City of Memphis

Interim Priority Areas Project Report

October 11, 2018

I certify under penalty of law that this document and all attachments were prepared under my direction or supervision in accordance with a system designed to assure that qualified personnel properly gather and evaluate the information submitted. Based on my inquiry of the person or persons who manage the system, or those persons directly responsible for gathering such information, the information submitted is, to the best of my knowledge and belief, true, accurate and complete. I am aware that there are significant penalties for submitting false information, including the possibility of fine and imprisonment for knowing violations.

Bobby D. Allen, P.E.

10-11-18

Date

Section 1
Introduction

On September 20, 2012, the United States District Court for the Western District of Tennessee entered a Consent Decree (CD) between the City of Memphis (the City) and the United States, the State of Tennessee, and the Tennessee Clean Water Network.

In accordance with CD Section V, Paragraph 11.a., Priority Rehabilitation Projects the assets in the collection system identified on the map in Appendix G, assessed in accordance with the Continuing Sewer Assessment Program (CSAP) under Paragraph 10f, are prioritized for rehabilitation through implementation of the Infrastructure Rehabilitation Program (IRP). Appendix G areas are a subset of the areas identified in Appendix E, which is the area that was required by the Consent Decree to be assessed pursuant to the CSAP in the first year following approval of the CSAP.

The Priority Rehabilitation Areas displayed in Appendix G are shown in Figure 1.1.

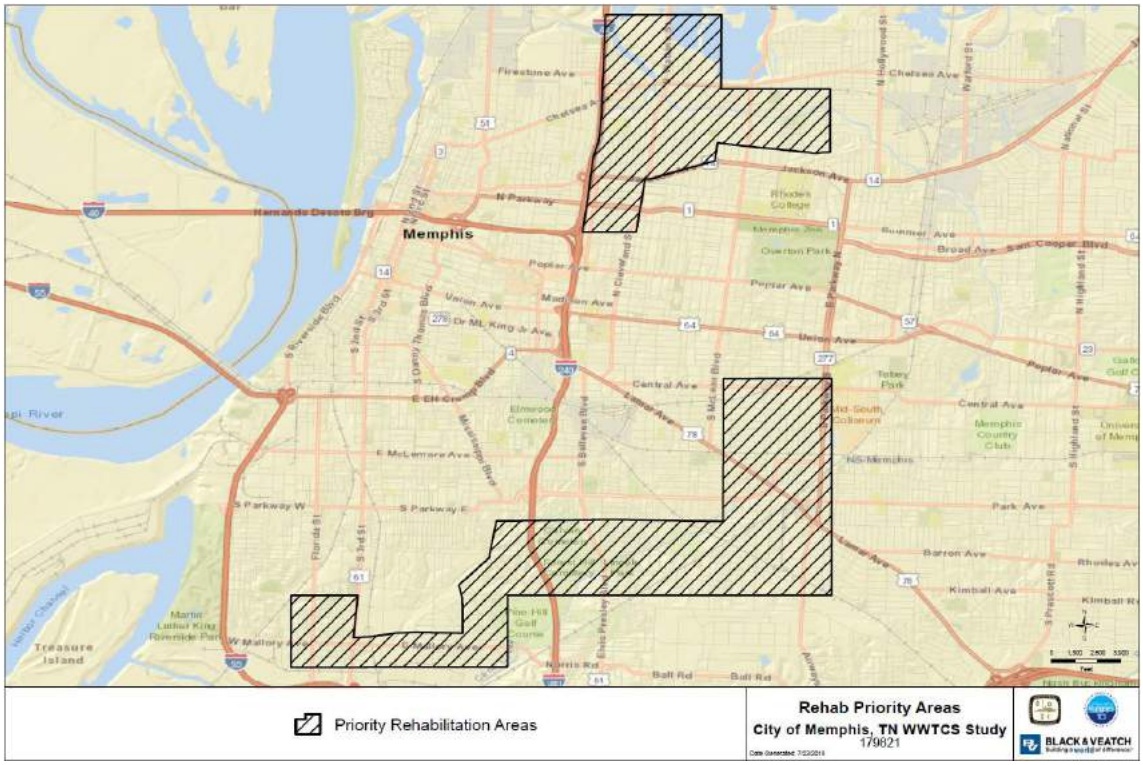


Figure 1.1 Priority Rehabilitation Areas

This Interim Priority Areas Project Report (Report) has been developed to set forth "a summary of the results to date of the implementation of the CSAP and IRP within the priority areas identified in Appendix G, including a thorough analysis of assessment data collected during implementation of the CSAP and IRP, and a description of the specific rehabilitation measures implemented by Memphis in these priority areas pursuant to the IRP," as stipulated in Section V, Paragraph 11.a of the CD. This Report is being submitted twenty-five to twenty-seven months after EPA's approval of

the IRP. The EPA approved the City's IRP on July 13, 2016, establishing the requirement for this summary submittal no later than October 13, 2018.

This report is organized into four sections:

- **Section 1** provides an introduction
- **Section 2** details the CSAP implementation in the Appendix G Priority Areas
- **Section 3** details the IRP implementation in the Appendix G Priority Areas
- **Section 4** provides a summary of the assessment and prioritization

Section 2
CSAP Implementation in the Priority Areas

2.1 Introduction

As stated in the CSAP, the CSAP "is intended to describe the approach to assess and analyze the infrastructure of the wastewater collection and transmission system (WCTS), including gravity sewers, manholes, lift stations, and force mains, by establishing procedures to be used in the assessment and a framework for prioritizing areas to be assessed." In accordance with the CD, the City of Memphis was required to assess the Priority Rehabilitation Areas of the WCTS outlined in Appendix G in the first year following EPA approval of the CSAP. The CSAP was approved by the EPA September 10, 2014. In addition, the City assessed the other areas of Appendix E during the first year after approval of the CSAP.

The Priority Rehabilitation Area (i.e., the Appendix G area) is comprised of 650,982 linear feet of 6" – 48" diameter gravity mains with approximately 2,044 manholes (a detailed table of the gravity main diameter by length breakdown is provided in Appendix A of this report). The area also contains 4 lift stations with 3,300 linear feet of associated force mains.

2.2 Condition Assessment Techniques

To assess the Priority Area assets, a range of condition assessment tools were used in accordance with the methods outlined in the CSAP. These techniques are used to assess and analyze the infrastructure in the WCTS. Once the assessments are performed, the information is stored in a GIS format and can be analyzed to make preventative maintenance and rehabilitation decisions.

2.2.1 Closed Circuit Television (CCTV)

The most commonly used condition assessment technique for gravity mains from 6-inch through 21-inch is closed circuit television (CCTV) inspections. This tool uses a color television camera inside a sewer to visually inspect the condition of the pipe. In accordance with the National Association of Sewer Service Companies (NASSCO) Pipeline Assessment and Certification Program (PACP) standards, CCTV inspections identify structural defects such as voids and collapses, operation and maintenance issues such as roots and grease, and construction features such as taps, deviations in the pipe alignment, and potential sources of inflow and infiltration (I/I). When the inspection is complete, the PACP software creates a report that identifies noted defects and gives each identified defect a severity score.

Prior to the CCTV inspection, each line receives a light cleaning to remove any loose grease or debris. If the camera cannot traverse the pipe after the initial light cleaning, a "heavy clean" is conducted to remove more substantial blockages including compacted grease and debris, significant roots, or intruding taps.

Once the contractor completes the inspection, the contractor delivers the CCTV video and PACP database to the City representatives where they were linked to the Geographic Information System (GIS) and assembled into a sortable, reviewable database (see Section 2.3, Information Management System). These standard PACP defect codes were compared across all pipes to assess which assets are most in need of rehabilitation or most likely to cause a sanitary sewer overflow (SSO). An example CCTV PACP report is included in Appendix B.1.

2.2.2 Large Diameter Sewer Sonar Inspection

A sonar inspection deploys a robotic sonar unit into a large diameter (24-inch and larger) gravity sewer main to evaluate the pipe cross section, pipe geometry and current debris levels. A sonar inspection is often used in conjunction with CCTV to inspect the pipe condition below the sewer flow line where a CCTV camera cannot inspect. The same PACP defect codes are used for a sonar inspection that are used for a traditional CCTV inspection. An example of a CCTV/Sonar inspection is shown in Appendix B.2.

2.2.3 Smoke Testing

Another tool used to evaluate the condition of gravity mains is smoke testing. Smoke testing is performed by placing a blower on a manhole and pumping smoke into the sewer line. The smoke fills the sewer and adjacent service laterals, and escapes the infrastructure at locations where the pipe is not properly sealed such as a crack, hole, broken service cleanout, or cross-connected storm drain. Smoke testing is particularly useful for identifying sources of I/I because the smoke escapes the pipe at locations where I/I could easily get into the pipe. A GPS point and picture are collected for each location where smoke leaves the pipe and this information is used to assess the structural condition of the pipe. Appendix B.3 displays a map with smoke defects on sewer segments in an area.

For the gravity mains in the Priority Rehabilitation Area, if a CCTV camera could not access the line or navigate the entire length of the asset (offset joint or debris prevented entire inspection), smoke testing was attempted to indirectly identify significant defects where a visual inspection was not feasible. In such cases where smoke testing was positive (i.e., detecting a likelihood of failure) the asset defect was deemed high.

2.2.4 Manhole Inspection

A manhole inspection gathers basic information about the manhole geometry and its condition, including location, orientation and size of incoming and outgoing pipes, depth of manhole, and surface conditions. Additionally, the inspection includes sub-meter GPS location of the manhole and pictures of the manhole condition. The inspections were conducted in accordance with NASSCO Manhole Assessment Certification Program (MACP) standards using standardized defect codes similar to PACP reports for pipes.

MACP reports are broken down into two scenarios: a Level 1 Inspection and a Level 2 Inspection. A Level 1 inspection was used for lampholes or manholes where full access is difficult or infeasible. These inspections include general information about the surface condition of the manhole and a GPS location. A Level 2 inspection is performed on manholes where access into the manhole is feasible and in which case the surface and interior condition of the manhole are documented. An example of a Level 2 manhole inspection is provided in Appendix B.4.

When a manhole cannot be inspected, the asset is initially noted in GIS as either Verified Buried or Unable to Locate (UTL). Verified Buried means that a CCTV camera has accessed the manhole through one of the incoming pipes and determined that the manhole exists but is not visible on the ground surface. Several methods were used in an attempt to locate Verified Buried manholes including metal detectors, thermal imaging, sonde frequency locators, and ground penetrating radar (GPR). If a manhole was located using one of these methods, it was raised and an MACP Level 2 inspection was completed. After reasonable field due diligence was performed, the remaining Verified Buried and UTL manholes were documented in the GIS using the original spatial location obtained from historical plans.

Once the contractor completes the inspection, the contractor delivered an MACP database to the City representatives where they were linked to the mapping GIS and assembled into a sortable, reviewable database (see Section 2.3, Information Management System).

2.2.5 Lift Station Assessment

A lift station assessment consisted of reviewing historical documentation of the lift station as well as completing a physical site inspection to assess the overall condition of the station to provide a Summary Report. The assessment generally included an evaluation of the following: capacity (pump run time), mechanical and physical condition, structural condition, electrical/instrumentation and controls, mechanical condition, historical performance, critical response time, and root cause failure analysis if necessary.

2.2.6 Force Main Desktop Analysis

A force main desktop analysis examined the profile of the force main to identify locations where corrosion or other force main failures were most likely to occur by reviewing plans, as-builts, or other relevant construction documents. The desktop analysis was used to assess which assets may need to be further inspected with surge modeling or field assessments.

2.3 Information Management System (IMS)

To be able to analyze and store the information gathered through the condition assessment described in Section 2.2, the City has implemented a GIS that captures spatial characteristics about the assets. Once the assets are assessed in the field, the information gathered is integrated into a GIS geodatabase and map displaying the assets. The geodatabase stores the information about the assets including conditions and defects noted in the PACP, MACP, sonar, and smoke testing results. This geodatabase allows for sortable assessment and review of the collected data, and can be utilized when making rehabilitation recommendations in accordance with the IRP which will be further discussed in Section 3.

The maps display the assessment information, gathered during the CSAP performance and entered into the database, and links it geographically to the displayed asset. The pipes, manholes, lift stations, and force mains are shown on the maps, located by obtaining GPS information during the assessment. Additional information such as roads, waterways, buildings, and parcel boundaries can be overlaid using other GIS maps and tools.

The assessment information in the geodatabase, including the PACP reports, the MACP reports, and the CCTV video and still picture data, is all stored on a cloud-based server and can be viewed through a web browser. The City utilizes selected software to be able to review the CCTV footage and the MACP pictures and reports.

2.4 Assessment Results

The condition assessment of the Priority Rehabilitation Areas was broken up into a Pilot Program, Phase 1 and Phase 2 work as shown in Figure 2.1.

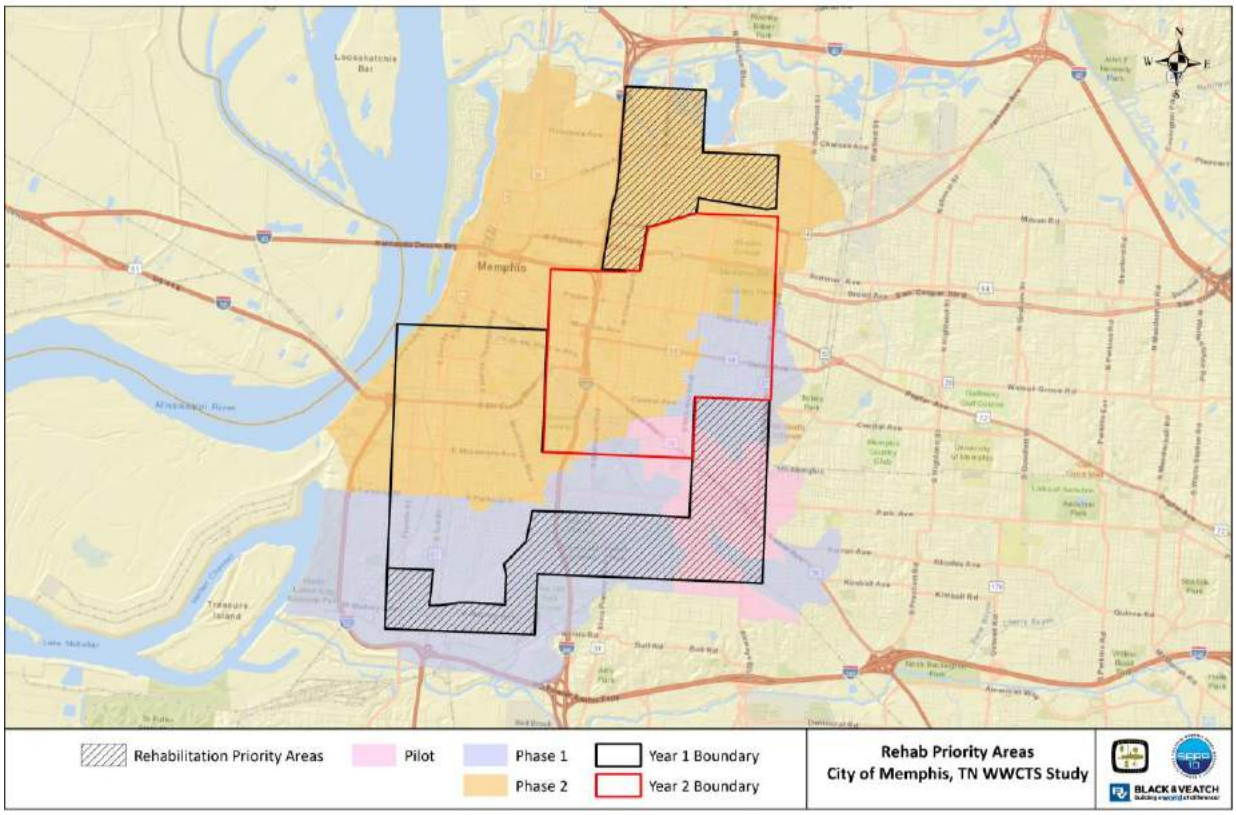


Figure 2.1 Condition Assessment Phases

The Pilot Program was developed to trial the procedures and data capture to be used in the CSAP. The Pilot area was selected to be completed first because of historical SSO concentrations in the area and was conducted from October 2013 to April 2014. This area includes part of the Southern Rehabilitation Priority Area. After the Pilot was completed, a larger area of the city was selected and assessed in Phase 1. This area was selected to coincide with the southern portion of the Year 1 assessment area in the CD and was completed from April 2014 to October 2014. This area included the remainder of the Southern Rehabilitation Priority Area. Phase 2 was then assessed and included all of the Northern Rehabilitation Priority Area, and coincided with the remainder of Year 1 and all of Year 2 of the CD CSAP requirement. This area was assessed from January 2015 to July 2015.

The assessment results of the gravity mains and manholes in Appendix G are listed below in Table 2.1.

