73.5	0.00	55.3	15.3	**0.0**	0	0.00	0	0	0	0.00	0.940
3/30/2016 4:44	32736812.77	-0.012	47.766	-0.027	0.000	0.00	581.77	0.0	2.52	73.5	0.00	55.3	15.3	**0.0**	0	0.00	0	0	0	0.00	0.940
3/30/2016 7:44	32747612.77	-0.013	47.498	-0.03	0.000	0.00	581.77	0.0	2.52	73.5	0.00	55.3	15.3	**0.0**	0	0.00	0	0	0	0.00	0.940
3/30/2016 10:44	32758412.77	-0.012	47.471	-0.028	0.000	0.00	581.77	0.0	2.52	73.5	0.00	55.3	15.3	**0.0**	0	0.00	0	0	0	0.00	0.940
3/30/2016 13:44	32769212.77	-0.013	47.786	-0.029	0.000	0.00	581.77	0.0	2.52	73.5	0.00	55.3	15.3	**0.0**	0	0.00	0	0	0	0.00	0.940
3/30/2016 16:44	32780012.77	-0.012	47.876	-0.028	0.000	0.00	581.77	0.0	2.52	73.5	0.00	55.3	15.3	**0.0**	0	0.00	0	0	0	0.00	0.940
3/30/2016 19:44	32790812.77	-0.013	47.891	-0.031	0.000	0.00	581.77	0.0	2.52	73.5	0.00	55.3	15.3	**0.0**	0	0.00	0	0	0	0.00	0.940
3/30/2016 22:44	32801612.77	-0.012	48.073	-0.028	0.000	0.00	581.77	0.0	2.52	73.5	0.00	55.3	15.3	**0.0**	0	0.00	0	0	0	0.00	0.940
3/31/2016 1:44	32812412.77	-0.014	47.422	-0.032	0.000	0.00	581.77	0.0	2.52	73.5	0.00	55.3	15.3	**0.0**	0	0.00	0	0	0	0.00	0.940
3/31/2016 3:20	32818172.77	0.253	46.889	0.585	0.000	0.00	581.77	0.0	2.52	73.5	0.00	55.3	15.3	**0.0**	0	0.00	0	0	0	0.00	0.940
3/31/2016 3:23	32818352.77	0.302	46.843	0.698	0.000	0.00	581.77	0.0	2.52	73.5	0.00	55.3	15.3	**0.0**	0	0.00	0	0	0	0.00	0.940
3/31/2016 3:26	32818532.77	0.352	46.856	0.813	0.000	0.00	581.77	0.0	2.52	73.5	0.00	55.3	15.3	**0.0**	0	0.00	0	0	0	0.00	0.940
3/31/2016 3:29	32818712.77	0.407	46.778	0.94	0.000	0.00	581.77	0.0	2.52	73.5	0.00	55.3	15.3	**0.0**	0	0.00	0	0	0	0.00	0.940
3/31/2016 3:32	32818892.77	0.461	46.778	1.064	0.124	1.49	581.89	4.2	2.64	75.3	0.00	57.2	17.2	**4.2**	1,875	2.70	752	5,626	752	0.01	0.940
3/31/2016 3:35	32819072.77	0.484	46.896	1.117	0.177	2.12	581.95	7.1	2.70	76.1	0.00	58.0	18.0	**7.1**	3,198	4.61	1,283	9,595	2,035	0.02	0.940
3/31/2016 3:38	32819252.77	0.498	47.085	1.15	0.210	2.52	581.98	9.2	2.73	76.5	0.00	58.5	18.5	**9.2**	4,133	5.95	1,658	12,400	3,693	0.03	0.940
3/31/2016 3:41	32819432.77	0.505	47.093	1.167	0.227	2.72	582.00	10.3	2.75	76.8	0.00	58.7	18.7	**10.3**	4,645	6.69	1,863	13,936	5,556	0.04	0.940
3/31/2016 3:44	32819612.77	0.504	47.105	1.163	0.223	2.68	581.99	10.1	2.74	76.7	0.00	58.7	18.7	**10.1**	4,523	6.51	1,814	13,569	7,369	0.06	0.940
3/31/2016 3:47	32819792.77	0.504	47.303	1.163	0.223	2.68	581.99	10.1	2.74	76.7	0.00	58.7	18.7	**10.1**	4,523	6.51	1,814	13,569	9,183	0.07	0.940
3/31/2016 3:50	32819972.77	0.507	47.352	1.17	0.230	2.76	582.00	10.6	2.75	76.8	0.00	58.8	18.8	**10.6**	4,738	6.82	1,900	14,213	11,083	0.08	0.940
3/31/2016 3:53	32820152.77	0.506	47.386	1.167	0.227	2.72	582.00	10.3	2.75	76.8	0.00	58.7	18.7	**10.3**	4,645	6.69	1,863	13,936	12,946	0.10	0.940
3/31/2016 3:56	32820332.77	0.509	47.204	1.174	0.234	2.81	582.00	10.8	2.75	76.9	0.00	58.8	18.8	**10.8**	4,862	7.00	1,950	14,586	14,896	0.11	0.940
3/31/2016 3:59	32820512.77	0.502	47.2	1.159	0.219	2.63	581.99	9.8	2.74	76.7	0.00	58.6	18.6	**9.8**	4,402	6.34	1,765	13,206	16,662	0.12	0.940
3/31/2016 4:02	32820692.77	0.509	47.289	1.176	0.236	2.83	582.01	11.0	2.76	76.9	0.00	58.9	18.9	**11.0**	4,924	7.09	1,975	14,773	18,637	0.14	0.940
3/31/2016 4:05	32820872.77	0.505	47.28	1.167	0.227	2.72	582.00	10.3	2.75	76.8	0.00	58.7	18.7	**10.3**	4,645	6.69	1,863	13,936	20,500	0.15	0.940
3/31/2016 4:08	32821052.77	0.505	47.402	1.167	0.227	2.72	582.00	10.3	2.75	76.8	0.00	58.7	18.7	**10.3**	4,645	6.69	1,863	13,936	22,363	0.17	0.940
3/31/2016 4:11	32821232.77	0.504	47.319	1.163	0.223	2.68	581.99	10.1	2.74	76.7	0.00	58.7	18.7	**10.1**	4,523	6.51	1,814	13,569	24,176	0.18	0.940
3/31/2016 4:14	32821412.77	0.504	47.175	1.163	0.223	2.68	581.99	10.1	2.74	76.7	0.00	58.7	18.7	**10.1**	4,523	6.51	1,814	13,569	25,990	0.19	0.940
3/31/2016 4:17	32821592.77	0.508	47.246	1.172	0.232	2.78	582.00	10.7	2.75	76.9	0.00	58.8	18.8	**10.7**	4,800	6.91	1,925	14,399	27,915	0.21	0.940
3/31/2016 4:20	32821772.77	0.504	47.325	1.163	0.223	2.68	581.99	10.1	2.74	76.7	0.00	58.7	18.7	**10.1**	4,523	6.51	1,814	13,569	29,729	0.22	0.940
3/31/2016 4:23	32821952.77	0.508	47.36	1.174	0.234	2.81	582.00	10.8	2.75	76.9	0.00	58.8	18.8	**10.8**	4,862	7.00	1,950	14,586	31,679	0.24	0.940
3/31/2016 4:26	32822132.77	0.507	47.4	1.17	0.230	2.76	582.00	10.6	2.75	76.8	0.00	58.8	18.8	**10.6**	4,738	6.82	1,900	14,213	33,579	0.25	0.940
3/31/2016 4:29	32822312.77	0.51	47.323	1.179	0.239	2.87	582.01	11.2	2.76	76.9	0.00	58.9	18.9	**11.2**	5,019	7.23	2,013	15,056	35,592	0.27	0.940
3/31/2016 4:32	32822492.77	0.507	47.28	1.17	0.230	2.76	582.00	10.6	2.75	76.8	0.00	58.8	18.8	**10.6**	4,738	6.82	1,900	14,213	37,492	0.28	0.940
3/31/2016 4:35	32822672.77	0.511	47.394	1.181	0.241	2.89	582.01	11.3	2.76	77.0	0.00	58.9	18.9	**11.3**	5,082	7.32	2,038	15,245	39,530	0.30	0.940
3/31/2016 4:38	32822852.77	0.512	47.366	1.183	0.243	2.92	582.01	11.5	2.76	77.0	0.00	59.0	19.0	**11.5**	5,145	7.41	2,063	15,435	41,593	0.31	0.940
3/31/2016 4:41	32823032.77	0.511	47.396	1.179	0.239	2.87	582.01	11.2	2.76	76.9	0.00	58.9	18.9	**11.2**	5,019	7.23	2,013	15,056	43,606	0.33	0.940
3/31/2016 4:44	32823212.77	0.513	47.382	1.185	0.245	2.94	582.02	11.6	2.76	77.0	0.00	59.0	19.0	**11.6**	5,209	7.50	2,089	15,626	45,695	0.34	0.940
3/31/2016 4:47	32823392.77	0.513	47.319	1.185	0.245	2.94	582.02	11.6	2.76	77.0	0.00	59.0	19.0	**11.6**	5,209	7.50	2,089	15,626	47,784	0.36	0.940


