Engineering Enterprises, Inc.

Subbasins A & E Phase 2 Sanitary Sewer System Evaluation Survey - 2019

June 2020

52 Wheeler Road, Sugar Grove, IL 60554 ~ (630) 466-6700 tel ~ (630) 466-6701 fax ~ www.eeiweb.com

SUBBASINS A & E PHASE 2 SANITARY SEWER SYSTEM EVALUATION SURVEY

City of Sandwich, IL

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Abbreviations

1 CMAP: Chicago Metropolitan Area Agency for Planning
2 CMOM: Capacity, Management, Operations, and Maintenance
3 DAF: Design Average Flow or Daily Average Flow
4 DIP: Ductile Iron Pipe
5 DWF: Dry Weather Flow
6 FY: Fiscal Year
7 GPCD: Gallons Per Capita per Day
8 GPD: Gallons Per Day
9 GPD/IDM: Gallons Per Day / Inch Diameter Mile
10 HDPE: High Density Polyethylene
11 I/I: Infiltration/Inflow
12 IDM: Inch Diameter Miles
13 IEMA: Illinois Emergency Management Agency
14 IEPA: Illinois Environmental Protection Agency
15 LF: Lineal Feet
16 MACP: Manhole Assessment and Certification Program
17 MGD: Millions of Gallons per Day
18 NASSCO: National Association of Sewer Service Companies
19 NPDES: National Pollutant Discharge Elimination System
20 PACP: Pipeline Assessment and Certification Program
21 PE: Population Equivalents
22 PVC Pipe: Polyvinyl Chloride Pipe
23 RCP: Reinforced Concrete Pipe
24 RCPP: Reinforced Concrete Pressure Pipe
25 RDII: Rain Derived Inflow and Infiltration
26 SSO: Sanitary Sewer Overflow
27 USEPA: United States Environmental Protection Agency
28 VCP: Vitrified Clay Pipe
29 WWF: Wet Weather Flow
30 WWTF: Wastewater Treatment Facility

EXECUTIVE SUMMARY

Existing Conditions – The City of Sandwich is approximately 60 miles west of Chicago. The City's current corporate limits lie within portions of DeKalb, Kendall and LaSalle Counties in the state of Illinois. The City operates one wastewater treatment facility (WWTF) with its respective collection system. Due to the hydraulic challenges within the sanitary sewer system, the City plans to reduce inflow and infiltration (I/I) through a three-step program. The steps include: 1) flow monitoring to identify and prioritize areas with significant I/I issues, 2) sewer system evaluation surveys (SSESs) to identify defects contributing to I/I, and 3) defect rehabilitation. The North Sandwich service area was flow monitored in the summer of 2018 to determine problem areas. The flow monitoring study completed by Engineering Enterprises is entitled 'North Sandwich Flow Monitoring Study – 2018'. The study identified Subbasins A-E and G have significant rainfall derived inflow and infiltration (RDII) issues and Subbasins B and D have significant continuous infiltration issues.

This report summarizes the SSES field work for Subbasins A and E, which were determined to be the highest priority at this point of time compared to other subbasins. As part of SSES work, manhole inspections and smoke testing were completed in Subbasins A and E to identify defects which contribute in I/I. This report also outlines Engineering Enterprises' recommendations for defect rehabilitation.

Collection of Data and Preliminary Analysis – Midwest Water Group (MWG), in partnership with RMS Utility Services, completed manhole inspections and smoke testing in subbasins A and E. Manhole inspections were completed on 126 manholes in Subbasins A and E, seventy-four (74) manholes in Subbasin A and fifty-two (52) manholes in Subbasin E. Manholes were analyzed using NASSCO standards and assigned a rehabilitation priority status. Smoke testing was completed on approximately 35,858 lineal feet (LF) of sanitary main in the study area. Defects found during smoke testing were categorized by type and ranked by the amount of smoke that was observed. Residents were alerted of SSES field activities via mailers, door hangers, the City's website, and the City's social media profiles. Road signs were also posted during the time of smoke testing.

Final Analysis of Data and Rehabilitation Recommendations – Analysis of the manhole inspections indicated that the manholes in Subbasins A and E have a variety of defects. During smoke testing, a total of 50 defects were identified in the two tested subbasins. Of these defects, 11 were smoking manholes, 9 were smoking mainlines, 2 were smoking catch basin, 1 was a downspout tie-in (illegal tie-in), 13 were cleanout lid issues,14 were lateral defects (building-no smoke, smoke-lateral, smoke-foundation).

Financial Analysis – Manhole inspections and smoke testing review identified defects in manholes, public sanitary sewer infrastructure, and private sanitary sewer infrastructure. The projected cost to the City for

the next phase of rehabilitation is $433,998. This work includes investigation at defective laterals and illegal tie-in locations, manhole repairs, and sanitary sewer televising. It is recommended that the City focus on reducing the defects which contribute the largest amounts of I/I and making necessary structural upgrades. Below is a recommended prioritized list of next steps for the City:

1. Rehabilitate Sanitary Manhole Defects
   Estimated Cost: $427,502

2. Televise Mains In Which Smoke Was Visible During Smoke Testing
   Estimated Cost: $6,496
   Comments: Televising mains also includes heavy cleaning and vac

3. Consider Notifying Property Owners of Private Defects, Including:
   a. Cleanout Issues (13 defects found in Subbasins A and E)
   b. Illegal Private Tie-ins (1 defect found in Subbasin A)
   c. Defective Laterals (2 defects found in Subbasins A and E)
   d. Smoke-Foundation (2 defects found in Subbasin A)

   Estimated Cost: Negligible

SECTION 1: EXISTING CONDITIONS

The City of Sandwich is located approximately 60 miles west of Chicago. Portions of the City lie within DeKalb, Kendall and LaSalle Counties in the state of Illinois. In 2017, the City's estimated population was approximately 7,387 within an estimated 2,724 households[1].

The City operates one WWTF located at 1120 East Church Street. It is located on the west bank of Harvey Creek. It has a DAF capacity of 1.50 MGD and DMF capacity of 3.75 MGD. The collection system includes over 155,000 LF of 6-inch to 36-inch pipes and 546 manholes. Exhibit 1-1 provides an overview of the sanitary sewer network.

1.1 Definitions

For the purposes of this report, infiltration, inflow and I/I will be defined by the "USEPA Handbook for Sewer System Infrastructure Analysis and Rehabilitation" of 1991. A thorough understanding of the following three terms will help comprehend this report:

Infiltration: The water entering a sewer system and service connections from the ground, through such means as, but not limited to, defective pipes, pipe joints, connections or manhole walls. Infiltration does not include, and is distinguished from inflow.

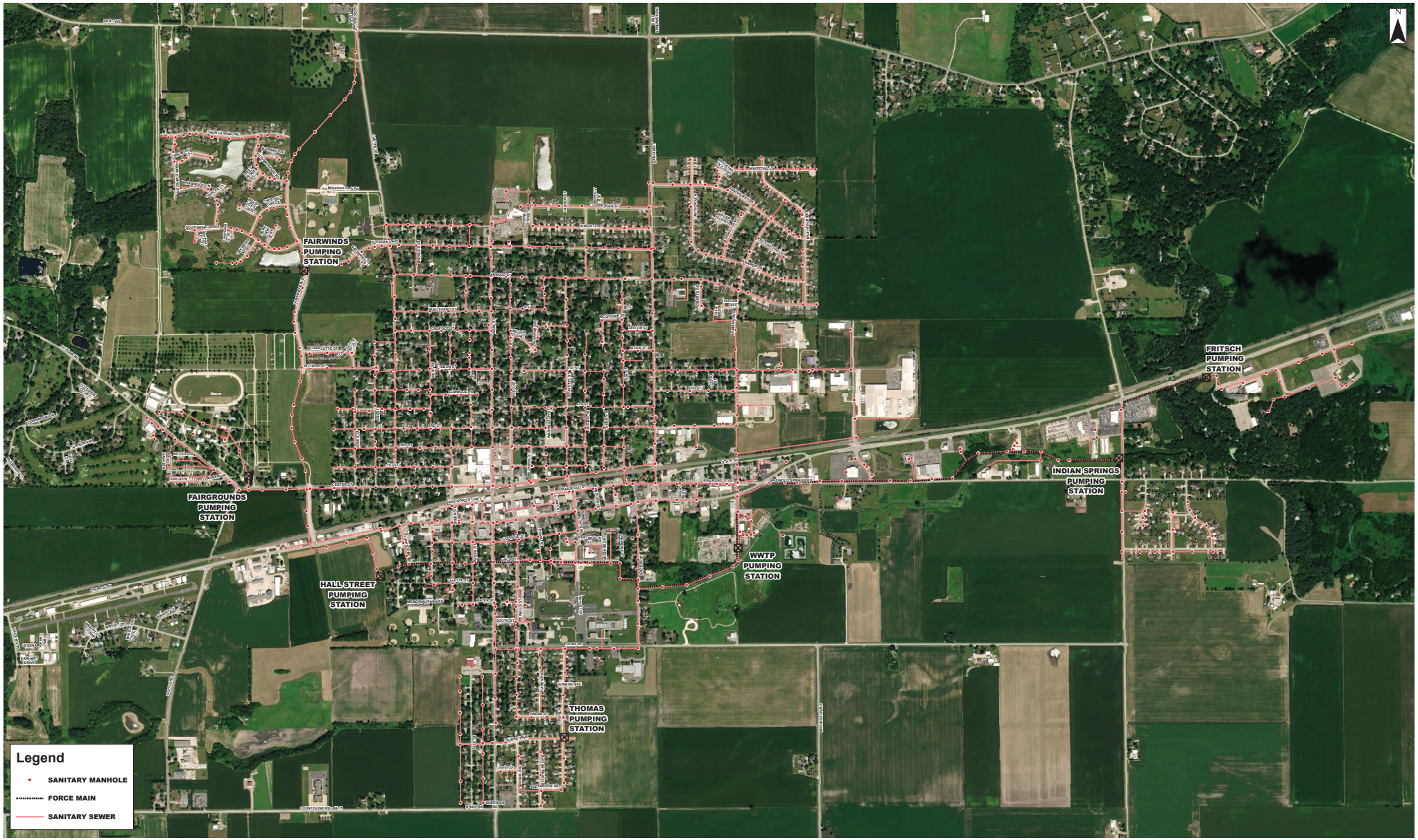
Inflow: The water discharged into a sewer system, including service connections, from such sources as, but not limited to, roof leaders, cellar, yard and area drains, foundation drains, cooling water discharges, drains from springs and swampy areas, manhole covers, cross connections from storm sewers and combined sewers, catch basins, storm sewers, surface run-off, street wash waters, or drainage. Inflow does not include, and is distinguished from infiltration.