Condition Assessment Phase	Gravity Main PACP Inspection (LF) (includes Sonar)	Gravity Main Smoke Testing (LF)	Gravity Main Assessed with PACP and/or Smoke Testing (LF)	Gravity Mains Assessed with Both PACP and Smoke Testing (LF)	Manholes Inspected (MACP)
Pilot	140,789	128,479	160,410	108,857	472
Phase 1	224,914	228,768	256,092	197,590	662
Phase 2	198,377	180,971	214,380	164,968	607
Total (% of Total Area)	564,080 (87%)	538,218 (83%)	630,882 (96.9%)	471,415 (72.4%)	1,741 (85%)

Table 2.1 Priority Rehabilitation Areas Assessment Statistics

As displayed in Table 2.1, the City was able to inspect 564,080 linear feet (87%) of gravity mains with CCTV and/or sonar. Additionally, smoke testing was completed on 538,218 linear feet (83%) of the Priority Rehabilitation Area. Of the 86,902 linear feet of gravity mains that was not able to be inspected using CCTV and/or sonar, 66,802 linear feet was assessed via smoke testing. Therefore, 630,882 linear feet of the 650,982 linear feet (96.9%) of gravity mains in the Priority Rehabilitation Areas was assessed using either CCTV or smoke testing.

A Level 1 or Level 2 manhole inspection with corresponding GPS location was completed for 1,741 (85%) of the manholes in the Priority Rehabilitation Areas. For the manholes that were not able to be field verified with a Level 1 or Level 2 MACP inspection, they were reviewed and reasonable due diligence was attempted to find and inspect the asset. This due diligence included the locating methods described in Section 2.2.4.

The four lift stations identified in the Priority Rehabilitation Area (837 N Claybrook St., 2019 Howell Ave., 1513 Levee Rd., and 1490 N Bellevue Blvd.) were visited and evaluated by an engineering firm. Statistics about these lift stations and their associated force mains are shown in Table 2.2. A Summary Report was produced for each station detailing the condition. A desktop analysis was also completed for each associated force main.

Lift Station	Year Built	Force Main Diameter (inches)	Force Main Length (ft)	Number of Pumps	Pump Capacity (gpm)
837 North Claybrook St.	2001	4	31	2	150
2109 Howell Ave.	1975	4	25	2	100
1513 Levee Rd.	2012	6	414	2	540
1490 Bellevue Blvd.	1989	24	2,855	2	5,600

Table 2.2 Priority Rehabilitation Areas Lift Station Statistics

2.5 Condition Assessment Impact on the Area

The condition assessment of the Priority Rehabilitation Area provided a robust collection of data about the assets in the area that can be used to make rehabilitation decisions. The assessment and cleaning efforts also had a positive impact on the overall SSO numbers in the area. Along with the light cleaning performed on gravity mains, 41,482 linear feet was heavy cleaned. An analysis of the SSOs within the Priority Areas found the majority were caused by heavy grease and debris collected in the lines and manholes. These SSO factors are amenable to cleaning, rather than rehabilitation, for improving performance. Graph 2.1 below illustrates that as the condition assessment and cleaning progressed, the SSOs/year in the Priority Rehabilitation Area decreased without completing significant rehabilitation.

*Through June 30, 2018. This total does not include 22 SSOs that occurred in the Priority Rehabilitation Area caused by broken pumps at the Stiles WWTP and are not related to issues in the WCTS.

Graph 2.1 SSOs in Priority Rehabilitation Areas (Appendix G)

Section 3
IRP Implementation in the Priority Areas

3.1 Introduction

Once the Priority Rehabilitation Areas were assessed in accordance with the CSAP procedures described in Section 2, the information regarding the assets was reviewed. Using professional judgement, the condition of the assets was rated for conditions causing, or likely to cause, an SSO. Utilizing the CSAP data via the IRP provided the basis for evaluating and prioritizing the management of, and response to, defects identified in the WCTS. As stated in the IRP, the IRP is intended to "utilize the information gathered from the CSAP…to provide a process for evaluating and prioritizing rehabilitation efforts" and aims to "maximize the effect of City expenditure of limited resources on the repair or rehabilitation of defects in the WCTS that have caused sanitary sewer overflows (SSOs) or are likely to cause an SSO due to conveyance, capacity, or structural failures." These recommendations, along with various other factors, are weighted in the IRP prioritization process to create rehabilitation project scopes.

3.2 IRP Data Analysis

3.2.1 Condition Assessment Data Review

The first step to prioritizing the assets for rehabilitation is to holistically review the condition assessment data collected in the field. All PACP reports, CCTV footage, and MACP reports collected in the field were reviewed by technical office personnel using their best engineering judgement through a review process referred to as the Engineering Tracker. This additional quality control/quality assurance step helps assess the likelihood of failure of the asset and the recommended rehabilitation. These reviews also provide consistency and uniformity within the database resulting in dependable data to be used with the IMS. Examples of pipe rehabilitation include cured-in-place pipe (CIPP), line replacement, and point repairs. Manhole rehabilitation can include coating of the manhole walls for structural stability, replacing the bench and channel for better hydraulic capacity, or complete replacement of the manhole.

For the four lift stations and associated force mains, the results of the assessments and desktop analyses were reviewed. No immediate rehabilitation was identified and monitoring will continue in accordance with the Lift Station and Force Main O&M Program.

3.2.2 Prioritization

After the condition assessment data was reviewed and checked, the resulting recommendations were prioritized by weighting the Consequence of Failure and Likelihood of Failure for each asset. In accordance with the IRP, the prioritization process evaluates the assets "based on both condition (likelihood of failure) and criticality (consequence of failure)" to determine the rehabilitation priority for each pipe. Considerations for the Likelihood and Consequence of Failure are shown below in Figure 3.2.

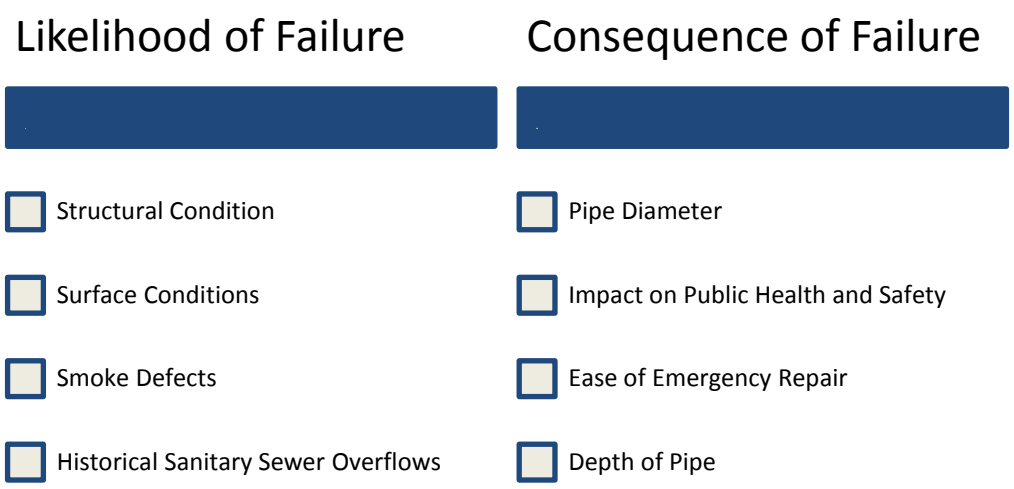


Figure 3.2: Gravity Main Prioritization Risk Considerations

3.3 Results of IRP Prioritization

The Likelihood of Failure (Condition) and Consequence of Failure (Criticality) for each asset were plotted on a heat map (similar to Figure 3.3) which prioritized the assets for rehabilitation. The assets associated with historical SSOs and those considered to be most likely to contribute to future SSOs (High Priority Repairs as defined by the IRP) were identified to receive rehabilitation. A list of these assets is compiled in Appendix C.1. From the Rehabilitation Priority Areas (Appendix G), approximately 18 miles of gravity mains (14.5% of the assets in the area) and 301 manholes (15.1%) were determined to be High Priority Repairs. The assets in the Rehabilitation Priority Areas that were not identified to receive rehabilitation (the yellow and green portions of Figure 3.3) will be reevaluated using the Re-assessment Program described in the IRP.

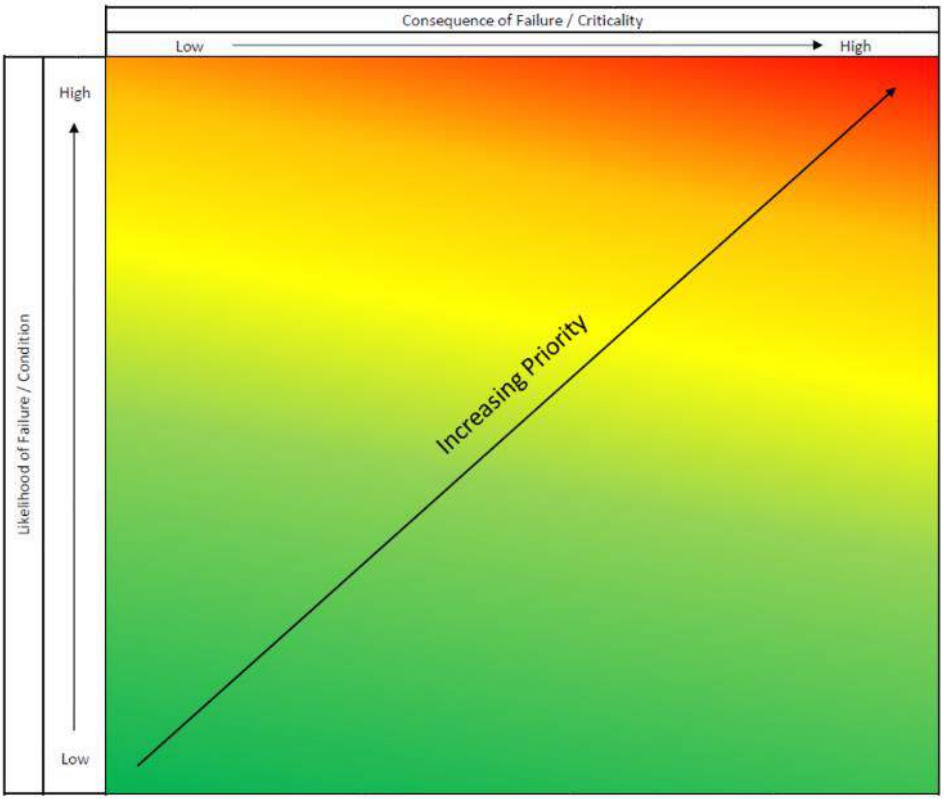


Figure 3.3 Rehabilitation Heat Map

The following rehabilitation recommendations were made for the High Priority Repair pipes and manholes in the Priority Rehabilitation Areas:

	Total	CIPP	Relay	Point Repair Only
Total Footage	650,982 LF	--	--	--
Rehab Footage	92,473 LF	53,764 LF	18,773 LF	19,936 LF
% of Total	14.2%	8.2%	2.9%	3.1%
% of Rehab	--	58.1%	20.3%	21.6%

Table 3.1 Gravity Main Rehabilitation Recommendations

	Quantity	Cementitious Coating	Install Inside Drop	Repair Bench/Channel	Replace Existing Manhole	Install New Manhole
Total Manholes	2,044	--	--	--	--	--
MHs For Rehab*	317	206	35	100	6	26
% of Total MHs	15.5%	10.1%	1.7%	4.9%	0.2%	1.3%
% of MH Rehab*	--	65.0%	11.0%	31.5%	2.0%	8.2%

*Does not equal 100% (of 317) because select manholes receive more than 1 type of rehab.

Table 3.2 Manhole Rehabilitation Recommendations

3.4 Rehabilitation Measures Completed

Along with prioritizing the assets for rehabilitation, the City procured a point repair contract to repair high value defects identified during assessment as well as a manhole adjustment contract to expose and raise to grade buried or inaccessible manholes. To date, the City has completed 35 point repairs and 163 manhole adjustments under these contracts in the Priority Rehabilitation Areas. These totals are independent of the results of the prioritization. These pipes and manholes are shown in Appendix C.2.

Additionally, the City has put together two rehabilitation packages for the gravity mains and manholes identified through the prioritization. The first package, Group 1 Relay, consists of replacing approximately 19,000 linear feet of existing 6"-8" diameter gravity mains (6" diameter lines replaced with 8"), installing 17 new manholes, and rehabilitating 24 existing manholes. This project began August 2018. Another rehabilitation project, Group 1 CIPP, consists of installing CIPP on approximately 53,700 linear feet of 8" – 36" diameter gravity mains, installing 9 new manholes, and rehabilitating 267 existing manholes. This project is anticipated to begin in 2019. Maps of the lines and manholes being rehabilitated are shown in Appendix C.3 and C.4. These two rehabilitation projects are anticipated to be completed by the CD required deadline of February 13, 2023.

Section 4
Summary

The City of Memphis, pursuant to CD Section V, Paragraph 11.a., Priority Rehabilitation Projects, has completed assessment of the Priority Rehabilitation Areas through implementation of the CSAP and prioritized the assets for rehabilitation in accordance with the IRP.

The City assessed the assets in the Priority Rehabilitation Areas using the methods specified in the CSAP and documented the information gathered through the assessment in a GIS-based Information Management System.

Through the assessment and cleaning efforts, the City was able to make a positive impact on the overall number of SSOs in the area. Since the program began in 2013, the number of SSOs has been trending downward.

The assessment and inspection data was compiled in the City's IMS and reviewed to develop rehabilitation scopes of work in the Priority Rehabilitation Areas. In accordance with the IRP, the data was reviewed and prioritized by weighting the Likelihood of Failure and Consequence of Failure of each asset. The assets determined to have caused an SSO or considered most likely to cause a future SSO were then grouped in two rehabilitation projects covering different scopes of work. 14.5% of gravity mains and 15.5% of manholes in the area were included in the rehabilitation projects. Group 1 Relay, consisting of approximately 19,000 linear feet of 6" - 8" diameter gravity main replacement (6" diameter lines replaced with 8") and associated manhole rehabilitation, began in August 2018. Group 1 CIPP which consists of approximately 53,700 linear feet of 8"-36" CIPP and associated manholes is scheduled to begin in 2019. All rehabilitation is anticipated to be completed by February 13, 2023, in accordance with the CD.

Appendix A
Gravity Main Diameter Breakdown

Gravity Main Diameter	Linear Footage
6”	113,456
8”	381,506
10”	44,298
12”	27,905
15”	19,233
18”	11,842
21”	2,453
24”	14,496
27”	2,903
30”	7,294
36”	24,716
48”	880
Total:	650,982

Appendix B.1
Example PACP Report (CCTV Only)

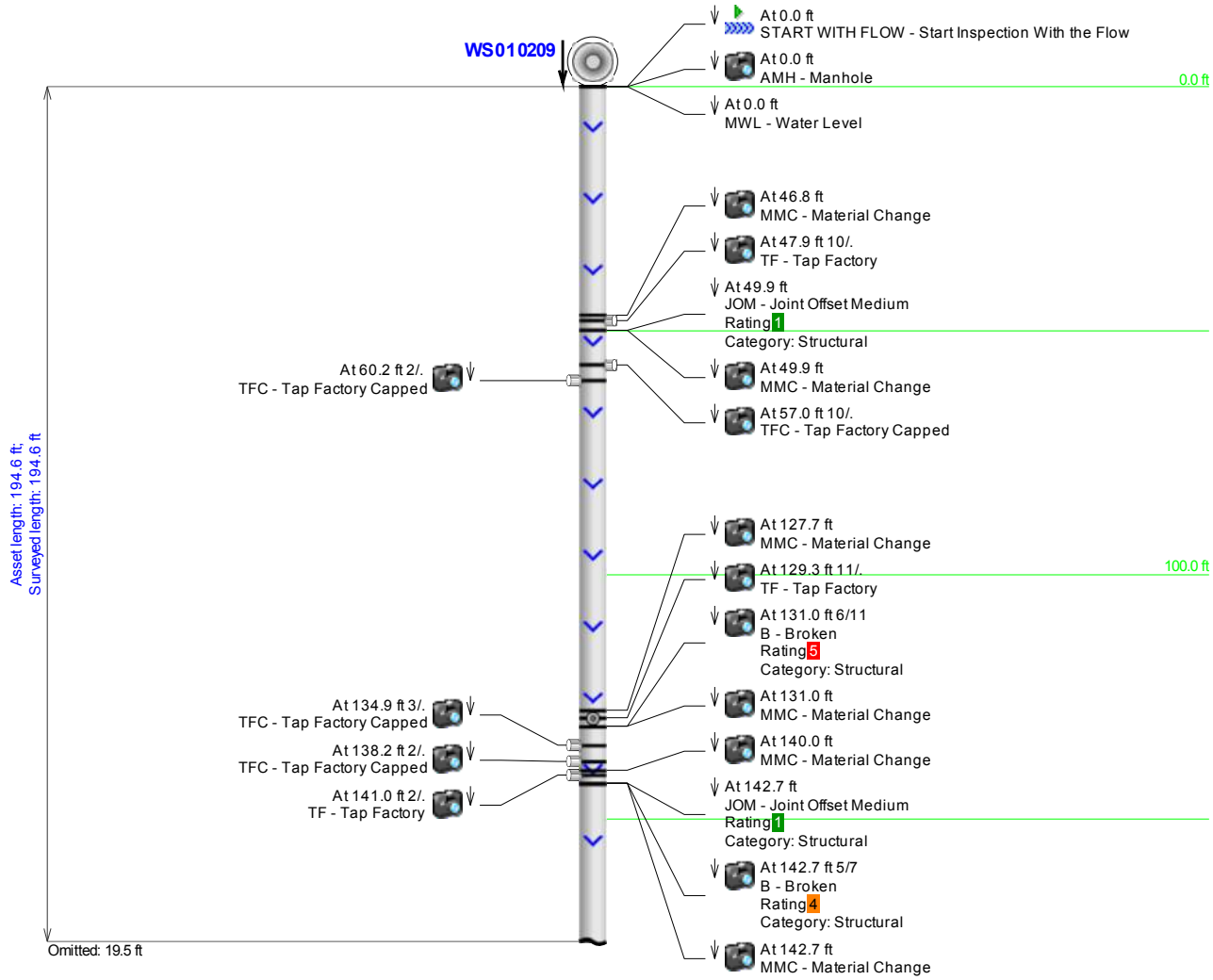
Main Inspection with Pipe-Run Graph

Project Name:	Pipeline segment ref:	City:	Street:
Phase 2	WS010209S	Memphis	1221 SMITH AVE

