Executive Summary

September 2009

Jones & Henry Engineers, Ltd.
2000 West Central Avenue
Toledo, Ohio 43606
419.473.9611
www.jheng.com

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Executive Summary

The City of Oregon has taken a proactive approach to identify and eliminate excess inflow and infiltration (I/I) in its wastewater collection system. To this regard, in the summer of 2008, the City obtained the services of Jones & Henry Engineers, to assist in conducting a flow monitoring program within the City's sewer system. The flow monitoring program is intended to better identify the areas with the greatest amount of I/I and prioritize areas for future field investigations. Other specific goals outlined by the city included the following:

- Identify and rank areas with highest peak flows and largest volume of infiltration and inflow (I/I).
- Identify and evaluate the data collected for two precipitation events, preferably with two different antecedent moisture conditions.
- Determine the flow range and peak flows from the Northwestern Water & Sewer District (NWW&SD) trunk sewers.
- Verify that the data collected is suitable for calibrating a sewer model of the area.

Another factor motivating the I/I reduction program is the occurrence of sanitary sewer overflows (SSO's) at three locations in the south-western portion of the City during large rainfall events.

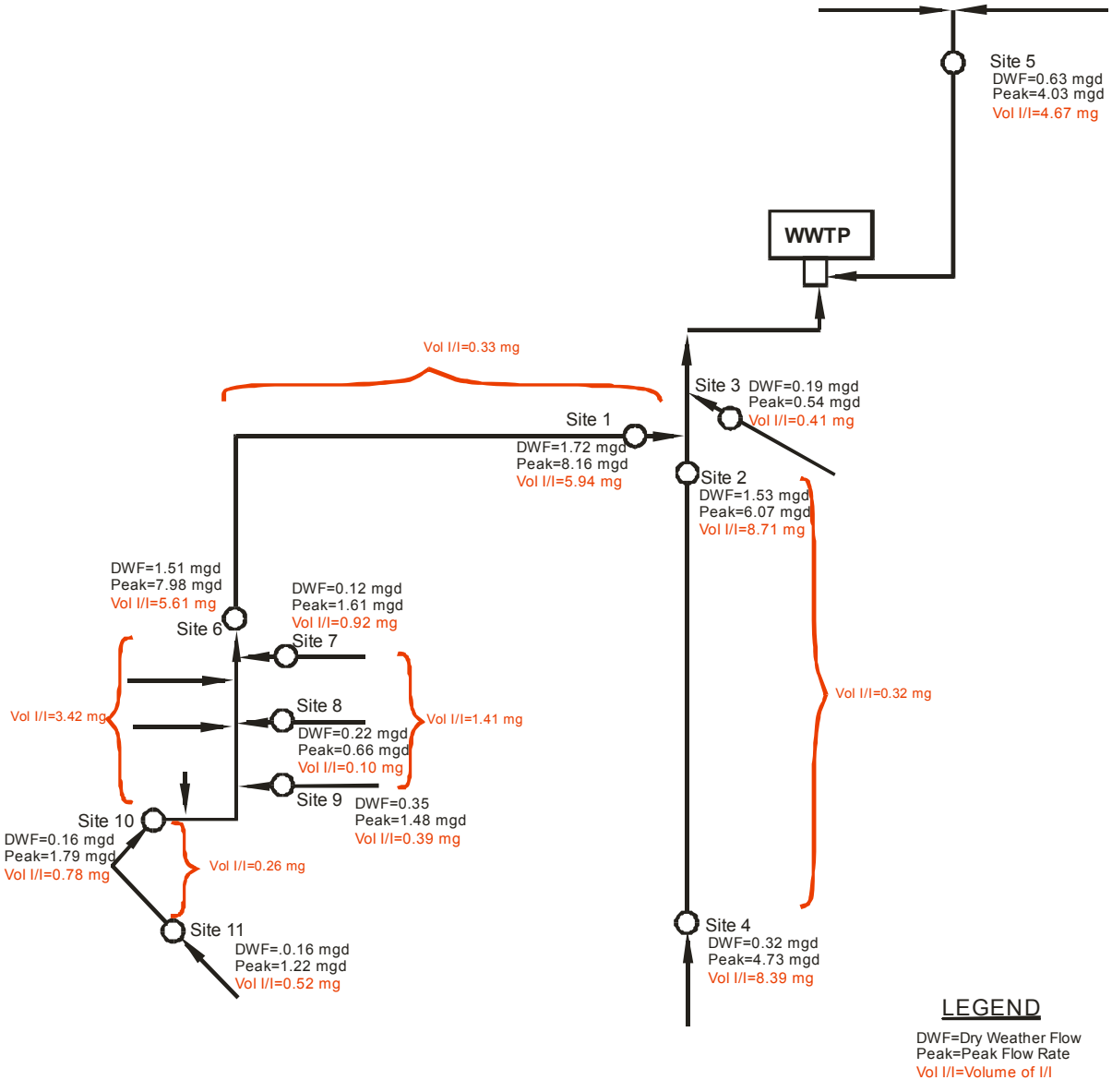
Since the inception of the program (September 2008), four interim reports were prepared and submitted to the City. Copies of those reports are included as attachments at the end of this report. This report is a summary of those reports. The first report submitted was a memorandum dated October 3, 2008 which provided information on the working status of the flow monitors and provided a brief description of base or dry-weather flow. The second report entitle "Interim Sewer Flow Monitor Report" was submitted in February 2009 and provided a more in-depth evaluation of the monitoring data. Two additional reports were submitted on June 2, 2009 and August 14, 2009. The report of August 2009 is the most comprehensive of the reports. It provides a clear overview of the monitoring data and highlights areas with highest I/I. It also provides a prioritized list of areas recommended for future field investigations of I/I.

