LOWELL REGIONAL WASTEWATER UTILITY
CITY OF LOWELL, MA
PHASE 1 SANITARY SEWER EVALUTION SURVEYS (SSES) REPORT
KLEINFELDER PROJECT #20220166.003A

April 11, 2025

PHASE 1 SANITARY SEWER EVALUATION SURVEYS (SSES) REPORT

CERTIFICATION STATEMENT

I certify under penalty of perjury 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 the information, the information submitted is, to the best of my knowledge and belief, true, accurate, and complete. I have no personal knowledge that the information submitted is other than 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.

Aaron Fox
Executive Director
Lowell Regional Wastewater Utility

4/14/2025
Date

A Report Prepared for:

Mr. Aaron Fox
Executive Director
Lowell Regional Wastewater Utility
451 First Street Blvd
Lowell, MA 01850

PHASE 1 SSES REPORT
CITY OF LOWELL, NA

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April 11, 2025
Kleinfelder Project No: 20220166.003A

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LOWELL REGIONAL WASTEWATER UTILITY
CITY OF LOWELL, MA
PHASE 1 SANITARY SEWER EVALUTION SURVEYS (SSES) REPORT

1 EXECUTIVE SUMMARY

In Spring of 2024, the Utility conducted the field investigations associated with Phase 1 of the SSES Implementation Plan as identified in the 2023 I/I Analysis Report. The field findings of Phase 1 SSES investigations are summarized herein with recommendations for sewer system rehabilitation and repair, including estimated design and construction costs with anticipate schedules.

Background

As the Lowell Regional Wastewater Utility (Utility) holds a National Pollution Discharge Elimination System (NPDES) permit enforced by the United States Environmental Protection Agency (USEPA) and MassDEP, the City is required to identify sources of I/I in their system. 314 CMR 12.04(2) requires phased I/I evaluations of sewer systems consistent with *MassDEP's Guidelines for Performing Infiltration/Inflow Analyses and Sanitary Sewer Evaluation Surveys*, May 2017 (MassDEP Guidelines).

The Consent Decree (CD) for the City was fully executed and filed with the U.S. District Court on May 17, 2024 (Case: 1:24-cv-10290-DJC, Document 13). The Consent Decree includes the following requirements, under Section VI. Remedial Measures, Paragraph 18:

> *The City shall develop and implement an ongoing program to identify and remove infiltration and inflow from the sewer system in accordance with 314 C.M.R. §12.04(2) and shall provide annual flow information for those communities serviced by the Lowell Regional Wastewater Utility ("LRWU"). To meet this requirement, the City shall:*
>
> *a. By January 31, 2024, submit to MassDEP for review and approval an I/I Analysis Report. The I/I Analysis Report shall be consistent with the provisions of 314 C.M.R. § 12.04(2) and, as referenced therein, the MassDEP's 2017 Guidelines for Performing Infiltration/Inflow Analyses and Sewer System Evaluation Surveys, and shall include a detailed assessment of flow data gathered from the 2023 sewer metering program. The I/I Analysis Report shall also include an implementation schedule, based on assessment of the flow data, for proceeding with sewer system evaluation surveys, and actions to address sources of Infiltration and Inflow.*

The 2023 sewer metering program was a City-wide flow monitoring program including sixty-three (63) temporary wastewater flow meters, one hundred and ten (110) groundwater gauges, and three (3) rain gauges to quantify the magnitude to of I/I entering the collection system. The Utility submitted the 2023 Infiltration/Inflow (I/I) Analysis Report on January 31, 2024 in accordance with the Consent Decree which included an 8-phase Sanitary Sewer Evaluation Survey (SSES) Implementation Plan.

The Utility committed to re-metering ten of the 2023 meter areas in Spring 2024 to determine I/I volumes from these areas, and revisit the prioritized SSES investigations and phasing presented in 2023 I/I Analysis Report based on the additional I/I results and other planned system improvements by the Utility. The supplemental flow monitoring program and revised SSES investigations are summarized in the I/I Analysis Supplemental Report (dated March 24, 2025) submitted to MassDEP by the Utility on March 28, 2025.

In tandem with the 2023 flow monitoring program, infiltration investigations were conducted in a portion of the sewers within the Downtown area of Lowell. Approximately 31,500 feet of sewer was inspected, along with 220 manholes. The Downtown sewer assets are some of the Utility's oldest infrastructure that are located in historical high I/I areas, noted in the 1990 I/I Report. The Downtown investigation findings and recommendations were summarized in 2023 I/I Field Investigation Program Findings Memorandum and included recommendations for sewer and manhole rehabilitation totaling $4.2 million.

Phase 1 SSES Investigations

Phase 1 SSES is focused on infiltration investigations of the Utility's river-front interceptor pipe and associated manholes, as well as the remaining portion of the Downtown area pipe and manhole inspections based on what was completed prior in the 2023 Field Program.

Interceptor Inspections

In May 2024, RedZone Robotics Inc. (RedZone) completed of a comprehensive multi-sensor inspection (CCTV, laser, and sonar) of the Utility's river-front interceptor piping network, which encompasses approximately 56,300 LF of sewer ranging in size from 36 to 120-inch in diameter. The interceptor pipeline system was identified by seven sections based on location as shown in **Figure ES-1**. Note Interceptor 6 has a "Main" section of pipe along the Merrimack River and a "Barasford" section of pipe, transporting flows from the Barasford CSO catchment area north to the Barasford CSO Station.

From April 17, 2024 to April 23, 2024, RedZone completed 146 top-side manhole inspections along Interceptors 1 through 7, excluding portions of Interceptor 6 Barasford and the upstream portion of

Interceptor 5. Fifty-one (51) manholes associated with the Interceptor 6 Barasford and Interceptor 5 were inspected by EST Inc between July 9, 2024 and September 9, 2024.

Legend

Phase 1 SSES

- Downtown Sewer Inspection Area
- Interceptor Sewer Inspection
- Pipe Inaccessible
- Siphon Pipe
- Gravity Sewer Pipe

DRACUT

TEWKSBURY

Interceptor 1
4,027 LF

Interceptor 2
6,201 LF

Interceptor 3
11,255 LF

Interceptor 4
4,410 LF

Interceptor 5
10,157 LF

Interceptor 6
15,996 LF

Interceptor 6
Barasford Section

Interceptor 7
4,296 LF

0 2,000 4,000
Feet

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Phase 1 SSES Report
Interceptor Pipelines and Downtown Area Keyplan

Lowell Regional Wastewater Utility
451 First Street Blvd.
Lowell, MA 01850

FIGURE
ES-1

Date: 3/25/2025 User: JRossini Path: \\azrgisstorp01\GIS_Projects\Client\MA_Lowell\20220166.003_Consent_Decree_Compliance\MXD\Lowell 2024_Field Program\Lowell 2024 Report Figures.aprx

In general, the reinforced concrete sections of the interceptors (Interceptors 1, 2, 3, part of 6, 7) were in fair structural condition. Interceptor 7 has fractures in an isolated downstream section of the pipeline near lower Tilden CSO Area. Interceptors 3 and Interceptor 6 along the Merrimack River both have heavy debris, reducing available pipe capacity. Interceptor 1, 3, and the 42/48-inch upstream Barasford section of Interceptor 6 consistently had infiltration defects at joints.

In general, the brick interceptors (Interceptors 4 and 5) showed evidence of barrel infiltration and encrustation. The brick interceptors also exhibited a few structural defects such as longitudinal fractures and missing bricks. Interceptor 4 showed consistent infiltration throughout the pipeline whereas in Interceptor 5, the infiltration observed was limited to two localized areas of pipe along the Concord River and one upstream cross-country pipe segment.

Infiltration rates were estimated for each defect observed and were summarized by interceptor. The total estimate of interceptor infiltration observed from pipe and manhole inspections is 72.6 gallons per minute (gpm) (0.1 million gallons per day). Interceptor 6 pipes were notably the largest contributor with a total of 40 gpm (57,600 gallons per day).

Groundwater gauges were in place during the interceptor inspection period and in general, the groundwater levels were significantly lower in 2024 than the groundwater levels previously observed in 2023 in support of the City-wide Flow Metering Program and summarized in the 2023 I/I Analysis Report. Infiltration from these interceptors may contribute more extraneous flow during periods of higher groundwater than what is estimated through the 2024 inspections.

Downtown Area Inspections

Between May 6, 2024 and June 3, 2024, National Water Main Cleaning Company (NWMCC) conducted approximately 21,300 linear feet of cleaning and CCTV inspections (in accordance with NASSCO PACP standards) of some of the Utility's oldest infrastructure in the Downtown area of the City in Meter Areas 51, 38, and 37. EST Inc. completed 86 top-side manhole inspections within the Downtown meter areas in accordance with NASSCO's MACP. The Downtown inspection areas are identified in Figure ES-1. The goal of the 2024 inspections was to effectively inspect all sewer collection pipes and manholes in the Downtown area (Meter Areas 51, 38, 37) when paired with the prior 2023 Downtown Area I/I Investigations discussed previously.

Notable maintenance defects in the downtown sewers included infiltration, roots, and heavy debris. Structural pipe defects identified include a large offset joint, a collapsed pipe, severe hinge fractures, multiple fractures, broken pipe, and separated joints. The downtown area manholes were overall in fair

structural condition but observed several instances of maintenance defects of infiltration, typically coming from the wall or bench components.

Infiltration rates for pipes and manholes were estimated for each defect observed and summarized by the asset and year the inspections were performed. As noted previously, groundwater levels were significantly lower in 2024 than the groundwater levels previously observed in 2023 in general. These pipelines and manholes may contribute more extraneous flow during periods of higher groundwater than what is estimated during 2024 field inspections. The total estimate of infiltration observed from Downtown area pipe and manhole inspections is 29.5 gpm or 0.04 mgd.

Interceptor Recommendations and Estimated Construction Costs

Kleinfelder recommends primary, secondary and monitor projects for the interceptor pipelines as shown in **Figure ES-2**. Primary projects were identified out of the substantial quantity of infiltration defects as well structural defects and are recommended to be addressed in 2 to 5 years. Secondary projects were identified as having infiltration contributions in need of mitigation but are in fair structural condition. Secondary projects will be evaluated for construction in future phases. Monitor projects have defects that are recommended to be re-inspected in 5 to 10 years to monitor their occurrence and severity. Additionally, Kleinfelder recommends cleaning and debris removal of identified sections within Interceptor 3 and 6 as well as removal of observed medium roots which impact available capacity of these critical assets.

Preliminary rehabilitation recommendations are provided for each primary, secondary, and monitor project for the purposes of developing planning-level cost estimates. Preliminary recommendations of cured-in-place pipelining (CIPP) were included for Interceptors 2, 4, 5, and 6 in specific locations where either infiltration or structural issues were present. Grouting of joints is recommended for concrete pipe in favorable structural condition where infiltration is present, such as in Interceptors 1 and 3 Secondary Projects. As the portion of Interceptor 6 along the Merrimack River between the Concord River Siphon and Merrimack River Siphon is 120-inch in diameter, spray lining is noted as a potential rehabilitation method for the Interceptor 6 Monitor Project. Kleinfelder recommends conducting an alternatives analysis during design to effectively determine the optimal approach of trenchless rehabilitation of the interceptor sewers.