Start date/time:		Width:	Height:	Material:	Upstream MH:	Downstream MH:
2015/05/04	09:49	8	8	CP	WS010209	WS010208

Direction:	Date Cleaned:	Pre Cleaning:	Location code:	Weather:	Total Length:	Length surveyed:
Downstream	2015/05/04	J	D	1	194.6	194.6

Additional info:	Certificate No:	Surveyed by:
	U-314-06020907	ADS/SKONSENG



Project Name:	Pipeline segment ref:	City:	Street:
Phase 2	WS010209S	Memphis	1221 SMITH AVE

Start date/time:		Width:	Height:	Material:	Upstream MH:	Downstream MH:
2015/05/04	09:49	8	8	CP	WS010209	WS010208

Direction:	Date Cleaned:	Pre Cleaning:	Location code:	Weather:	Total Length:	Length surveyed:
Downstream	2015/05/04	J	D	1	194.6	194.6

Additional info:	Certificate No:	Surveyed by:
	U-314-06020907	ADS/SKONSENG

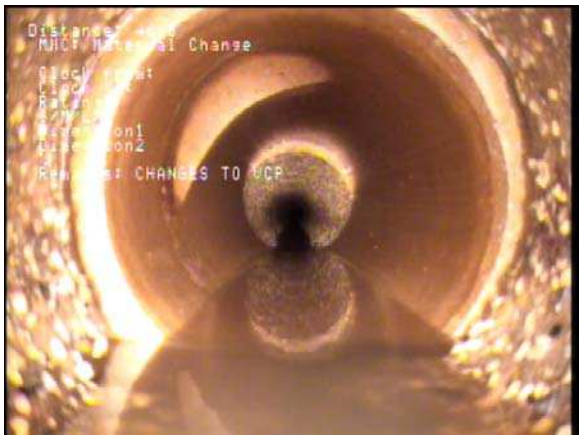
City of Memphis -- Phase 2

Structure ID WS010209S

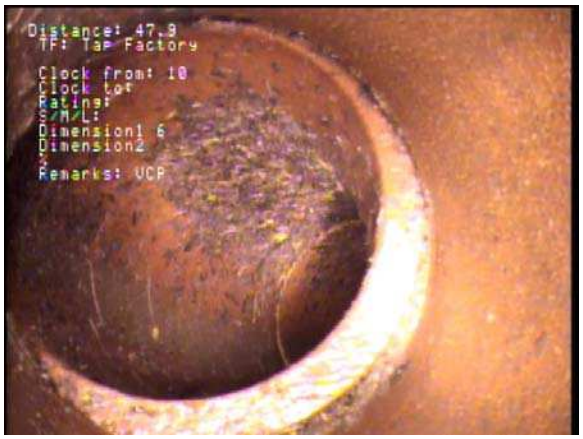
LS WS010209 to WS010208

FLow → Measurement

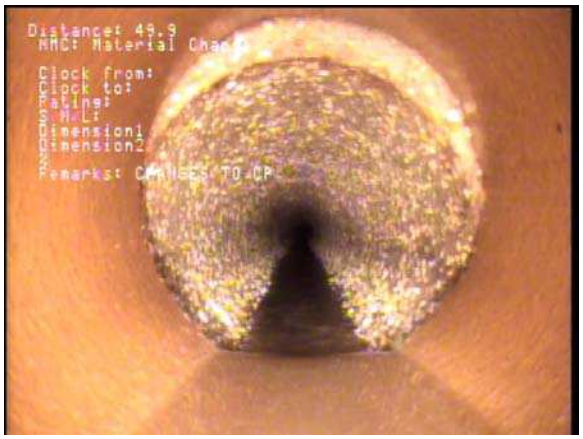
AMH AMH WS010209 0 l.f.



MMC Material Change -- CHANGES TO VCP 46.8 l.f.



TF Tap Factory -- VCP 47.9 l.f.



MMC Material Change -- CHANGES TO CP 49.9 l.f.

TFC Tap Factory Capped -- CP 57 l.f.

TFC Tap Factory Capped -- CP 60.2 l.f.

City of Memphis -- Phase 2

Structure ID WS010209S

LS WS010209 to WS010208

FLow → Measurement

MMC Material Change -- CHANGES TO VCP 127.7 l.f.

TF Tap Factory -- VCP -- ROOTS 129.3 l.f.

MMC Material Change -- CHANGES TO CP 131 l.f.

B Broken 131 l.f.

B Broken 131 l.f.

TFC Tap Factory Capped -- CP 134.9 l.f.

City of Memphis -- Phase 2

Structure ID WS010209S

LS WS010209 to WS010208

FLow → Measurement →

TFC Tap Factory Capped -- CP 138.2 l.f.

MMC Material Change -- CHANGES TO VCP 140 l.f.

TF Tap Factory -- VCP 141 l.f.

B Broken 142.7 l.f.

MMC Material Change -- CHANGES TO CP 142.7 l.f.

AMH AMH WS010208 194.6 l.f.

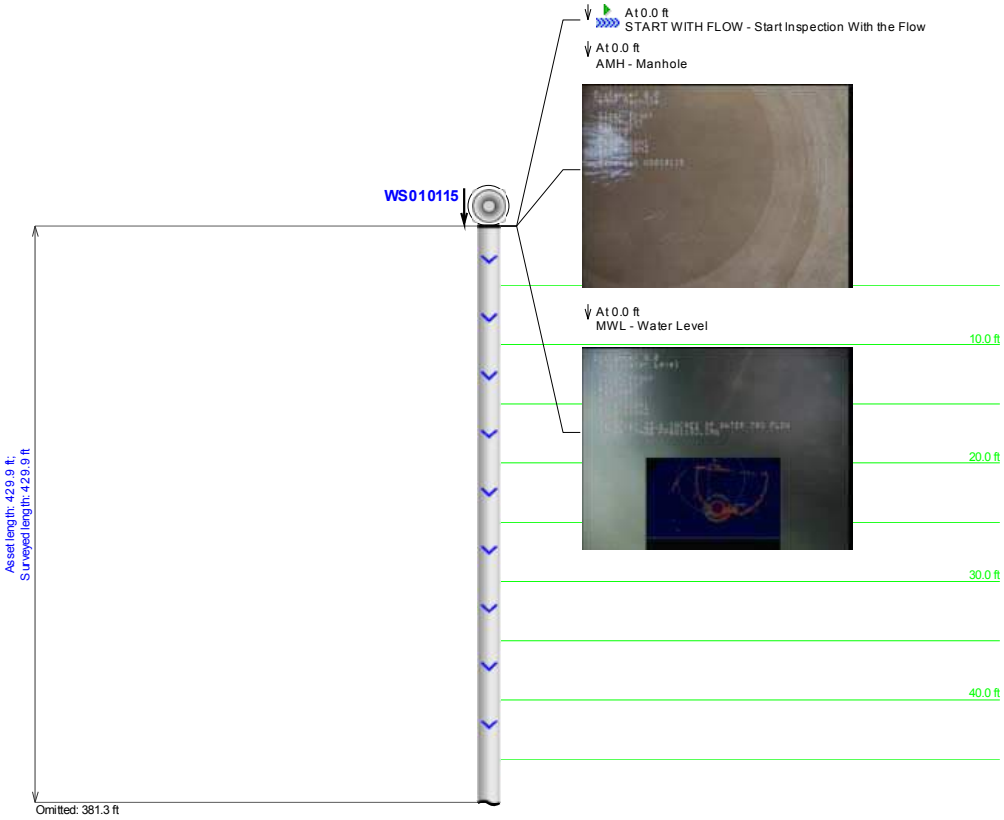
Appendix B.2
Example CCTV Report (CCTV/Sonar)

Compliance EnviroSystems, LLC
1401 Seabord Drive
Baton Rouge, LA 70810
Phone: (255) 769-2933
www.ces-sses.com

Main Inspection with Pipe-Run Graph and Images

MEMPHIS, TN

Pipe ID:	WS010115S		Drainage Area:	WS01	
UpsMH / Depth:	WS010115	14.4	Address / Street:	CHELSEA AVE (OFF)	
DnsMH / Depth:	WS010114	0	Date / Time:	20150901085917	
Material:	DIP		Surveyor:	ADS/AHOWELLS	
Shape:	C		Pre-Cleaning / Date:	N	
Joint Length:	20		Diameter:	36	
Pipe Length:	429.9		Length surveyed:	429.9	Downstream
Comment:					



Compliance EnviroSystems, LLC
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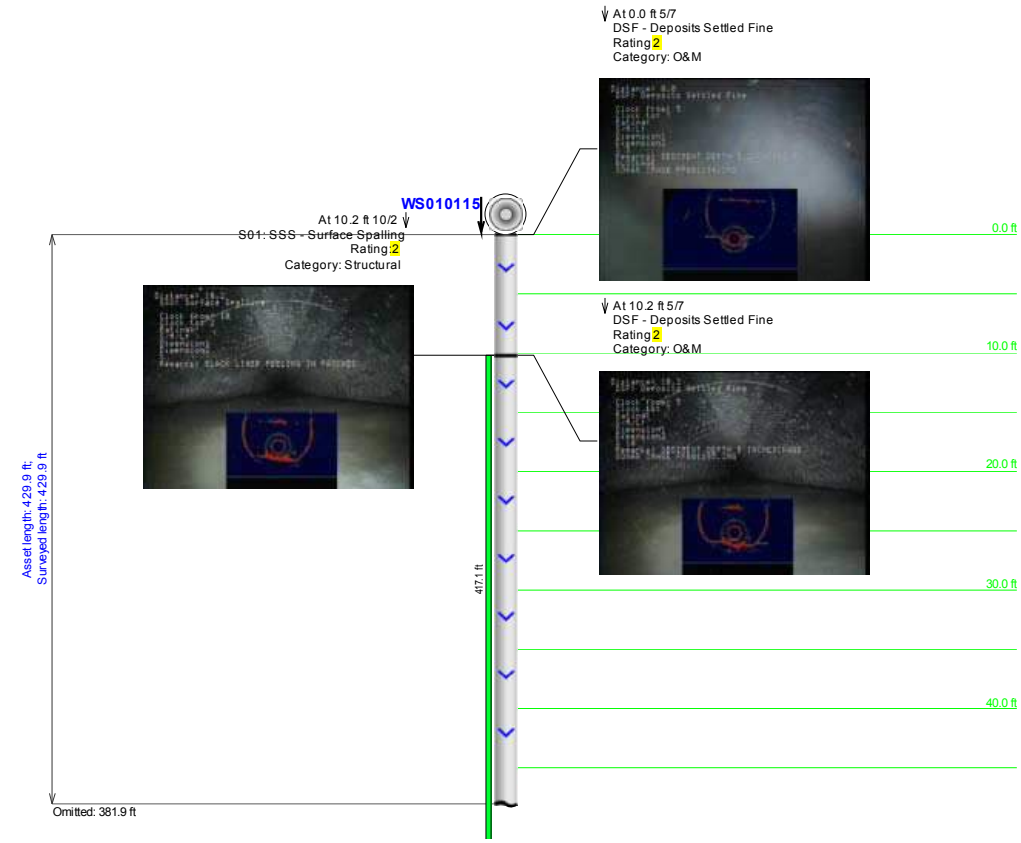
Baton Rouge, LA 70810
Phone: (255) 769-2933
www.ces-sses.com

MEMPHIS, TN

Pipe ID:	WS010115S		Drainage Area:	WS01	
UpsMH / Depth:	WS010115	14.4	Address / Street:	CHELSEA AVE (OFF)	
DnsMH / Depth:	WS010114	0	Date / Time:	20150901085917	
Material:	DIP		Surveyor:	ADS/AHOWELLS	
Shape:	C		Pre-Cleaning / Date:	N	
Joint Length:	20		Diameter:	36	
Pipe Length:	429.9		Length surveyed:	429.9	Downstream
Comment:					

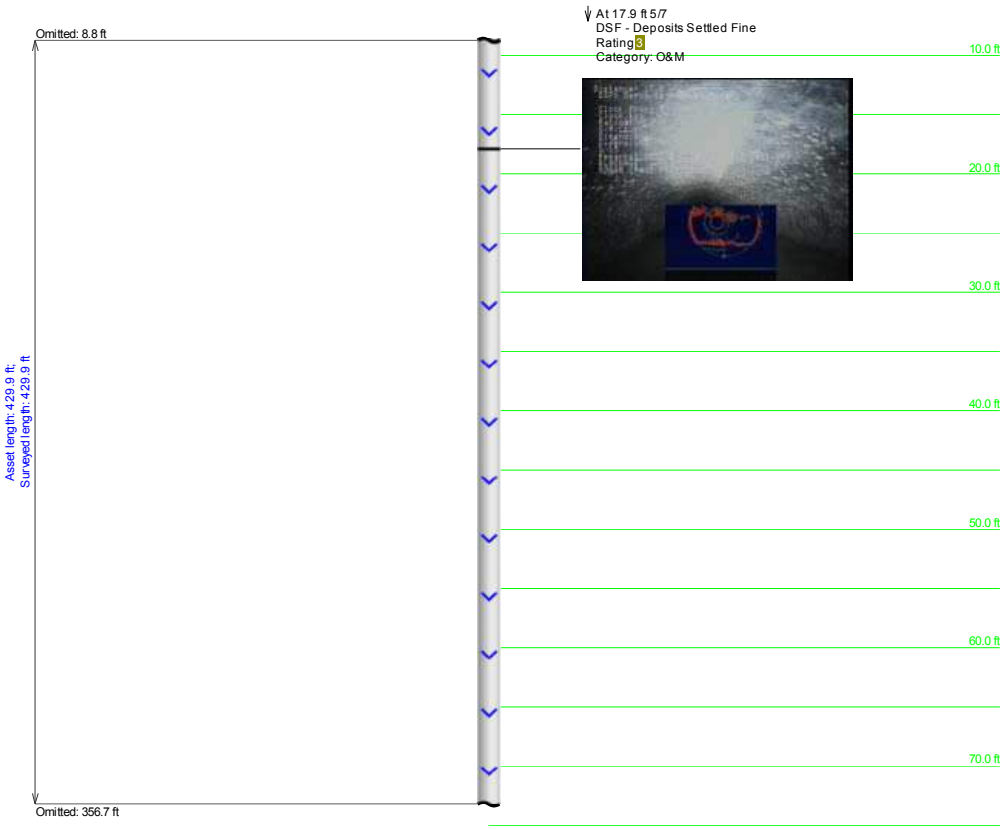


Compliance EnviroSystems, LLC
1401 Seabord Drive
Baton Rouge, LA 70810
Phone: (255) 769-2933
www.ces-sses.com

MEMPHIS, TN

Pipe ID:	WS010115S	
UpsMH / Depth:	WS010115	14.4
DnsMH / Depth:	WS010114	0
Material:	DIP	
Shape:	C	
Joint Length:	20	
Pipe Length:	429.9	
Comment:		

Drainage Area:	WS01	
Address / Street:	CHELSEA AVE (OFF)	
Date / Time:	20150901085917	
Surveyor:	ADS/AHOWELLS	
Pre-Cleaning / Date:	N	
Diameter:	36	
Length surveyed:	429.9	Downstream



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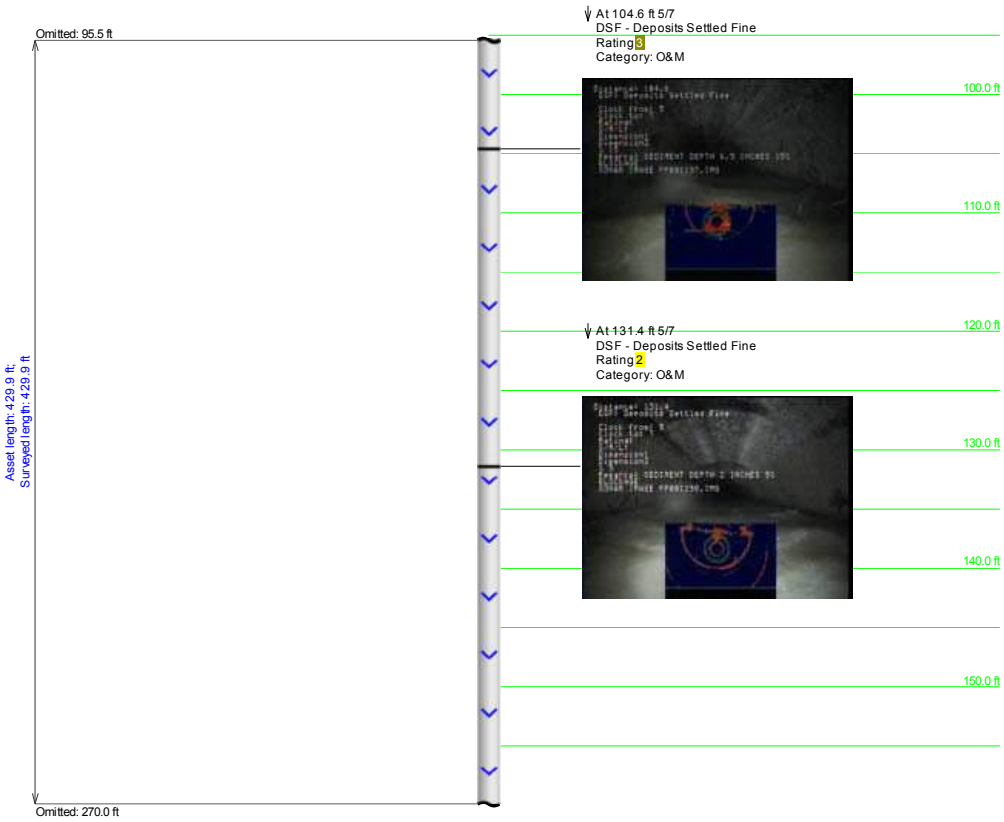
MEMPHIS, TN