The first stage of the monitor program included the installation of five flow monitors to obtain general information on the nature of the I/I flow in five major sewer sub-basins within the City (Figure 1). Site 1: Seaman @ Lallendorf (West) was selected to monitor flows from the western (oldest) portion of the City. Site 2: Lallendorf @ Seaman (South) monitors the south-western portion of the City and includes flow from NWW&SD. Site 3: Lallendorf @ Seaman (East) monitors the eastern portion of the City and includes flows from neighboring townships. Site 4: Lallendorf South of Brown monitors flows exclusively from NWW&SD. Site 5: N. Wynn Road @ Bayshore was originally installed near the WWTP. It was later moved to its current location due to low velocities, WWTP operation, and other difficulties with the flow monitoring. Site 5 monitors flow from the northern portion of the City in lakeshore neighborhoods.

Early in the monitoring program, high flows were noted at Site 1 which monitors the western portion of the City. This is the area where SSO's occur. Consequently, in April of 2009 six additional flow monitors were installed within Site 1 sub-basin in an attempt to narrow down the areas with highest I/I contribution. These sites are labeled 6 through 11 and are also shown on Figure 1. It should be noted that the sub-basin with highest I/I is monitored by Site 4. This area corresponds to the Northwestern Water and Sewer District (NWW&SD). The City of Oregon has no jurisdiction over this area; consequently, the I/I investigation efforts were shifted to the area west of the City, as this area has three known/reported

sanitary sewer overflows (SSO's). It should also be noted that the area north of the City represented by Site 5 is also a major contributor of I/I, however, no SSO's or private property flooding occurs in this area. This is better illustrated by Figure 2 which is a schematic of the flow monitoring data obtained for the rain event of June 19 & 20, 2009.

Figure 2
Schematic of Flow Monitoring for
June 19 & 20 Rain Event



Also noticeable during the first phase of the monitoring program is the effect that operational practices at the WWTP has on the sewer system. If flows to the plant exceed plant treatment capacity, it is the practice of the City to regulate the flows to the WWTP by closing gates at a junction box in front of the WWTP pump station. On several occasions in December 2008 through February 2009, precipitation coupled with snowmelt, resulted in excessive I/I and high flows in the sewers, requiring the City to close the gates at the junction box. This created a surcharge (backup) of up to 160 inches (13.3 feet) in the sewer system which was observed in the flow monitor data from Sites 1 through 5. Monitors at Sites 6 through 11 were not installed at the time.

Summary of Findings

In general, the flow monitoring program indicated that infiltration and antecedent moisture conditions are the predominant factor influencing the I/I noted. This was evident by small precipitation events under antecedent moisture conditions (saturated soil – early spring) creating large peak flow, whereas, larger precipitation event in summer did not create similar large peaks. There are a few smaller sub-basins where inflow was a significant factor.

The rain events of April 14 resulted in a precipitation of 1.62 inch/day (equivalent to a return period of 6 months). The event of June 19 and 20 resulted in a precipitation of approximately 1.75 and 0.59 inches/day respectively. The precipitation event of June 19, at its most intense hour had a precipitation of 0.95 inches, which correspond to a return period of 1 year. The overall intensity of 1.75 inches corresponds to a return period of 8 months. As mention earlier, the event of April 14 resulted in greater I/I than the combined effect of the precipitation of June 19 and 20. It is interesting to note that during the June events, the higher peak flow was noted on June 20.

Also interesting is that flows recorded at the WWTP during both events indicate a volume of 21.4 mgd on April 15, 2009 and 10.7 mgd on June 21, 2009. The April 15 flow was exactly twice that of June 21, although the rain intensity was greater in June. This is another clear indication that, in general, antecedent moisture, including snow melt and infiltration play the most prominent roles in the problems noted.