CSO Summary
Weir Overflow Discharge Rate
Cumulative CSO Volume
Cumulative CSO (Mgal)
Flowrate (GPM)
Million Gallons
14.00
12.00
10.00
8.00
6.00
4.00
2.00
0.00
7,000
6,000
5,000
4,000
3,000
2,000
1,000
0
3/29/2016 0:00
3/30/2016 0:00
3/31/2016 0:00
4/1/2016 0:00
4/2/2016 0:00
4/3/2016 0:00
4/4/2016 0:00
4/5/2016 0:00


CSO Summary
Transducer Depth
Weir Overflow Discharge Rate
Transducer Depth
Weir Height
Flowrate (GPM)
Transducer Depth Reading (Feet)
Flowrate (GPM)
1.4
1.2
1
0.8
0.6
0.4
0.2
0
7,000
6,000
5,000
4,000
3,000
2,000
1,000
0
3/29/2016 0:00
3/30/2016 0:00
3/31/2016 0:00
4/1/2016 0:00
4/2/2016 0:00
4/3/2016 0:00
4/4/2016 0:00
4/5/2016 0:00
Date & Time

CITY OF MANISTEE
MONTHLY ESTIMATE OF INFLOW AND INFILTRATION
2012-2015
2/11/2016

DRAFT - Working Copy

Columns/ Cells populated with data from City, other sources, and/or assumptions

Data still needed or needing to be verified.