Legend

- Siphon Pipe
- Gravity Sewer Pipe

Pipe Material

- Brick
- Concrete

MONITOR
INTERCEPTOR 2:
84" CIPP LINE 2300 LF

REMOVE ROOTS

INTERCEPTOR 3 DEBRIS REMOVAL SHARES THE SAME EXTENTS NOTED AS THIS PROJECT

SECONDARY PRIORITY INTERCEPTOR 3:
96" GROUT 25 JOINTS

SECONDARY PRIORITY INTERCEPTOR 3:
96" GROUT 40 JOINTS

REMOVE ROOTS

SECONDARY PRIORITY INTERCEPTOR 7:
36" CIPP LINE 780 LF

PRIMARY PRIORITY INTERCEPTOR 4:
52x35" CIPP LINE 2600 LF
48" CIPP LINE 200 LF

INTERCEPTOR 6 DEBRIS REMOVAL

MONITOR
INTERCEPTOR 6:
120" SPRAY LINE 4100 LF

SECONDARY PRIORITY INTERCEPTOR 5:
90" CIPP LINE 650 LF
84" CIPP LINE 400 LF

SECONDARY PRIORITY INTERCEPTOR 5:
84" CIPP LINE 650 LF

PRIMARY PRIORITY INTERCEPTOR 6:
42" CIPP LINE 450 LF
48" CIPP LINE 1700 LF

SECONDARY PRIORITY INTERCEPTOR 1:
48" GROUT 40 JOINTS

SECONDARY PRIORITY INTERCEPTOR 5:
84" CIPP LINE 800 LF

REMOVE ROOTS

DRACUT

TEWKSBURY

0 2,000 4,000
Feet

N

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Phase 1 SSES Report
Interceptor Recommendations

Lowell Regional Wastewater Utility
451 First Street Blvd.
Lowell, MA 01850

FIGURE
ES-2

Manhole recommendations for 42 manholes along the interceptors include cementitious lining, cover replacement, and cleaning. Rehabilitation is recommended for these manholes to primarily address active infiltration and are in alignment with pipes identified for rehabilitation in Interceptors 4, 5, and 6. The rehabilitation of these manholes are included in the associated interceptor pipeline rehabilitation priority level recommendations and cost estimates. It is recommended that the Utility address manholes noted for cleaning as part of their collection system on-call cleaning and lining maintenance contract.

The project costs for the primary rehabilitation projects for Interceptor 4 and Interceptor 6 highlighted in **Figure ES-2** are $2.7 million and $2.2 million respectively. Total project costs include a 25% contingency applied to the construction subtotals and an additional 25% for engineering. Construction costs for the Interceptor Secondary Priority and Monitor Projects are estimated to total $40.9 million including construction contingency and engineering services.

Downtown Area Recommendations and Estimated Construction Costs

Figure ES-3 shows the repair/rehabilitation recommendations for the Downtown Area sewer pipe and manholes. The Downtown area recommendations are presented as primary and secondary priority projects based on the severity of defects observed. The recommendations from the 2023 and 2024 Downtown area field investigations include 1,400 linear feet of pipe replacement, 18,700 linear feet of pipe rehabilitation, and rehabilitation of 61 manholes. The pipes identified for renewal are assumed to be rehabilitated with CIPP. Further design will be needed to verify the proposed rehabilitation method and what additional work is required to facilitate the rehabilitation technique based on the existing defects. The construction costs for the Downtown area rehabilitation are $7.1 million in total for the primary and secondary projects as shown in **Figure ES-3**. Total project costs include a 25% contingency applied to the construction subtotals and an additional 25% for engineering.

Anticipated Schedule of Interceptor and Downtown Area Rehabilitation

The Utility is focused on sewer separation as outlined in their Consent Decree but see the value-add in incorporating interceptor rehabilitation projects into ongoing collection system projects where funding allows. Interceptor 4 recommendations will be added to the Phase 3 Sewer Separation Project, anticipated to be constructed by 2032 per the Utility's *Phase 3 Candidate Area Sewer Separation Preliminary Design Report* (December 2024). The Phase 3 Sewer Separation Project includes work within the Grand, Lower Saunders, and Peavy catchment areas. The upstream limit of the Interceptor 4 rehabilitation is located on Middlesex Street within the Grand catchment area.

In July 2024, the Utility requested funding for construction of rehabilitation of the Downtown area sewers through the MassDEP's Clean Water State Revolving Fund. The Downtown Area Sewer

Improvements Project was listed on MassDEP's 2025 Final Intended Use Plan (Dated April 8, 2025), with an anticipated $6 million of construction funding. The Utility intends to begin design of the Downtown Area Sewer Improvements in 2025 with an anticipated construction start by June 2026 in accordance with the 2025 CWSRF requirements.

While the Utility is making significant investments with the sewer separation program and other collection system improvements to reduce CSO volumes and SSO occurrences, the Utility intends to maintain their existing budget of $2 million per year for appropriated construction funds for projects to reduce I/I within the collections system. It is recommended that rehabilitation of Interceptor 6 Barasford be included as part of larger capital project or be prioritized after the Downtown area rehabilitation, anticipated to be completed by 2029. The Utility intends to address debris removal of Interceptors 3 and 6 as part of a larger capital project or under an on-call maintenance contract. A phased approach of secondary interceptor projects will be implemented until 2032, at which time the City will review all programs comprehensively and will update their priorities in the Long Term Control Plan (LTCP) update in accordance with the Consent Decree.

DRACUT

Legend

- Primary Pipe to Replace
- Primary Pipe to Rehab
- Secondary Pipe to Rehab
- SMH Replace/Rehab (61)
- Siphon Pipe
- Gravity Sewer Pipe

0 1,000 2,000
Feet

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Phase 1 SSES Report
Downtown Area Comprehensive Recommendations

Lowell Regional Wastewater Utility
451 First Street Blvd.
Lowell, MA 01850

FIGURE
ES-3

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2 BACKGROUND

As the Lowell Regional Wastewater Utility (Utility) holds a National Pollution Discharge Elimination System (NPDES) permit enforced by the United States Environmental Protection Agency (USEPA) and MassDEP, the City is required to identify sources of I/I in their collection system. The Utility's collection system is depicted in **Figure 1**. 314 CMR 12.04(2) requires phased I/I evaluations of sewer systems consistent with *MassDEP's Guidelines for Performing Infiltration/Inflow Analyses and Sanitary Sewer Evaluation Surveys*, May 2017 (MassDEP Guidelines).

The Consent Decree (CD) for the City was fully executed and filed with the U.S. District Court on May 17, 2024 (Case: 1:24-cv-10290-DJC, Document 13). The Consent Decree includes the following requirements, under Section VI. Remedial Measures, Paragraph 18:

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>
> *b. By January 31, 2024, submit to MassDEP for review and approval an I/I Analysis Report. The I/I Analysis Report shall be consistent with the provisions of 314 C.M.R. § 12.04(2) and, as referenced therein, the MassDEP's 2017 Guidelines for Performing Infiltration/Inflow Analyses and Sewer System Evaluation Surveys, and shall include a detailed assessment of flow data gathered from the 2023 sewer metering program. The I/I Analysis Report shall also include an implementation schedule, based on assessment of the flow data, for proceeding with sewer system evaluation surveys, and actions to address sources of Infiltration and Inflow.*

The 2023 sewer metering program was a City-wide flow monitoring program including sixty-three (63) temporary wastewater flow meters, one hundred and ten (110) groundwater gauges, and three (3) rain gauges to quantify the magnitude to of I/I entering the collection system. The 2023 flow meter areas are depicted in **Figure 2**. Upon review of the final metering data for all sites, Kleinfelder excluded data from eleven (11) meter areas from the I/I analysis due to poor quality of data. The Utility submitted the 2023 Infiltration/Inflow (I/I) Analysis Report on January 31, 2024 in accordance with the Consent Decree which included an 8-phase Sanitary Sewer Evaluation Survey (SSES) Implementation Plan. The 8-phase

SSES Implementation Plan proposes SSES investigations through 2032 and construction through 2034. At that time, an overall system assessment is anticipated to begin in support of the Updated LTCP and future I/I identification and removal efforts will be developed in coordination with the Updated LTCP.

The Utility committed to re-metering ten of the 2023 meter areas in Spring 2024 to determine I/I volumes from these areas, and revisit the prioritized SSES investigations and phasing presented in 2023 I/I Analysis Report based on the additional I/I results and other planned system improvements by the Utility. The supplemental flow monitoring program and revised SSES investigations are summarized in the I/I Analysis Supplemental Report (dated March 24, 2025) submitted to MassDEP by the Utility on March 28, 2025. The revised SSES plan are described in **Table 1** and **Figure 3**.

2.1 SEWER COLLECTION AND CONVEYANCE SYSTEM

The Utility's sewer system is 226 miles of sewer pipe comprised of portions of combined (approximately 52%) and separated (approximately 48%) sewers by linear foot dating back to the 1830s and largely developed from 1870s to the 1970s. The pipes range from 8-inch to 120-inch in diameter, with the majority of 36-inch in size or smaller. The sewer system is predominantly Vitrified Clay (VC), Concrete, Brick, and Asbestos Cement (AC) with the remaining materials including Cast Iron (CI), Ductile Iron (DI), and Polyvinyl Chloride (PVC). The system also includes six siphons (double or triple barrel), 5 miles of force main, 14 pump stations, 9 diversion structures, 1 siphon station, 5 intermunicipal meter stations, 1 flow control station, 3 permanent rain gauges (located at Duck Island Wastewater Treatment Facility, Warren CSO Station, Rivers Edge Pump Station) and the Duck Island Wastewater Treatment Facility (Duck Island). There are 6 six metering stations bordering the City that are not owned or operation by the Utility. The Utility collects and treats flows from Chelmsford, Dracut, Tewksbury, and Tyngsborough (Member Communities) under an established Inter-Municipal Agreement (IMA). **Figure 1** illustrates the Utility's sewer system.

The Utility is making significant investments throughout the collection system with improvements to reduce CSO volumes and SSO occurrences through the Centralville Area Sewer Separation Projects, Phase 3 CSO Separation Projects, and construction of the Douglas Road Wet Weather Storage Tank. The reported occurrences of SSOs within the collection system caused by reduced capacity during wet weather events, are concentrated within these CSO areas with planned collection system improvements to reduce these occurrences.

2.2 2023 DOWNTOWN AREA I/I INVESTIGATIONS

In tandem with the 2023 flow monitoring program, infiltration investigations were conducted in a portion of the sewers within the downtown area of Lowell. Approximately 31,500 feet of sewer was inspected, along with 220 manholes, in Meter Areas 51 and 38. The Downtown sewer assets are some of the Utility's oldest infrastructure that are located in historical high I/I areas, noted in the 1990 I/I Report. The Downtown investigation findings and recommendations were summarized in 2023 I/I Field Investigation Program Findings Memorandum (**Appendix A**), included as Attachment E of the I/I Analysis Report. The memorandum recommended $4.2 million of sewer and manhole rehabilitation.

The 2023 I/I Field Investigation Program Findings Memorandum also noted the inflow source in the Kearney Square sewer was anticipated to be repaired in 2024. However, in August 2024 the Utility collaborated with Boott Hydropower (current Canal owner) to discover the Kearney Square inflow source was actually a failed hatch that cross-connects the Canalway to the sewer. Boott Hydropower made a temporary repair with the intent of addressing the inflow source with a permanent solution in 2025.