Overall, the area contributing the most volume of I/I corresponds to Site 4 which represents flow from the NWW&SD. It also accounts for the largest peak flows noted. This area is out of the City's direct jurisdiction and needs to be addressed separately.

Within the City limits, the area that contributes the highest volume of I/I is the western portion of the City also known as the Wheeling Sewer District and represented by Site 1: Seaman Road @ Lallendorf (West). This area was the focus of a more detailed flow monitoring study with the installation of six additional flow monitors. Figure 2, shown previously, provides a clear illustration of the areas monitored and their I/I contribution during a precipitation event. For a more detailed analysis or each of the basins is presented in the report of August 14, 2009.

In summary, the results of the flow monitoring data can be summarized as follows:

Major Basins

The major basins were evaluated and are listed in order of severity of problem noted:

- Sites with high peak (instant) flows
  - Site 4: This sub-basin is located entirely within the NWW&SD
  - Site 2: (influenced by Site 4 which includes the flow from NWW&SD)
  - Site 1: Wheeling Sewer District
  - Site 5: North Wynn Road @ Bayshore

- Sites with high ratio of peak flow to dry-weather flow
  - Site 4: Lallendorf South of Brown (NWW&SD)
  - Site 5: North Wynn Road @ Bayshore
- Sites with high volume of I/I
  - Site 4: This sub-basin is located entirely within the NWW&SD
  - Site 2: (influenced by Site 4 which includes the flow from NWW&SD)
  - Site 1: Wheeling Sewer District
  - Site 5: North Wynn Road @ Bayshore
- Sites with high ratio of inflow to length of sewers installed
  - Site 5: North Wynn Road @ Bayshore
  - Site 1: Wheeling Sewer District

Note: The actual length of sewer contributing to the basin monitored by Site 2 & 4 is unknown. Therefore, the ratio of inflow to length of sewer could not be determined for these locations.

Wheeler Sewer District (Sub-Basin 1)

The sub-basins within the Wheeling Sewer District were evaluated and are listed in order of severity of problem noted.

- Sites with high peak (instant) flows
  - Site 10: Pickle East of Wheeling
  - Site 7: Randall @ Bellcourt
  - Site 11: Woodville Road @ RR Tracks
- Sties with high ratio of peak flow to dry-weather flow
  - Site 7: Randall @ Bellcourt
  - Site 10: Pickle East of Wheeling
  - Site 11: Woodville Road @ RR Tracks
- Sites with high volume of I/I
  - Area West of Wheeling
  - Site 7: Randall @ Bellcourt
  - Site 10: Pickle East of Wheeling
- Sites with high ratio of inflow to length of sewers installed
  - Site 7: Randall & Bellcourt
  - Site 6: Wheeling North of Starr
  - Site 11: Woodville Road @ RR Tracks

Flow from NWW&SD

One goal of the monitoring program was to evaluate and understand the flow from NWW&SD. Flow from this area is represented by Site 4: Lallendorf South of Brown. The 1980 agreement between the City and NWW&SD includes a provision that the rate of flow in the trunk sewer from NWW&SD to the City of Oregon's sewers will not exceed 3,470 gallons per minute (5.0 mgd).

The flow monitoring data collected at Site 4 (NWW&SD) indicates that, for most dry days and even after some rain events, flow is below 5.0 mgd. However, there are occasions during wet weather events and on some dry days when the flow exceeds 5.0 mgd and it has been as high as 20 mgd or more. Flow from NWW&SD is somewhat erratic and could be the result of random on/off of the different pump stations within the NWW&SD basin.

Flow Monitoring and Model Calibration

Another goal of the monitoring program is to collect data that can be used in the calibration of a sanitary sewer model. Sufficient data has been collected and is adequate for calibration of the areas represented by the flow monitoring data. The exception is Site 4. Data collected from this site is erratic and may be of limited value for modeling purposes.

It should be noted that model calibration can only be representative within a percentage of the precipitation noted. Large (or extreme) precipitation events have not occurred during the monitoring period. Consequently, a model representative of large precipitation events cannot be accurately calibrated and verified with the flow monitoring data available.

Prioritized Areas for Future Investigations

Based on the results of the flow monitoring conducted, the following areas have been prioritized for future I/I investigations:

- The area contributing the highest volume of I/I is the NWW&SD. This area is out of the City's jurisdiction; however, it should be given priority in the efforts to reduce excessive wet-weather flows in the Oregon sewers.
- The Wheeler Sewer District (represented by Site 1) was investigated in more detail, resulting in six sub-areas. These have been prioritized in ascending order for future investigation based on the second phase of the flow monitoring program. These areas are illustrated on Figure 3.