Pipe ID:	WS010115S	
UpsMH / Depth:	WS010115	14.4
DnsMH / Depth:	WS010114	0
Material:	DIP	
Shape:	C	
Joint Length:	20	
Pipe Length:	429.9	
Comment:		

Drainage Area:	WS01	
Address / Street:	CHELSEA AVE (OFF)	
Date / Time:	20150901085917	
Surveyor:	ADS/AHOWELLS	
Pre-Cleaning / Date:	N	
Diameter:	36	
Length surveyed:	429.9	Downstream



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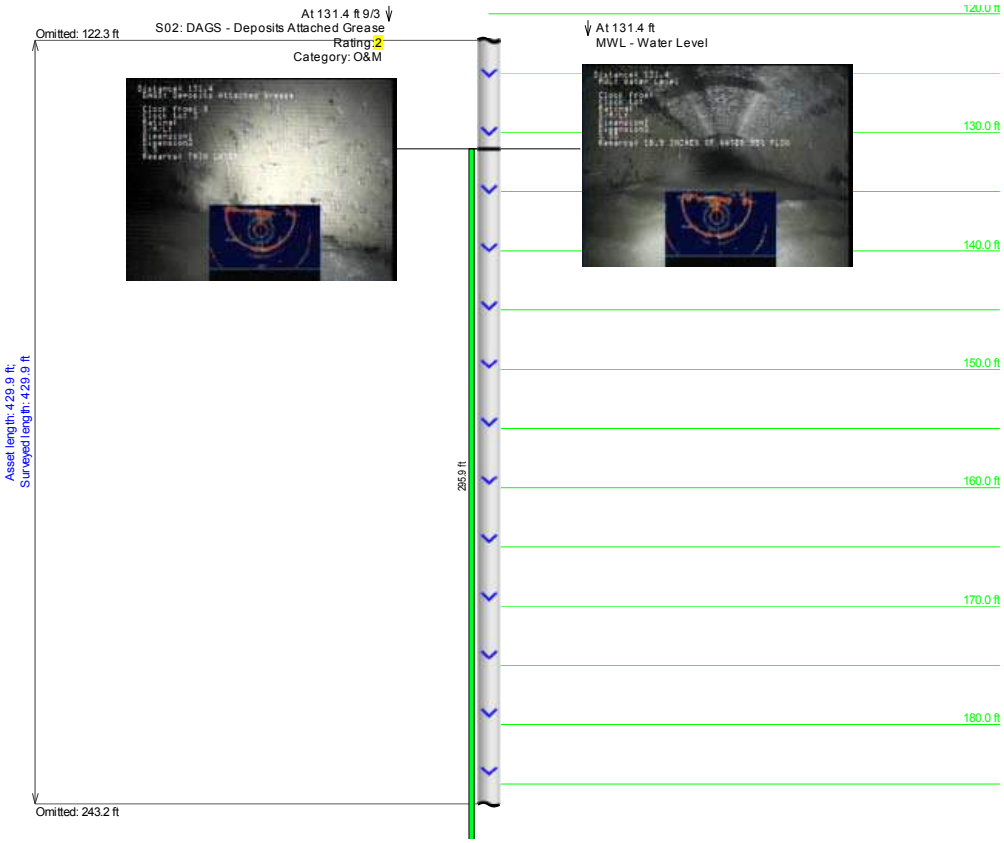
MEMPHIS, TN

Pipe ID:	WS010115S	
UpsMH / Depth:	WS010115	14.4
DnsMH / Depth:	WS010114	0
Material:	DIP	
Shape:	C	
Joint Length:	20	
Pipe Length:	429.9	
Comment:		

Drainage Area:	WS01	
Address / Street:	CHELSEA AVE (OFF)	
Date / Time:	20150901085917	
Surveyor:	ADS/AHOWELLS	
Pre-Cleaning / Date:	N	
Diameter:	36	
Length surveyed:	429.9	Downstream



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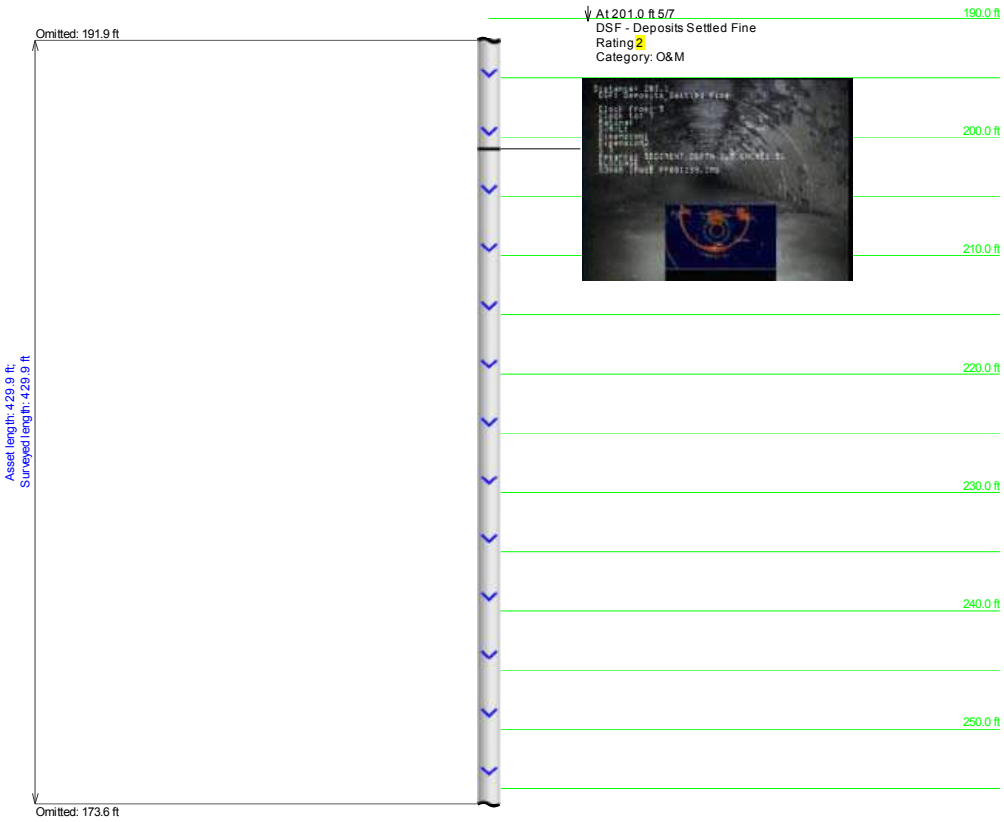
MEMPHIS, TN

Pipe ID:	WS010115S	
UpsMH / Depth:	WS010115	14.4
DnsMH / Depth:	WS010114	0
Material:	DIP	
Shape:	C	
Joint Length:	20	
Pipe Length:	429.9	
Comment:		

Drainage Area:	WS01	
Address / Street:	CHELSEA AVE (OFF)	
Date / Time:	20150901085917	
Surveyor:	ADS/AHOWELLS	
Pre-Cleaning / Date:	N	
Diameter:	36	
Length surveyed:	429.9	Downstream



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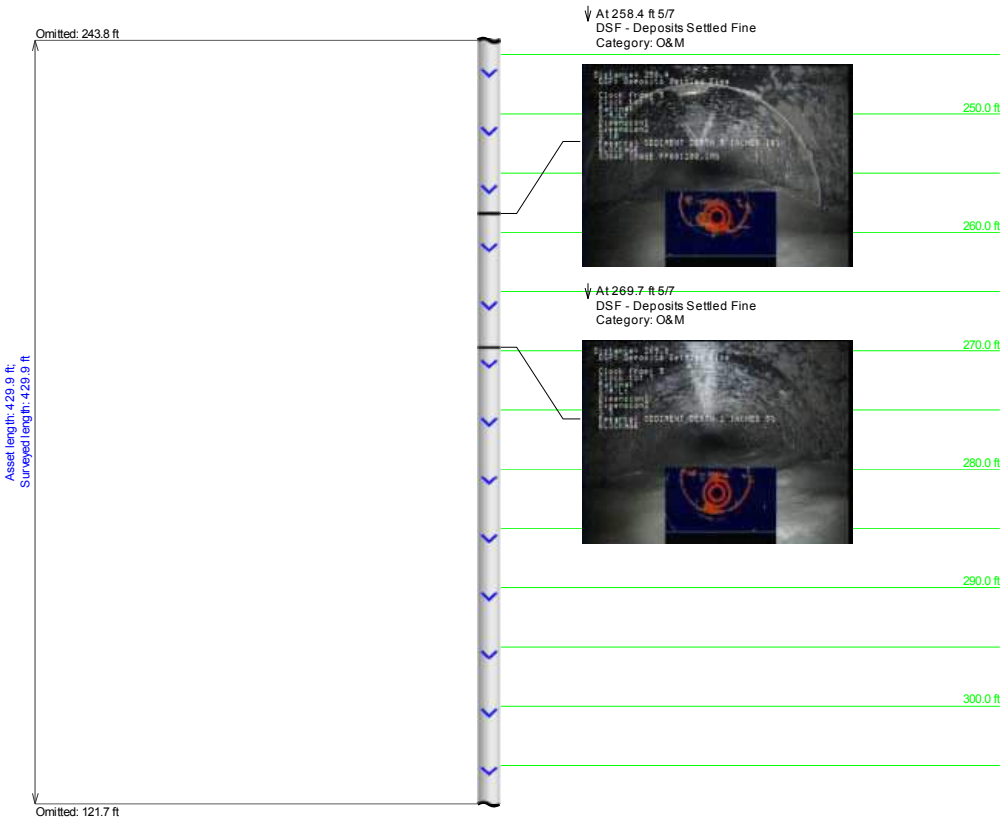
MEMPHIS, TN

Pipe ID:	WS010115S	
UpsMH / Depth:	WS010115	14.4
DnsMH / Depth:	WS010114	0
Material:	DIP	
Shape:	C	
Joint Length:	20	
Pipe Length:	429.9	
Comment:		

Drainage Area:	WS01	
Address / Street:	CHELSEA AVE (OFF)	
Date / Time:	20150901085917	
Surveyor:	ADS/AHOWELLS	
Pre-Cleaning / Date:	N	
Diameter:	36	
Length surveyed:	429.9	Downstream



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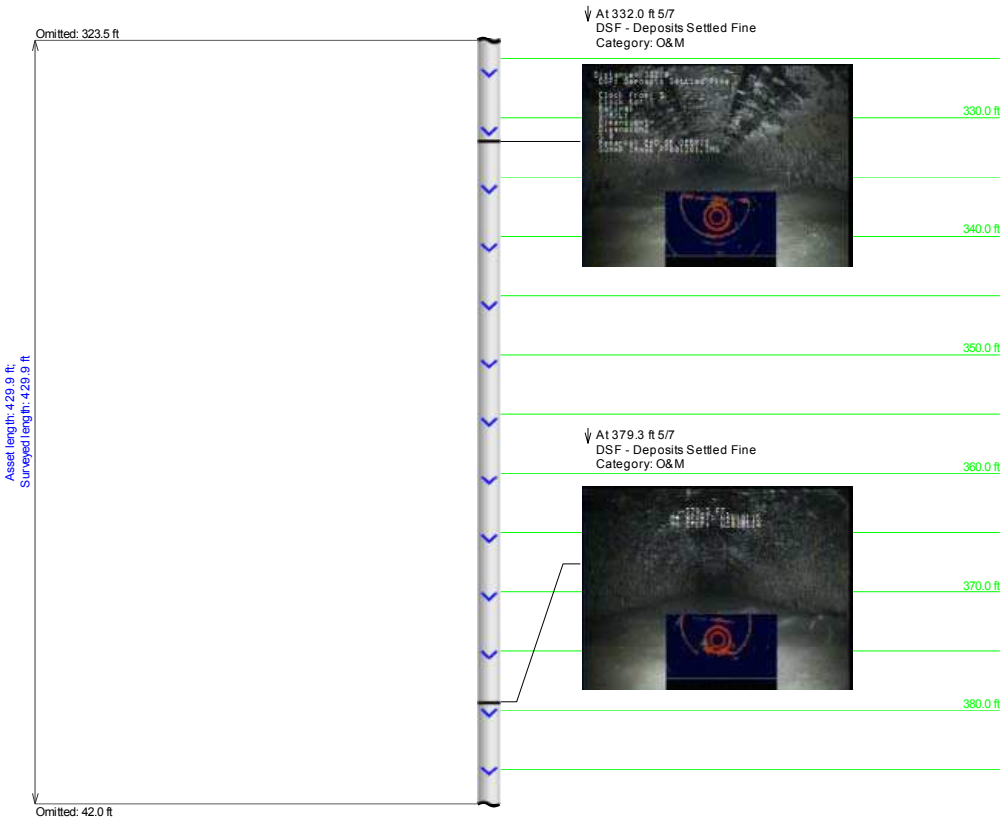
MEMPHIS, TN

Pipe ID:	WS010115S		Drainage Area:	WS01	
UpsMH / Depth:	WS010115	14.4	Address / Street:	CHELSEA AVE (OFF)	
DnsMH / Depth:	WS010114	0	Date / Time:	20150901085917	
Material:	DIP		Surveyor:	ADS/AHOWELLS	
Shape:	C		Pre-Cleaning / Date:	N	
Joint Length:	20		Diameter:	36	
Pipe Length:	429.9		Length surveyed:	429.9	Downstream
Comment:					



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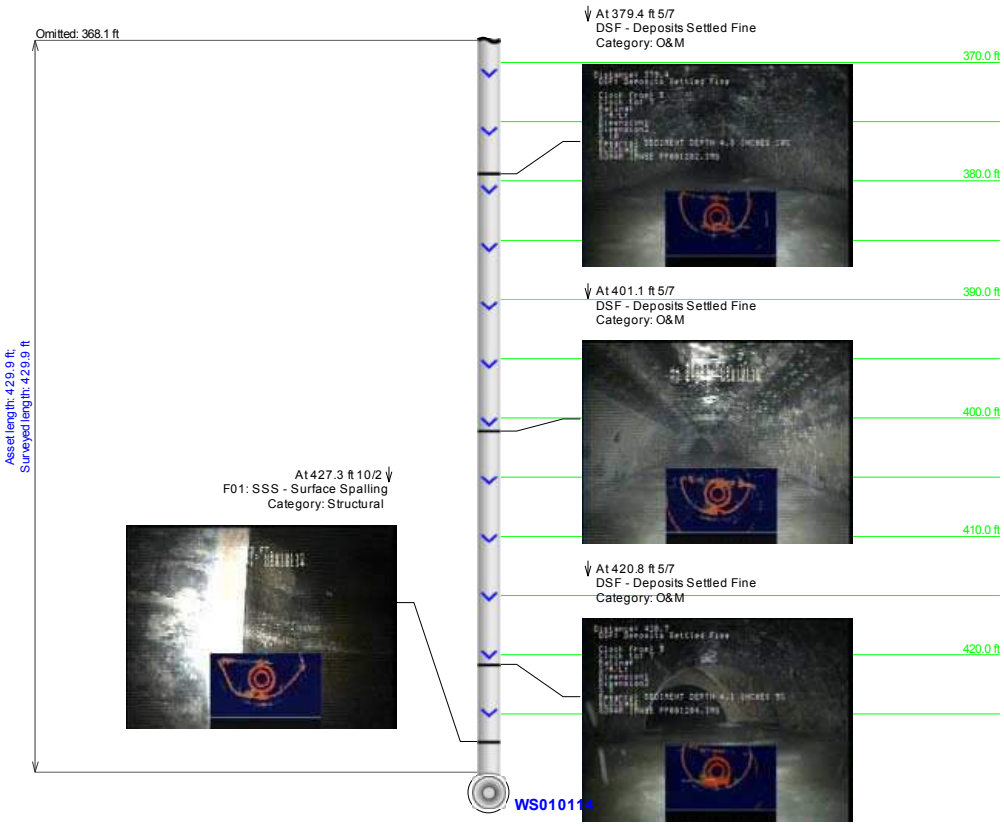
MEMPHIS, TN