2.3 PHASE 1 SSES

In Spring of 2024, the Utility conducted the field investigations associated with Phase 1 of the SSES Implementation Plan as identified in the 2023 I/I Analysis Report. Phase 1 SSES is focused on infiltration investigations of the remaining portion of the Downtown area (Meter Areas 51, 38, 37) and multi-sensor inspections (CCTV, laser, and sonar) of the Utility's river-front interceptor pipe, approximately 56,300 LF of sewer ranging in size from 36 to 120-inch in diameter. CCTV of approximately 24,000 feet of sewer and 50 manholes inspections were identified in the Downtown Area to be completed under Phase 1 SSES. Inflow investigations for Meter Area 37 are to be conducted in SSES Phase 2 as this area is partially separated. Inflow investigations are not recommended for Meter Areas 38 and 51 at this time as they are combined systems with no plans for future separation. **Figure 4** illustrates the Downtown Area and interceptor sewers identified for inspection.

The field findings of Phase 1 SSES investigations are summarized herein with and recommendations for sewer system rehabilitation and repair, including estimated design and construction costs with anticipate schedules. Per MassDEP Guidelines, recommendations shall also include a post-construction flow monitoring program to document the effectiveness of the I/I removal work.

Legend

- Gravity Sewer Pipe
- Force Main
- Siphon Pipe
- Combined Sewer
- Separated Sewer

Station Type

- Diversion Structure and CSO Outfall
- Metering Station
- Pump Station
- Siphon Station
- Wastewater Treatment Plant
- Flow Control Station

TYNGSBOROUGH

DRACUT

BEAVER BROOK

WEST

TILDEN

FIRST ST

READ

DUCK ISLAND

WALKER

BARASFORD

MERRIMACK

WARREN

Merrimack River

CHELMSFORD

TEWKSBURY

WESTFORD

BILLERICA

0 4,000 8,000

Feet

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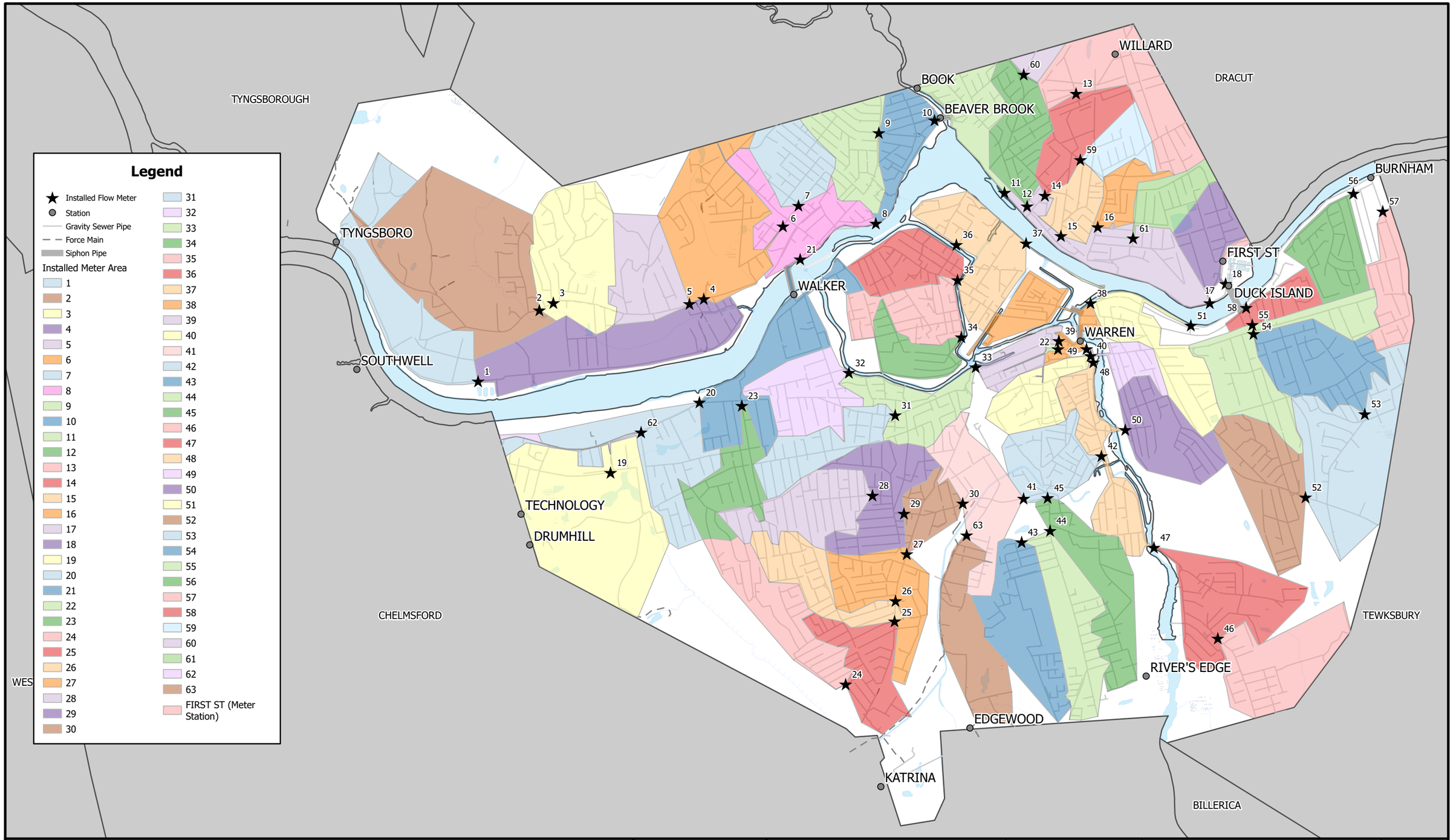
Phase 1 SSES Report
LRWWU Sewer System

Lowell Regional Wastewater Utility
451 First Street Blvd.
Lowell, MA 01850

FIGURE
1



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Phase 1 SSES Report
2023 Flow Meter Areas Keyplan

Lowell Regional Wastewater Utility
451 First Street Blvd.
Lowell, MA 01850

FIGURE
2

Date: 1/31/2024 User: JRossini Path: \\azrgisstorp01\GIS_Projects\Client\MA_Lowell\20220166.003_Consent_Decree_Compliance\MXD\Lowell 2023_Flow_Meter\Lowell 2023_Flow_Meter.aprx

Table 1: 2024 SSES Implementation Program

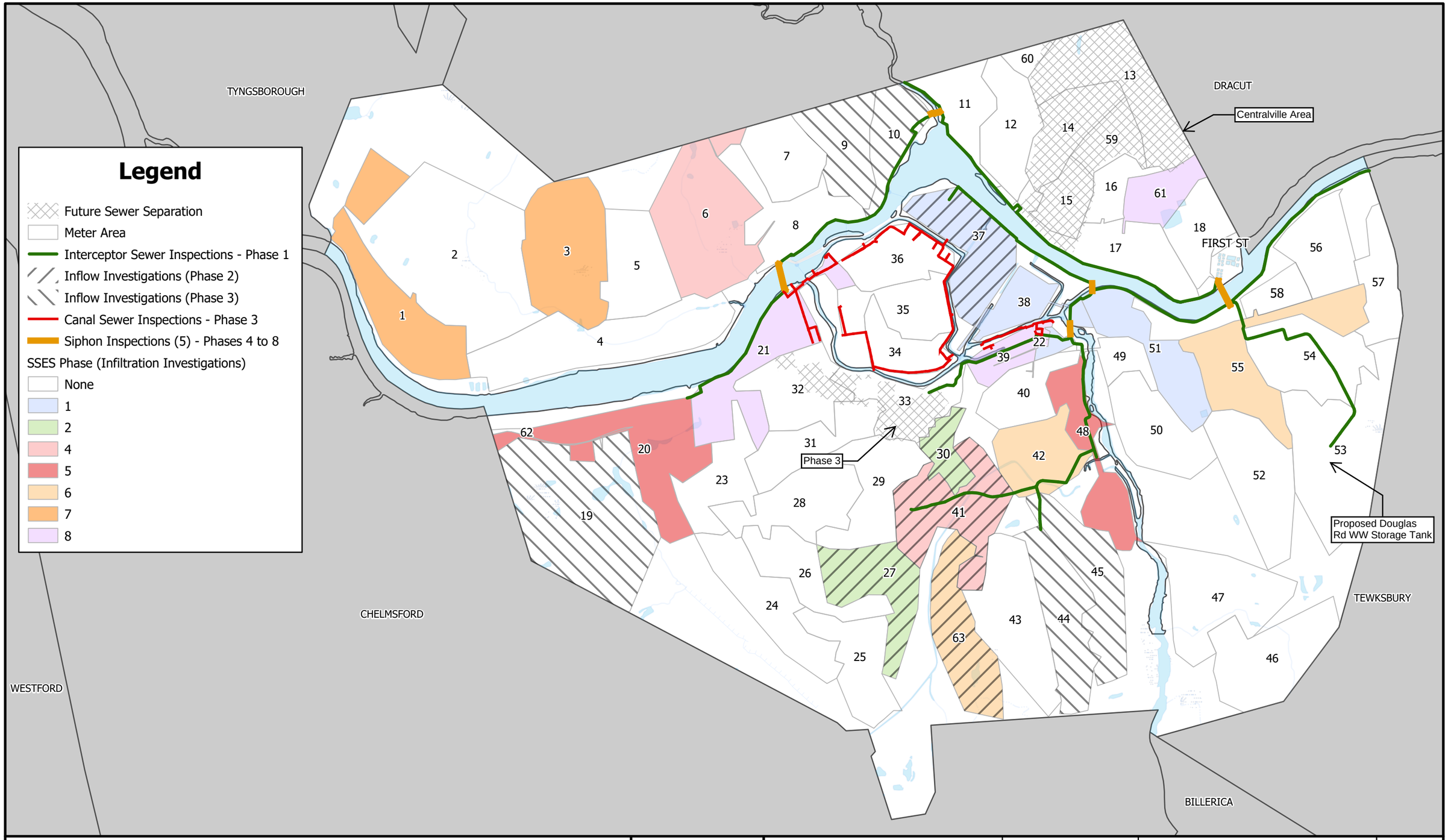
Fiscal Year[2]	Phase	Meter Area	CCTV (LF)	MH Inspections (EA)	Siphon Inspection (EA)	Flow Isolation (LF)	Smoke Testing (LF)	Building Inspections (EA)	Dye Testing (EA)
2023	0*	M38, M51	31,500	220	East Merrimack	-	-	-	-
2024	1*	M37, M38, M51	21,300	86	-	-	-	-	-
2024	1*	Interceptor	56,300	197	-	-	-	-	-
2026	2	M27[3], M30[3], M37[1], M41[1], M63[1]	31,900	180	-	31,900	89,600	310	135
2027	3	M9[1], M10[1], M19[1], M44[1], M45[1]	0	0	-	-	98,500	350	150
2027	3	Canal Pipe	23,500	0	-	23,500	-	-	-
2028	4	M6, M41	44,900	270	Walker	44,900			
2029	5	M20, M48	52,500	305	Beaver Brook	52,500	-	-	-
2030	6	M42, M55, M63	55,300	305	Merrimack River	55,300	-	-	-
2031	7	M1, M3	43,900	240	Warren	43,900	-	-	-
2032	8	M21, M22, M39, M61	48,400	275	Concord River	48,400	-	-	-
	TOTAL		**409,500**	**2,078**	**6**	**300,400**	**188,100**	**660**	**285**

**Phase 0 field inspections completed in 2023; Phase 1 field inspections completed in 2024.*

[1] Inflow investigations only (smoke testing, building inspections, dye testing).

[2] Fiscal year begins on July 1st and ends on June 30th the following year.

[3] Both infiltration and inflow investigations.