I/I: The total quantity of water from both infiltration and inflow without distinguishing the source.

1.2 Purpose of Study

The City of Sandwich has observed an increase in reported sanitary sewer backups over the past several years. The areas with the highest amount of sewer backups reported were in the northcentral portion of the City. The high amount of sewer backups seemed to be attributed to an elevated amount of I/I. The City has completed

[1] http://worldpopulationreview.com/us-cities/sandwich-il-population/



Engineering Enterprises, Inc.
CONSULTING ENGINEERS
52 Wheeler Road
Sugar Grove, Illinois 60554
(630) 466-6700 / www.eeiweb.com

City of Sandwich
144 E. Railroad Street,
Sandwich, IL 60548

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FILE: SA1901_EXHIBIT 1-1 LOCATION MAP .MXD

NORTH SANDWICH FLOW MONITORING PLAN

SANDWICH, ILLINOIS

EXHIBIT 1-1
SANITARY SEWER SYSTEM OVERVIEW

the first phase of an I/I reduction program, flow monitoring, within the northern portion of the City. As part of that study, the northern portion (basin) of the City of Sandwich was split into eight smaller areas, known as subbasins. Exhibit 1-2 provides a summary of the flow monitoring plan. Flows and rainfall within the eight subbasins were monitored for approximately two months. The flow monitoring data was used to determine which of these eight areas had elevated rainfall derived inflow and infiltration (RDII) and which areas had excessive constant infiltration.

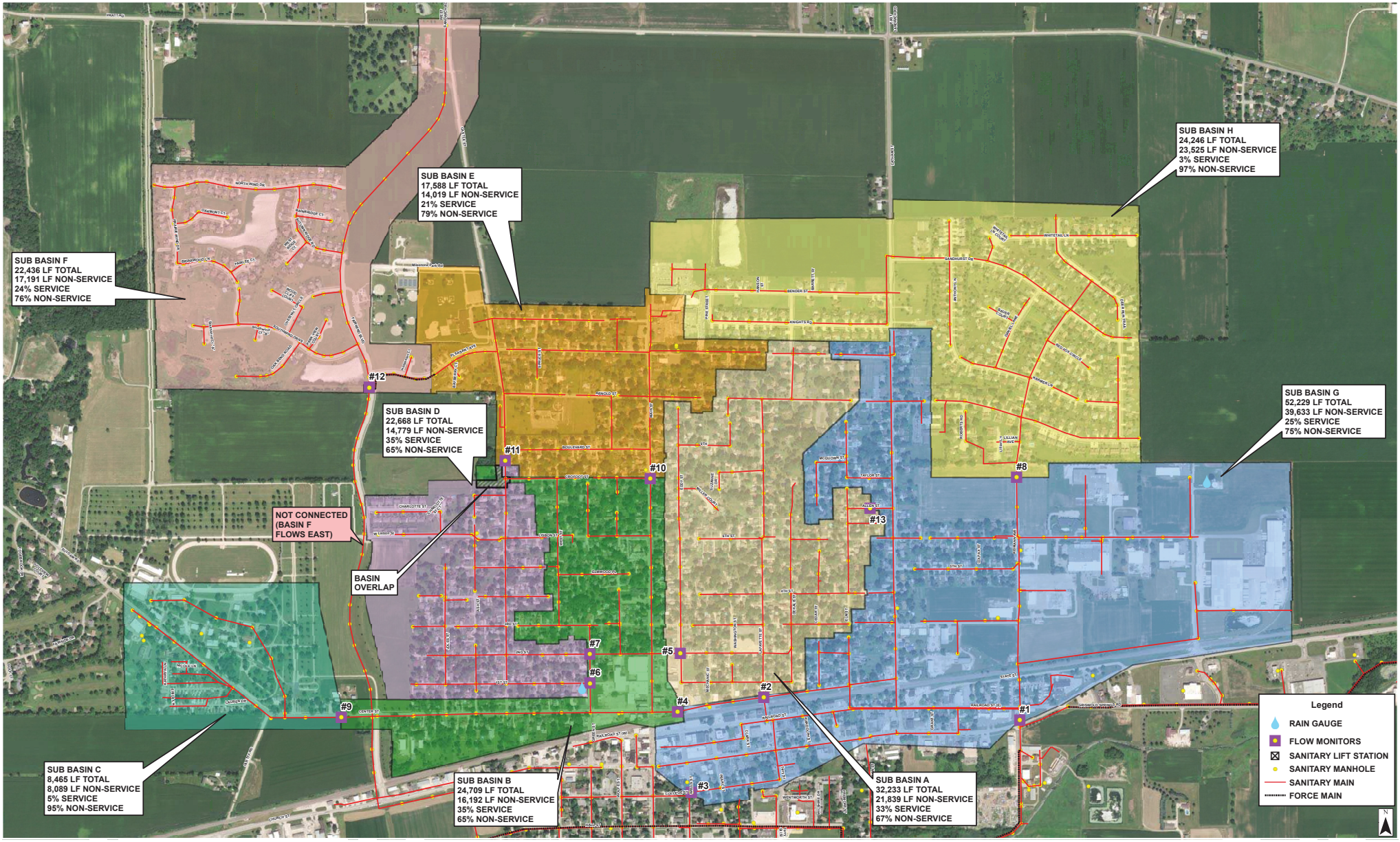
Based on the flow data, Subbasins A-E and G have significant inflow issues and Subbasins B and D have significant infiltration issues. More findings from the flow monitoring can be found in the 'North Sandwich Flow Monitoring Study – 2018' Report.

This report summarizes the second step of I/I reduction, sewer system evaluation surveys (SSESs), which identify specific sanitary sewer and manhole defects that contribute to I/I. Due to budget constraints, the City prioritized the subbasins and determined Subbasins A & E were the highest priority. Field work for the SSES in Subbasins A and E occurred in July of 2019. This report also outlines Engineering Enterprises' recommendations for the rehabilitation of sanitary sewer defects contributing to I/I, which is the third step of I/I reduction.