Pipe ID:	WS010115S	
UpsMH / Depth:	WS010115	14.4
DnsMH / Depth:	WS010114	0
Material:	DIP	
Shape:	C	
Joint Length:	20	
Pipe Length:	429.9	
Comment:		

Drainage Area:	WS01	
Address / Street:	CHELSEA AVE (OFF)	
Date / Time:	20150901085917	
Surveyor:	ADS/AHOWELLS	
Pre-Cleaning / Date:	N	
Diameter:	36	
Length surveyed:	429.9	Downstream



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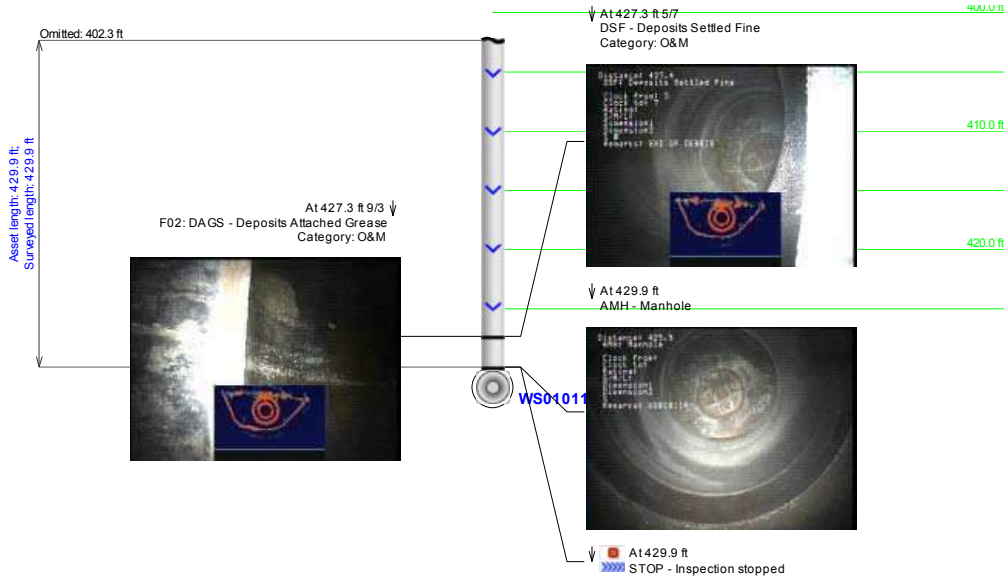
MEMPHIS, TN

Pipe ID:	WS010115S		Drainage Area:	WS01	
UpsMH / Depth:	WS010115	14.4	Address / Street:	CHELSEA AVE (OFF)	
DnsMH / Depth:	WS010114	0	Date / Time:	20150901085917	
Material:	DIP		Surveyor:	ADS/AHOWELLS	
Shape:	C		Pre-Cleaning / Date:	N	
Joint Length:	20		Diameter:	36	
Pipe Length:	429.9		Length surveyed:	429.9	Downstream
Comment:					



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PACP Sewer Report

Surveyed by:	Certificate No:	Owner:	Survey Customer	Drainage area:	Sheet number:
ADS/AHOWELLS	U-1007-5566	CoM		WS01	

Work order:	Pipeline segment ref:	Start date/time:		Street:	City:
	WS010115S	2015/09/01	08:59	CHELSEA AVE (OFF)	MEMPHIS, TN

Location details:	Upstream manhole No:	Rim to invert:	Grade to invert:	Rim to grade:
DNS MH BOLTED TIGHT	WS010115	14.4	9.9	4.5

Downstream manhole No:	Rim to invert:	Grade to invert:	Rim to grade:	Sewer use:	Direction:	Flow control:	Height:
WS010114	0.0	0.0	4.9	SS	D	N	36

Width:	Shape:	Material:	Ln. method:	Pipe joint length:	Total length:	Length surveyed:	Year laid:	Year renewed:	Media label:
36	C	DIP		20.0	429.9	429.9			ADS_20150911

Purpose:	Sewer category:	Pre-cleaning	Date cleaned:	Weather:	Location code:	Additional info:
A		N		1	D	

Starting access point:

Easting:	Northing:	Elevation:	Coordinate system:	GPS accuracy:

Grade	Structural Amount of Structural Defects	Structural Segment Grade	Structural Pipe Rating	Structural Quick Rating	Structural Pipe Rating Index	O&M Amount of O&M Defects	O&M Segment Grade	O&M Pipe Rating	O&M Quick Rating	O&M Pipe Rating Index	Overall Pipe Rating	Overall Pipe Rating Index
1	0	0	166	2O00	2	0	0	148	322M	2.027397	314	2.01282
2	83	166				71	142					
3	0	0				2	6					
4	0	0				0	0					
5	0	0				0	0					

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Surveyed by:	Owner:	Start date/time:	Upstream manhole No:	Pipeline segment ref:	Sheet number:
ADS/AHOWELLS	CoM	2015/09/01	WS010115	WS010115S	

Distance (Feet) (Meters)	Video Ref.	Group/ Descriptor	Modifier/ Severity	Continuous Defect	S/M/L	Value Inches (mm) 1st	Value Inches (mm) 2nd	%	Joint	Circumferential Location At/From	Circumferential Location to	Image Ref.	Family	Rating	Remarks
0.0	18	AMH										WS010115_WS010114_D_20150910859_0.0_AMH.jpg			WS010115
0.0	145	MWL						70				WS010115_WS010114_D_20150910859_0.0_MWL.jpg			23.6 INCHES OF WATER 70% FLOW SONAR IMAGE PP001193.IMG
0.0	204	DSF						5		5	7	WS010115_WS010114_D_20150910859_0.0_DSF.jpg	O&M	2	SEDIMENT DEPTH 3.2 INCHES 5% BLOCKAGE SONAR IMAGE PP001194.IMG
10.2	325	SSS	S01							10	2	WS010115_WS010114_D_20150910859_10.2_SSS.jpg	S	2	BLACK LINER PEELING IN PATCHES
10.2	345	DSF						10		5	7	WS010115_WS010114_D_20150910859_10.2_DSF.jpg	O&M	2	SEDIMENT DEPTH 5 INCHES 10% BLOCKAGE SONAR IMAGE PP001195.IMG
17.9	463	DSF						15		5	7	WS010115_WS010114_D_20150910859_17.9_DSF.jpg	O&M	3	SEDIMENT DEPTH 7.8 INCHES 15% BLOCKAGE SONAR IMAGE PP001196.IMG

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Surveyed by:	Owner:	Start date/time:	Upstream manhole No:	Pipeline segment ref:	Sheet number:
ADS/AHOWELLS	CoM	2015/09/01	WS010115	WS010115S	

Distance (Feet) (Meters)	Video Ref.	Group/ Descriptor	Modifier/ Severity	Continuous Defect	S/M/L	Value Inches (mm) 1st	2nd	%	Joint	Circumferential Location At/From	to	Image Ref.	Family	Rating	Remarks
104.6	718	DSF						15		5	7	WS010115_WS010114_D_20150901085 9_104.6_DSF.jpg	O&M	3	SEDIMENT DEPTH 6.9 INCHES 15% BLOCKAGE SONAR IMAGE PP001197.IMG
131.4	918	DSF						5		5	7	WS010115_WS010114_D_20150901085 9_131.4_DSF.jpg	O&M	2	SEDIMENT DEPTH 2 INCHES 5% BLOCKAGE SONAR IMAGE PP001198.IMG
131.4	954	MWL						55				WS010115_WS010114_D_20150901085 9_131.4_MWL.jpg			18.9 INCHES OF WATER 55% FLOW
131.4	1001	DAGS		S02				5		9	3	WS010115_WS010114_D_20150901085 9_131.4_DAGS.jpg	O&M	2	THIN LAYER
201.0	1210	DSF						5		5	7	WS010115_WS010114_D_20150901085 9_201.0_DSF.jpg	O&M	2	SEDIMENT DEPTH 1.5 INCHES 5% BLOCKAGE SONAR IMAGE PP001199.IMG
258.4	1420	DSF						10		5	7	WS010115_WS010114_D_20150901085 9_258.4_DSF.jpg	O&M	2	SEDIMENT DEPTH 5 INCHES 10% BLOCKAGE SONAR IMAGE PP001200.IMG
269.7	1491	DSF						5		5	7	WS010115_WS010114_D_20150901085 9_269.7_DSF.jpg	O&M	2	SEDIMENT DEPTH 2 INCHES 5% BLOCKAGE

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Surveyed by:	Owner:	Start date/time:	Upstream manhole No:	Pipeline segment ref:	Sheet number:
ADS/AHOWELLS	CoM	2015/09/01	WS010115	WS010115S	

Distance (Feet) (Meters)	Video Ref.	Group/ Descriptor	Modifier/ Severity	Continuous Defect	S/M/L	Value Inches (mm) 1st	2nd	%	Joint	Circumferential Location At/From	to	Image Ref.	Family	Rating	Remarks
332.0	1706	DSF						0		5	7	WS010115_WS010114_D_20150909010859_332.0_DSF.jpg	O&M	2	END OF DEBRIS SONAR IMAGE PP001201.IMG
379.3	1872	DSF						0		5	7	WS010115_WS010114_D_20150909010859_379.3_DSF.jpg	O&M	2	
379.4	1887	DSF						10		5	7	WS010115_WS010114_D_20150909010859_379.4_DSF.jpg	O&M	2	SEDIMENT DEPTH 4.8 INCHES 10% BLOCKAGE SONAR IMAGE PP001202.IMG
401.1	1995	DSF						0		5	7	WS010115_WS010114_D_20150909010859_401.1_DSF.jpg	O&M	2	END OF DEBRIS SONAR IMAGE PP001203.IMG
420.8	2094	DSF						5		5	7	WS010115_WS010114_D_20150909010859_420.8_DSF.jpg	O&M	2	SEDIMENT DEPTH 4.1 INCHES 5% BLOCKAGE SONAR IMAGE PP001204.IMG
427.3	2170	SSS	F01							10	2	WS010115_WS010114_D_20150909010859_427.3_SSS.jpg	S	2	
427.3	2177	DAGS	F02					5		9	3	WS010115_WS010114_D_20150909010859_427.3_DAGS.jpg	O&M	2	
427.3	2193	DSF						0		5	7	WS010115_WS010114_D_20150909010859_427.3_DSF0.jpg	O&M	2	END OF DEBRIS
429.9	2224	AMH										WS010115_WS010114_D_20150909010859_429.9_AMH.jpg			WS010114

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Sonar Sediment Report

MAINLINE DATA

Project Name:	Pipeline segment ref:
Phase 2	WS010115S

Start date/time:	City:	Street:
9/1/2015	MEMPHIS, TN	CHELSEA AVE (OFF)

Width:	Height:	Shape:	Material:	Location code:
36	36	C	DIP	D

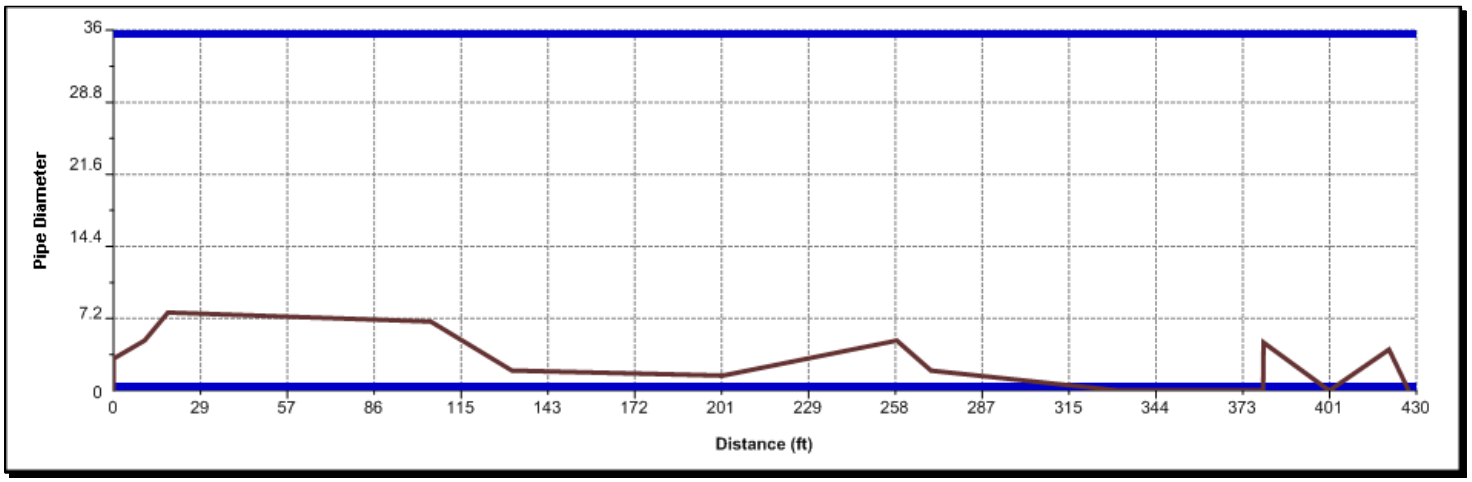
SEDIMENT DATA

Max grease on top:	Avg. Sediments on top:	Est. Sediments Vol. on top:	Blockage % on top:
0.0	0.0		

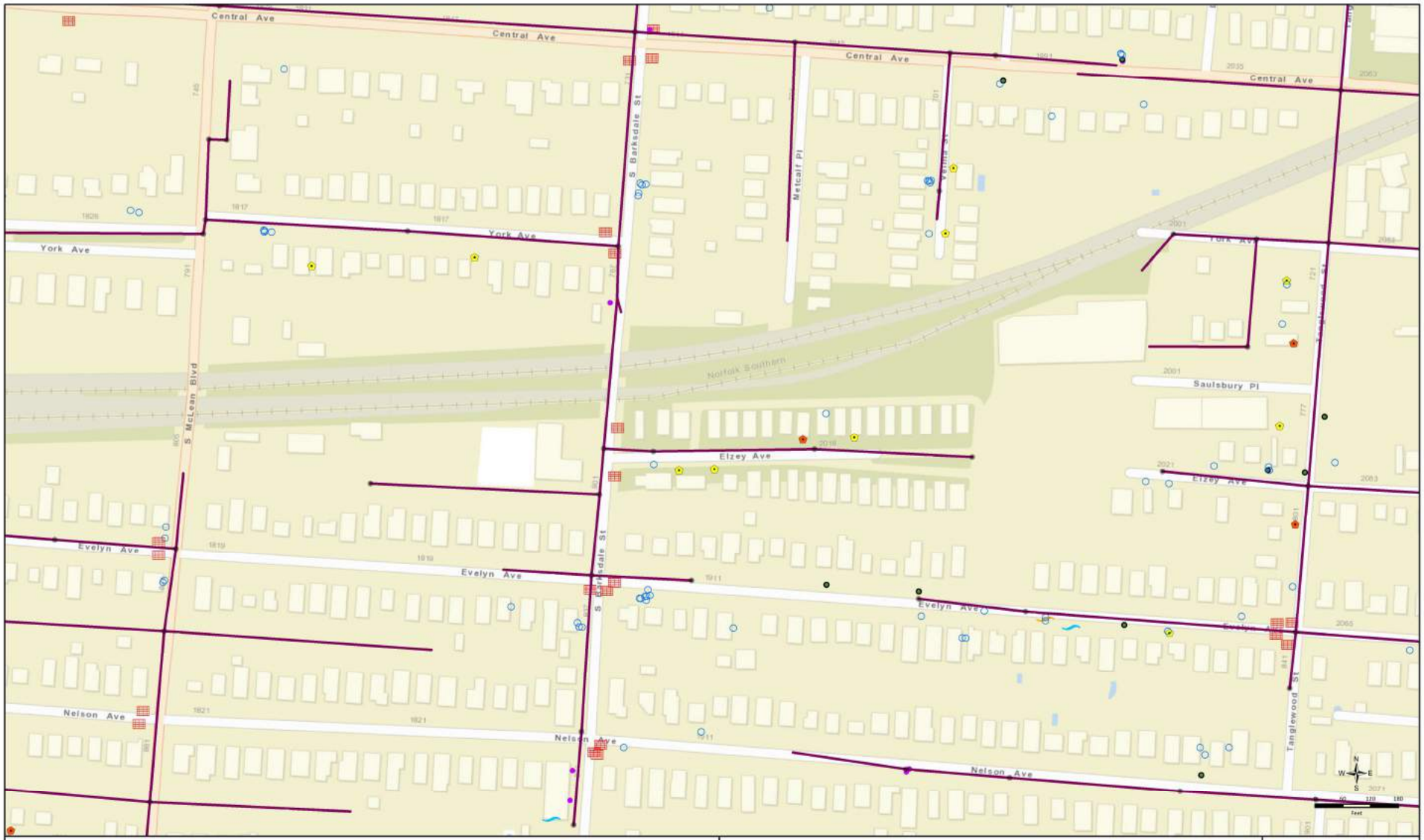
Max debris on bottom:	Avg. Sediments on bottom:	Est. Sediments Vol. on bottom:	Blockage % on bottom:
7.8	3.0	160.45 cu ft	5.3 %

Max debris sum:	Avg. Sediment sum:	Est. Sediment Vol. sum:	Total blockage %:
7.8	3.0	160.45 cu ft	5.3 %