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Feet

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Phase 1 SSES Report
2024 SSES Implementation Plan

Lowell Regional Wastewater Utility
451 First Street Blvd.
Lowell, MA 01850

FIGURE
3

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3 FIELD INVESTIGATION PROGRAM

Phase 1 of the SSES phased implementation plan includes approximately 10.5 miles of interceptor pipeline inspections with associated manhole inspections, as well as the remaining portion of the Downtown area pipe and manhole inspections based on what was completed prior in the 2023 Field Program. This Section will provide details related to those pipe and manhole inspections.

3.1 INTERCEPTOR INSPECTIONS

In May 2024, RedZone Robotics Inc. (RedZone) completed of a comprehensive multi-sensor inspection (MSI) of the Utility's river-front interceptor piping network, which encompasses approximately 56,300 LF of sewer ranging in size from 36 to 120-inch in diameter. Approximately 5,000 linear feet of interceptor pipe was not inspected due to the drop configuration upstream of Barasford CSO station, limiting manhole access to deploy the camera equipment as well as a few connection pipes around various stations or special structures throughout all interceptors. **Figure 4** depicts the seven sections of the interceptor pipeline system used for identification and planning based on location. Note interceptor 6 has a "base" section of pipe along the Merrimack River and a section pipe that flows north to the Barasford CSO Station, transporting flows from the Barasford CSO catchment area. This section of Interceptor 6 is referred to as the "Barasford" section for ease of discussion and distinction between the two pipelines. **Appendix B** provides a compilation of RedZone's PACP reports. These interceptor inspections have the added benefit of increasing assessment of the total amount of easement pipes within the City's combined system as well as identifying accessibility to sewer manholes and other hydraulic structures.

RedZone's MSI utilized advanced sensors to conduct digital closed-circuit television (CCTV) and laser/sonar inspections of the pipelines. RedZone did not conduct any pre-cleaning of the pipes, as use of muti-sensor technology allows for data collection both above and below the flow line within the pipe, including depth of sediment. In general, the equipment was able to pass through the pipe without being obstructed by debris. When analyzing the data, RedZone input a reference shape based on the best available data (GIS and as-builts in this case) and compares the laser/sonar readings against the reference shapes to note positive or negative deviations, presented in the MSI reports (provided in **Appendix C**). These MSI reports are subject to interpretation, making it critical to cross-compare the CCTV video inspections when identifying and understanding anomalies in the pipes. The reports include corrosion/pipe material loss, sediment levels/volumes, ovality/deflection, and pipe geometry.

Table 2 summarizes the quick maintenance rating (QMR) defects and **Table 3** summarizes the quick structural rating (QSR) defects of the interceptors. The most common maintenance issues were deposits attached encrustation, roots fine joints, and different magnitudes of infiltration. The most common structural issues were surface damage including minor aggregate visible, reinforcement visible, roughness increased, and spalling of coating. Overall, the interceptor pipes were in adequate structural condition with targeted areas of concern, and various areas with moderate to substantial infiltration contributions. **Figures 5 and 6** show the QMR and QSR ratings of each pipe segment**. Figure 7** depicts debris accumulation, from estimate values presented in the MSI Reports, as well as several instances of more significant roots in Interceptor 2, 5, and 7 which are noted by Pipe or Manhole Asset ID.

Figures 5 and **6** associate color with severity of defects. This is helpful for quick visual comparison of pipes within the inspection based on National Association of Sewer Service Companies' (NASSCO) pipeline assessment certification program (PACP) coded defects. NASSCO defects are pre-rated based on their classification, i.e. surface damage reinforcement visible is automatically assigned a value of 4 out of 5, with 5 being the most severe. In almost all instances, the 4 or 5 QSR ratings are driven by reinforcement visible or reinforcement projecting. These defects were further assessed by Kleinfelder though detailed CCTV review to which are technically accurate but not concerning and are artificially inflated, as confirmed on a case-by-case basis determined though detailed CCTV review. **Appendix D** depicts a thorough pipe by pipe summary of defects based on Kleinfelder's CCTV video review which are to be considered when understanding the severity and implications of defects portrayed in **Figures 5 and 6**.

Legend

Phase 1 SSES

- Downtown Sewer Inspection Area
- Interceptor Sewer Inspection
- Pipe Inaccessible
- Siphon Pipe
- Gravity Sewer Pipe

DRACUT

TEWKSBURY

Interceptor 1
4,027 LF

Interceptor 2
6,201 LF

Interceptor 3
11,255 LF

Interceptor 4
4,410 LF

Interceptor 5
10,157 LF

Interceptor 6
15,996 LF

Interceptor 6
Barasford Section

Interceptor 7
4,296 LF

0 2,000 4,000
Feet

N

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Phase 1 SSES Report
Interceptor Pipelines and Downtown Area Keyplan

Lowell Regional Wastewater Utility
451 First Street Blvd.
Lowell, MA 01850

FIGURE
4

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Table 2: Interceptor Quick Maintenance Rating (QMR) Defect Summary

NASSCO PACP Defect Type	Interceptor Operation and Maintenance Defect Quantity						
	Interceptor 1	Interceptor 2	Interceptor 3	Interceptor 4	Interceptor 5	Interceptor 6	Interceptor 7
Deposits Attached Encrustation (DAE)	35	6	12	57	129	115	9
Deposits Attached Ragging (DAR)	5	7	7	17	10	65	15
Deposits Attached Grease (DAGS)	0	8	13	3	0	11	0
Deposits Attached Other (DAZ)	0	0	0	4	0	0	0
Roots Fine Joint (RFJ)	6	13	9	0	1	15	20
Roots Fine Barrel (RFB)	0	11	0	0	8	0	2
Roots Fine Connection (RFC)	0	0	0	2	2	0	0
Roots Medium Joint (RMJ)	0	2	0	0	0	4	4
Roots Medium Barrel (RMB)	0	0	0	0	1	0	0
Roots Ball Joint (RBJ)	0	9	0	0	0	0	1
Infiltration Stain Barrel (ISB)	0	0	0	0	2	15	0
Infiltration Dripper Barrel (IDB)	0	1	0	16	33	18	0
Infiltration Runner Barrel (IRB)	0	0	0	1	5	2	0
Infiltration Dripper Joint (IDJ)	12	2	2	2	0	47	0
Infiltration Runner Joint (IRJ)	2	2	2	0	0	21	0
Infiltration Stain Joint (ISJ)	12	8	34	0	0	27	12
Infiltration Gusher Barrel (IGB)	0	0	0	1	0	2	0
Infiltration Gusher Joint (IGJ)	0	0	0	0	0	9	0
Infiltration Weeper Barrel (IWB)	0	5	2	56	162	37	1
Infiltration Weeper Joint (IWJ)	22	8	53	2	4	74	2
Infiltration Weeper Connection (IWC)	0	0	0	0	0	1	0
Obstruction Built Into Structure (OBS)	0	0	0	0	0	2	0
Obstruction External Pipe or Cable (OBP)	0	0	0	1	0	0	0
Vermin Cockroach (VC)	0	0	2	0	0	1	0
O&M Total Defects	**94**	**82**	**136**	**162**	**357**	**466**	**66**
Length of Pipe Inspected (LF)	**4,027**	**6,201**	**11,255**	**4,410**	**10,157**	**15,996**	**4,296**

Note: Interceptor 6 includes the Main and Barasford Sections.

Table 3: Interceptor Quick Structural Rating (QSR) Defect Summary

NASSCO PACP Defect Type	Interceptor Structural Defect Quantity						
	Interceptor 1	Interceptor 2	Interceptor 3	Interceptor 4	Interceptor 5	Interceptor 6	Interceptor 7
Crack Circumferential (CC)	3	3	20	0	0	11	4
Crack Longitudinal (CL)	7	5	3	3	0	57	8
Crack Multiple (CM)	2	4	5	1	0	25	4
Crack Spiral (CS)	1	1	0	1	0	2	0
Fracture Circumferential (FC)	0	0	0	0	0	1	4
Fracture Longitudinal (FL)	0	0	0	15	0	0	0
Fracture Multiple (FM)	0	0	0	0	0	0	3
Broken (B)	0	0	0	0	0	0	1
Joint Angular Medium (JAM)	0	0	0	0	1	0	0
Surface Damage Aggregate Visible (SAV)	28	28	20	4	2	53	14
Surface Damage Reinforcement Visible (SRV)	2	77	99	22	1	30	24
Surface Damage Roughness Increased (SRI)	0	14	44	9	2	32	40
Surface Damage Spalling of Coating (SSC)	28	30	64	13	0	77	54
Surface Damage Surface Spalling (SSS)	0	4	3	0	1	0	1
Surface Damage Corrosion (SCP)	0	4	0	0	0	0	0
Surface Damage Reinforcement Projecting (SRP)	0	0	0	0	1	2	0
Point Repair Patch (RPP)	0	0	0	1	0	0	1
Point Repair Liner (PRL)	0	0	0	0	2	0	0
Missing Brickwork (MB)	0	0	0	3	0	0	0
Displaced Brickwork (DB)	0	0	0	2	1	1	0
Missing Mortar Medium (MMM)	0	0	0	0	1	0	0
Structural Total Defects	**71**	**170**	**258**	**74**	**12**	**291**	**158**
Length of Pipe Inspected (LF)	**4,027**	**6,201**	**11,255**	**4,410**	**10,157**	**15,996**	**4,296**

Note: Interceptor 6 includes the Main and Barasford Sections.

Legend

- Gravity Sewer Pipe
- Siphon Pipe

QMR Pipe Rating

- 0 = No Maintenance Defect
- 1 = Fine Joint Roots, Infiltration Stain
- 2 = Minor Attached Deposit, Fine Barrel Roots, Infiltration Weeper
- 3 = Moderate Attached Deposit, Infiltration Dripper
- 4 = Substantial Attached Deposit, Medium Roots, Infiltration Runner
- 5 = Severe Attached Deposit, Infiltration Gusher
- Pipe DNE, Inaccessible, Etc.

DRACUT

TEWKSBURY

Interceptor 1

Interceptor 2

Interceptor 3

Interceptor 4

Interceptor 5

Interceptor 6

Interceptor 7

Notable Defect Summary

Interceptor 1 (4K LF) : DAE (35), IWJ (22)
Interceptor 2 (6K LF) : RFJ (13), RFB (11)
Interceptor 3 (11K LF): IWJ (53), ISJ (34)
Interceptor 4 (4K LF) : DAE (57), IWB (56)
Interceptor 5 (10K LF): DAE (129), IWB (162)
Interceptor 6 (16K LF): DAE (115), IWJ (74)
Interceptor 7 (4K LF) : RFJ (20), DAR (15)

0 2,000 4,000
Feet

N

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Phase 1 SSES Report
Interceptor Quick Maintenance Rating (QMR) Defect Map

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451 First Street Blvd.
Lowell, MA 01850

FIGURE
5

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Legend

- Gravity Sewer Pipe
- Siphon Pipe

QSR Pipe Rating

- 0 = No Structural Defect
- 1 = Crack Circumferential, Surface Damage Roughness Increased
- 2 = Surface Damage Aggregate Visible, Surface Damage Spalling of Coating
- 3 = Crack Multiple, Fracture Longitudinal
- 4 = Surface Damage Reinforcement Visible
- 5 = Surface Damage Reinforcement Projecting
- Pipe DNE, Inaccessible, Etc.