Table1-1: North Sandwich Sanitary Sewer Inventory

City of Sandwich, IL

Size	Subbasin-A	Subbasin-B	Subbasin-C	Subbasin-D	Subbasin-E	Subbasin-F	Subbasin-G	Subbasin-H	Total
Sanitary Sewers									
Diameter (in)	Length (ft)	Length (ft)	Length (ft)	Length (ft)	Length (ft)	Length (ft)	Length (ft)	Length (ft)	Length (ft)
6	1,805	3,910	1,477	3,152	760	903	2,564	70	14,641
8	17,778	8,277	3,129	7,556	12,551	7,831	21,709	12,501	91,332
10	882	811	3,319	903	708	0	1,659	1,273	9,555
12	1,210	1,574	0	2,264	0	4,030	4,238	8,561	21,877
15	0	670	0	904	0	0	2,688	1,081	5,343
16	0	0	0	0	0	0	0	0	0
18	0	302	0	0	0	2,658	2,762	0	5,722
24	164	641	0	0	0	1,769	2,995	0	5,569
30	0	0	0	0	0	0	0	0	0
36	0	0	0	0	0	0	119	0	119
Unknown	0	7	164	0	0	0	899	39	1,109
Total Non-service length (rev)	**21,839**	**16,192**	**8,089**	**14,779**	**14,019**	**17,191**	**39,633**	**23,525**	**155,267**
Manholes									
	73	56	22	52	52	92	118	81	**546**



Engineering Enterprises, Inc.
CONSULTING ENGINEERS
52 Wheeler Road
Sugar Grove, Illinois 60554
(630) 466-6700 / www.eeiweb.con

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144 E. Railroad Street,
Sandwich, IL 60548

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INFLOW & INFILTRATION REDUCTION PROGRAM - PHASE 2 SSES
SANDWICH, ILLINOIS

EXHIBIT 1-2
NORTH SANDWICH FLOW MONITORING PLAN

SECTION 2: COLLECTION OF FIELD DATA AND PRELIMINARY ANALYSIS

Manhole inspections and smoke testing were conducted in Subbasins A and E. A description of these field work items and corresponding results follows.

2.1 Manhole Inspections

Manhole inspections can be used to identify and locate the potential sources of I/I within manholes. Manhole inspections can also be used to identify manhole attributes that are not typically directly related to I/I, such as material types, rim to invert heights and number of connections. A total of 126 manholes in Subbasins A and E were scheduled for inspection.

Midwest Water Group (MWG), in partnership with RMS Utility Services, conducted level-2 manhole inspections in July 2019 in accordance with guidelines set forth by the National Association of Sewer Service Companies (NASSCO). Manhole inspections were conducted by lowering a camera into each manhole and taking a video of the manhole interior. The camera was used to create a 'Panoramo' file which can be used to create photo images, find approximate depths, and obtain an 'unfolded' view of the manhole. When a panoramo camera could not be used because of access concerns for the panoramo truck, a pole camera was used to create a video of the manhole. The panoramo and video files can be found in Appendix G (provided electronically). In addition to the panoramo and video files, field technicians took note of attributes that could not be obtained by the camera. The files and measurements were evaluated by a NASSCO-certified individual who cataloged manhole attributes and defects according to the NASSCO standards. NASSCO standards are objective and are intended to identify all attributes and defects within a manhole. A summary of the NASSCO documented attributes of each inspected manhole can be found in Appendix A.

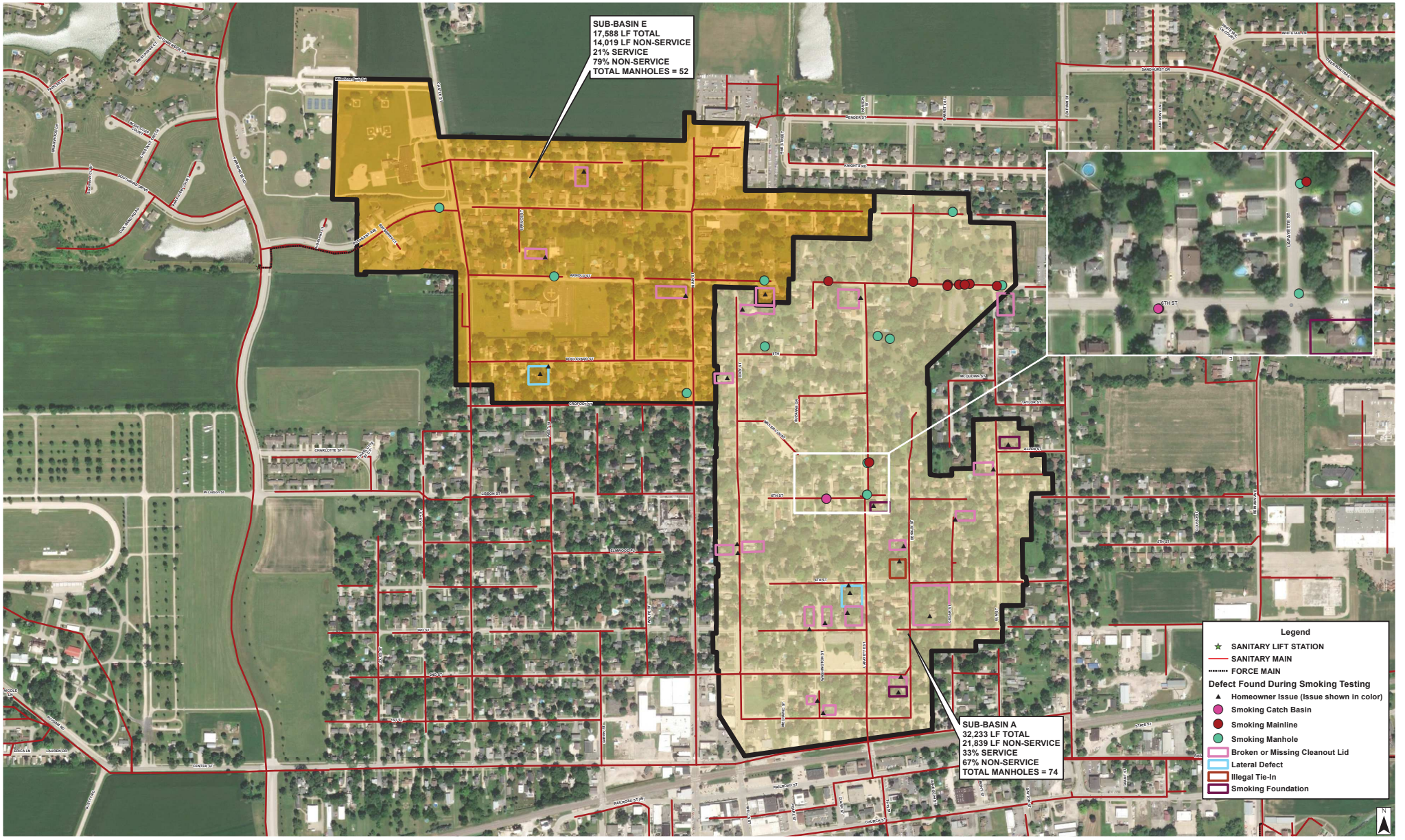
While NASSCO standards are an excellent way to catalog defects due to their objectivity, it can be difficult to formulate a rehabilitation plan from the defects alone due to the plethora of attributes cataloged as part of each manhole inspection. Additionally, not all manhole defects are likely to cause I/I or other problems. Therefore, MWG worked with EEI to develop repair recommendations and rehabilitation prioritization rankings apart from the NASSCO standards. The rehabilitation prioritization rankings are based off structural defects as well as defects which are likely to contribute to I/I problems. The rehabilitation prioritization rankings do not directly mirror the defects within the manhole, they describe the urgency with which a manhole should be rehabilitated based on the noted defects. These rehabilitation prioritization recommendations are listed with the manhole defects in Appendix A and discussed more thoroughly in Section 3. The unabridged NASSCO documentation can be found in Appendix H (provided electronically). Residents were alerted of manhole inspections using a mailer which can be found in Appendix B.

2.2 Smoke Testing

Smoke testing is conducted by blowing a non-harmful vapor under low pressure into the sanitary sewers. If a defect is present, smoke escapes through the defect in the sanitary sewer during smoke testing and becomes visible above grade to onsite technicians. Typical defects found during smoke testing include storm structure connections, illegal tie-ins, cleanout defects, broken laterals, and defects in manhole frames or lids.

Smoke testing was completed by MWG, in partnership by RMS Utility Services, from July 23, 2019 to July 25, 2019 for all sanitary mains in Subbasins A and E. Residents were alerted of smoke testing via mailers and door hangers. The communication material alerted the residents of what they must do to prevent smoke from entering their homes and let the residents know that the vapor was non-toxic and non-staining. The communication material provided ways for the residents to reach out to the City or MWG if they had questions or concerns regarding smoke testing. The City also used their website and their social media pages to provide information, such as maps of the study area and the smoke testing vapor MSDS, to their residents. Finally, road signs alerting the residents of smoke testing were also placed in the study area before and during smoke testing. The police and fire departments were notified that smoke testing would be completed in the study area. Copies of the communication materials, along with the Smoke Testing Standard Operating Procedure and the MSDS for the smoke test, can be found in Appendix B.

Defects identified during smoke testing were classified by their defect type and the intensity of smoke. During smoke testing, a total of 50 defects were identified in the two tested subbasins. Of these defects, 11 were smoking manholes, 9 were smoking mainlines, 2 were smoking catch basin, 1 was downspout tie-in (illegal tie-ins), 13 were cleanout lid issues,14 were lateral defects (building-no smoke, smoke-lateral, smoke-foundation). A map of all defects found during smoke testing can be found on Exhibit 2-1.