Run Water Billing Information averaged for these months

	Water Production			Wastewater Treatment Plant (WWTP) / Combined Sewer Overflows (CSO's)								Estimated Sewer Flows - Based upon individual Water/ Sewer Billing Records (Adjusted for meter readings)																		
Date	Total Water Pumpage (1)			Total WWTP Flows (2)					Monthly CSO/SSO Total (3)	CSO as a percentage of Monthly Treated Wastewater	WWTP & CSO Total	Total Sewer Usage from Water/Sewer Billing Reports (4)			Adjustment for Large Meter Readings (5)		Additional Flows (Seers Report) - Water Usage Adjustment for small Meters (6)		Estimated Sewer Flows from Non-Metered or Non Revenue Sources (7)		Total Estimaed Sewer Usage from Billings including Adjustments for Meter Readings				ESTIMATED INFLOW/ INFILTRATION (WWTP Flows Less Adj Billed - Non Rev)				Monthly Rainfall (8)	Lake Level (IGLD88) Mich/ Manistee IGLD 1985 (Feet) (9)	
Month-Year	Total (MG)	Avg Day (MGD)	Avg (GPM)	Total (MG)	Avg Day (MGD)	Max Day (MGD)	Avg (GPM)	Max (GPM)	Total (MG)	(%)	Total (MG)	Total (MG)	Avg Day (MGD)	Avg (GPM)	Estimated Increase (MG)	Percent Increase (%)	Estimated Increase 7.0%	Estimated Increase (MG)	Estimated Increase 0.1%	Estimated Increase (MG)	Total (MG)	Avg Day (MGD)	Avg (GPM)	Total % Change	Estimated Total I/I (MG)	Estimated I/I Avg Day (MGD)	I/I Average (GPM)	% of WWTP Flows	Total Rainfall (Inches)	Monthly Mean Actual Level +/-	LongTerm Mean Level
Jan-12	21.4	0.690	479	28.12	0.907	1.293	630	898	0.848	3.0%	28.965	15.388	0.496	345	0.585	3.80%	7.00%	1.0772	0.10%	0.015	17.07	0.551	382	10.9%	11.899	0.384	267	42.3%	2.27	577.4	578.4
Feb-12	20.4	0.728	505	29.14	0.940	1.179	653	819	0.000	0.0%	29.140	16.554	0.591	411	0.585	3.53%	7.00%	1.1588	0.10%	0.017	18.31	0.654	454	10.6%	10.826	0.387	268	41.1%	1.25	577.3	578.4
Mar-12	21.4	0.689	479	35.65	1.150	1.617	799	1123	0.558	1.6%	36.208	22.282	0.719	499	0.702	3.15%	7.00%	1.5597	0.10%	0.022	24.57	0.792	550	10.3%	11.642	0.376	261	32.7%	2.50	577.4	578.4
Apr-12	23.5	0.784	545	27.34	0.882	1.527	613	1060	0.297	1.1%	27.639	16.250	0.542	376	0.639	3.93%	7.00%	1.1375	0.10%	0.016	18.04	0.601	418	11.0%	9.596	0.320	222	36.3%	2.16	577.5	578.7
May-12	33.2	1.071	744	30.38	0.980	1.649	681	1145	0.501	1.6%	30.881	18.280	0.590	409	0.477	2.61%	7.00%	1.2796	0.10%	0.018	20.05	0.647	449	9.7%	10.826	0.349	243	35.6%	2.11	577.6	579.0
Jun-12	37.7	1.258	873	21.82	0.704	0.933	489	648	0.040	0.2%	21.864	18.896	0.630	437	0.819	4.33%	7.00%	1.3227	0.10%	0.019	21.06	0.702	487	11.4%	0.807	0.027	19	3.8%	1.61	577.7	579.2
Jul-12	45.4	1.463	1,016	22.79	0.735	0.982	510	682	0.216	0.9%	23.001	20.952	0.676	469	1.152	5.50%	7.00%	1.4666	0.10%	0.021	23.59	0.761	528	12.6%	-0.591	(0.019)	-13	-2.6%	2.42	577.6	579.3
Aug-12	35.8	1.154	802	20.77	0.670	0.836	465	581	0.000	0.0%	20.770	21.425	0.691	480	1.341	6.26%	7.00%	1.4998	0.10%	0.021	24.29	0.783	544	13.4%	-3.517	(0.113)	-79	-16.9%	1.03	577.3	579.2
Sep-12	28.7	0.956	664	19.53	0.630	0.860	438	597	0.000	0.0%	19.530	15.186	0.490	340	1.485	9.78%	7.00%	1.0630	0.10%	0.015	17.75	0.573	398	16.9%	1.781	0.057	40	9.1%	2.63	577.0	579.1
Oct-12	23.5	0.759	527	27.53	0.888	1.762	617	1224	1.008	3.7%	28.536	13.908	0.464	322	0.864	6.21%	7.00%	0.9736	0.10%	0.014	15.76	0.525	365	13.3%	12.777	0.426	296	48.0%	6.21	576.6	578.8
Nov-12	17.7	0.591	410	19.81	0.639	0.777	444	540	0.000	0.0%	19.809	15.718	0.524	364	0.387	2.46%	7.00%	1.1003	0.10%	0.016	17.22	0.574	399	9.6%	2.588	0.086	60	13.5%	0.87	576.4	578.6
Dec-12	17.5	0.564	392	26.47	0.854	1.648	593	1144	0.032	0.1%	26.506	14.365	0.463	322	0.630	4.39%	7.00%	1.0056	0.10%	0.014	16.01	0.517	359	11.5%	10.491	0.338	235	39.6%	3.09	576.2	578.5
2012	**326.2**	**0.894**	**621**	**309.35**	**0.848**	**1.762**	**589**	**1224**	**3.50**	**1.1%**	**312.848**	**209.204**	**0.573**	**398**	**9.666**	**4.62%**	**7.00%**	**14.644**	**0.10%**	**0.209**	**233.72**	**0.640**	**444**	11.7%	**79.125**	**0.218**	**151**	**25.7%**	**28.15**	**577.2**	**578.8**