SEDIMENT IN PIPE



Appendix B.3
Smoke Testing Defect Map



Manhole
Gravity Main
Stormwater
Private Cleanout
Public Cleanout
Main Sewer
Other
Private Surface Crack
Public Surface Crack
Service Lateral

Smoke Defects in Northern and Southern Priority Rehab Areas

BLACK & VEATCH
Building a world of difference

Appendix B.4
MACP Inspection

MACP Inspection Report

Manhole Number	Access Type	Drainage Area	MH Use	Owner	Customer
NN022451	Manhole	NN02	Sanitary	CoM	

Year Built	Year Renewed	City	Street Address	1802 ELVIS PRESLEY BLVD
		MEMPHIS, TN	Location Details	IN STREET

Location Code	Surface Type:
Light Highway	☑ Asphalt ☐ Concrete Pavement ☐ Concrete Collar ☐ Grass/Dirt ☐ Gravel ☐ Other

Surveyor	Cert No.	Project	Work Order	PO#	Purpose	Category
CES/RAH, JAB	U-610-10891	Phase 1			Not known	

Date	Time	Inspection Level	Inspection Status	Evidence of Surcharge	Weather	Potential for Runoff
2014-10-16	8:31	Level 2	Remote Inspection	No	Saturated	Sheeting

Pre-Cleaning	Date Cleaned	Rim to Invert	Grade to Invert	Rim to Grade	Additional Info
No Pre-Cleaning		10.1	10.1	0	

GPS Accuracy	Coordinate System	Northing	Easting	Elevation
Sub-Meter	State Plane Tennessee NAD 83	302356.46265502	766847.012212528	252.174361711508

Additional Component Info	ADJ RING PHOTO, FRAME PHOTO, NO CHIMNEY

NN022451

Cover

Cover Type

- [ ] Solid
- [x] Vented
- [ ] Gasketed
- [ ] Bolted
- [ ] Inner Cover
- [ ] Locking
- [ ] Hatch - Single
- [ ] Hatch - Double
- [ ] Lamphole

Cover Shape:	Circular
Cover Size:	24
Cover Width:	0
Cover Material:	Cast Iron
Hole Number:	4
Hole Diameter:	> 1 inch (25mm) <= 1 1/2 inc
Cover Bearing Surface Dia:	23.8
Cover Bearing Surface Width:	0
Cover/Frame Fit:	Good

Cover Condition

- [x] Sound
- [ ] Cracked
- [ ] Broken
- [ ] Corroded
- [ ] Bolts Missing
- [ ] Missing
- [ ] Restraint Missing
- [ ] Restraint Defective

Cover Insert

Insert Type: None

Insert Condition

- [ ] Sound
- [ ] Poorly Fitting
- [ ] Cracked
- [ ] Leaking
- [ ] Insert Fell
- [ ] Corroded

Adjustment Ring

Ring Type: Solid

Ring Material: Cast Iron

Ring Height: 8

Adjustment Ring Condition

- [ ] Sound
- [ ] Cracked
- [ ] Broken
- [ ] Corroded
- [x] Leaking
- [x] Poor Install

Frame

Material:	Cast Iron
Frame Depth:	15
Frame Bearing Surface Width:	1.3
Frame Bearing Surface Depth:	1
Frame Clear Open Diam:	22
Frame Offset Distance:	0
Frame Seal Inflow:	None

Frame Condition

- [ ] Sound
- [ ] Cracked
- [ ] Broken
- [ ] Missing
- [x] Corroded
- [ ] Coated

Frame Seal Condition

- [x] Sound
- [ ] Cracked
- [ ] Loose
- [ ] Offset
- [ ] Missing

Chimney

Chimney Material1:	Not Known
Chimney Material2:	
Chimney I/I:	None
Chimney Clear Opening:	0
Chimney Depth:	0
Chimney Lining Interior:	
Chimney Lining Exterior:	

Cone

Cone Type:	Conical centered
Cone Material:	Brick
Cone Depth:	4.7
Cone Lining Interior:	None - No Coating
Cone Lining Exterior:	None - No Coating

Wall

Wall Diameter:	42
Wall By Size:	0
Wall Material:	Brick
Wall Depth:	9.1
Wall Lining Interior:	Cementitious
Wall Lining Exterior:	None - No Coating

Bench

Bench Present:	Yes
Bench Material:	Concrete (non-reinforced)
Bench Lining:	None - No Coating

Channel

Channel Installed:	Yes
Channel Material:	Concrete (non-reinforced)
Channel Type:	Formed
Channel Exposure:	Fully Opened

Steps

Step Number:	5
Step Material:	Metal

MH Connections

Pipe #:	1	Clock: 6	Rim to Invert:	10.1	
Direction:	Out		Material:	Concrete Pipe (non-reinf	
Shape:	Circular		Dia 1:	8	Dia 2 0
Pipe Condition:	Defective		Seal Condition:	Sound	
Special Condition:	Gravity Relief Connection		Pipe ID:	NN022450	
Comments:					

Pipe #:	2	Clock: 9	Rim to Invert:	7.6	
Direction:	In		Material:	Concrete Pipe (non-reinf	
Shape:	Circular		Dia 1:	8	Dia 2 0
Pipe Condition:	Sound		Seal Condition:	Sound	
Special Condition:	Outside Drop Upper		Pipe ID:	NN022631	
Comments:					

Pipe #:	3	Clock: 9	Rim to Invert:	9.5	
Direction:	In		Material:	Concrete Pipe (non-reinf	
Shape:	Circular		Dia 1:	8	Dia 2 0
Pipe Condition:	Sound		Seal Condition:	Sound	
Special Condition:	Outside Drop Lower		Pipe ID:	NN022451	
Comments:					

Pipe #:	4	Clock: 12	Rim to Invert:	10	
Direction:	In		Material:	Concrete Pipe (non-reinf	
Shape:	Circular		Dia 1:	8	Dia 2 0
Pipe Condition:	Sound		Seal Condition:	Sound	
Special Condition:	Gravity Relief Connection		Pipe ID:	NN022452	
Comments:					

Appendix C.1
Assets Being Rehabilitated in CD Appendix G

Pipe Facility ID	Rehabilitation Method
FS021687S	Point Repair
FS021699S	Mainline Relay
FS022502S	CIPP
FS022672S	Point Repair
FS022678.01S	CIPP
FS022682S	CIPP
FS022683.01S	CIPP
FS022686S	Point Repair
FS022690S	Point Repair
FS022693S	CIPP
FS022694S	Point Repair
FS022696.01S	Point Repair
FS022696S	CIPP
FS022698S	CIPP
FS022701S	Point Repair
FS022703S	Point Repair
FS022721.02S	Point Repair
FS022721.06S	Point Repair
FS022721S	CIPP
FS022724S	Point Repair
FS022725S	Point Repair
FS022729S	Point Repair
FS022731S	Mainline Relay
FS022743S	Point Repair
FS045130.06S	Point Repair
FS045131.03S	Point Repair
FS045131S	CIPP
FS045208S	Mainline Relay
FS045209S	Mainline Relay
FS045210S	CIPP
FS045221S	Mainline Relay
FS045254.01S	CIPP
FS045254.03S	CIPP
FS045254S	CIPP
FS045257.01S	Mainline Relay
FS045368S	Point Repair
FS045372S	Mainline Relay
FS045444S	CIPP
FS045445S	CIPP
FS045448S	Mainline Relay
FS045449S	Mainline Relay
FS045534S	CIPP
FS045536S	Mainline Relay
FS045601.02S	Point Repair
FS045621S	Mainline Relay

Pipe Facility ID	Rehabilitation Method
NN021411.01S	Point Repair
NN021420S	CIPP
NN021421S	CIPP
NN021422S	Mainline Relay
NN021424S	Mainline Relay
NN021428.01S	CIPP
NN021429S	CIPP
NN021430S	CIPP
NN021434S	Point Repair
NN021442S	Mainline Relay
NN021447S	Mainline Relay
NN021449S	Mainline Relay
NN021512S	CIPP
NN021529.01S	CIPP
NN021529S	CIPP
NN021530S	CIPP
NN021531S	CIPP
NN021532S	CIPP
NN021534S	CIPP
NN021596S	CIPP
NN021628.01S	CIPP
NN021629S	CIPP
NN021656S	CIPP
NN021657S	CIPP
NN021809S	Point Repair
NN021843S	Point Repair
NN021891S	Point Repair
NN021905S	Point Repair
NN021950S	CIPP
NN021960.01S	CIPP
NN021960S	CIPP
NN021962S	Point Repair
NN022031S	Point Repair
NN022301S	CIPP
NN022302S	CIPP
NN022303S	CIPP
NN022304S	CIPP
NN022308.04S	Point Repair
NN022358S	CIPP
NN022359S	CIPP
NN022365S	CIPP
NN022370S	CIPP
NN022371S	CIPP
NN022401S	Point Repair
NN022426S	CIPP

Pipe Facility ID	Rehabilitation Method
FS045632S	Mainline Relay
FS045640S	CIPP
FS045677S	CIPP
NN010104S	CIPP
NN010227S	Mainline Relay
NN010725S	Mainline Relay
NN010727S	Mainline Relay
NN010728.04S	Mainline Relay
NN010728S	Mainline Relay
NN010732S	CIPP
NN010735S	Point Repair
NN010736S	Mainline Relay
NN010739S	Mainline Relay
NN010745S	Mainline Relay
NN010746S	Point Repair
NN010747S	CIPP
NN010748S	Mainline Relay
NN010752S	Mainline Relay
NN010754S	Point Repair
NN010767S	Mainline Relay
NN020137S	CIPP
NN020138S	CIPP
NN020143S	CIPP
NN020159S	CIPP
NN020184S	CIPP
NN020188S-2	Mainline Relay
NN020189S	CIPP
NN020193.01S	CIPP
NN020518S	CIPP
NN020537S	CIPP
NN020545S	CIPP
NN020567.01S	CIPP
NN020570.01S	Mainline Relay
NN020570S	CIPP
NN020572S	CIPP
NN020573S	CIPP
NN020574S	CIPP
NN020575.01S	CIPP
NN020575S	CIPP
NN020576.01S	CIPP
NN020576S	CIPP
NN020577S	CIPP
NN020578S	CIPP
NN020582S	CIPP
NN020590S	CIPP

Pipe Facility ID	Rehabilitation Method
NN022435S	Mainline Relay
NN022459S	CIPP
NN022460S	CIPP
NN022495S	CIPP
NN022542S	Mainline Relay
NN022546S	CIPP
NN022555S	CIPP
NN022611S	CIPP
NN022612S	CIPP
NN022613S	CIPP
NN022618S	Mainline Relay
NN022653S	CIPP
NN022671S	CIPP
NN022674S	CIPP
NN022740S	CIPP
NN022741S	CIPP
NN023130.01S	CIPP
NN023141S	CIPP
NN023142S	Point Repair
NN023150S	CIPP
NN023178S	Point Repair
NN023180S	CIPP
NN023182S	Mainline Relay
NN023235S	Point Repair
NN023273S	Mainline Relay
NN023315S	Point Repair
NN023326S	CIPP
NN023398S	CIPP
NN023537S	Point Repair
NN023606S	CIPP
NN023633S	CIPP
NN023658S	Mainline Relay
NN023668S	Point Repair
NN023675S	Mainline Relay
NN023755S	CIPP
NN023759S	Mainline Relay
NN023760S	Mainline Relay
NN023782S	Point Repair
NN023793S	Mainline Relay
NN023943S	CIPP
NN023961S	Point Repair
NN024024S	Point Repair
NN024059.01S	CIPP
NN024059S	Point Repair
NN024062S	Mainline Relay

Pipe Facility ID	Rehabilitation Method
NN020602S	CIPP
NN020603S	CIPP
NN020619S	CIPP
NN020620S	CIPP
NN020623S	CIPP
NN020624S	CIPP
NN020625S	CIPP
NN020640S	CIPP
NN020643S	CIPP
NN020661S	CIPP
NN020671S	CIPP
NN020685S	Point Repair
NN020698S	CIPP
NN020708S	CIPP
NN020709S	CIPP
NN020710S	CIPP
NN020712S	Mainline Relay
NN020715S	Mainline Relay
NN020720S	CIPP
NN020733S	CIPP
NN020734S	CIPP
NN020740S	Point Repair
NN020741S	Mainline Relay
NN020765S	CIPP
NN020766S	CIPP
NN020767.01S	CIPP
NN020767S	CIPP
NN020768S	CIPP
NN020780S	Mainline Relay
NN020782S	Point Repair
NN020783S	Mainline Relay
NN020829S-1	Point Repair
NN020843S	CIPP
NN020882S	CIPP
NN020890.01S	Point Repair
NN020893S	Point Repair
NN020898S	Point Repair
NN020911S	CIPP
NN020940S	CIPP
NN020982S	CIPP
NN020983S	CIPP
NN020989S	CIPP
NN020990S	CIPP
NN021007S	Mainline Relay
NN021021S	CIPP

Pipe Facility ID	Rehabilitation Method
WS010118.13S	CIPP
WS010204.01S	CIPP
WS010207S	CIPP
WS010208S	Point Repair
WS010266S	CIPP
WS010267S	CIPP
WS010268S	CIPP
WS010271S	CIPP
WS010363.09S	CIPP
WS010363.10S	Point Repair
WS010363.12S	CIPP
WS010363.20S	Mainline Relay
WS010365.02S	CIPP
WS010369S	CIPP
WS010374S	CIPP
WS010502.01S	CIPP
WS010504.02S	CIPP
WS010505S	CIPP
WS010508.02S	CIPP
WS010508.03S	CIPP
WS010508S	CIPP
WS010511S	Point Repair
WS010538S	Mainline Relay
WS010539S	Point Repair
WS010549S	Mainline Relay
WS010566S	Mainline Relay
WS010570S	Mainline Relay
WS010640S	Mainline Relay
WS011046S	Point Repair
WS011070.02S	Point Repair
WS011078S	CIPP
WS011096S	CIPP
WS011097S	CIPP
WS011098S	CIPP
WS011106.01S	CIPP
WS011114S	CIPP
WS011185S	CIPP
WS011203.02S	Point Repair
WS011205S	Point Repair
WS011218S	Point Repair
WS011222S	Point Repair
WS011241.01S	CIPP
WS011249.03S	Point Repair
WS011267S	Point Repair
WS011274.02S	CIPP

Pipe Facility ID	Rehabilitation Method
NN021048S	CIPP
NN021055S	CIPP
NN021071S	Mainline Relay
NN021072S	Mainline Relay
NN021082S	CIPP
NN021083S	CIPP
NN021085S	CIPP
NN021090S	CIPP
NN021334S	Mainline Relay
NN021409S	CIPP

Pipe Facility ID	Rehabilitation Method
WS011337S	Point Repair
WS011341S	Point Repair
WS011346S	CIPP
WS011371S	CIPP
WS011383S	Point Repair
WS012199S	CIPP
WS012206.03S	CIPP
WS012214S	Point Repair
WS012217S	Point Repair

Manhole Facility ID	Rehabilitate or Replace
FS021699	Rehabilitate Manhole
FS022671	Rehabilitate Manhole
FS022673	Rehabilitate Manhole
FS022674	Rehabilitate Manhole
FS022675	Rehabilitate Manhole
FS022676	Rehabilitate Manhole
FS022699	Rehabilitate Manhole
FS022729	Rehabilitate Manhole
FS022736	Rehabilitate Manhole
FS022742	Rehabilitate Manhole
FS045131	Rehabilitate Manhole
FS045132	Rehabilitate Manhole
FS045133.02	Rehabilitate Manhole
FS045136	Rehabilitate Manhole
FS045201.02	Rehabilitate Manhole
FS045201.03	Rehabilitate Manhole
FS045202	Rehabilitate Manhole
FS045203.01	Rehabilitate Manhole
FS045204	Rehabilitate Manhole
FS045208	Rehabilitate Manhole
FS045209	Rehabilitate Manhole
FS045223	Rehabilitate Manhole
FS045224	Rehabilitate Manhole
FS045226	Rehabilitate Manhole
FS045251	Rehabilitate Manhole
FS045442	Rehabilitate Manhole
FS045444	Rehabilitate Manhole
FS045451	Rehabilitate Manhole
FS045452	Rehabilitate Manhole
FS045548.01	Rehabilitate Manhole
FS045674	Rehabilitate Manhole
NN010106.04	Rehabilitate Manhole
NN010257	Rehabilitate Manhole
NN010260	Rehabilitate Manhole
NN010261	Rehabilitate Manhole
NN010725	Rehabilitate Manhole
NN010728	Rehabilitate Manhole
NN010728.02	Rehabilitate Manhole
NN010728.03	Rehabilitate Manhole
NN010728.05	Rehabilitate Manhole
NN010728.06	Rehabilitate Manhole
NN010733	Rehabilitate Manhole
NN010741	Rehabilitate Manhole
NN010746	Rehabilitate Manhole
NN010748	Rehabilitate Manhole