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CONSULTING ENGINEERS
52 Wheeler Road
Sugar Grove, Illinois 60554
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INFLOW & INFILTRATION REDUCTION PROGRAM - PHASE 2 SSES
SANDWICH, ILLINOIS

EXHIBIT 2-1
SUBBASIN A&E SMOKE TESTING
DEFECT SUMMARY

A list of all defects identified during smoke testing can be seen on Table No. 2-1.

Table 2-1: Smoke Testing Defects (Excluding Smoking Manholes)

City of Sandwich, IL

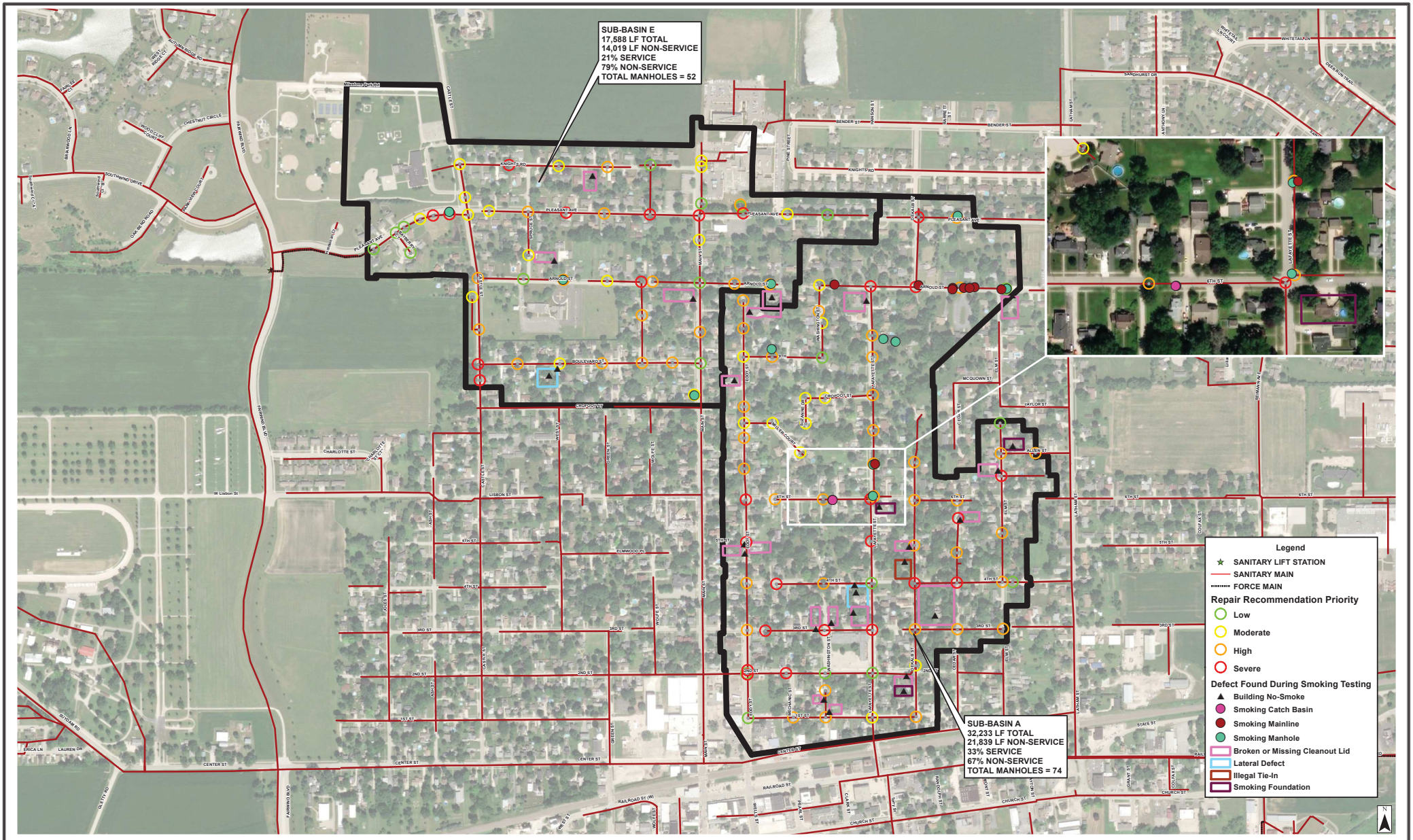
Defect ID	Defect Type	Defect Ownership	Intensity of Defect	Address of Defect
RP08	Smoke - Mainline	City	4-Moderate/constant	619 E Arnold St
RP14	Smoke - Mainline	City	4-Moderate/constant	609 E Arnold St
RP11	Smoke - Mainline	City	4-Moderate/constant	509 E Arnold St
RP12	Smoke - Mainline	City	4-Moderate/constant	509 E Arnold St
RP13	Smoke - Mainline	City	4-Moderate/constant	509 E Arnold St
RP07	Smoke - Mainline	City	4-Moderate/constant	609 E Arnold St
RP17	Smoke - Mainline	City	4-Moderate/constant	618 N Lafayette St
MF10	Smoke - Mainline	City	2-Faint/Constant	315 W Arnold St
MF13	Smoke - Catch Basin	City	2-Faint/Constant	308 6th St
MF12	Smoke - Catch Basin	City	2-Faint/Constant	307 6th St
MF09	Smoke - Mainline	City	1-Faint/Not Constant	420 E Arnold St

Defect ID	Defect Type	Defect Ownership	Intensity of Defect	Address of Defect
RP02	Smoke - Downspout Tie-In	Private	6-Strong, Constant	407 Dekalb St
RP04	Clean Out - Missing	Private	6-Strong, Constant	121 Dekalb St
RP05	Smoke - Foundation	Private	6-Strong, Constant	115 Dekalb St
RP06	Clean Out - Missing	Private	6-Strong, Constant	321 E 3rd St
RP10	Clean Out - Damaged	Private	6-Strong, Constant	702 E Arnold St
RP20	Smoke - Foundation	Private	6-Strong, Constant	522 N Lafayette St
RP21	Clean Out - Lid Not Sealed	Private	6-Strong, Constant	319 N Lafayette St
RP03	Clean Out - Missing	Private	5-Strong, Not Constant	421 Dekalb St
RP23	Clean Out - Lid Not Sealed	Private	5-Strong, Not Constant	936 N Eddy St
MF19	Clean Out - Lid Not Sealed	Private	5-Strong, Not Constant	311 W Arnold St
MF04	Clean Out - Lid Not Sealed	Private	4-Moderate/constant	209 E 1st St
MF11	Clean Out - Lid Not Sealed	Private	4-Moderate/constant	936 N Lafayette St
RP22	Smoke - Lateral	Private	4-Moderate/constant	319 N Lafayette St
RP24	Clean Out - Missing	Private	4-Moderate/constant	815 N Eddy St
MF18	Clean Out - Lid Not Sealed	Private	4-Moderate/constant	20 E Arnold St
RP29	Clean Out - Lid Not Sealed	Private	4-Moderate/constant	310 Boulevard St
MF01	Smoke - Foundation	Private	3-Moderate/Not Constant	707 Allen St
MF20	Smoke - Lateral	Private	3-Moderate/Not Constant	310 Boulevard St
RP26	Clean Out - Lid Not Sealed	Private	2-Faint/Constant	214 W Knights Rd
RP01	Building - No Smoke	Private	0-None	619 Elm St
MF02	Building - No Smoke	Private	0-None	516 Cedar St
MF03	Building - No Smoke	Private	0-None	513 E 3rd St
MF05	Building - No Smoke	Private	0-None	104 N Washington St
MF07	Building - No Smoke	Private	0-None	219 Washington St
MF06	Building - No Smoke	Private	0-None	301 Washington St
MF15	Building - No Smoke	Private	0-None	420 N Eddy St
MF16	Building - No Smoke	Private	0-None	418 N Eddy St
RP25	Building - No Smoke	Private	0-None	935 N Main St

In addition to noting addresses, the defects identified during smoke testing were also documented by using a Trimble Unit to obtain GPS points. The locations of the points were used to create an ArcGIS shape file

which was then updated with relevant smoke testing information and paired with pictures taken during smoke testing.

Exhibit 2-2 summarizes the manhole inspection and smoke testing results by displaying the defects identified during smoke testing and the manhole rehabilitation priorities in a single exhibit.



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52 Wheeler Road
Sugar Grove, Illinois 60554
(630) 466-6700 / www.eeiweb.con

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INFLOW & INFILTRATION REDUCTION PROGRAM - PHASE 2 SSES
SANDWICH, ILLINOIS

EXHIBIT 2-2
SUBBASIN A&E SMOKE TESTING AND MANHOLE INSPECTION DEFECT SUMMARY

SECTION 3: FINANCIAL ANALYSIS OF DATA AND REHABILITATION RECOMMENDATIONS

This section details the documented defects and rehabilitation options identified during manhole inspections and smoke testing. Sanitary sewer rehabilitation can be classified a variety of ways, but for the purposes of this report it will be split into three categories: manhole rehabilitation (defects identified during manhole inspections), sewer rehabilitation (defects identified during smoke testing), and private rehabilitation (defects identified during smoke testing).