Jan-13	19.6	0.632	439	29.92	0.965	1.652	670	1147	0.500	1.7%	30.415	15.913	0.513	356	0.612	3.85%	7.00%	1.1139	0.10%	0.016	17.65	0.570	395	10.9%	12.760	0.412	286	42.7%	2.84	576.0	578.4
Feb-13	17.9	0.640	444	33.11	1.068	1.674	742	1163	0.192	0.6%	33.300	15.219	0.544	377	0.810	5.32%	7.00%	1.0653	0.10%	0.015	17.11	0.611	424	12.4%	16.190	0.578	402	54.1%	2.90	576.2	578.4
Mar-13	19.2	0.619	430	35.43	1.143	1.77	794	1229	0.870	2.5%	36.303	16.755	0.540	375	0.756	4.51%	7.00%	1.1729	0.10%	0.017	18.70	0.603	419	11.6%	17.602	0.568	394	49.7%	1.25	576.2	578.4
Apr-13	21.0	0.702	487	42.75	1.379	1.862	958	1293	3.419	8.0%	46.168	15.508	0.517	359	0.900	5.80%	7.00%	1.0856	0.10%	0.016	17.51	0.584	405	12.9%	28.659	0.955	663	69.3%	3.86	576.6	578.7
May-13	30.1	0.969	673	29.48	0.951	1.27	660	882	0.000	0.0%	29.481	17.685	0.570	396	0.567	3.21%	7.00%	1.2380	0.10%	0.018	19.51	0.629	437	10.3%	9.973	0.322	223	33.8%	2.53	577.2	579.0
Jun-13	33.4	1.112	772	24.89	0.803	1.238	558	860	0.200	0.8%	25.093	17.176	0.573	398	0.927	5.40%	7.00%	1.2023	0.10%	0.017	19.32	0.644	447	12.5%	5.771	0.192	134	24.0%	1.76	577.6	579.2
Jul-13	43.0	1.388	964	23.53	0.759	1.08	527	750	0.000	0.0%	23.529	19.979	0.644	448	1.053	5.27%	7.00%	1.3985	0.10%	0.020	22.45	0.724	503	12.4%	1.078	0.035	24	4.6%	1.32	577.7	579.3
Aug-13	40.6	1.310	910	23.72	0.765	1.214	531	843	0.000	0.0%	23.715	22.160	0.715	496	1.665	7.51%	7.00%	1.5512	0.10%	0.022	25.40	0.819	569	14.6%	-1.683	(0.054)	-38	-7.1%	2.24	577.7	579.2
Sep-13	33.7	1.124	781	21.61	0.697	0.786	484	546	0.000	0.0%	21.607	16.670	0.538	373	1.683	10.10%	7.00%	1.1669	0.10%	0.017	19.54	0.630	438	17.2%	2.070	0.067	46	9.6%	0.89	577.6	579.1
Oct-13	22.8	0.735	511	24.06	0.776	1.347	539	935	0.040	0.2%	24.096	14.776	0.493	342	0.999	6.76%	7.00%	1.0343	0.10%	0.015	16.82	0.561	389	13.9%	7.272	0.242	168	31.2%	5.50	577.5	578.8
Nov-13	18.2	0.605	420	32.86	1.06	1.725	736	1198	0.625	1.9%	33.485	15.735	0.525	364	0.495	3.15%	7.00%	1.1015	0.10%	0.016	17.35	0.578	402	10.2%	16.138	0.538	374	50.7%	5.30	577.5	578.6
Dec-13	21.5	0.693	481	29.57	0.954	1.428	663	992	0.000	0.0%	29.574	17.900	0.577	401	0.603	3.37%	7.00%	1.2530	0.10%	0.018	19.77	0.638	443	10.5%	9.800	0.316	220	33.1%	2.32	577.3	578.5
2013	**321.0**	**0.879**	**611**	**350.92**	**0.961**	**1.862**	**668**	**1293**	**5.85**	**1.7%**	**356.766**	**205.476**	**0.562**	**391**	**11.070**	**5.39%**	**7.00%**	**14.383**	**0.10%**	**0.205**	**231.13**	**0.633**	**439**	12.5%	**125.632**	**0.348**	**241**	**36.2%**	**32.71**	**577.1**	**578.8**
Jan-14	22.4	0.723	502	30.91	0.997	1.62	692	1125	0.000	0.0%	30.907	15.506	0.500	347	0.792	5.11%	7.00%	1.0854	0.10%	0.016	17.40	0.561	390	12.2%	13.508	0.436	303	43.7%	3.87	577.3	578.4
Feb-14	28.0	1.000	694	35.77	1.154	1.508	801	1047	0.000	0.0%	35.774	16.006	0.572	397	0.468	2.92%	7.00%	1.1204	0.10%	0.016	17.61	0.629	437	10.0%	18.164	0.649	450	56.2%	1.32	577.3	578.4
Mar-14	37.2	1.199	833	44.70	1.442	1.727	1001	1199	0.250	0.6%	44.952	19.577	0.632	439	0.621	3.17%	7.00%	1.3704	0.10%	0.020	21.59	0.696	484	10.3%	23.364	0.754	523	52.3%	1.84	577.3	578.4
Apr-14	29.9	0.996	692	47.15	1.521	1.735	1056	1205	24.172	51.3%	71.323	36.548	1.218	846	0.621	1.70%	7.00%	2.5584	0.10%	0.037	39.76	1.325	920	8.8%	31.559	1.052	731	69.2%	4.34	577.6	578.7
May-14	30.9	0.996	692	42.35	1.366	1.698	949	1179	0.300	0.7%	42.646	18.504	0.597	415	1.035	5.59%	7.00%	1.2953	0.10%	0.019	20.85	0.673	467	12.7%	21.793	0.703	488	51.5%	2.82	578.3	579.0
Jun-14	39.4	1.313	912	32.49	1.048	1.605	728	1115	0.450	1.4%	32.938	17.699	0.590	410	0.756	4.27%	7.00%	1.2389	0.10%	0.018	19.71	0.657	456	11.4%	13.226	0.441	306	42.1%	3.49	578.7	579.2