Manhole Facility ID	Rehabilitate or Replace
NN021426.01	Rehabilitate Manhole
NN021427	Rehabilitate Manhole
NN021428.01	Rehabilitate Manhole
NN021502	Rehabilitate Manhole
NN021506	Rehabilitate Manhole
NN021519	Rehabilitate Manhole
NN021522	Rehabilitate Manhole
NN021523	Rehabilitate Manhole
NN021524	Rehabilitate Manhole
NN021526	Rehabilitate Manhole
NN021528	Rehabilitate Manhole
NN021529	Rehabilitate Manhole
NN021529.01	Rehabilitate Manhole
NN021530	Rehabilitate Manhole
NN021533	Rehabilitate Manhole
NN021552	Rehabilitate Manhole
NN021553	Rehabilitate Manhole
NN021562	Rehabilitate Manhole
NN021564	Rehabilitate Manhole
NN021569	Rehabilitate Manhole
NN021571.01	Rehabilitate Manhole
NN021572	Rehabilitate Manhole
NN021594	Rehabilitate Manhole
NN021629	Rehabilitate Manhole
NN021630	Rehabilitate Manhole
NN021631	Rehabilitate Manhole
NN021641	Rehabilitate Manhole
NN021646	Rehabilitate Manhole
NN021653	Rehabilitate Manhole
NN021656	Rehabilitate Manhole
NN021796	Rehabilitate Manhole
NN021890	Rehabilitate Manhole
NN022032	Rehabilitate Manhole
NN022248	Rehabilitate Manhole
NN022251	Rehabilitate Manhole
NN022253	Rehabilitate Manhole
NN022294	Rehabilitate Manhole
NN022297	Rehabilitate Manhole
NN022298	Rehabilitate Manhole
NN022299.03	Rehabilitate Manhole
NN022301	Rehabilitate Manhole
NN022303	Rehabilitate Manhole
NN022308.04	Rehabilitate Manhole
NN022309.01	Rehabilitate Manhole
NN022310	Rehabilitate Manhole

Manhole Facility ID	Rehabilitate or Replace
NN010749	Rehabilitate Manhole
NN010765	Rehabilitate Manhole
NN010766	Rehabilitate Manhole
NN020138	Rehabilitate Manhole
NN020139	Rehabilitate Manhole
NN020146	Rehabilitate Manhole
NN020152	Rehabilitate Manhole
NN020153	Rehabilitate Manhole
NN020155	Rehabilitate Manhole
NN020159	Rehabilitate Manhole
NN020178.01	Rehabilitate Manhole
NN020181	Rehabilitate Manhole
NN020184	Rehabilitate Manhole
NN020185	Rehabilitate Manhole
NN020185.01	Rehabilitate Manhole
NN020187	Rehabilitate Manhole
NN020188	Rehabilitate Manhole
NN020194-A	Rehabilitate Manhole
NN020195	Replace Manhole
NN020502	Rehabilitate Manhole
NN020508	Rehabilitate Manhole
NN020509	Rehabilitate Manhole
NN020514	Rehabilitate Manhole
NN020516	Rehabilitate Manhole
NN020518	Rehabilitate Manhole
NN020539.04	Rehabilitate Manhole
NN020542	Rehabilitate Manhole
NN020546	Rehabilitate Manhole
NN020556	Replace Manhole
NN020570	Rehabilitate Manhole
NN020572	Rehabilitate Manhole
NN020573	Rehabilitate Manhole
NN020575.01	Rehabilitate Manhole
NN020576	Rehabilitate Manhole
NN020577	Rehabilitate Manhole
NN020582	Rehabilitate Manhole
NN020582.01	Rehabilitate Manhole
NN020583	Rehabilitate Manhole
NN020586	Replace Manhole
NN020586.01	Replace Manhole
NN020587	Replace Manhole
NN020592.01	Rehabilitate Manhole
NN020595	Rehabilitate Manhole
NN020596	Rehabilitate Manhole
NN020602.01	Rehabilitate Manhole

Manhole Facility ID	Rehabilitate or Replace
NN022312.01	Rehabilitate Manhole
NN022359	Rehabilitate Manhole
NN022397	Rehabilitate Manhole
NN022398	Rehabilitate Manhole
NN022403	Rehabilitate Manhole
NN022423	Rehabilitate Manhole
NN022473	Rehabilitate Manhole
NN022474	Rehabilitate Manhole
NN022496	Rehabilitate Manhole
NN022613	Rehabilitate Manhole
NN022618	Rehabilitate Manhole
NN022634	Rehabilitate Manhole
NN022652	Rehabilitate Manhole
NN022654	Rehabilitate Manhole
NN022664	Rehabilitate Manhole
NN022684	Rehabilitate Manhole
NN022688	Rehabilitate Manhole
NN022738	Rehabilitate Manhole
NN022739	Rehabilitate Manhole
NN022740	Rehabilitate Manhole
NN022753	Rehabilitate Manhole
NN022816	Rehabilitate Manhole
NN022928	Rehabilitate Manhole
NN022997	Rehabilitate Manhole
NN023136	Rehabilitate Manhole
NN023153	Rehabilitate Manhole
NN023185	Rehabilitate Manhole
NN023198	Rehabilitate Manhole
NN023206	Rehabilitate Manhole
NN023251	Rehabilitate Manhole
NN023312	Rehabilitate Manhole
NN023325	Rehabilitate Manhole
NN023326	Rehabilitate Manhole
NN023326.01	Rehabilitate Manhole
NN023326.07	Rehabilitate Manhole
NN023329	Rehabilitate Manhole
NN023330	Rehabilitate Manhole
NN023331	Rehabilitate Manhole
NN023396	Rehabilitate Manhole
NN023410	Rehabilitate Manhole
NN023540	Rehabilitate Manhole
NN023541	Rehabilitate Manhole
NN023605	Rehabilitate Manhole
NN023606	Rehabilitate Manhole
NN023610	Rehabilitate Manhole

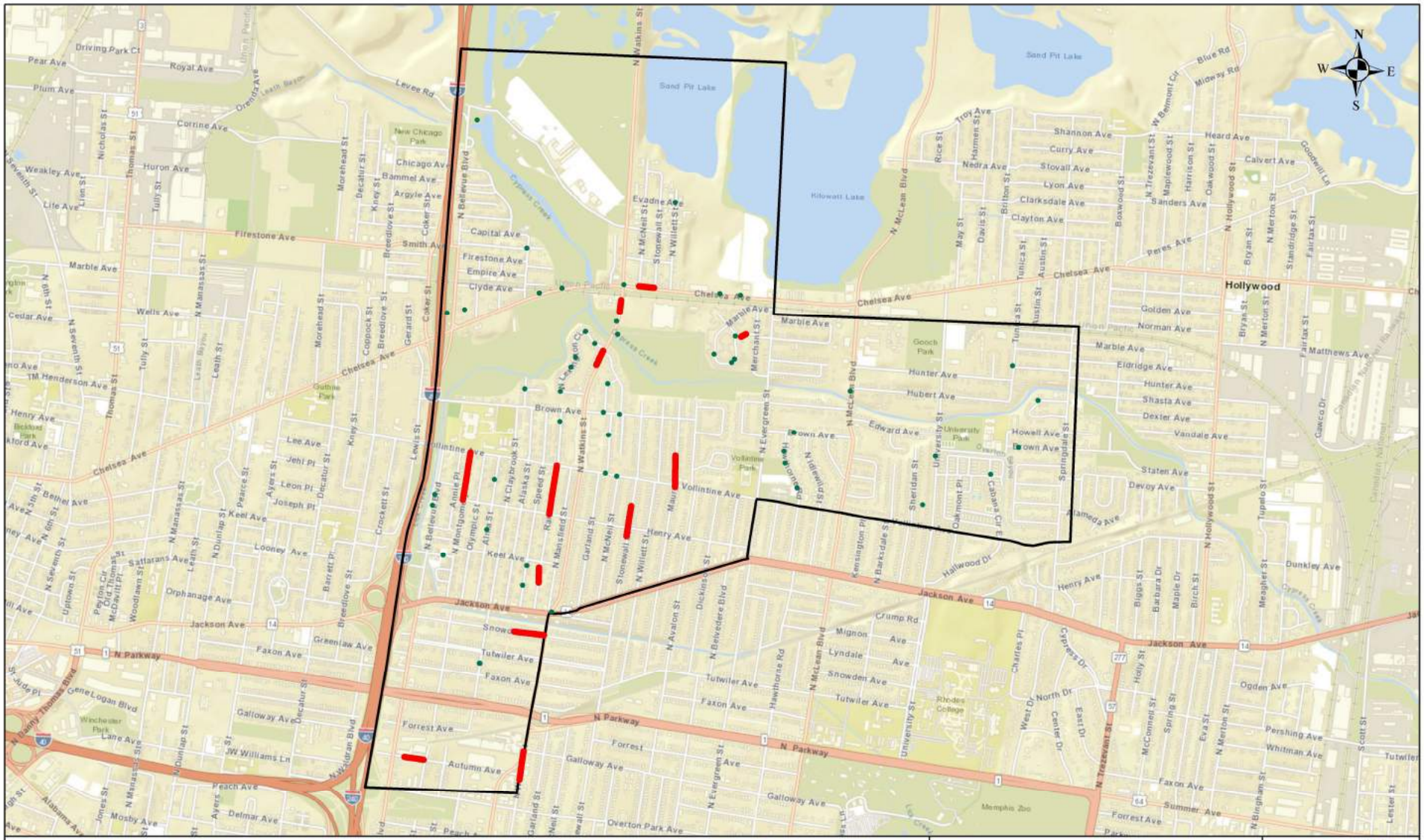
Manhole Facility ID	Rehabilitate or Replace
NN020603	Rehabilitate Manhole
NN020611	Rehabilitate Manhole
NN020613	Rehabilitate Manhole
NN020614	Rehabilitate Manhole
NN020615	Rehabilitate Manhole
NN020621	Rehabilitate Manhole
NN020626	Rehabilitate Manhole
NN020627	Rehabilitate Manhole
NN020645	Rehabilitate Manhole
NN020646	Rehabilitate Manhole
NN020661	Rehabilitate Manhole
NN020665	Rehabilitate Manhole
NN020674	Rehabilitate Manhole
NN020690	Rehabilitate Manhole
NN020708	Rehabilitate Manhole
NN020708.01	Rehabilitate Manhole
NN020709	Rehabilitate Manhole
NN020710	Rehabilitate Manhole
NN020719	Rehabilitate Manhole
NN020736	Rehabilitate Manhole
NN020737	Rehabilitate Manhole
NN020741	Rehabilitate Manhole
NN020742	Rehabilitate Manhole
NN020766	Rehabilitate Manhole
NN020767	Rehabilitate Manhole
NN020781	Rehabilitate Manhole
NN020783	Rehabilitate Manhole
NN020793	Rehabilitate Manhole
NN020794	Rehabilitate Manhole
NN020819	Replace Manhole
NN020820	Rehabilitate Manhole
NN020830	Rehabilitate Manhole
NN020831	Rehabilitate Manhole
NN020834	Rehabilitate Manhole
NN020835	Rehabilitate Manhole
NN020856	Rehabilitate Manhole
NN020858	Rehabilitate Manhole
NN020865	Rehabilitate Manhole
NN020867	Rehabilitate Manhole
NN020872	Rehabilitate Manhole
NN020873	Rehabilitate Manhole
NN020890.01	Rehabilitate Manhole
NN020898	Rehabilitate Manhole
NN020902	Rehabilitate Manhole
NN020920	Rehabilitate Manhole

Manhole Facility ID	Rehabilitate or Replace
NN023614	Rehabilitate Manhole
NN023627	Rehabilitate Manhole
NN023633	Rehabilitate Manhole
NN023668	Rehabilitate Manhole
NN023673	Rehabilitate Manhole
NN023725	Rehabilitate Manhole
NN023731	Rehabilitate Manhole
NN023935	Rehabilitate Manhole
NN023938	Rehabilitate Manhole
NN023939.03	Rehabilitate Manhole
NN023942	Rehabilitate Manhole
NN023945	Rehabilitate Manhole
NN023947	Rehabilitate Manhole
NN023972	Rehabilitate Manhole
NN023993	Rehabilitate Manhole
NN024014	Rehabilitate Manhole
NN024019.01	Rehabilitate Manhole
NN024019.02	Rehabilitate Manhole
NN024059	Rehabilitate Manhole
NN024059.01	Rehabilitate Manhole
NN024061	Rehabilitate Manhole
WS010132	Rehabilitate Manhole
WS010170	Rehabilitate Manhole
WS010211	Rehabilitate Manhole
WS010269	Rehabilitate Manhole
WS010310	Rehabilitate Manhole
WS010348.03	Rehabilitate Manhole
WS010363	Rehabilitate Manhole
WS010363.01	Rehabilitate Manhole
WS010363.02	Rehabilitate Manhole
WS010363.05	Rehabilitate Manhole
WS010363.08	Rehabilitate Manhole
WS010363.10	Rehabilitate Manhole
WS010505	Rehabilitate Manhole
WS010522	Rehabilitate Manhole
WS010538	Rehabilitate Manhole
WS010541	Rehabilitate Manhole
WS010570	Rehabilitate Manhole
WS010604	Rehabilitate Manhole
WS011017	Rehabilitate Manhole
WS011034	Rehabilitate Manhole
WS011049	Rehabilitate Manhole
WS011070.01	Rehabilitate Manhole
WS011089	Rehabilitate Manhole
WS011130.01	Rehabilitate Manhole

Manhole Facility ID	Rehabilitate or Replace
NN020921	Rehabilitate Manhole
NN020938	Rehabilitate Manhole
NN020942	Rehabilitate Manhole
NN020946	Rehabilitate Manhole
NN021006	Rehabilitate Manhole
NN021079	Rehabilitate Manhole
NN021082	Rehabilitate Manhole
NN021334	Rehabilitate Manhole
NN021406	Rehabilitate Manhole
NN021408	Rehabilitate Manhole
NN021411	Rehabilitate Manhole
NN021426	Rehabilitate Manhole

Manhole Facility ID	Rehabilitate or Replace
WS011141	Rehabilitate Manhole
WS011197	Rehabilitate Manhole
WS011205	Rehabilitate Manhole
WS011263	Rehabilitate Manhole
WS011301	Rehabilitate Manhole
WS011302	Rehabilitate Manhole
WS011351	Rehabilitate Manhole
WS011365	Rehabilitate Manhole
WS011375	Rehabilitate Manhole
WS011381	Rehabilitate Manhole
WS012003	Rehabilitate Manhole

Appendix C.2
Point Repairs and Manhole Adjustments Completed to Date in Priority Rehabilitation Areas


Manhole Adjustment Completed
Point Repair Completed
Rehabilitation Priority Area
Completed Rehabilitation
City of Memphis, TN WWCTS Study
BLACK & VEATCH
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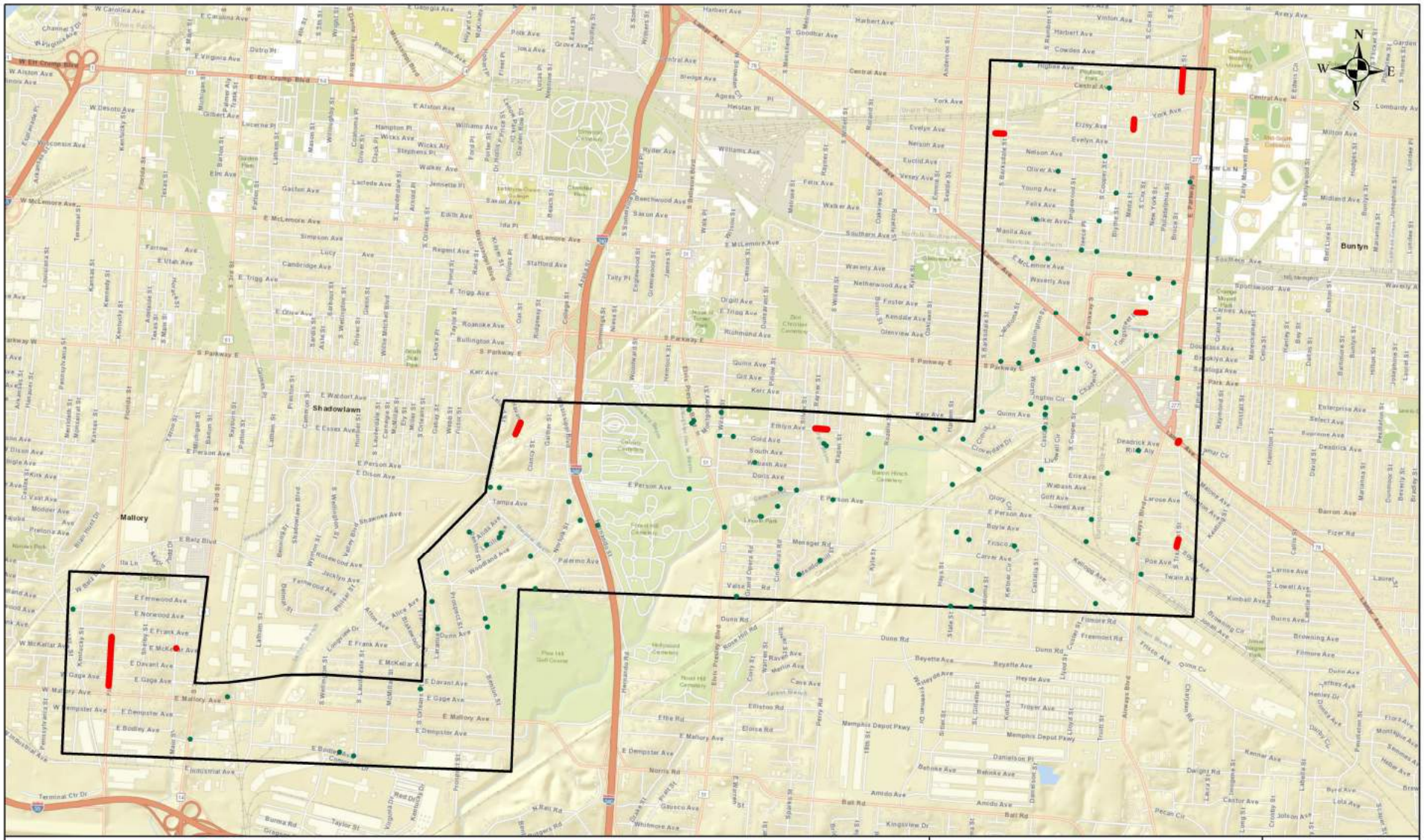
Hollywood
Sand Pit Lake
Kilowatt Lake
Cypress Creek
Jackson Ave
N Parkway
Chelsea Ave
Marble Ave
Brown Ave
Vollintine Ave
Hallwood Dr
Tutwiler Ave
Faxon Ave
Galloway Ave
Forrest Ave
Autumn Ave
Overton Park Ave
Rhodes College
Memphis Zoo
Gooch Park
Guthrie Park
Vollintine Park
University Park