3.1 Manhole Rehabilitation

As noted in Section 2.1, EEI and MWG cataloged manhole defects and recommended manhole rehabilitation techniques and rehabilitation priorities based on the defects. A manhole may have more than one recommended rehabilitation.

3.1.1 Rehabilitation Technique - The list below describes manhole rehabilitation methods and their projected costs; the listed costs do not include engineering or contingency costs. As discussed in Section 2.1, while the classification of manhole defects using NASSCO defect criteria is objective, the repair recommendations and rehabilitation prioritization ratings are more subjective and may vary depending on the preferences of a community. The rehabilitation methods below are organized into eight general categories, and methods are defined within those categories.

Lining

Lining: Install cementitious, cementitious + epoxy or geopolymer lining; Cost includes standard preparation which would be patching of the manhole, cleaning, removal of steps and basic grouting as well as applying a 1" thickness of the cementitious or geopolymer lining product or a manufacturer recommended thickness of an epoxy lining option. Expected cost of $290/LF.

Root Treatment

Root Treatment: Utilize a root foaming herbicide system to kill the active roots -OR- add a herbicidal root inhibitor to the curtain grout material when curtain grout is also selected. Expected cost of $290/Manhole.

Frame and Cover Modifications

Replace Frame and Cover: Excavate and replace both frame and cover, whether because the frame is corroded and beyond repair, the cover/frame fit is not good, and/or the cover should be replaced with bolted lid. Expected cost of $4,000/Manhole for manholes in paved areas and $2,590/Manhole for manholes in unpaved areas.

Raise or Reset Frame: If frame/chimney is offset or damaged and the best means of repair is to excavate down to cone section, rebuild chimney and or reset the frame on the existing chimney. Expected cost of $2,880/Manhole for manholes in paved areas and $1,725/Manhole for manholes in unpaved areas.

Replace Cover: Replace cover if it has open pick hole(s), is cracked or poorly fits. Expected cost of $400/Manhole.

Bench/Channel Modifications

Replace Bench/Channel: Remove and replace existing bench/channel, or install a bench or channel. Expected cost of $1,725/Manhole.

Repair Bench/Channel: Clean and patch (or line when LINING is also selected) bench and/or channel section. Expected cost of $870/Manhole.

Install Chimney Seal

Internal Chimney Seal: Install internal chimney seal when chimney section is leaking and excavation and resetting the frame is not needed or too costly (i.e. likely due to pavement restoration). Expected cost of $575/Manhole.

External Chimney Seal: Install external chimney seal when the frame needs to be raised, the frame reset, or higher level of I/I protection is needed. Expected cost of $2,300/Manhole for manholes in paved areas and $575/Manhole for manholes in unpaved areas.

Joint Repair

Grout and Wipe Joints: Ground and wipe joints, with fast acting concrete patch material, in precast structures when there are active leaks at barrel joints and pipe intrusions. Expected cost of $750/Manhole.

Wipe Joints (No Grout): Wipe joints with fast cure concrete patch material when joints are subpar and there is no active infiltration detected at the defect. Expected cost of $400/Manhole.

Curtain Grout

Curtain Grout: Installation of AV100 or similar curtain grouting system by injecting grout through the wall and encapsulating the structure; Details in the notes section specify if the entire structure should be curtain grouted or just the lower 18" – 4'. When the entire structure is identified to be curtain grouted, then it is assumed that the bench and channel (pipe intrusions) should also be curtain grouted. Expected cost of $175/LF.

No I/I Issue or Specialty Work

Install Drop: Install drop when there is a connection point in the structure that is not properly routed to the flow line and could potentially cause degradation to the manhole wall (e.g. H2S corrosion, erosion, etc); Costs are calculated based on installing a PVC drop to the flow line or concrete profiling the pipe to the flowline. Expected cost of $1200/drop.

Vac: Vactor out excess debris in bench and/or channel. This would be completed by City Staff which would result in variable costs.

Special Observation or Repair: Category reserved for unique observations or defects associated with this project. This would be completed by City Staff which would result in variable costs.

3.1.2 Classification and Prioritization System - Rehabilitation prioritization ratings provide a recommended timeline for rehabilitating the defects identified during manhole inspections. The rehabilitation prioritization ratings were assigned by a NASSCO certified individual, but are not ratings associated with NASSCO.

Severe Rehabilitation Priority Manholes: Severe priority structures are classified as having severe defects (either multiple or singular), of I/I potential or structural integrity, and should be addressed within 1 year.

High Rehabilitation Priority Manholes: High rehabilitation priority structures are classified as having many defects or singular defects with high impact on structural and/or I/I potential. Repairs should be made within 1-3 years.

Moderate Rehabilitation Priority Manholes: Moderate rehabilitation priority structures are classified as having moderate defects; repairs should be made within 3-5 years based on their I/I and/or structural defects.

Low Rehabilitation Priority Manholes: Low rehabilitation priority structures are classified as having no defects, or minimal defects that should be addressed in 5-10 years or as a preventative measure. These are the structures that are considered to be of least priority based on I/I and/or structural integrity.

3.1.3 Rehabilitation Summary - Table No. 3-1 outlines the number of rehabilitation recommendations made within Subbasins A and E in accordance with corresponding manhole rehabilitation priority ratings. The rehabilitation recommendations are classified into the eight general categories based on the type and location of each defect. Manholes may have more than one repair recommendation. Therefore, the total tabulation of manhole rehabilitation recommendations is greater than the total number of manholes in the

area, and the repairs for each specific manhole are clarified in Exhibits 3-1. a-b, referenced in this section below. Appendix C includes detailed cost estimates for the manhole rehabilitations.

Exhibits 3-1.a-b display the rehabilitation priorities for all surveyed manholes and notes whether each manhole has a recommended rehabilitation method within one of the eight categories by using a 'pie piece' marker for each of the defect categories. Therefore, if a manhole had no rehabilitation recommendations, it would have no 'pie pieces'; however, if a manhole had a rehabilitation recommendation from every one of the eight categories the entire 'pie' would appear.

The manholes in the study area had a wide range of rehabilitation priorities; 28 manholes had a severe rehabilitation priority, 52 manholes had a high rehabilitation priority, 26 manholes had a moderate rehabilitation priority and 20 manholes had no appreciable defects and have no considerable repair recommendations at this time. Exhibits 3-1.a-b. Appendix D shows the manholes and their repair recommendations based on subbasins and rehabilitation priority, Appendix D also includes a list of each recommended defect by manhole.

The rehabilitation priorities outline the timeline which has been recommended for manhole rehabilitation for each manhole. The City may elect to complete rehabilitation in manholes of a more urgent rehabilitation priority (e.g. severe, high) one year and may elect to withhold work on the manholes that have less urgent rehabilitation recommendations (e.g. moderate, low) for several years. However, the City may also choose to work on rehabilitations for all manholes with recommended rehabilitation items (e.g. lining, rooting) regardless of severity. Appendix E lists manhole rehabilitation recommendations based on each rehabilitation type.