Jul-14	42.8	1.382	960	28.43	0.917	1.229	637	853	0.000	0.0%	28.427	20.416	0.659	457	0.855	4.19%	7.00%	1.4291	0.10%	0.020	22.72	0.733	509	11.3%	5.706	0.184	128	20.1%	1.37	578.9	579.3
Aug-14	39.9	1.286	893	25.76	0.831	1.03	577	715	0.000	0.0%	25.761	21.651	0.698	485	1.287	5.94%	7.00%	1.5156	0.10%	0.022	24.48	0.790	548	13.0%	1.286	0.041	29	5.0%	1.55	579.0	579.2
Sep-14	30.4	1.013	703	27.96	0.902	1.555	626	1080	0.685	2.4%	28.647	16.423	0.530	368	1.665	10.14%	7.00%	1.1496	0.10%	0.016	19.25	0.621	431	17.2%	9.393	0.303	210	33.6%	4.05	579.1	579.1
Oct-14	23.6	0.761	529	39.37	1.27	1.778	882	1235	0.500	1.3%	39.870	17.481	0.583	405	1.170	6.69%	7.00%	1.2237	0.10%	0.017	19.89	0.663	460	13.8%	19.978	0.666	462	52.4%	7.36	579.2	578.8
Nov-14	21.5	0.718	498	39.65	1.279	1.76	888	1222	0.000	0.0%	39.649	15.337	0.511	355	0.648	4.23%	7.00%	1.0736	0.10%	0.015	17.07	0.569	395	11.3%	22.575	0.753	523	58.8%	4.39	579.2	578.6
Dec-14	22.2	0.717	498	37.08	1.196	1.706	831	1185	11.500	31.0%	48.576	18.179	0.586	407	0.333	1.83%	7.00%	1.2725	0.10%	0.018	19.80	0.639	444	8.9%	28.773	0.928	645	77.6%	0.93	579.2	578.5
2014	**368.2**	**1.009**	**700**	**431.61**	**1.183**	**1.778**	**821**	**1235**	**37.86**	**8.8%**	**469.470**	**233.327**	**0.640**	**444**	**10.251**	**4.39%**	**7.00%**	**16.333**	**0.10%**	**0.233**	**260.14**	**0.713**	**495**	11.5%	**209.326**	**0.576**	**400**	**48.7%**	**37.33**	**578.4**	**578.8**
Jan-15	23.4	0.754	523	28.30	0.913	1.038	634	721	0.00	0.0%	28.303	15.181	0.490	340	0.585	3.85%	7.00%	1.0627	0.10%	0.015	16.84	0.543	377	11.0%	11.459	0.370	257	40.5%	1.31	579.1	578.4
Feb-15	23.6	0.843	585	27.06	0.873	1.221	606	848	0.00	0.0%	27.063	15.191	0.543	377	0.0	0.00%	7.00%	1.0634	0.10%	0.015	16.27	0.581	404	7.1%	10.793	0.385	268	44.2%	1.13	579.1	578.4
Mar-15	44.9	1.448	1,006	43.96	1.418	1.759	985	1222	1.11	2.5%	45.068	31.743	1.024	711	0.0	0.00%	7.00%	2.2220	0.10%	0.032	34.00	1.097	762	7.1%	11.071	0.357	248	25.2%	0.80	579.2	578.4
Apr-15	25.9	0.862	599	38.31	1.277	1.733	887	1203	2.43	6.3%	40.740	17.757	0.592	411	0.0	0.00%	7.00%	1.2430	0.10%	0.018	19.02	0.634	440	7.1%	21.722	0.724	503	56.7%	2.63	579.3	578.7
May-15	29.6	0.954	663	32.49	1.048	1.507	728	1047	0.15	0.5%	32.638	17.802	0.574	399	0.0	0.00%	7.00%	1.2461	0.10%	0.018	19.07	0.615	427	7.1%	13.572	0.438	304	41.8%	3.85	579.5	579.0
Jun-15	31.7	1.056	733	36.39	1.174	1.749	815	1215	3.76	10.3%	40.154	17.409	0.562	390	0.0	0.00%	7.00%	1.2186	0.10%	0.017	18.65	0.601	418	7.1%	21.509	0.694	482	59.1%	3.99	579.8	579.2
Jul-15	39.3	1.268	881	32.74	1.056	1.626	733	1129	3.80	11.6%	36.536	24.121	0.778	540	0.0	0.00%	7.00%	1.6885	0.10%	0.024	25.83	0.833	579	7.1%	10.702	0.345	240	32.7%	3.95	579.9	579.3
Aug-15	35.1	1.132	786	29.23	0.943	1.376	655	956	0.48	0.0%	29.713	21.243	0.685	476	0.0	0.00%	7.00%	1.4870	0.10%	0.021	22.75	0.734	510	7.1%	6.962	0.225	156	23.8%	3.93	579.8	579.2
Sep-15	29.0	0.967	672	27.31	0.881	1.200	612	833	0.00	0.0%	27.311	16.993	0.548	381	0.0	0.00%	7.00%	1.1895	0.10%	0.017	18.20	0.587	408	7.1%	9.111	0.294	204	33.4%	2.57	579.8	579.1
Oct-15	24.0	0.774	538	24.74	0.798	0.986	554	685	0.00	0.0%	24.738	17.112	0.552	383	0.0	0.00%	7.00%	1.1978	0.10%	0.017	18.33	0.591	411	7.1%	6.411	0.207	144	25.9%	2.12	579.4	578.8
Nov-15	20.2	0.673	468	30.75	0.992	1.703	689	1183	4.64	15.1%	35.392	18.298	0.590	410	0.0	0.00%	7.00%	1.2809	0.10%	0.018	19.60	0.632	439	7.1%	15.795	0.510	354	51.4%	4.42	579.2	578.6
Dec-15	21.2	0.683	475	38.01	1.226	1.744	851	1211	5.99	15.8%	43.996	20.004	0.645	448	0.0	0.00%	7.00%	1.4003	0.10%	0.020	21.42	0.691	480	7.1%	22.572	0.728	506	59.4%	4.11	579.3	578.5
2015	**347.8**	**0.953**	**662**	**389.29**	**1.067**	**1.759**	**741**	**1222**	**22.36**	**5.7%**	**411.652**	**232.854**	**0.632**	**439**	**0.585**	**0.25%**	**7.00%**	**16.300**	**0.10%**	**0.233**	**249.97**	**0.678**	**471**	**7.4%**	**161.680**	**0.440**	**305**	**41.2%**	**34.81**	**579.4**	**578.8**