DRACUT

TEWKSBURY

Interceptor 1

Interceptor 2

Interceptor 3

Interceptor 4

Interceptor 5

Interceptor 6

Interceptor 7

Notable Defect Summary

Interceptor 1 (4K LF) : SAV (28), SSC (28)
Interceptor 2 (6K LF) : SRV (77), SSC (30)
Interceptor 3 (11K LF): SRV (99), SSC (64)
Interceptor 4 (4K LF) : SRV (22), FL (15)
Interceptor 5 (10K LF): SAV (2), SRI (2)
Interceptor 6 (16K LF): SSC (77), CL (57)
Interceptor 7 (4K LF) : SSC (54), SRI (40)

0 2,000 4,000
Feet

N

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Phase 1 SSES Report
Interceptor Quick Structural Rating (QSR) Defect Map

Lowell Regional Wastewater Utility
451 First Street Blvd.
Lowell, MA 01850

FIGURE
6

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Legend

- Gravity Sewer Pipe
- Siphon Pipe
- Pipe DNE, Inaccessible, Etc.

Debris (CU FT)

- 0 - 110
- 110.1 - 379
- 379.1 - 1248
- 1248.1 - 2678
- 2678.1 - 5294

DRACUT

TEWKSBURY

INTERCEPTOR 3:
96" DIA.
14,000 CU FT

SMH-007878-SMH-007879 REMOVE TWO INSTANCES OF ROOTS

SMH-002488-SMH-002480
SMH-002481-SMH-002513
SMH-002507-SMH-002508
SMH-002512-SMH-003242
REMOVE ROOTS

INTERCEPTOR 6:
120" DIA.
5,400 CU FT TOTAL

SMH-002077 REMOVE ROOTS

0 2,000 4,000
Feet

N

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Phase 1 SSES Report
Interceptor Debris Accumulation and Root Locations

Lowell Regional Wastewater Utility
451 First Street Blvd.
Lowell, MA 01850

FIGURE
7

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3.1.1 Interceptor Pipelines Inspection Findings

Interceptor 1

Interceptor 1 is comprised of approximately 4,027 linear feet of 48-inch reinforced concrete pipe (RCP) along the southern boundary of the Merrimack River, terminating at the Walker Siphon. The majority of maintenance defects in this section were deposit attached encrustation (DAE), which are evidence of infiltration, as well as infiltration weepers at joints (IWJ). Most structural defects were surface damage aggregate visible (SAV) and surface damage spalling of coating (SSC). The aforementioned defects were observed throughout the pipeline rather than in targeted instances. Although these defects indicate the initial signs of pipe deterioration, they do not appear to be severe in nature at this time. **Photographs 1 and 2** below show representative defects of typical observations for this interceptor section.

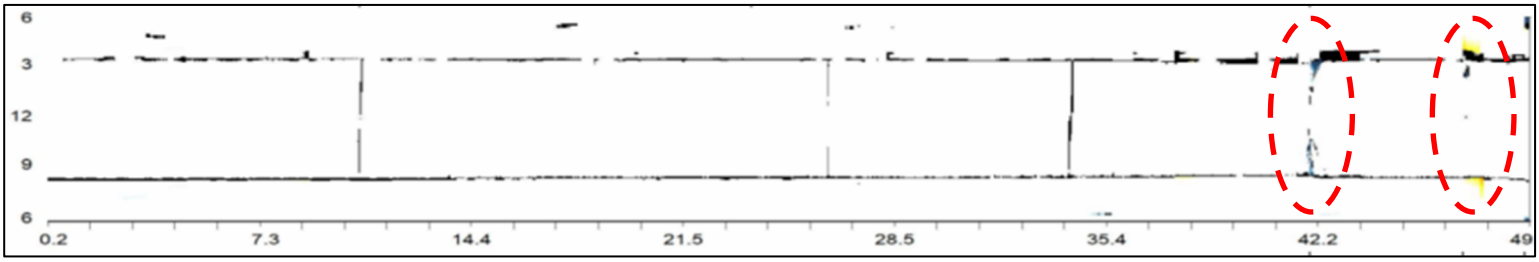
Photograph 1: Interceptor 1 48-inch RCP Pipe Infiltration Runner at Joint with Encrustation

Photograph 2: Interceptor 1 48-inch RCP Pipe Minor Surface Damage Aggregate Visible

Interceptor 2

Interceptor 2 is comprised of approximately 6,201 linear feet of 36-inch, 84-inch, and 96-inch RCP along the northern boundary of the Merrimack River, between the Walker Siphon and the Beaver Brook Siphon. The majority of maintenance defects in this section were roots fine at joints (RFJ) and roots fine at barrel (RFB). Most structural defects were surface damage reinforcement visible (SRV) and surface damage spalling of coating (SSC). The aforementioned defects were observed throughout the pipeline rather than in targeted instances. Although these defects indicate the initial signs of pipe deterioration, they do not appear to be severe in nature at this time. An example from the MSI reports is shown below depicting root intrusion (depicted in blue) and surface damage (depicted in yellow). **Photographs 3 and 4** below show representative defects of typical observations for this interceptor section.

Example from MSI Report (SMH-007874-SMH-007873)



Photograph 3: Interceptor 2 36-inch RCP Pipe Medium Root Intrusion at Joint

Photograph 4: Interceptor 2 85-inch RCP Pipe Minor Surface Damage Reinforcement Visible

Interceptor 3

Interceptor 3 is comprised of approximately 11,255 linear feet of 42-inch and 96-inch RCP along the northern boundary of the Merrimack River, spanning from the Beaver Brook Siphon to the Duck Island Wastewater Treatment Facility (DIWWTF). The majority of maintenance defects in this section were infiltration weepers at joints (IWJ) and infiltration stains at joints (ISJ). Most structural defects were surface damage reinforcement visible (SRV) and surface damage spalling of coating (SSC). The aforementioned defects were observed throughout the pipeline rather than in targeted instances. Although these defects indicate the initial signs of pipe deterioration, they do not appear to be severe in nature at this time. As indicated from the MSI data, there is a substantial quantity (estimated at 14,000 cubic feet) of debris accumulated in the 96-inch upstream reach of this section. **Photographs 5 and 6** below show representative defects of typical observations for this interceptor section.

Photograph 5: Interceptor 3 96-inch RCP Pipe Minor Surface Damage Reinforcement Visible

Photograph 6: Interceptor 3 96-inch RCP Pipe Infiltration at Joint

Interceptor 4

Interceptor 4 is comprised of approximately 4,410 linear feet of 52x35-inch and 32x47-inch brick pipe with an approximately 520-ft section of 48-inch RCP. Its alignment abuts the Pawtucket Canal for a portion and is largely located within Jackson Street and terminates at the Warren Siphon. The majority of maintenance defects in this section were deposits attached encrustation (DAE) and infiltration weepers at barrel (IWB) which were both observed throughout the pipeline. Limited structural defects were surface damage reinforcement visible (SRV) of the small section of RCP in this pipeline and missing bricks and fracture longitudinal (FL) in the brick section. Intersection 4 is subject to higher traffic loadings than other sections which is likely a contributing factor to the structural defects of concern. **Photographs 7 and 8** below show representative defects of typical infiltration observations and an instance of missing brick, respectively, for this interceptor section.

Photograph 7: Interceptor 4 53x35-inch Brick Pipe Barrel Infiltration and Encrustation

Photograph 8: Interceptor 4 52x35-inch Brick Pipe Missing Brick

Interceptor 5

Interceptor 5 is comprised of approximately 10,157 linear feet of 72-inch and 84-inch brick pipe spanning along the Concord River and terminating at the Warren Siphon. The upstream reach of the interceptor crosses both the Lowell Connector and River Meadow Brook. The majority of maintenance defects in this section were deposits attached encrustation (DAE) and infiltration weeper at barrel (IWB). Most structural defects were surface damage aggregate visible (SAV) and surface damage roughness increased (SRI). Although these defects indicate the initial signs of pipe deterioration, they do not appear to be severe in nature at this time. **Photographs 9 and 10** below show representative defects of typical observations for this interceptor section.

Photograph 9: Interceptor 5 74-inch Brick Pipe Barrel Infiltration Runner

Photograph 10: Interceptor 5 69x46-inch Brick Pipe Barrel Infiltration Weeper

Interceptor 6

Interceptor 6 is comprised of two sections, Main and Barasford, and is approximately 15,966 linear feet of 42-inch, 48-inch, 60-inch, 72-inch, 84-inch, 96-inch, and 120-inch RCP. The Barasford Section is largely 42-inch and 48-inch RCP with an approximately 2,600-ft section downstream of 48-inch and 60-inch brick pipe that terminates at the Merrimack Siphon. The Main interceptor ranges from 72-inch to 120-inch RCP and abuts the Concord River and southern boundary of the Merrimack River. The majority of maintenance defects in the upstream portion of the Main section west of the Merrimack Siphon, and along the Barasford section were deposits attached encrustation (DAE) and infiltration weeper at joint (IWJ). Most structural defects were surface damage spalling of coating (SSC) and crack longitudinal (CL). The priority defects for the Main Section are infiltration defects in the upstream section west of the Merrimack Siphon. The priority defects for the Barasford Section are infiltration defects throughout the pipeline as well as moderate localized surface damage. As indicated from the MSI data, there is a moderate quantity (estimated at 5,400 cubic feet) of debris accumulated in the 120-inch main

interceptor reach of this section. **Photographs 11 and 12** below show representative defects of typical infiltration observations and an instance of moderate surface damage reinforcement visible, respectively, for this interceptor section.

Photograph 11: Interceptor 6 Barasford 48-inch RCP Infiltration Runner/Gushers at Joint

Photograph 12: Interceptor 6 Barasford 48-inch RCP Moderate Surface Damage Reinforcement Visible

Interceptor 7

Interceptor 7 is comprised of approximately 4,269 linear feet of 36-inch, 72-inch, and 84-inch RCP along the Lowell Riverwalk abutting the southern boundary of the Merrimack River. The majority of maintenance defects in this section were roots fine at joints (RFJ) and deposits attached ragging (DAR). Most structural defects were surface damage spalling of coating (SSC) and surface damage roughness increased (SRI). The primary defects in Interceptor 7 are several medium roots and structural defects (fractures, one instance of broken pipe) in the downstream 780-ft section of the interceptor. **Photographs 13 and 14** below show notable defects for this interceptor section.

Photograph 13: Interceptor 7 36-inch RCP Multiple Fractures

Photograph 14: Interceptor 7 36-inch RCP Medium Root at Joint

3.1.2 Interceptor Manhole Inspections

A total of 225 manholes were identified for inspection along Interceptors 1 through 7. The original scope of the interceptor inspections for pipe and manholes was increased to take advantage of the mobilized contractor for economy of scale savings. From the increase in scope, some of the added manhole inspection scope was allocated to EST Associates, Inc. (EST). Between RedZone and EST, the interceptor manholes associated with the pipelines inspected were all included in the scope. Manhole inspections were conducted in accordance with NASSCO's manhole assessment certification program (MACP). Manhole recommendations are included in Section 4.

From April 17, 2024 to April 23, 2024, RedZone completed 146 top-side manhole inspections (out of a scope of 165) along Interceptors 1 through 7, excluding portions of Interceptor 6 Barasford and the upstream portion of Interceptor 5. Approximately 11 manholes in the most upstream section of Interceptor 2 are located within the Merrimack River or its bank, therefore inspections were strategically timed for low River levels. Although inspection was complete for most of these manholes, their assessment was completed in low River level conditions, see **Photograph 21**. **Appendix F** provides a compilation of RedZone's SMH inspection reports. From July 9, 2024 through September 9, 2024, EST completed 51 top-side manhole inspections (out of a scope of 60) along Interceptor 6 Barasford and the upstream portion of Interceptor 5. **Appendix G** provides a compilation of EST's SMH inspection reports. 28 manholes weren't inspected due to inability to locate or inability to open.