Table No. 3-1: Manhole Rehabilitation Recommendations Summary

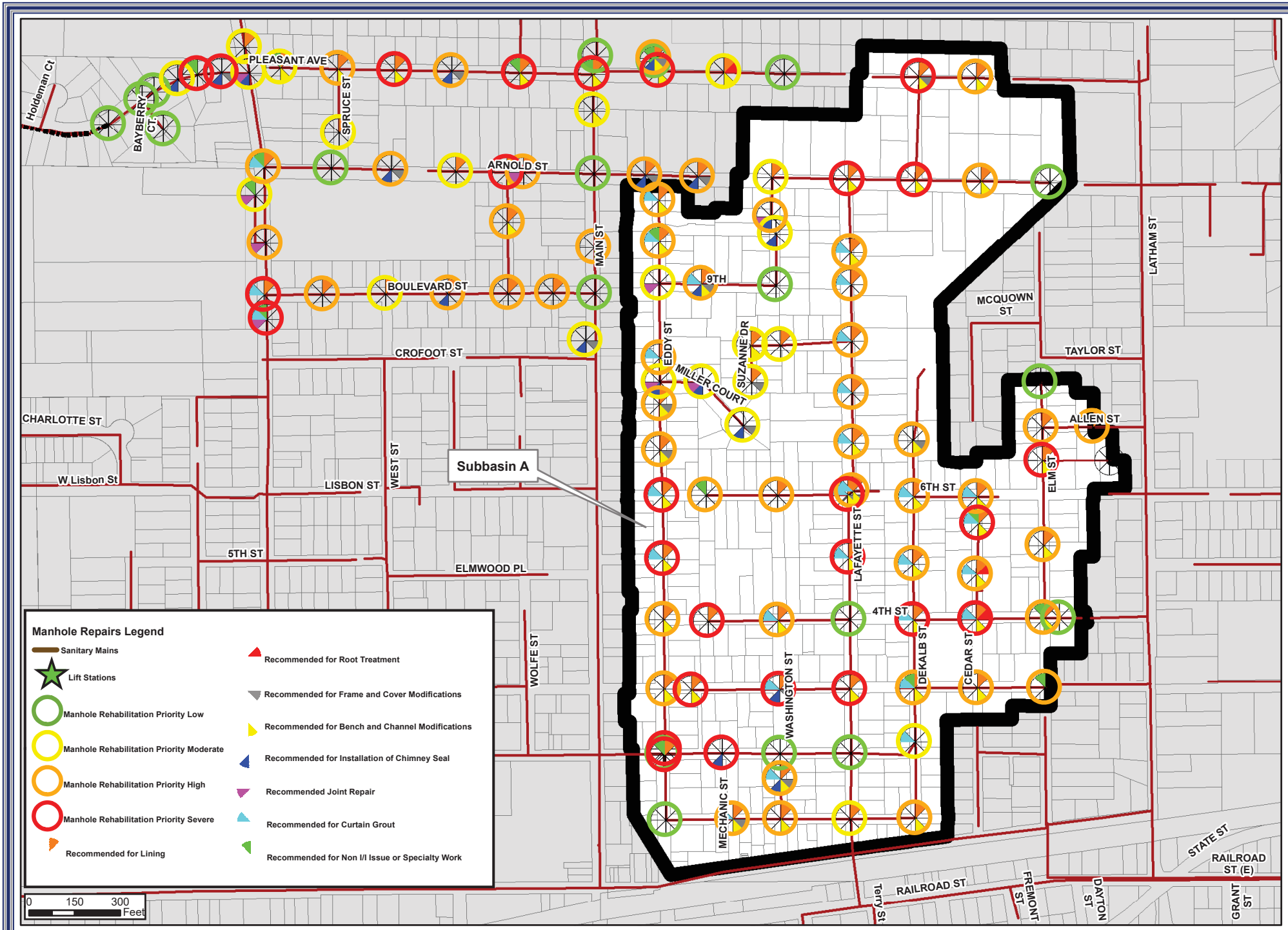
City of Sandwich, IL

Manhole Rehabilitation Priority	Category	Method	Location	Subbasin		
				A	E	Total
Severe (3)	Lining	Lining	Paved	15	7	22
			Unpaved	1	1	2
	Root Treatment	Root Treatment	Paved	2	0	2
			Unpaved	0	0	0
	Frame and Cover Modifications	Replace Frame and Cover	Paved	1	1	2
			Unpaved	0	0	0
		Raise or Reset Frame	Paved	0	0	0
			Unpaved	0	2	2
		Replace Cover	Paved	2	0	2
			Unpaved	0	0	0
	Bench/Channel Modifications	Replace Bench/Channel	Paved	6	3	9
			Unpaved	1	1	2
		Repair Bench/Channel	Paved	5	2	7
			Unpaved	0	0	0
	Install Chimney Seal	Internal Chimney Seal	Paved	2	0	2
			Unpaved	0	0	0
		External Chimney Seal	Paved	0	0	0
			Unpaved	0	1	1
	Joint Repair	Grout and Wipe Joints	Paved	0	0	0
			Unpaved	0	1	1
		Wipe Joints (No Grout)	Paved	0	0	0
			Unpaved	0	0	0
	Curtain Grout	Curtain Grout	Paved	8	1	9
			Unpaved	0	0	0
		Curtain Grout Lower 4'	Paved	0	0	0
			Unpaved	0	1	1
	Non I/I Issue or Speciality Work	Install Drop	Paved	0	0	0
			Unpaved	0	0	0
		Vac	Paved	2	4	6
			Unpaved	0	0	0
		Special Observation or Repair	Paved	0	1	1
			Unpaved	0	1	1
		Replace Structure	Paved	0	0	0
			Unpaved	0	0	0
	Total			**45**	**27**	**72**
High (2)	Lining	Lining	Paved	26	9	35
			Unpaved	5	4	9
	Root Treatment	Root Treatment	Paved	1	0	1
			Unpaved	0	0	0
	Frame and Cover Modifications	Replace Frame and Cover	Paved	3	1	4
			Unpaved	0	4	4
		Raise or Reset Frame	Paved	3	0	3
			Unpaved	0	0	0
		Replace Cover	Paved	2	0	2
			Unpaved	0	3	3
	Bench/Channel Modifications	Replace Bench/Channel	Paved	11	1	12
			Unpaved	1	1	2
		Repair Bench/Channel	Paved	13	3	16
			Unpaved	1	0	1
	Install Chimney Seal	Internal Chimney Seal	Paved	2	1	3
			Unpaved	1	3	4
		External Chimney Seal	Paved	0	1	1
			Unpaved	0	1	1
	Joint Repair	Grout and Wipe Joints	Paved	0	1	1
			Unpaved	1	1	2
		Wipe Joints (No Grout)	Paved	0	0	0
			Unpaved	0	0	0
	Curtain Grout	Curtain Grout	Paved	13	1	14
			Unpaved	5	0	5
		Curtain Grout Lower 4'	Paved	0	0	0
			Unpaved	0	0	0
	Non I/I Issue or Speciality Work	Install Drop	Paved	1	1	2
			Unpaved	0	0	0
		Vac	Paved	1	0	1
			Unpaved	0	0	0
		Special Observation or Repair	Paved	2	0	2
			Unpaved	0	0	0
		Replace Structure	Paved	2	0	2
			Unpaved	0	0	0
	Total			**94**	**36**	**130**

Table No. 3-1: Manhole Rehabilitation Recommendations Summary

City of Sandwich, IL

Manhole Rehabilitation Priority	Category	Method	Location	Subbasin		
				A	E	Total
Moderate (1)	Lining	Lining	Paved	5	6	11
			Unpaved	0	2	2
	Root Treatment	Root Treatment	Paved	0	1	1
			Unpaved	0	0	0
	Frame and Cover Modifications	Replace Frame and Cover	Paved	0	0	0
			Unpaved	0	0	0
		Raise or Reset Frame	Paved	2	0	2
			Unpaved	0	1	1
		Replace Cover	Paved	0	0	0
			Unpaved	0	0	0
	Bench/Channel Modifications	Replace Bench/Channel	Paved	0	1	1
			Unpaved	0	0	0
		Repair Bench/Channel	Paved	1	2	3
			Unpaved	0	0	0
	Install Chimney Seal	Internal Chimney Seal	Paved	4	1	5
			Unpaved	0	2	2
		External Chimney Seal	Paved	0	0	0
			Unpaved	0	1	1
	Joint Repair	Grout and Wipe Joints	Paved	3	1	4
			Unpaved	0	3	3
		Wipe Joints (No Grout)	Paved	0	0	0
			Unpaved	0	0	0
	Curtain Grout	Curtain Grout	Paved	0	0	0
			Unpaved	0	0	0
		Curtain Grout Lower 4'	Paved	1	0	1
			Unpaved	0	0	0
	Non I/I Issue or Speciality Work	Install Drop	Paved	0	0	0
			Unpaved	0	0	0
		Vac	Paved	0	1	1
			Unpaved	0	0	0
		Special Observation or Repair	Paved	0	0	0
			Unpaved	0	1	1
		Replace Structure	Paved	0	0	0
			Unpaved	0	0	0
	Total			**16**	**23**	**39**
Low (0)	Lining	Lining	Paved	0	0	0
			Unpaved	0	0	0
	Root Treatment	Root Treatment	Paved	0	0	0
			Unpaved	0	0	0
	Frame and Cover Modifications	Replace Frame and Cover	Paved	0	0	0
			Unpaved	0	0	0
		Raise or Reset Frame	Paved	0	0	0
			Unpaved	0	0	0
		Replace Cover	Paved	0	0	0
			Unpaved	0	0	0
	Bench/Channel Modifications	Replace Bench/Channel	Paved	0	0	0
			Unpaved	0	0	0
		Repair Bench/Channel	Paved	0	0	0
			Unpaved	0	0	0
	Install Chimney Seal	Internal Chimney Seal	Paved	0	0	0
			Unpaved	0	0	0
		External Chimney Seal	Paved	0	0	0
			Unpaved	0	0	0
	Joint Repair	Grout and Wipe Joints	Paved	0	0	0
			Unpaved	0	0	0
		Wipe Joints (No Grout)	Paved	0	0	0
			Unpaved	0	0	0
	Curtain Grout	Curtain Grout	Paved	0	0	0
			Unpaved	0	0	0
		Curtain Grout Lower 4'	Paved	0	0	0
			Unpaved	0	0	0
	Non I/I Issue or Speciality Work	Install Drop	Paved	0	0	0
			Unpaved	0	0	0
		Vac	Paved	0	0	0
			Unpaved	0	0	0
		Special Observation or Repair	Paved	0	0	0
			Unpaved	0	1	1
		Replace Structure	Paved	0	0	0
			Unpaved	0	0	0
	Total			**0**	**1**	**1**