(1) Total Monthly Pumpage Volumes obtained from Water Monthly Operating Reports - Sum of all Well Pumpage for the month

(2) Monthly Average Day and Max Day flows were taken from Wastewater Monthly Operating Reports

(3) Combined Sewer Overflow (CSO) taken from Monthly Wastewarter Operating Reports

(4) Total Sewer Flows were obtained from Water/Sewer Monthly Billing Reports -
Sewer flows for the month were provided for only flows that would enter the sanitary sewer system, includes adjustments for Compound meters

(5) Large meters that have historically read low by a factor of 10. Sum of known meter reading differences and adjustments on compound meter readings

(6) Small meters have been adjusted 7% +/- overall based on recent meter efficiency study and assuming an overall average

(7) Estimated sewage flows from sources that are not metered (i.e. Muncipal restrooms, Buildings, Etc.)

(8) Monthly Rainfall Totals summed from daily rainfall totals on Monthly Wastewater Operating Reports

(9) Monthly Lake Levels obtained from United States Army Corp of Engineers historical records

(10) Sum of Flow Meter Data seen at Flow Meters 6,7,8 and 12

2.21 Inches in Jan

Avg Rainfall in Manistee: 34.7 Inches

PREPARED BY: SPICER GROUP INC.

Flow Monitoring Summary Table - 2015 Flow Monitoring by District

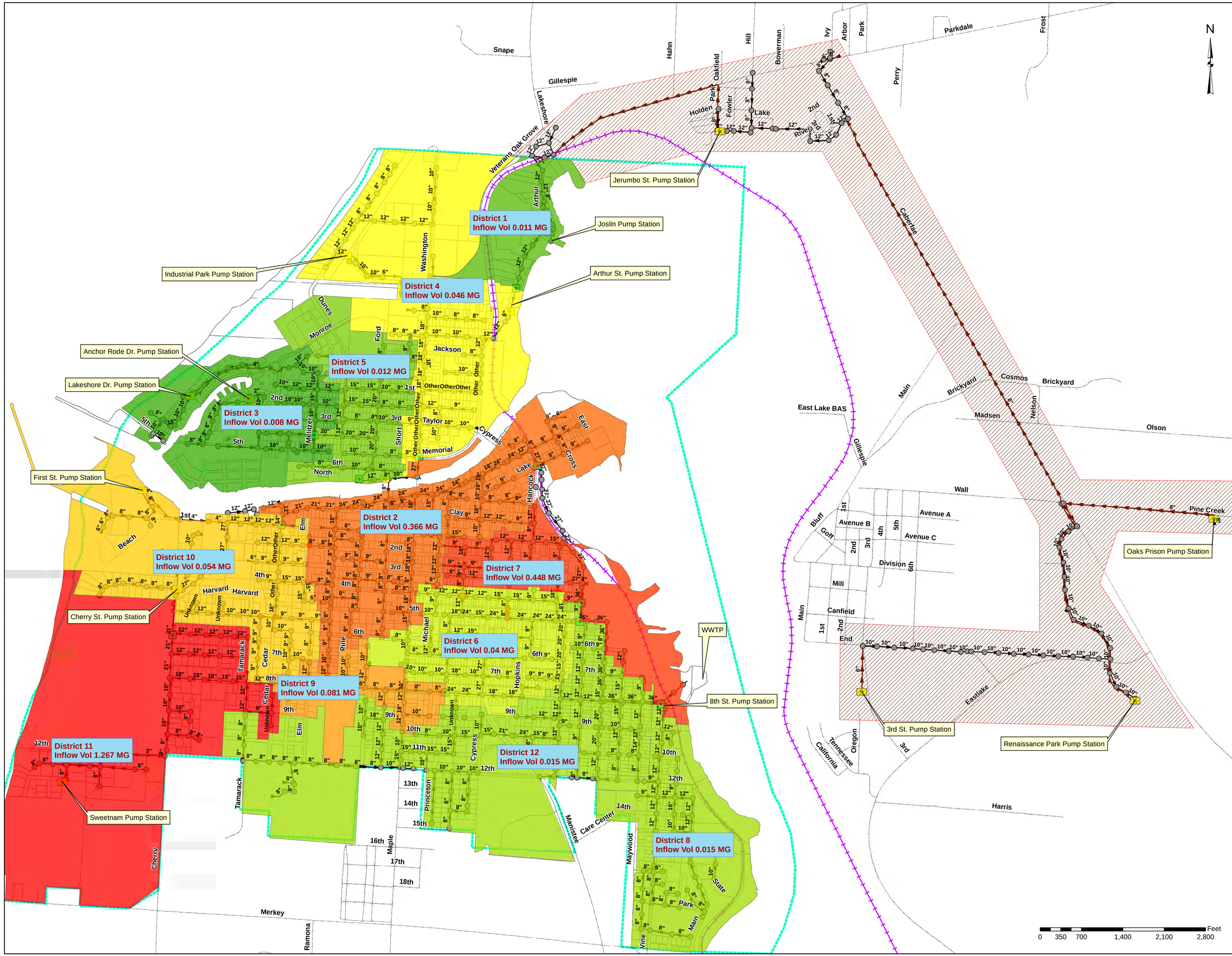
		Infiltration Estimate *				Inflow Estimate **		
Flow District	**Upstream Districts Collected**	**Estimated Infiltration per Month Average Volume (MG)**	**Infiltration Per Foot of Sanitary Sewer (gpd/ LF Sewer)**	**% of Total Infiltration**	**Rank**	**Total Inflow Average per Event (MG)**	**% of Total Inflow**	**Rank**
1		0.3	0.2	2.4%	9	0.01	0.5%	11
2	4,5,10	-3.2	-3.0	-26.6%	12	0.37	15.5%	3
3		0.3	0.6	2.2%	7	0.01	0.3%	12
4	1	1.4	2.2	11.8%	5	0.05	2.0%	6
5	3	2.3	5.0	19.4%	2	0.01	0.5%	10
6	9	2.2	3.7	18.6%	3	0.45	18.9%	2
7	2	5.7	11.6	46.9%	1	1.27	53.6%	1
8		0.1	0.2	0.6%	10	0.02	0.7%	8
9		0.0	0.0	0.0%	11	0.02	0.6%	9
10	11	1.6	2.4	13.3%	4	0.08	3.4%	4
11		0.2	0.4	1.5%	8	0.05	2.3%	5
12		1.2	1.1	9.8%	6	0.04	1.7%	7
		12.09				2.37		

* Flow Monitoring Summary Table (January - October 2015 Estimated Inflow and Infiltration)

* Infiltration Estimates are Based upon 10 Months of Flow Monitoring Data

** Inflow Estimates are based upon 4 significant events that were monitored in 2015

Note: Negative Value is due to lower flow meter readings downstream, meter has been validated, may be loss to other districts or Storm Sewer



LEGEND

- Flow Meter Locations
- District Outside of City Limits
- Sanitary Manholes
- Sanitary Gravity
- Sanitary Force Main
- Roads
- Railroads
- City Boundary
- Parcels

Single Districts Storm Inflow Vol (MG)

Low — *High*

RAIN EVENT STATISTICS

All Storm Events Avg
Interval = 5.4 hr
Peak Intensity = 0.80 in/hr

NOTES:

1. Sanitary sewer shown on this map is a combination of surveyed structures and pipes from a previous GIS system build provided by Infogrpahics and approximately located pipes and structures from a City sewer system CAD map provided by Abonmarche.

2. Flow districts shown on this map are generated from the current sanitary sewer system flow directions. In locations of the system with two outlets, flow direction was assigned to one outlet. These manholes will need to be field verified that they contain more than one outlet.

3. Flows outside City limits flowing into the City of Manistee sanitary sewer system are shown on the map as a generalized service area within flow district 1.