Manhole Adjustment Completed

Point Repair Completed

Rehabilitation Priority Areas

Completed Rehabilitation
City of Memphis, TN WWCTS Study

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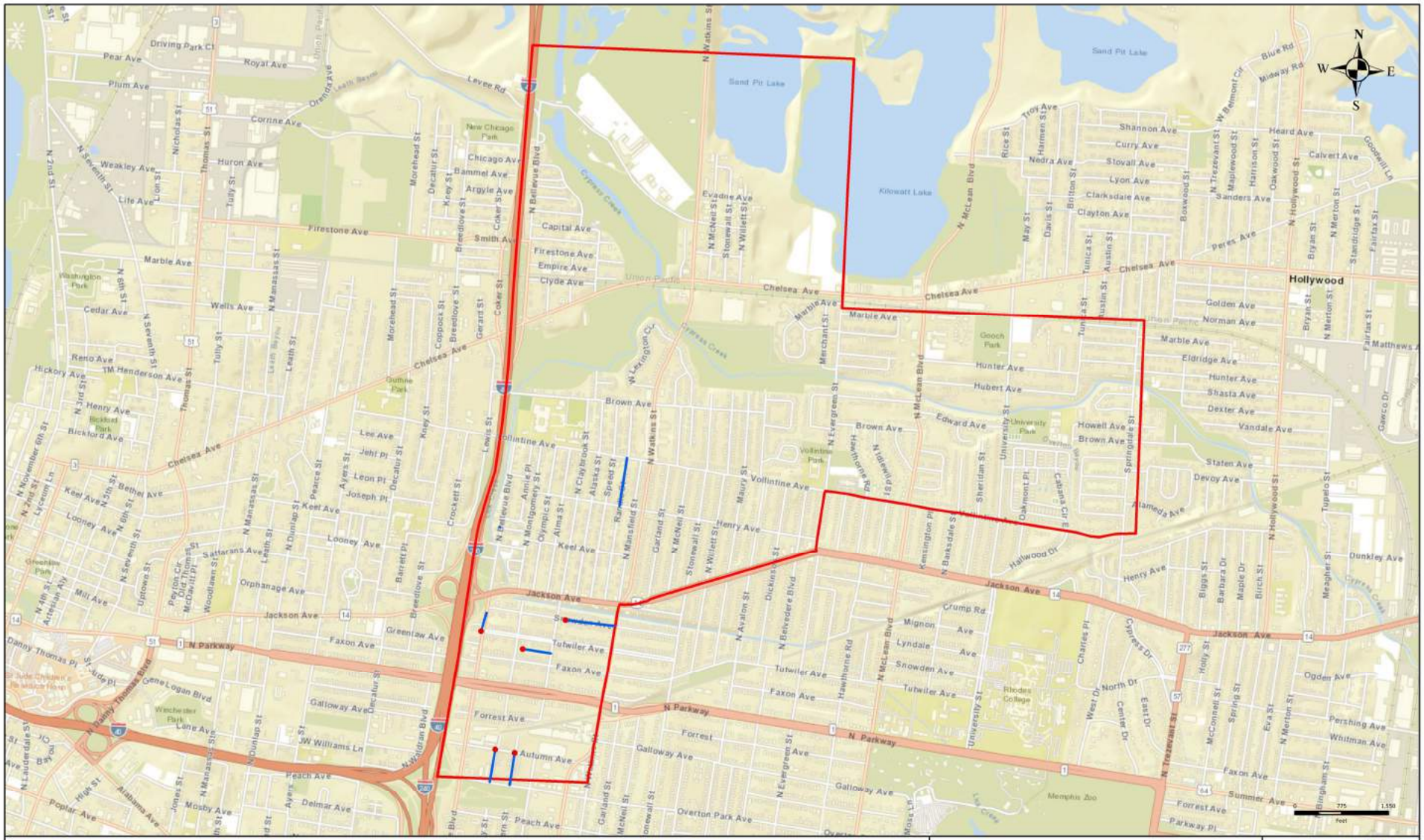
Appendix C.3
Assets Being Rehabilitated in Group 1 Relay



Manhole Included in Rehabilitation Plan

Gravity Main Included In Rehabilitation Plan

Northern Priority Area

Group 1 Relay Northern Area

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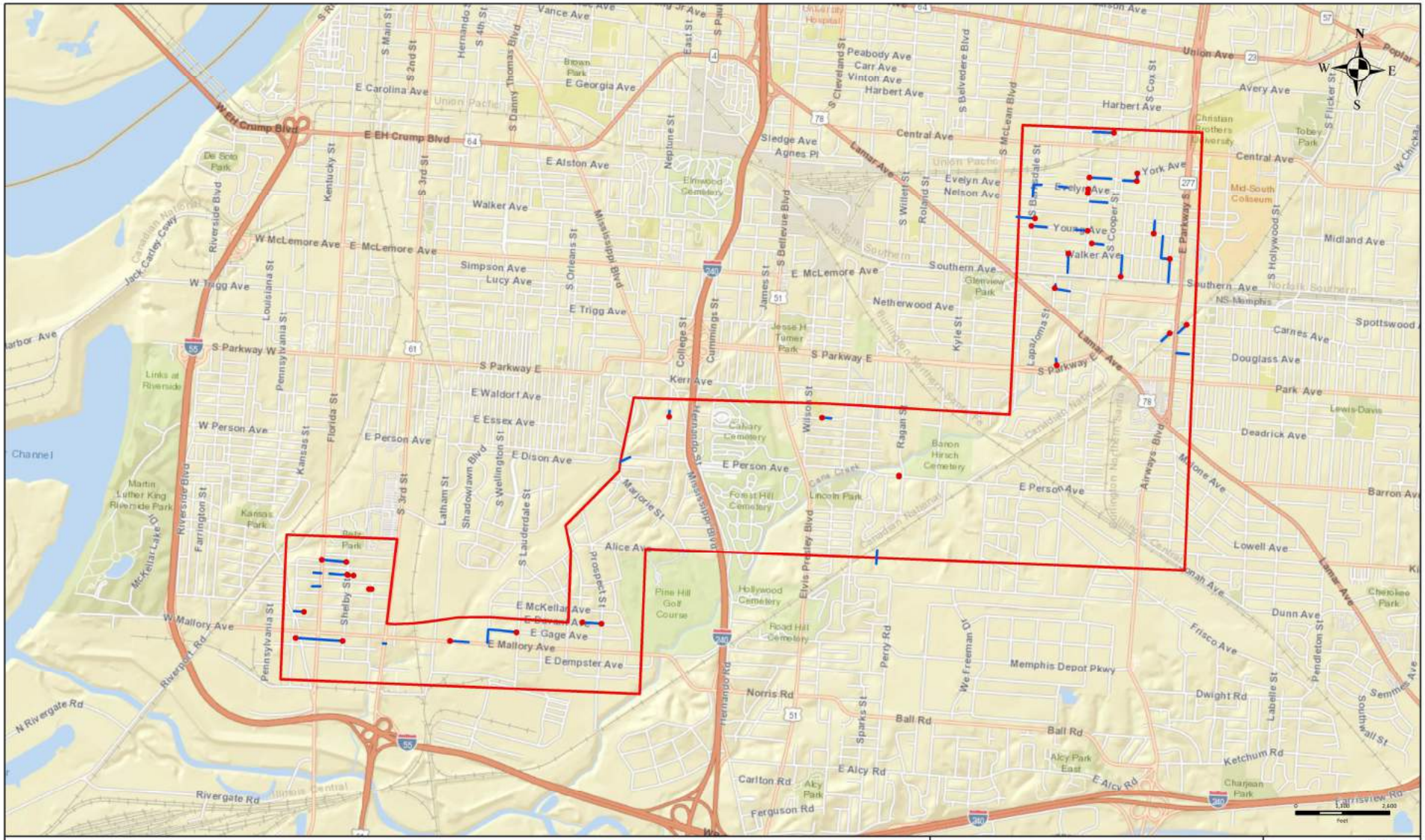
Manhole Included In Rehabilitation Plan
Gravity Main Included In Rehabilitation Plan
Southern Priority Area
Group 1 Relay
Southern Area
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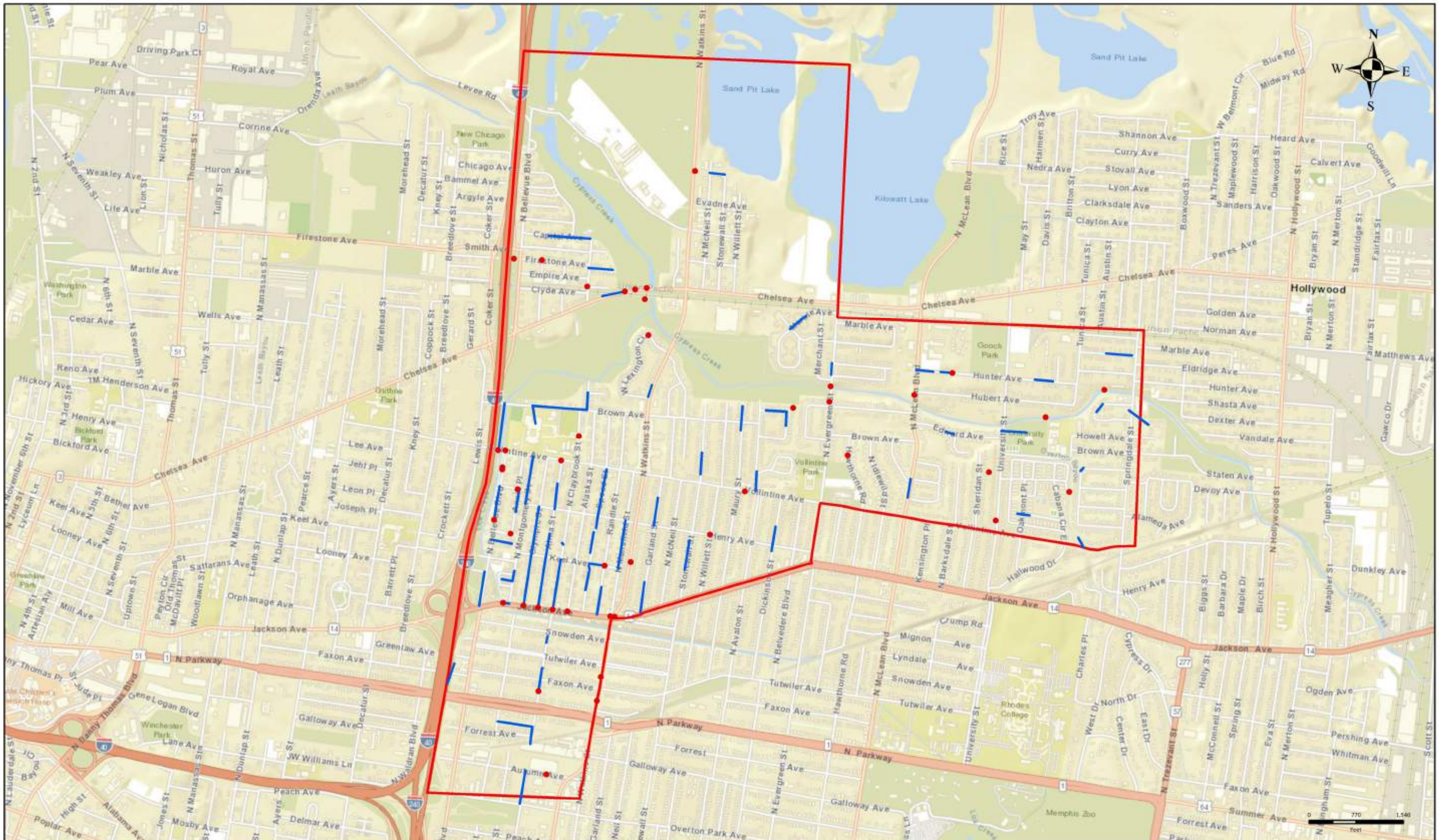
Appendix C.4
Assets Being Rehabilitated in Group 1 CIPP



Manhole Included in Rehabilitation Plan

Gravity Main Included in Rehabilitation Plan

Northern Priority Area

Group 1 CIPP
Northern Area

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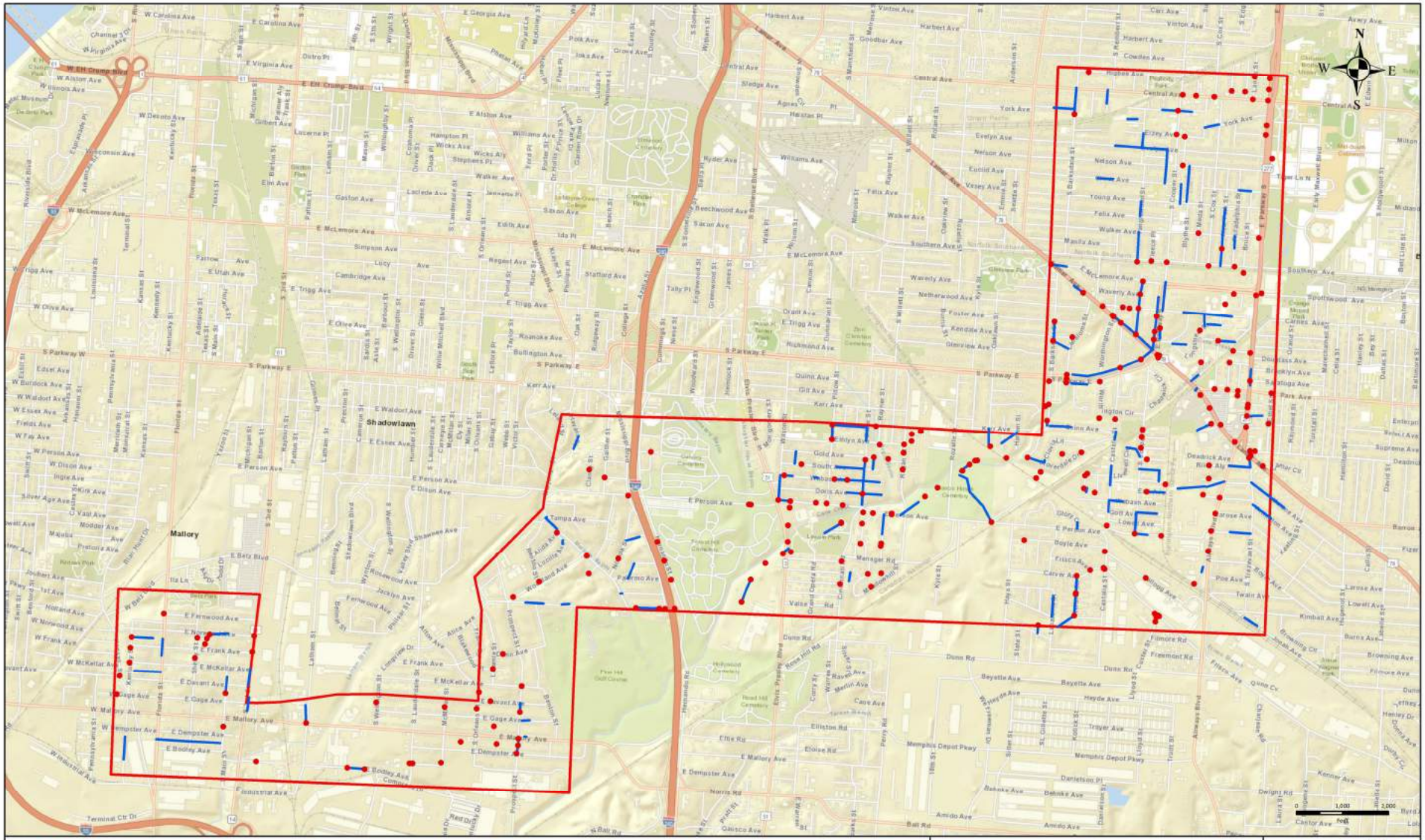

Manhole Included in Rehabilitation Plan

Gravity Main Included in Rehabilitation Plan

Southern Priority Area

Group 1 CIPP Southern Area

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