Photograph 21: Pill Box Manhole, Interceptor 2

In general, the interceptor manholes were structurally in fair condition. Manholes along Interceptors 1, 2, 3, 6 (Main Section), and 7 were mostly in fair condition with a few manholes with heavy debris and in need of cleaning. Manholes along Interceptors 4, 5, and 6 (Barasford Section) exhibited signs of infiltration, consistent with observed infiltration identified in the associated pipeline inspections of Interceptors 4, 5, and 6 (Barasford Section).

3.1.3 Interceptor Findings Summary

In general, the reinforced concrete sections of the interceptors (interceptors 1, 2, 3, part of 6, 7) were in fair structural condition. Interceptor 7 has fractures in an isolated downstream section of the pipeline near lower Tilden CSO Area. Interceptors 3 and Interceptor 6 along the Merrimack River both have heavy debris, reducing pipe capacity. Interceptor 1, 3, and the 42/48-inch upstream Barasford section of Interceptor 6 consistently had infiltration defects at joints.

In general, the brick interceptors (interceptors 4 and 5) showed evidence of barrel infiltration and encrustation. The brick interceptors also exhibited a few structural defects such as longitudinal fractures and missing bricks. Interceptor 4 showed consistent infiltration throughout the pipeline whereas in Interceptor 5, the infiltration observed was limited to two localized areas of pipe along the Concord River and one upstream cross-country pipe segment.

Infiltration rates were estimated for each defect observed and are summarized by interceptor in **Table 4** below. The total estimate of interceptor infiltration (both pipe and manhole) is 72.6 gallons per minute (gpm) (0.1 million gallons per day). Interceptor 6 pipes were notably the largest contributor with a total of 40 gpm (57,600 gallons per day).

Groundwater gauges were in place during the interceptor inspection period in support of the metering efforts of the Supplemental I/I Report, mentioned in Section 2. In general, the groundwater levels were significantly lower than the groundwater levels previously observed in 2023 in support of the City-wide Flow Metering Program and summarized in the 2023 I/I Analysis Report. Therefore, the infiltration estimates provided below may underestimate the infiltration contributions from the interceptors that contributed to the infiltration quantities reported in 2023 I/I Analysis Report. Infiltration from these interceptors may contribute much more extraneous flow during period of higher groundwater than what is estimated in **Table 4** below.

Table 4: Interceptor Estimate Infiltration Summary

Location	Asset Type	Contractor	Infiltration Estimated Pipe (GPM)	Infiltration Estimated Manhole (GPM)	Total Estimate Infiltration (GPM)
Interceptor 1	Pipe	RedZone	2.2	-	2.2
Interceptor 2	Pipe	RedZone	1.3	-	1.3
Interceptor 3	Pipe	RedZone	1.2	-	1.2
Interceptor 4	Pipe	RedZone	4.3	-	4.3
Interceptor 5	Pipe	RedZone	5.8	-	5.8
Interceptor 6	Pipe	RedZone	40.0	-	40.0
Interceptor 7	Pipe	RedZone	0.0	-	0.0
Interceptor	Manhole	RedZone	-	0.0	0.0
Interceptor	Manhole	EST	-	17.8	17.8
		Total:	54.8	17.8	72.6

Note: Interceptor Manholes inspected by EST were along the upstream portion of Interceptor 5 and Interceptor 6 Barasford Section.

3.2 DOWNTOWN AREA INSPECTIONS

Between May 6, 2024 and June 3, 2024, National Water Main Cleaning Company (NWMCC) conducted approximately 21,300 linear feet of cleaning and CCTV inspections (in accordance with NASSCO PACP standards) of some of the Utility's oldest infrastructure in the Downtown Area of the City in Meter Areas 51, 38, and 37. The goal of the 2024 inspections was to effectively inspected all sewer collection pipes in the Downtown Area (Meter Areas 51, 38, 37) when paired with the prior 2023 Downtown Area I/I Investigations discussed in Section 2. **Figure 8** depicts the respective scope for each year. Approximately 4,000 linear feet of the pipelines and associated manholes in were not inspected due to inaccessible manholes or manholes unable to be located or opened. **Appendix E** provides a compilation of NWMCC's PACP inspection reports.

Figures 9 and 10 show the QMR and QSR defect scoring, respectively, of the Downtown area from both 2023 and the 2024 field programs. Notable maintenance defects included infiltration runner in Dutton Street, a large root ball removed in George Street, and heavy cleaning of Lewis Street. Notable structural defects identified include a large joint offset on Hanover Street, collapsed pipe on Hall Street, and severe hinge fractures in Church Street. These defects are presented in **Photographs 15 through 20.**

Additional maintenance defects were infiltration defects on Perkins Street, Cabot Street, and Market Street. As well as moderate structural defects such as broken soil visible, multiple fractures, and joint separated medium in Fairmount Street, Fairview Ave, Talbot Street, and Mansur Street Area.

Figure 11 depicts the level of cleaning of the Downtown area from both the 2023 and 2024 field programs. Areas noted with medium to heavy cleaning may be used as indicators to prioritize cleaning of these individual pipelines in the Utility's on-call collection system cleaning and CCTV program.

DRACUT

Legend

- Gravity Sewer Pipe
- Siphon Pipe
- 2023 CCTV Scope
- 2024 CCTV Scope

0 1,000 2,000

Feet

N

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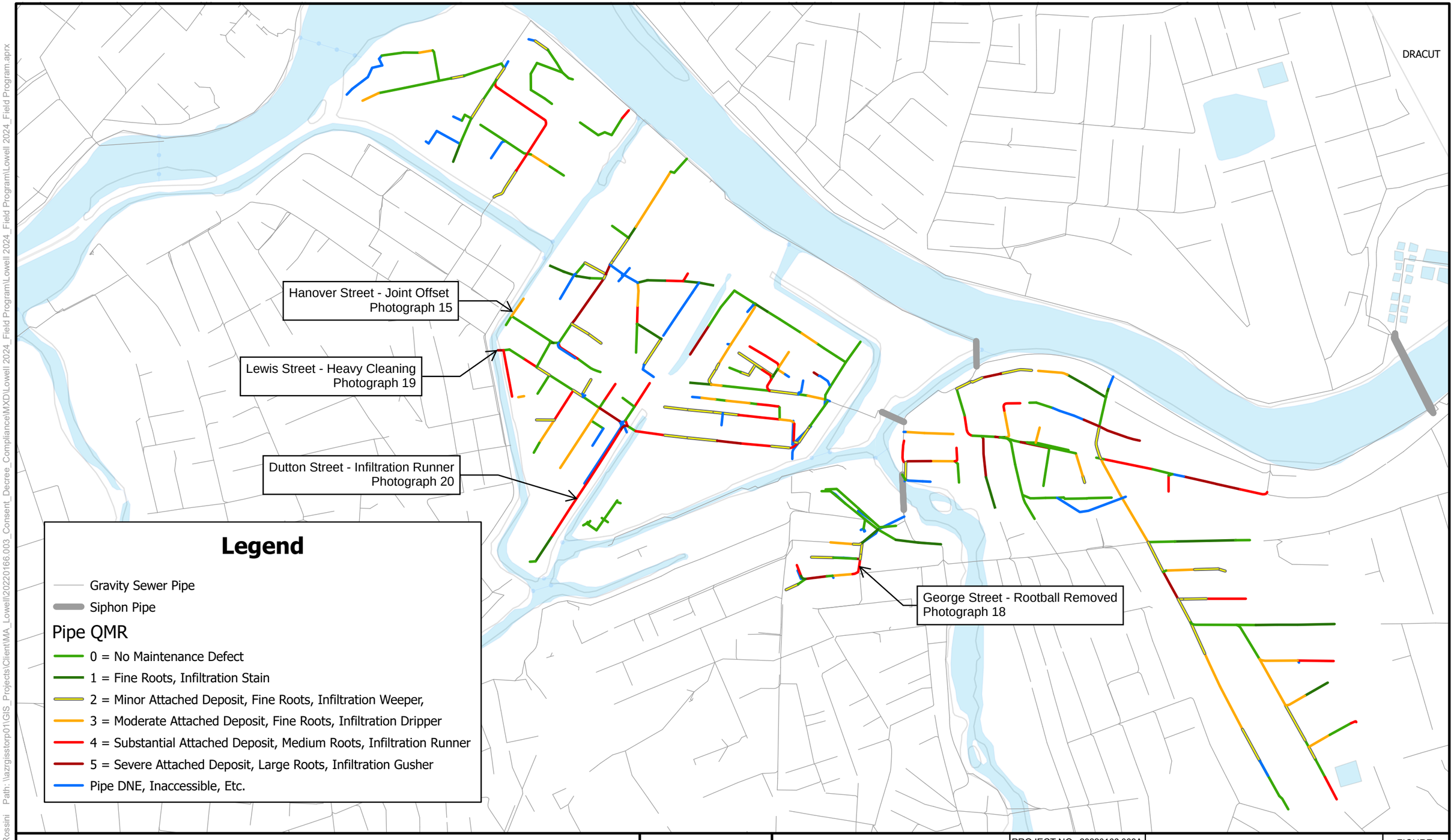
Phase 1 SSES Report
2023/2024 Downtown Area Scope Keyplan

Lowell Regional Wastewater Utility
451 First Street Blvd.
Lowell, MA 01850

FIGURE
8



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Phase 1 SSES Report
2023/2024 Downtown Pipe QMR Defect Map

Lowell Regional Wastewater Utility
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FIGURE
9

Date: 7/8/2024 User: JRossini Path: \\azrgisstorp01\GIS_Projects\Client\MA_Lowell\20220166.003_Consent_Decree_Compliance\MXD\Lowell 2024_Field Program\Lowell 2024_Field Program.aprx

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Hall Street - Pipe Collapse
Photograph 16

Church Street - Severe Hinge Fracture
Photograph 17

Legend

- Gravity Sewer Pipe
- Siphon Pipe

Pipe QSR

- 0 = No Structural Defect
- 2 = Minor Fracture, Crack
- 3 = Moderate Fracture, Large Missing Mortar
- 4 = Substantial Fracture, Large Offset
- 5 = Collapse, Broken, Severe Fracture
- Pipe DNE, Inaccessible, Etc.

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Phase 1 SSES Report
2023/2024 Downtown Pipe QSR Defect Map

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FIGURE
10

DRACUT

Legend

- Gravity Sewer Pipe
- Siphon Pipe

Degree of Cleaning

- Heavy
- Hourly
- Medium
- Light
- Pipe DNE, Inaccessible, Etc.