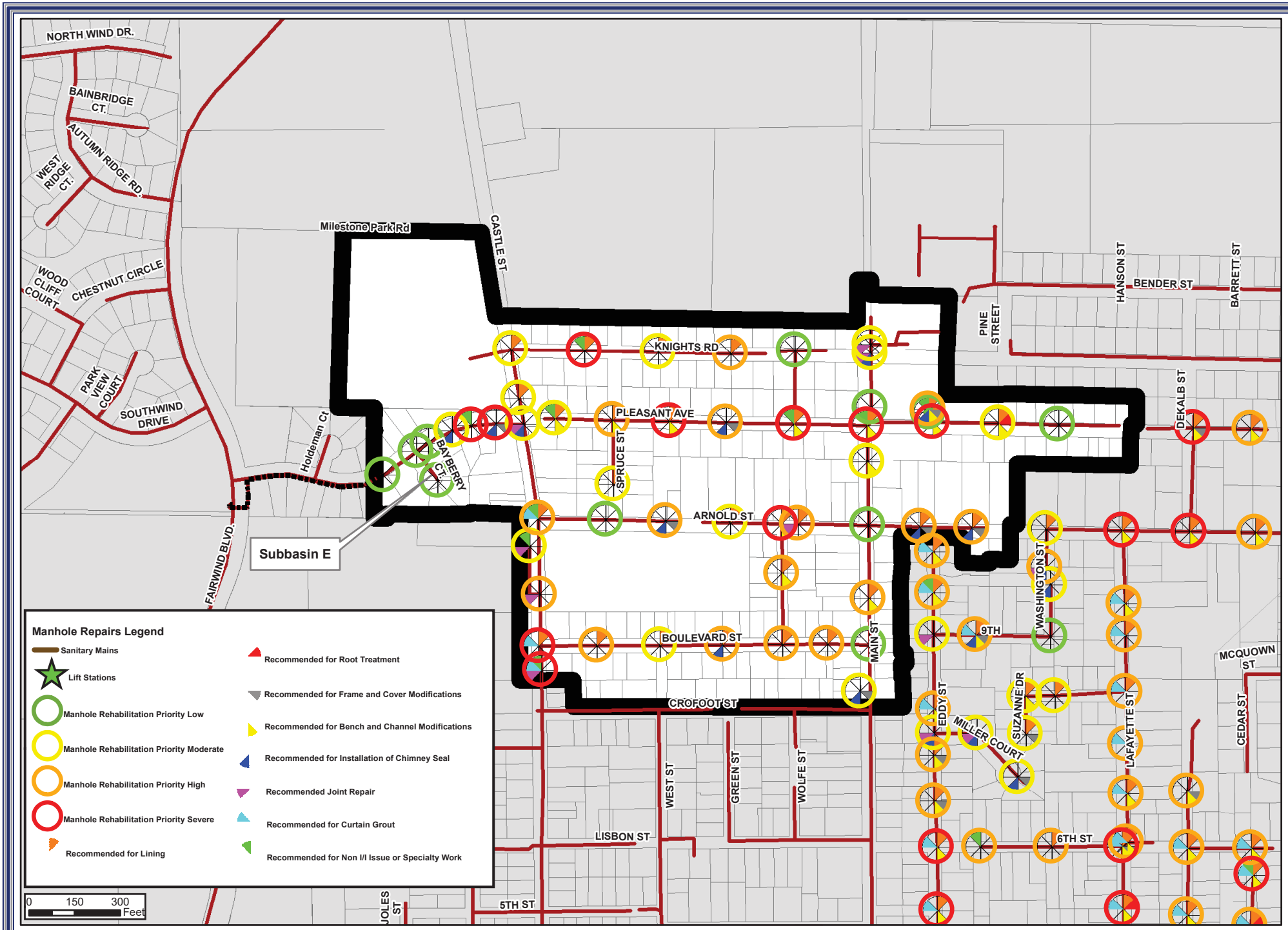
Engineering Enterprises, Inc.
52 Wheeler Road
Sugar Grove, Illinois 60554
(630) 466-6700
www.eeiweb.com

City of Sandwich
144 E. Railroad Street,
Sandwich, IL 60548

DATE:	AUGUST 2019
PROJECT NO.:	SA1901
BY:	MJT
PATH:	H:\GIS\Public\Saint Charles\2018\SR1803\SR1803_Appendix D-1a.mxd
FILE:	SA1901_Exhibit 3-1a Manhole Inspection Summary

INFLOW & INFILTRATION REDUCTION PROGRAM - PHASE 2 SSES

Exhibit 3-1a
Subbasin A
Manhole Inspections Summary



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FILE:	SA1901_Exhibit 3-1b Manhole Inspection Summary

INFLOW & INFILTRATION REDUCTION PROGRAM - PHASE 2 SSES

Exhibit 3-1b
Subbasin E
Manhole Inspections Summary

3.2 Sewer Rehabilitation

Sanitary sewer rehabilitation is a broad term and can encompass any number of items which are not within a manhole and occur within infrastructure owned by the City. Defects which are likely to cause RDII (such as storm tie-ins, smoking manholes) are likely to be found during smoke testing and manhole inspections. Due to high inflow, Subbasins A and E were smoke tested.

The sanitary sewer defects discovered during smoke testing were classified by their defect type and smoke amount as seen in Table No. 2-1 and Appendices I and K. The defects located in infrastructure owned by the City can be classified as smoking manholes and smoking mainlines.

Smoking Manholes: There are a variety of permanent defects which could cause a manhole to smoke during smoke testing; the manholes could have a lid defect, a broken or missing seal, could be affected by structural defects in the chimney, etc. Manholes may also smoke due to maintenance defects such as if the seal has been clogged with dirt or shifted out of place. Manholes with identical defects may contribute different amounts of I/I based on their elevation and surroundings, i.e. an open-pick manhole over which water frequently ponds will cause more I/I than an open-pick manhole in an elevated area with very little flow over the surface. Because manhole inspections estimate the extent of I/I based on evidence within the manhole, it is believed to be a better indicator of amount of I/I rather than the smoke testing, which indicates I/I potential. Therefore, it is recommended that the City prioritizes recommended rehabilitation documented during manhole inspections over manholes documented during smoke testing. The City may consider completing manhole rehabilitation on smoking manholes, such as cover replacement, as a lower priority.

Smoking Mainline: There can be hairline cracks or factures in the main sanitary sewer line. When tested, smoke comes out through these cracks and can be visible above ground. These defects one of the significant causes of infiltration and indicates I/I potential. Therefore, it is recommended that the City televise these mains to identify the defect and perform sewer rehabilitation based on the televising results.

3.2.1 Rehabilitation Technique – There are numerous rehabilitation techniques that can be used to rehabilitate certain defects identified during smoke testing review. Communities may exercise judgement to select the rehabilitation method that they prefer. The sections below outline recommended rehabilitation strategies for the defects identified during each SSES work item.

3.2.1.1 *Defects Identified During Smoke Testing* - The rehabilitation techniques recommended to correct defects identified during smoke testing are as follows

Rehabilitate Smoking Manholes: Because any number of defects may cause a manhole to smoke during smoke testing, prior to manhole rehabilitation the defect(s) must first be identified. Although the City may elect to replace covers on smoking manholes which are otherwise classified as requiring no rehabilitation work per the outcome of manhole inspections, it is recommended that the City focus on recommended rehabilitations from the manhole inspections. All manhole rehabilitation recommendations can be found in Section 3.1.

Rehabilitate Smoking Mainlines: Smoke can come out of the mainline during smoke testing due to various reasons. There may be a crack, fracture or even collapse within the mainline. Before the City takes further steps, that particular portion of the main must be televised to determine the actual defect.

Disconnect Catch Basins: The catch basins are considered as a defect during smoke testing because, they are meant to capture storm water only. Connecting catch basins to the sanitary main may lead to surcharging in the sanitary manholes and will result in excess influent flow to the WWTF. Hence, it is recommended that the City disconnect the catch basins from the sanitary sewer and tie it to the storm sewer.

3.2.2 Classification and Prioritization System – All defects identified were classified according to their potential for I/I, and/or how the defects would affect conveyance and structural integrity.