MANISTEE FLOW MONITORING
CITY OF MANISTEE, MICHIGAN

SANITARY FLOW DISTRICT MAP STORM INFLOW BY VOLUME (MG) ALL STORM EVENTS AVERAGE

Spicer group ©2016

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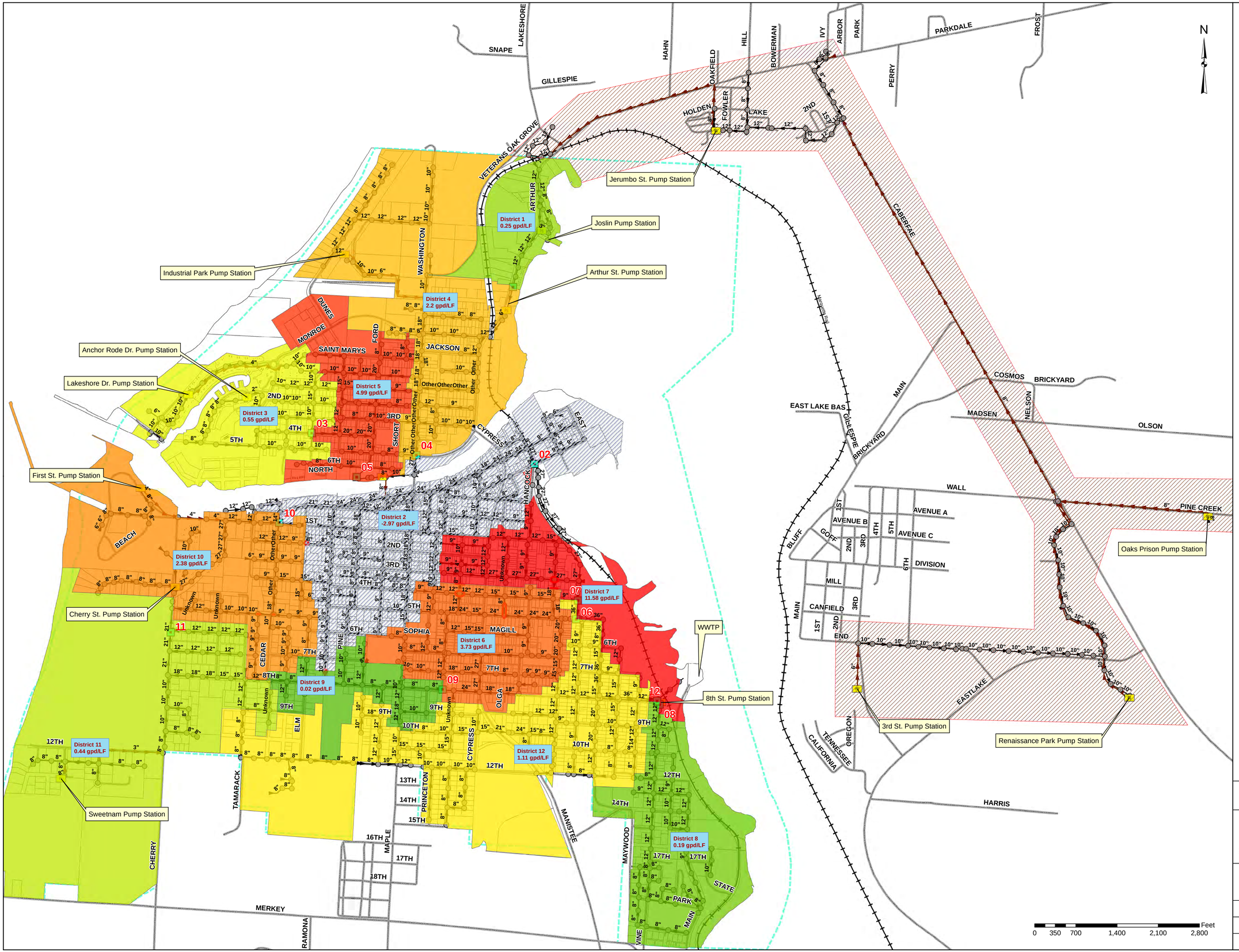
DE. BY: RCE DR. BY: RCE	CH. BY: SPM APP. BY: SPM	PROJECT NO. 120924SG2013-26
STDS.	SHEET 01 OF 01	
DATE: 02/09/2016 SCALE : 1 " = 700 '	FILE NO.	

PLOTTED BY: ELLENARC 02/09/2016 02:24 PM FILE LOCATION: E:\Dropbox\120924SG2013_2013-16CityofManisteeEngrgRecord\1_Project Work\120924SG2013 - Task 026 Flow Monitoring_CAD_GIS\GIS\Inflow_Tributary.mxd



LEGEND

- District Outside of City Limits
- Sanitary Pump Station
- Sanitary Manholes
- Sanitary Gravity
- Sanitary Force Main
- City Boundary
- Parcels

Infiltration Volume

Low — *High*

NOTES:

1. Sanitary sewer shown on this map is a combination of surveyed structures and pipes from a previous GIS system build provided by Infogrpahics and approximately located pipes and structures from a City sewer system CAD map provided by Abonmarche.

2. Flow districts shown on this map are generated from the current sanitary sewer system flow directions. In locations of the system with two outlets, flow direction was assigned to one outlet. These manholes will need to be field verified that they contain more than one outlet.

3. Flows outside City limits flowing into the City of Manistee sanitary sewer system are shown on the map as a generalized service area within flow district 1.

MANISTEE FLOW MONITORING
CITY OF MANISTEE, MICHIGAN

SANITARY FLOW DISTRICT MAP AVG INFILTRATION RATE (GAL PER DAY/LIN FT OF SEWER)

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DE. BY: RCE DR. BY: RCE	CH. BY: SPM APP. BY: SPM	PROJECT NO. 120924SG2013-26
STDS.	SHEET 01 OF 01	
DATE: 05/10/2016 SCALE : 1 " = 700 '	FILE NO.	

PLOTTED BY: ELLENARC 05/10/2016 10:11 PM FILE LOCATION: E:\Dropbox\120924SG2013_2013-16CityofManisteeEngofRecord\1_Project Work\120924SG2013 - Task 026 Flow Monitoring_CAD_GIS\GIS\Infiltration_All.mxd

City of Manistee

70 Maple Street • Manistee, Michigan 49660 • www.manisteemi.gov

CITY HALL

ADMINISTRATION
FAX 231.723.1546

CITY MANAGER
231.398.2801

CITY ASSESSOR
231.398.2802

BUILDING INSPECTOR
231.398.2806

PLANNING & ZONING
231.398.2805

CLERK/TREASURER
FAX 231.723.5410

CITY CLERK
231.398.2803

CITY TREASURER/ FINANCE DIRECTOR
231.398.2804

WATER BILLING
231.723.2559

POLICE DEPARTMENT
231.723.2533
FAX 231.398.2012

FIRE DEPARTMENT
281 First Street
231.723.1549
FAX 231.723.3519

DEPT. OF PUBLIC WORKS
280 Washington St.
- **Street Dept.**
- **Parks Dept.**
- **Water Maintenance**

280 Washington St.
231.723.7132
FAX 231.723.1803

WASTEWATER PLANT
15 Ninth St.
231.723.1553

March 26, 2015

Michigan Department of Environmental Quality
Cashier's Office
WRD-NP1
P.O. Box 30657
Lansing, MI 48909-8157

Re: NPDES Permit No.MI0020362
Manistee Wastewater Treatment Plant
City of Manistee
Application for Reissuance

Enclosed is a completed application for renewal of the National Pollutant Discharge Elimination System permit for the City of Manistee Wastewater Treatment Plan.

Also enclosed is a check for $750.00 made out to the "State of Michigan".

If you have any questions, please contact me at (231) 723-1553.

Sincerely,

CITY OF MANISTEE

Jeffrey W. Mikula
Public Works Director

cc: Mr. Mitch Deisch, City of Manistee
Mr. Brian Maturen, MDEQ
Mr. Shawn Middleton, Spicer Group, Inc. (cover letter only)
Mr. Brian House, Spicer Group, Inc. (cover letter only)
Mr. Brian Jankowski, MDEQ (cover letter only)

Enc.