0 1,000 2,000

Feet

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Phase 1 SSES Report
2023/2024 Downtown Pipe Degree of Cleaning Map

Lowell Regional Wastewater Utility
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FIGURE
11

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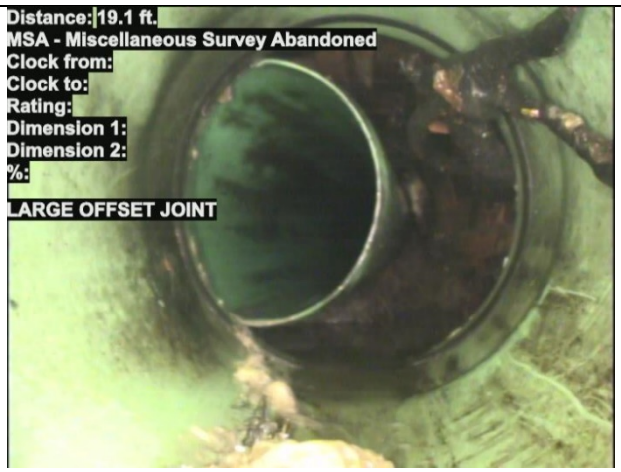
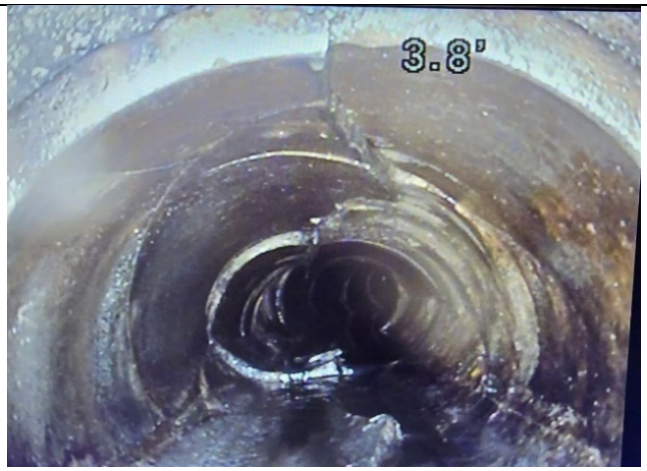
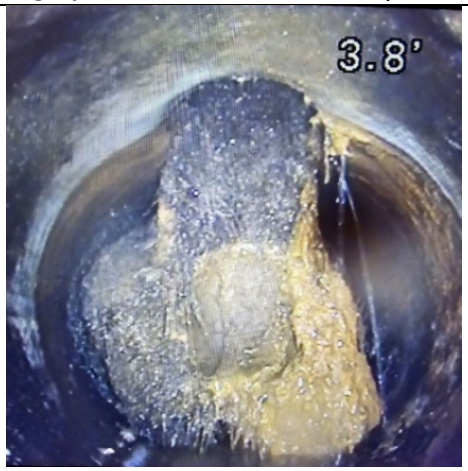


Photograph 15: Hanover Street – Joint Offset Large

Photograph 16: Hall Street – Collapsed Pipe



Photograph 17: Church Street – Severe Hinge Fracture



Photograph 18: George Street – Rootball Removed

Photograph 19: Lewis Street – Heavy Cleaning

Photograph 20: Dutton Street – Infiltration Runner

Infiltration rates for pipes and manholes were estimated for each defect observed and are summarized by the asset and year the inspections were performed in **Table 5**. As noted in Section 3.1.3, the groundwater levels were significantly lower in 2024 than the groundwater levels previously observed in 2023 in general. Therefore, infiltration estimates observed during 2024 inspections may underestimate the infiltration contributions from the Downtown area pipes and manholes, as quantified through the 2023 I/I Analysis. These pipelines and manholes inspected in 2024 may contribute more extraneous flow during period of higher groundwater than what is estimated in **Table 5** below. The total estimate of Downtown infiltration (both pipe and manhole) is 29.5 gpm or 0.04 mgd.

Table 5: Downtown Area Estimate Infiltration Summary

Asset Type	Contractor	Year	Infiltration Estimated Pipe (GPM)	Infiltration Estimated Manhole (GPM)	Total Estimate Infiltration (GPM)
Pipe	NWMCC	2023	6.5	-	6.5
Pipe	NWMCC	2024	11.3	-	11.3
Manhole	EST	2023	-	11.3	11.3
Manhole	EST	2024	-	0.3	0.3
		Total:	**17.8**	**11.7**	**29.5**

3.2.1 Downtown Area Manhole Inspections

From July 9, 2024 through September 9, 2024, EST completed 86 top-side manhole inspections (out of a scope of 110) within the downtown meter areas in accordance with NASSCO's MACP. **Appendix G** provides a compilation of EST's SMH inspection reports. The downtown area manholes were overall in fair structural condition with several instances of infiltration, typically coming from the wall or bench components. Manhole recommendations are included in Section 4.

4 RECOMMENDATIONS

This Section presents the sewer pipe and manhole rehabilitation and repair recommendations for the Interceptors and Downtown Area.

4.1 INTERCEPTOR RECOMMENDATIONS

Kleinfelder recommends primary, secondary and monitor projects for the interceptor pipelines. Primary projects were identified out of the substantial quantity of infiltration defects as well structural defects and are recommended to be addressed in 2 to 5 years. Secondary projects were identified as having infiltration contributions in need of mitigation but are in fair structural condition. Secondary projects will be evaluated for construction in future phases. Monitor projects have defects that are recommended to be re-inspected in 5-10 years to monitor their occurrence and severity. The substantial costs associated for rehabilitation or repair of the critical interceptor pipelines should be considered for long-term future planning. Additionally, Kleinfelder recommends cleaning and debris removal of identified sections within Interceptor 3 and 6 as well as removal of observed medium roots.

Figure 12 displays the primary, secondary, and monitor projects based on evaluation of the observed pipe conditions as well as the sections of debris and root removal. Preliminary rehabilitation recommendations are provided for each primary, secondary, and monitor project for the purposes of developing planning-level cost estimates. Preliminary recommendations of cured-in-place pipelining (CIPP) were included for Interceptors 2, 4, 5, and 6 in specific locations where either infiltration or structural issues were present. In addition to bypass of sewer flows, CIPP lining may require dewatering wells for groundwater management in instances where the pipe rehabilitation cause is from infiltration defects. Grouting of joints is recommended for concrete pipe in favorable structural condition where infiltration is present, such as in Interceptors 1 and 3 Secondary Projects. As the portion of Interceptor 6 along the Merrimack River, between the Concord River Siphon and Merrimack River Siphon, is 120-inch in diameter, spray lining is noted as a potential rehabilitation method for the Interceptor 6 Monitor Project. Kleinfelder recommends conducting an alternatives analysis during design to effectively determine the optimal approach of trenchless rehabilitation of the interceptor pipes.

Figure 13 shows the 2024 manhole recommendations for both the interceptor and Downtown area where inspections were performed. **Figure 13** depicts recommendations for the 197 interceptor

manholes inspected. Manhole recommendations include cementitious lining, replace cover, and cleaning for 42 manholes along the interceptors. Rehabilitation is recommended for these manholes to primarily address active infiltration and are in alignment with pipes identified for rehabilitation in Interceptors 4, 5, and 6. The rehabilitation of these manholes are included in the associated interceptor pipeline rehabilitation priority level recommendations and costs. It is recommended that the Utility address manholes noted for cleaning as part of their collection system on-call cleaning and lining maintenance contract. Additionally, the City should confirm the watertight covers of the 11 manholes susceptible to submersion along Interceptor 2 to prevent inflow.

Legend

- Siphon Pipe
- Gravity Sewer Pipe

Pipe Material

- Brick
- Concrete

MONITOR
INTERCEPTOR 2:
84" CIPP LINE 2300 LF

REMOVE ROOTS

INTERCEPTOR 3 DEBRIS REMOVAL SHARES THE SAME EXTENTS NOTED AS THIS PROJECT

SECONDARY PRIORITY INTERCEPTOR 3:
96" GROUT 25 JOINTS

SECONDARY PRIORITY INTERCEPTOR 3:
96" GROUT 40 JOINTS

REMOVE ROOTS

SECONDARY PRIORITY INTERCEPTOR 7:
36" CIPP LINE 780 LF

PRIMARY PRIORITY INTERCEPTOR 4:
52x35" CIPP LINE 2600 LF
48" CIPP LINE 200 LF

INTERCEPTOR 6 DEBRIS REMOVAL

MONITOR
INTERCEPTOR 6:
120" SPRAY LINE 4100 LF

SECONDARY PRIORITY INTERCEPTOR 5:
90" CIPP LINE 650 LF
84" CIPP LINE 400 LF

SECONDARY PRIORITY INTERCEPTOR 5:
84" CIPP LINE 650 LF

PRIMARY PRIORITY INTERCEPTOR 6:
42" CIPP LINE 450 LF
48" CIPP LINE 1700 LF

SECONDARY PRIORITY INTERCEPTOR 1:
48" GROUT 40 JOINTS

SECONDARY PRIORITY INTERCEPTOR 5:
84" CIPP LINE 800 LF

REMOVE ROOTS

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0 2,000 4,000
Feet

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Phase 1 SSES Report
Interceptor Recommendations

Lowell Regional Wastewater Utility
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FIGURE
12

Legend

- Siphon Pipe
- Gravity Sewer Pipe

SMH Recommendation

- Cement Line (59)
- Replace Cover (1)
- Clean (4)
- Clean - Bags (1)
- Clean - Roots (1)
- Investigate - Surcharged (2)
- None (206)
- Not Inspected (61)

This portion of Interceptor 2 manholes are located within the river or its banks. Therefore, they are affected by river stages and likely susceptible to submersion.

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Phase 1 SSES Report
2024 Manhole Recommendations

Lowell Regional Wastewater Utility
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FIGURE
13

4.2 DOWNTOWN AREA RECOMMENDATIONS

The Downtown Area recommendations are presented as primary and secondary priority projects based on the severity of defects observed. The manholes not spatially located on primary pipelines were grouped into the secondary project costs as lower priority. The recommendations from the 2023 and 2024 field programs include 1,400 linear feet of pipe replacement, 18,700 linear feet of pipe rehabilitation, and rehabilitation of 61 manholes. The pipes slated for rehabilitation are assumed to be CIPP with a token amount of assumed spot repairs. Further design will be needed to verify the proposed rehabilitation method and what additional work is required to facilitate the rehabilitation technique based on the existing defects. **Figure 14** shows repair/rehabilitation recommendations for the Downtown Area sewer pipe and manholes.

4.3 COST ESTIMATES

The primary projects for Interceptor 4 ($2.7M) and Interceptor 6 ($2.2M) project costs are presented in **Tables 6 and 7**, respectively. The various secondary projects and monitor projects costs are presented in **Table 8**. The total interceptor projects comprehensive costs are presented in **Table 9**. Construction costs for the Interceptor Secondary Priority and Monitor Projects are estimated to total over $40 million (including engineering services). The general approach for trenchless rehabilitation is CIPP, assuming a small percentage of heavy cleaning required, as well as manhole cementitious lining with chimney seals. As such, the costs are subject to change during design phase if alternative trenchless rehabilitation methods are pursued. Total project costs include a 25% contingency applied to the construction subtotals and an additional 25% for engineering.

The Utility is focused on sewer separation as outlined in their Consent Decree but see the value-add in incorporating interceptor rehabilitation projects into ongoing collection system projects where funding allows. Interceptor 4 recommendations will be added to the Phase 3 Sewer Separation Project, anticipated to be constructed by 2032 per the Utility's *Phase 3 Candidate Area Sewer Separation Preliminary Design Report* (December 2024). The Phase 3 Sewer Separation Project includes work within the Grand, Lower Saunders, and Peavy catchment areas. The upstream limit of the Interceptor 4 rehabilitation is located on Middlesex Street within the Grand catchment area.

The Downtown primary ($3.1M), secondary ($3.8M), and total ($7.1M) construction costs are presented in **Tables 10, 11, and 12** respectively. Total project costs include a 25% contingency applied to the construction subtotals and an additional 25% for engineering.