3.2.2.1 *Defects Identified During Smoke Testing* – Defects identified during smoke testing were classified by the type of defect and by the amount and consistency of smoke. The type of defect, as well as, the amount and consistency of smoke were used to estimate the potential amount of I/I. Typically, storm tie-ins are considered to be the largest contributors of I/I. The recommended classification and prioritization of manhole defects can be found in Section 3.1.

3.2.3 Rehabilitation Summary – Sanitary sewer defects were identified by smoke testing and by televising. The summary of the rehabilitation for the defects on city-owned infrastructure is outlined below, and the summary of rehabilitation needed for private property is outlined in Section 3.3. Appendix C includes detailed cost estimates for all main rehabilitations.

3.2.3.1 *Defects Identified During Smoke Testing* – Smoke testing identified smoking manholes, smoking mainlines, storm tie-ins, catch basins, lateral and cleanout defects. All defects identified during smoke testing can be found in Appendices I and K.

Smoke testing identified 10 smoking manholes and 9 smoking mainlines throughout the study area. Not all smoking manholes have rehabilitation recommendations as listed in Section 3.1. While the City may wish

to replace any manhole covers which were found to be smoking, it may be prudent to utilize the manhole inspection information to identify the manholes prioritized for rehabilitation.

3.3 Private Property Rehabilitation

Smoke testing identified private and City-owned defects; City-owned defects are described in Section 3.2 and private property defects are discussed in this section. The types of private defects identified during smoke testing can be found below.

Cleanout Lid Defects: These defects include missing, broken, or unsealed cleanout lids. A defective cleanout lid can lead to large amounts of inflow if a large area can drain into the cleanout. Cleanout lid defects are often caused by damage to the lids inflicted by lawnmowers, weedwhackers, or other yard care equipment.

Lateral Defects: These defects include cracks, fractures or other damages in the lateral lines. This can cause significant infiltration into the laterals which in turn adds to the mainline flow. The property owners are responsible for rehabilitating defective laterals.

Illegal Tie-Ins: Illegal tie-ins are classified as down-spouts, sump pumps, or other drainage of clear water into the sanitary sewer system from a private property source.

3.3.1 Rehabilitation Technique – There are a variety of rehabilitation techniques for private property sanitary sewer defects. It is prudent to mitigate defects which would contribute the most I/I to the sanitary sewer system prior to mitigating less severe defects.

Replace/Repair Cleanout Lids: Missing or broken cleanout lids can typically be easily repaired by installing a new cleanout lid. Cleanout lids are relatively inexpensive.

Rehabilitate Defective Laterals: The property owners can conduct lateral televising to determine the actual defects. They can take necessary rehabilitation measures based on these televising results.

Disconnect Illegal Tie-Ins: Illegal tie-in connections will have to be modified so that the tie-in will be removed from the sanitary sewer and either tied to the storm sewer or drained to a lower elevation land area.

3.3.2 Classification and Prioritization System – Private defects are typically considered to be the responsibility of private property owners, and the financial analysis included in Section 4 assumes that the homeowner would be responsible for the repair costs. The City may choose to send a letter to the residents to alert them of the defects and request that the defects be fixed. These letters can include a picture of the defect, describe the effect that these defects have on the sanitary sewers, and ask homeowners to correct the problems. If the City wishes to focus on city-owned causes of I/I, the City may instead catalog the private defects and consider mitigation at an appropriate future time.

The City may also choose to take more aggressive approaches to rehabilitating private property defects, such as requiring all defects to be fixed prior to properties being sold. If the City desires, they may instead elect to fix all or some of the private defects themselves, although this option comes at the greatest cost to the City.

3.3.3 Rehabilitation Summary – As seen in Table No. 2-1, there are a total of 13 cleanout issues, 14 lateral defects and 1 illegal tie-in. Smoke testing identified four (4) missing cleanout lid, eight (8) unsealed cleanout lids in both Subbasin A and E. Smoke testing also identified one illegal tie-ins, a downspout tie-in at 407 DeKalb St.

SECTION 4: SUMMARY AND FINANCIAL ANALYSIS

4.1 Estimated Construction Costs

As summarized in Table No. 4-1, the estimated construction costs to the City for the manhole rehabilitation and sanitary rehabilitation is approximately $434,000.

Projected costs for rehabilitation outlined in this report do not include engineering, project manual preparation, bidding, construction contract administration and observation.

Televising which is listed in the sanitary sewer rehabilitation section in Table 4-1, is originally a part of the SSES work. However, smoke was visible through the mainlines during smoke testing. This calls for the need to televise these mains before any rehabilitation work is carried out.

4.2 Implementation Plan

As discussed in Section 3, the City may choose from several different methods regarding their rehabilitation actions, depending on what they have budgeted for sanitary sewer improvements in 2020 and beyond. It is recommended that the City work to reduce the highest contributors of I/I first. The highest contributors of I/I in Subbasins A and E are likely the illegal tie-ins. To rehabilitate these items, the City will need to confirm the tie-ins with dye testing and/or televising and then disconnect the illegal tie-ins.

The next recommendation is to complete televising in those mains where smoke was visible during smoke testing. Visible smoke from mainline indicates a potential crack, fracture or even collapse within the mainline.

The City should then move on toward rehabilitation of remaining manhole defects. It is recommended that, at minimum, the City complete all recommended rehabilitations for manholes that are classified as having a severe rehabilitation priority. Depending on budgeting, the City may also choose to complete manhole rehabilitations on infrastructure with high, medium, or low rehabilitation priorities.

The final step of rehabilitation is alerting residents with private defects of the defect details and suggesting or requiring that they fix the defects and is of lower priority.

Below is a bullet point prioritization list (which is also included in the Executive Summary of this report). This list assists in prioritizing the I/I removal and general upgrades from Subbasins A and E based on removing the largest sources of I/I first and maintaining the structural integrity of the sanitary sewer main.

Table No. 4-1: Cost Summary Table

City of Sandwich, IL

Category	Description	Subbasin-A	Subbasin-E	Total
Rehabilitation For Defects Identified During 2019-SSES (Manhole Inspections and Smoke Testing)				
Manhole Rehabilitation Priority	**All Manhole Rehabilitation-Severe**	$72,938	$45,392	**$118,330**
	All Manhole Rehabilitation-High	$155,233	$72,738	**$227,971**
	All Manhole Rehabilitation-Moderate	$33,804	$46,197	**$80,001**
	All Manhole Rehabilitation-Low	$0	$1,200	**$1,200**
	Total-All Manhole Rehab.	***$261,975***	***$165,527***	***$427,502***
Sanitary Sewer Rehabilitation/ Review	**Storm Tie-In Investigations**	$0	$0	**$0**
	Televising	$6,496	$0	**$6,496**
	Total-All Sanitary Sewer Rehab/Review	***$6,496***	***$0***	***$6,496***
Private Defect Rehabilitation	**Cleanout Issues**	Homeowner Cost		
	Illegal Private Tie-Ins			
	Lateral Defects			
Subtotal		***$268,471***	***$165,527***	***$433,998***

** Includes $2.0/LF for televising and $1.5/LF for heavy cleaning and vac. The smoking mainlines are along Arnold Street (Length of 1,286 LF) and Lafayette Street (Length of 570 LF) in Subbasin A*

G:\Public\Sandwich\2019\SA1901 Subbasins A & E Phase 2 SSES\Eng\[A & E SSES Tables.xlsx]table 4-1 cost estimate

1. Rehabilitate Sanitary Manhole Defects

   Estimated Cost: $427,502

   Comments: It is recommended that the City immediately rehabilitate all manholes with a “severe” rehabilitation rating, which is projected to cost $118,330, not including engineering or contingency costs. It is also recommended to rehabilitate additional manholes with “high” or “moderate” rehabilitation ratings as funds allow. The City may also elect to begin rehabilitation for manholes with “low” rehabilitation ratings. The projected cost of rehabilitation, not including engineering or contingency costs, for manholes with “high”, “moderate”, and “low” rehabilitation severity ratings is $227,971, $80,001 and $1,200 respectively for a total projected manhole rehabilitation cost of $309,172.

2. Televise Mains In Which Smoke Was Visible During Smoke Testing

   Estimated Cost: $ 6,496

   Comments: The mainlines in which there was smoke visible during smoke testing indicate the possibility of cracks, fractures and collapse. These mains must be televised to determine the actual defect so as to take necessary rehabilitation measures. Televising cost also includes heavy cleaning and vactor.

3. Consider Notifying Property Owners of Private Defects, Including:
   a. Cleanout Issues (13 defects found in Subbasins A and E)
   b. Illegal Private Tie-ins (1 defect found in Subbasin A)
   c. Defective Laterals (14 defects found in Subbasins A and E)

   Estimated Cost: Negligible

   Comments: City Staff/Administrative Labor would prepare and send letters describing the defect and the necessary rehabilitation to the homeowner. Public Works Staff may follow up with the home-owner if desired.