SECTION II – Treatment Works Treating Domestic Sewage

B. Outfall Information

Item 1-H. Inflow and Infiltration

City of Manistee

70 Maple Street • Manistee, Michigan 49660 • www.manisteemi.gov

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WASTEWATER PLANT
15 Ninth St.
231.723.1553

March 26, 2015

NPDES Permits Section
Water Resources Division
Michigan Department of Environmental Quality
P.O. Box 30458
Lansing, MI 48909-7958

Re: NPDES Permit No.MI0020362 Application
Manistee Wastewater Treatment Plant
City of Manistee
Section II.B.Item1-H. Inflow and Infiltration

Utilizing a S2 grant, the City is currently working to complete a sewer system evaluation study (SSES) which is to include a State Revolving Fund (SRF) project plan to remove the City's last combined sewer overflow (CSO) 018. As part of the SSES the City has televised, smoke tested, dye tested, flow monitored, and visually inspected portions of the sewer system. Throughout the study, the City has bulkheaded or removed illicit connections as they were found. To date approximately 80% of residential and 70% of commercial known sources of Inflow and Infiltration (I+I) have been corrected. However, there has been no measurable decrease in flows at the City's wastewater treatment plant (WWTP) or decrease in overflow incidents at CSO 018.

The City has continued to invest in resolving the I+I problem. Most recently the City has:

1) Fall 2014: Installed a transducer and data logger system to better monitor CSO 018.

2) Winter 2015: Installed a weather station at the City's WWTP to better monitor precipitation.

3) Twelve (12) area velocity sewer flow meters were installed in January 2015 throughout the City's sewer system. These meters will be collecting data through fall 2015 in an attempt to isolate and determine which sections of the sewer system still have illicit connections and/or I+I problems.

4) Historical flows at the WWTP are being analyzed in conjunction with historical river and lake levels to see if there is a correlation between the two.

Targeted field investigations are planned once all the data from the above explorations has been examined.

The project plan from the SSES mentioned above is scheduled to be submitted after the data collection and investigations. We believe the project plan, if submitted at this point, will be premature because it will not incorporate all the valuable data that is scheduled to follow. The City is programmed to start receiving grant funds through Michigan's storm water, asset management and wastewater (SAW) program in fall of 2015. As part of this grant the City will be televising and assessing all of their sanitary sewer system. We feel that the City will have much more knowledge of the system after it has been completely mapped, cleaned, televised, and modeled. With this knowledge a more appropriate and effective project plan for reducing or collecting and treating I+I can be created and ultimately lead to the closure of CSO 018.

We must assume the project plan components will be capital intensive and will require time to develop funding alternatives.

Elimination of CSO 018 is the last remaining item on the City's 20-year fixed date schedule. Over the 20 years, the City has eliminated 14 of its 15 CSO's ahead of schedule resulting in over $25 million of construction.

A proposed timeline for CSO 018 closure follows:

Sewer Flow Monitoring	January 2015 – Fall 2015
Monitor CSO 018 and wwtp flows	Present – Fall 2020
Targeted Sewer Field Investigations	Winter 2015 - 2019
SAW Grant Activities	Fall 2015 – Fall 2018
Bulkhead/Remove Illicit Connections	Present – Spring 2019
Finalize Project Plan	Spring 2019
Submit Project Plan to MDEQ	Summer 2019
Complete Project Design	Fall 2019
Complete Project Construction	Fall 2020
Closure of CSO 018	Fall 2021

A chart showing the history and forecasted future of CSO 018 is attached.

If you have any questions, please contact me at (231) 723-7132.

Sincerely,

CITY OF MANISTEE

Jeffrey W. Mikula
Public Works Director

Mitch Deisch
City Manager

cc: Mr. Mitch Deisch, City of Manistee
Mr. Brian Maturen, MDEQ
Mr. Shawn Middleton, Spicer Group, Inc. (cover letter only)
Mr. Brian House, Spicer Group, Inc. (cover letter only)
Mr. Brian Jankowski, MDEQ (cover letter only)

Enc.

Dates	Events/Activites	1890-1930	1930-1940	1940-1970	1970-1980	1980-1996	1996	1997-2001	2002-2010	2011	2012	2013	2014	Winter 2015	Spring 2015	Summer 2015	Fall 2015	Winter 2016	Spring 2016	Summer 2016	Fall 2016	Winter 2017	Spring 2017	Summer 2017	Fall 2017	Winter 2018	Spring 2018	Summer 2018	Fall 2018	Winter 2019	Spring 2019	Summer 2019	Fall 2019	Winter 2020	Spring 2020	Summer 2020	Fall 2020
1890-1900	Combined Sewer System Constructed to Replace Ditches - Direct to River/Lake																																				
1930's	WWTP and Interceptor Sewers Construction (1939)- Combined System																																				
1940-1970	Expansion of sewer system																																				
1970-80	Sewer Separation Efforts Performed on parts of system																																				
1980-1996	Expansion of sewer system																																				
1996	Fixed Date Schedule for Separation of System established						X																														
1997-2001	Sewer Separation - SRF Funding to separate system ($20 million expended)																																				
August 23, 2011	SSES and SRF Project Plan Agreement Executed Between City and Abonmarche									X																											
2011 - 2014	SSES smoke/dye testing and field investigations of sewer system																																				
December 1, 2011	NPDES permit takes effect									X																											
2011-12	Final districts of known combined sewer separated																																				
May 13, 2013	Notice of violation issued											X																									
July 3, 2014	Abonmarche requests extension for SSES/SRF project plan												X																								
Fall 2014	CSO 008 Separated																																				
Fall 2014	Transducer Installed at CSO 018																																				
Winter 2014	Weather Station installed at wwtp																																				
December 30, 2014	Abonmarche requests extension for SSES/SRF project plan													X																							
January 15, 2015	MDEQ grants extension to SSES/SRF project plan													X																							
Jan. - Fall 2015	Second round of flow metering																																				
April 24, 2015	Original deadline to submit approved project plan														X																						
June 1, 2016	Current deadline to submit approvable project plan																		X																		
Summer - Winter 2015	Targeted Field Investigations																																				
Through fall 2015	Monitor wwtp and CSO 018 flows																																				
April 1, 2015	Deadline for NPDES renewall application														X																						
Fall 2015	Tentative release of SAW grant funds																																				
Fall 2016	Expected NPDES permit issuance																																				
Fall 2015 - Fall 2018	SAW grant Activities (televising, mapping, and modeling of sewer system)																																				
Through Spring 2018	Bulkead or Remove known illicit connections																																				
Spring 2018	Proposed Finalization of SRF project plan																																				
Spring 2018	Proposed SRF project public hearing																																				
Summer 2018	Proposed Submittal of final project plan to MDEQ																																				
Fall 2018	Proposed I+I removal / storage project design																																				
Fall 2019	Proposed I+I removal / storage project construction																																				
Fall 2020	Proposed Closure of CSO 018																																				

LEGEND

	Past sewer construction
X	Hard dates
	Past combined sewer separation and CSO/illicit connection removal work
	Future CSO and illicit connection removal work that will be done
	Anticipated dates
	Proposed future planning, design, and construction work