Table 6: Interceptor 4 Project Cost Estimate

Item No.	Item Desc.	QTY	UNIT	UNIT COST	COST
1	Mobilization/Demobilization (5% of All Other Items)	1	LS	$ 83,240	$ 83,240
2	52X35" NON-CIRCULAR CIPP LINING (WITH PRE-LINER)	2600	LF	$ 480	$ 1,248,000
3	48" CIPP LINING (WITH PRE-LINER)	200	LF	$ 500	$ 100,000
4	HEAVY CLEANING VARIOUS DIAMETER	280	LF	$ 125	$ 35,000
5	MANHOLE CEMENT LINING	60	VF	$ 450	$ 27,000
6	MANHOLE CHIMNEY SEAL	4	EA	$ 1,200	$ 4,800
7	BYPASS FLOW HANDLING	1	LS	$ 200,000	$ 200,000
8	TRAFFIC MANAGEMENT	1	LS	$ 50,000	$ 50,000
				Construction Subtotal	$ 1,748,040
				Contingency (25%)	$ 437,010
				Engineering (25%)	$ 546,263
				Total Cost	$ 2,731,313

Table 7: Interceptor 6 Project Cost Estimate

Item No.	Item Desc.	QTY	UNIT	UNIT COST	COST
1	Mobilization/Demobilization (5% of All Other Items)	1	LS	$ 67,091	$ 67,091
2	42" CIPP LINING (WITH PRE-LINER)	450	LF	$ 450	$ 202,500
3	48" CIPP LINING (WITH PRE-LINER)	1700	LF	$ 500	$ 850,000
4	HEAVY CLEANING VARIOUS DIAMETER	215	LF	$ 125	$ 26,875
5	MANHOLE CEMENT LINING	165	VF	$ 450	$ 74,250
6	MANHOLE CHIMNEY SEAL	11	EA	$ 1,200	$ 13,200
7	BYPASS FLOW HANDLING	1	LS	$ 150,000	$ 150,000
8	TRAFFIC MANAGEMENT	1	LS	$ 25,000	$ 25,000
				Construction Subtotal	$ 1,408,916
				Contingency (25%)	$ 352,229
				Engineering (25%)	$ 440,286
				Total Cost	$ 2,201,432

Table 8: Interceptor Secondary and Monitor Projects Cost Estimate

Item No.	Interceptor	Item Desc.	QTY	UNIT	UNIT COST	COST
1	N/A	Mobilization/Demobilization (5% of All Other Items)	1	LS	$ 1,247,239	$ 1,247,239
2	1	48" GROUTING JOINTS	40	EA	$ 1,000	$ 40,000
3	3	96" GROUTING JOINTS	65	EA	$ 2,800	$ 182,000
4	7	36" CIPP LINING	780	LF	$ 375	$ 292,500
5	2	84" CIPP LINING	2300	LF	$ 2,100	$ 4,830,000
6	5	84" CIPP LINING	1850	LF	$ 2,100	$ 3,885,000
7	5	90" CIPP LINING	650	LF	$ 2,100	$ 1,365,000
8	6	120" SPRAY LINING	4100	LF	$ 3,000	$12,300,000
9	N/A	HEAVY CLEANING VARIOUS DIAMETER	475	LF	$ 125	$ 59,375
10	N/A	MANHOLE CEMENT LINING	405	VF	$ 450	$ 182,250
11	N/A	MANHOLE CHIMNEY SEAL	27	EA	$ 1,200	$ 32,400
12	3	96" DIA. HEAVY CLEANING (FOR MAINTENANCE)	3450	LF	$ 125	$ 431,250
13	6	120" DIA. HEAVY CLEANING (FOR MAINTENANCE)	4100	LF	$ 200	$ 820,000
14	N/A	BYPASS FLOW HANDLING	1	LS	$ 500,000	$ 500,000
15	N/A	TRAFFIC MANAGEMENT	1	LS	$ 25,000	$ 25,000
					Construction Subtotal	$26,167,014
					Contingency (25%)	$ 6,541,753
					Engineering (25%)	$ 8,177,192
					Total Cost	$40,885,959

Table 9: Total Interceptor Projects Cost Estimate

Item No.	Interceptor	Item Desc.	QTY	UNIT	UNIT COST	COST
1	N/A	Mobilization/Demobilization (5% of All Other Items)	1	LS	$1,386,776	$ 1,386,776
2	1	48" GROUTING JOINTS	40	EA	$ 1,000	$ 40,000
3	3	96" GROUTING JOINTS	65	EA	$ 2,800	$ 182,000
4	7	36" CIPP LINING	780	LF	$ 375	$ 292,500
5	4	52X35" NON-CIRCULAR CIPP LINING (WITH PRE-LINER)	2600	LF	$ 480	$ 1,248,000
6	6	42" CIPP LINING (WITH PRE-LINER)	450	LF	$ 450	$ 202,500
7	6	48" CIPP LINING (WITH PRE-LINER)	1700	LF	$ 500	$ 850,000
8	2	84" CIPP LINING	2300	LF	$ 2,100	$ 4,830,000
9	5	84" CIPP LINING	1850	LF	$ 2,100	$ 3,885,000
10	5	90" CIPP LINING	650	LF	$ 2,100	$ 1,365,000
11	6	120" SPRAY LINING	4100	LF	$ 3,000	$12,300,000
12	N/A	HEAVY CLEANING VARIOUS DIAMETER	1443	LF	$ 125	$ 180,375
13	N/A	MANHOLE CEMENT LINING	630	VF	$ 450	$ 283,500
14	N/A	MANHOLE CHIMNEY SEAL	42	EA	$ 1,200	$ 50,400
15	3	96" DIA. HEAVY CLEANING (FOR MAINTENANCE)	3450	LF	$ 125	$ 431,250
16	6	120" DIA. HEAVY CLEANING (FOR MAINTENANCE)	4100	LF	$ 200	$ 820,000
17	N/A	BYPASS FLOW HANDLING	1	LS	$ 700,000	$ 700,000
18	N/A	TRAFFIC MANAGEMENT	1	LS	$ 75,000	$ 75,000
					Construction Subtotal	$29,122,301
					Contingency (25%)	$ 7,280,575
					Engineering (25%)	$ 9,100,719
					Total Cost	$45,503,596

Table 10: Downtown Primary Project Cost Estimate

Description	Qty	Unit	Unit Cost	Total
Mob/Demob	1	LS	$ 95,400	$ 95,400
8-10" CIPP	0	LF	$ 40	$ -
12-15" CIPP	1200	LF	$ 80	$ 96,000
16-18" CIPP	0	LF	$ 90	$ -
20-24" CIPP	4400	LF	$ 175	$ 770,000
30-36" CIPP	0	LF	$ 300	$ -
42-48" CIPP	0	LF	$ 380	$ -
MH Cement Line	50	VF	$ 450	$ 22,500
MH Chimney Seal	5	EA	$ 1,200	$ 6,000
Spot Repairs	4	EA	$ 12,000	$ 48,000
10" PVC	300	LF	$ 600	$ 180,000
12" PVC	700	LF	$ 650	$ 455,000
15" PVC	400	LF	$ 700	$ 280,000
Traffic Management	1	LS	$ 50,000	$ 50,000
			Subtotal	***$ 2,002,900***
			Contingency (25%)	$ 500,700
			Engineering (25%)	$ 625,900
			TOTAL	**$ 3,129,500**

Table 11: Downtown Secondary Project Cost Estimate

Description	Qty	Unit	Unit Cost	Total
Mob/Demob	1	LS	$116,000	$ 116,000
8-10" CIPP	400	LF	$ 40	$ 16,000
12-15" CIPP	6700	LF	$ 80	$ 536,000
16-18" CIPP	3100	LF	$ 90	$ 279,000
20-24" CIPP	0	LF	$ 175	$ -
30-36" CIPP	1600	LF	$ 300	$ 480,000
42-48" CIPP	1400	LF	$ 380	$ 532,000
MH Cement Line	560	VF	$ 450	$ 252,000
MH Chimney Seal	56	EA	$ 1,200	$ 67,200
Spot Repairs	6	EA	$ 12,000	$ 72,000
10" PVC	0	LF	$ 600	$ -
12" PVC	0	LF	$ 650	$ -
15" PVC	50	LF	$ 700	$ 35,000
Traffic Management	1	LS	$ 50,000	$ 50,000
			Subtotal	***$ 2,435,200***
			Contingency (25%)	$ 608,800
			Engineering (25%)	$ 761,000
			TOTAL	**$ 3,805,000**

Table 12: Total Downtown Projects Cost Estimate

Description	Qty	Unit	Unit Cost	Total
Mob/Demob	1	LS	$217,100	$ 217,100
8-10" CIPP	400	LF	$ 40	$ 16,000
12-15" CIPP	6600	LF	$ 80	$ 528,000
16-18" CIPP	2000	LF	$ 90	$ 180,000
20-24" CIPP	6700	LF	$ 175	$ 1,172,500
30-36" CIPP	1600	LF	$ 300	$ 480,000
42-48" CIPP	1400	LF	$ 380	$ 532,000
MH Cement Line	610	VF	$ 450	$ 274,500
MH Chimney Seal	61	EA	$ 1,200	$ 73,200
Spot Repairs	10	EA	$ 12,000	$ 120,000
10" PVC	300	LF	$ 600	$ 180,000
12" PVC	700	LF	$ 650	$ 455,000
15" PVC	400	LF	$ 700	$ 280,000
Traffic Management	1	LS	$ 50,000	$ 50,000
			Subtotal	***$ 4,558,300***
			Contingency (25%)	$ 1,139,600
			Engineering (25%)	$ 1,424,500
			TOTAL	**$ 7,122,400**

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Legend

- Primary Pipe to Replace
- Primary Pipe to Rehab
- Secondary Pipe to Rehab
- SMH Replace/Rehab (61)
- Siphon Pipe
- Gravity Sewer Pipe

0 1,000 2,000
Feet

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Downtown Area Comprehensive Recommendations

Lowell Regional Wastewater Utility
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FIGURE
14

4.4 PROPOSED SCHEDULE

As discussed in Section 4.3, Interceptor 4 rehabilitation will be included as part of the Utility's upcoming Phase 3 Sewer Separation Project, anticipated to be constructed by 2032 per the *Phase 3 Candidate Area Sewer Separation Preliminary Design Report* (December 2024).

In July 2024, the Utility requested funding for construction of rehabilitation of the downtown area sewers through the MassDEP's Clean Water State Revolving Fund. The Downtown Area Sewer Improvements Project was listed on MassDEP's 2025 Final Intended Use Plan (Dated April 8, 2025), with an anticipated $6 million of construction funding. The Utility intends to begin design of the Downtown Area Sewer Improvements in 2025 with an anticipated construction start by June 2026 in accordance with the 2025 CWSRF requirements.

While the Utility is making significant investments with the sewer separation program and other collection system improvements to reduce CSO volumes and SSO occurrences, the Utility intends to maintain their existing budget of $2 million per year for appropriated construction funds for projects to reduce I/I within the collections system. It is recommended that rehabilitation of Interceptor 6 Barasford be included as part of larger capital project or be prioritized after the Downtown area rehabilitation, anticipated to be completed by 2029. The Utility intends to address debris removal of Interceptors 3 and 6 as part of a larger capital project or under an on-call maintenance contract. A phased approach of secondary interceptor projects will be implemented until 2032, at which time the City will perform a comprehensive flow monitoring program to understand the effectiveness of the completed system improvements in the reduction of CSOs, SSOs, and I/I throughout the collection system. The Utility will review all programs comprehensively and will update their priorities in the Long Term Control Plan (LTCP) update in accordance with the Consent Decree.