2008/2009 I/I Reduction Program
City of Oregon Sanitary Sewer Atlas

Legend

PS PumpStations

Flow Meters

1 Phase 1 (Installed Fall 2008)

6 Phase 2 (Installed Spring 2009)

SSO Location

Utility

Sanitary Manhole

Sanitary Sewer (Various Colors on Map)

Sanitary Collection

Name

North Oregon Sewer District

Cedar Point Sewer District (Future)

Seaman and Stadium Sewer District

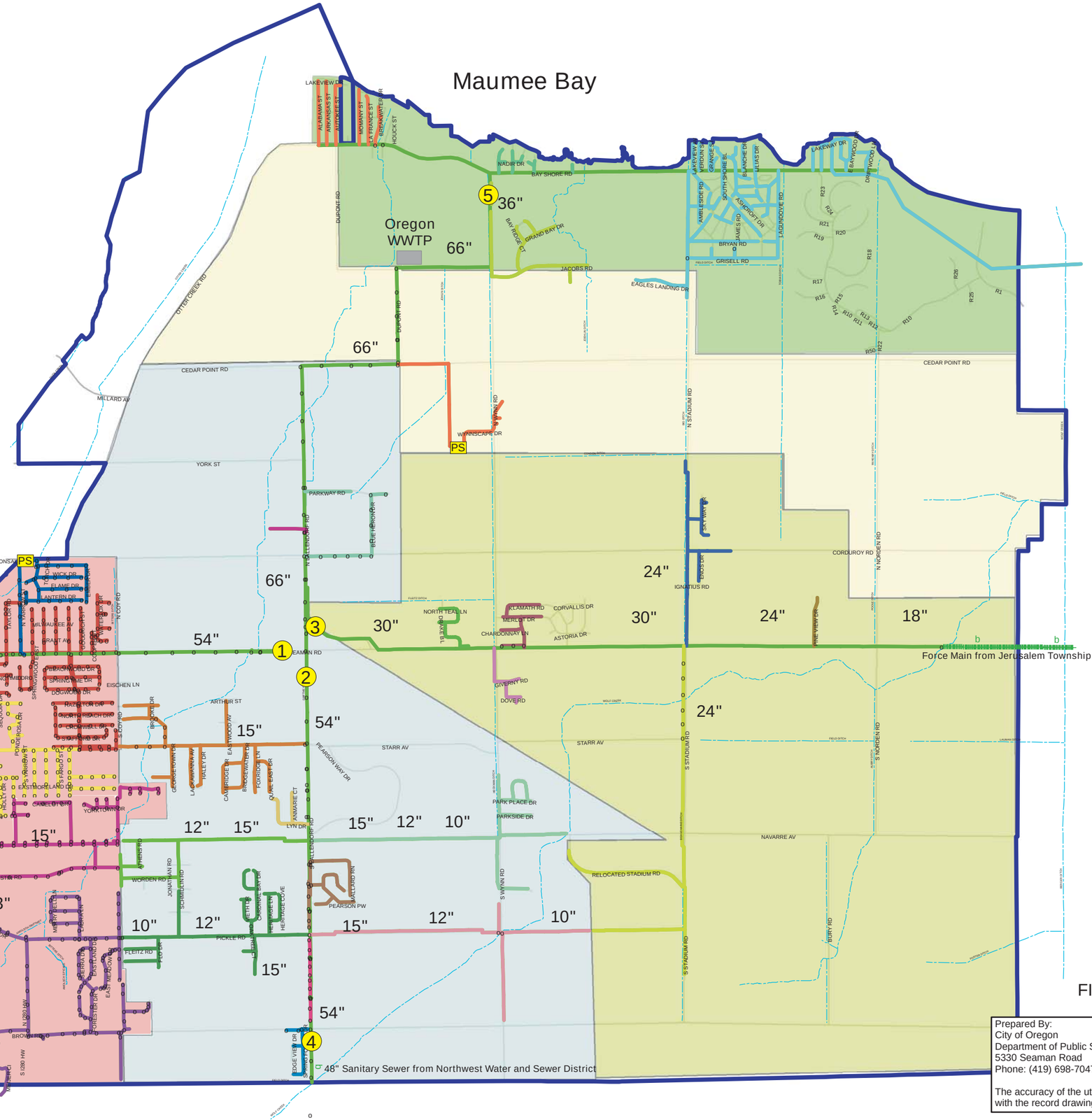
Lallendorf Sewer District

Wheeling Sewer District

Streets

Streams

Oregon Corp Limit



Modified from map by the City of Oregon - 2009

FIGURE 1

Prepared By:
City of Oregon
Department of Public Service
5330 Seaman Road
Phone: (419) 698-7047

The accuracy of the utilities shown shall be verified with the record drawings.