Office of the Mayor
Chokwe Lumumba, Mayor

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Brad Ammons
Environmental Engineer
Clean Water Enforcement Branch
Municipal & Industrial Enforcement Section
U.S. EPA Region 4
61 Forsyth St., SW
Atlanta, GA 30303

July 31, 2013

RE: City of Jackson
EPA Consent Decree
West Bank Interceptor Work Plan

Dear Mr. Ammons,

Attached please find the West Bank Interceptor Work Plan. The plan was developed and submitted by the City in accordance with the EPA Consent Decree dated March 1, 2013. Paragraph 22. of the Consent Decree requires the City to submit to EPA for review and approval a West Bank Interceptor Work Plan.

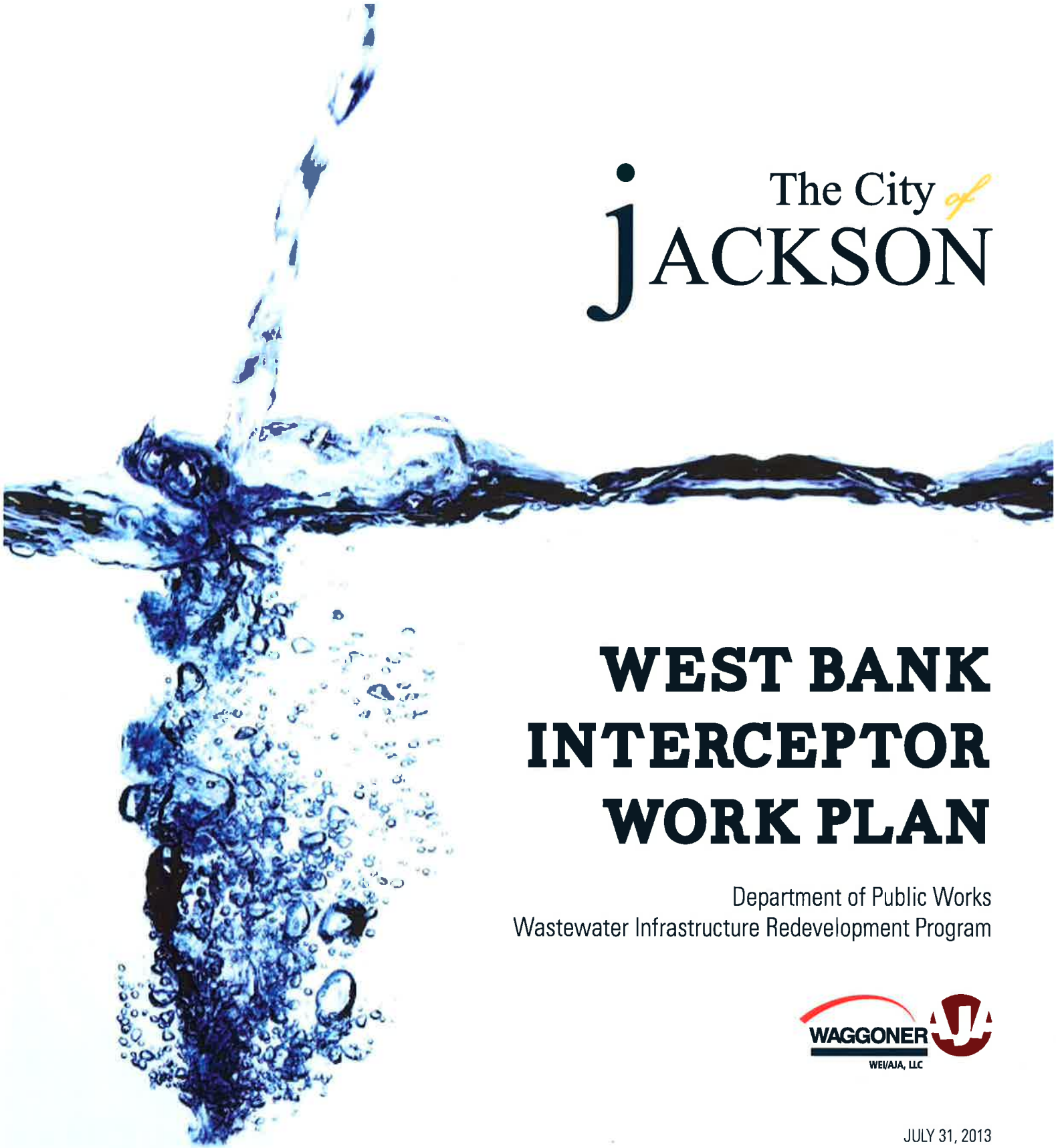
I certify under penalty of law that this document and all attachments were prepared under my direction or supervision in accordance with a system designed to assure that qualified personnel properly gather and evaluated the information submitted. Based on my inquiry of the person or persons who manage 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.

We look forward to your review and approval of the plan.

Sincerely,

Chokwe Lumumba
Mayor

cc: Les Herrington, P.E., Mississippi Department of Environmental Quality
Pieter Teeuwissen, City Attorney
Dan Gaillet, P.E., Director, Department of Public Works
Public Depository, Eudora Welty Public Library



The City of JACKSON

WEST BANK INTERCEPTOR WORK PLAN

Department of Public Works
Wastewater Infrastructure Redevelopment Program

WAGGONER
WEI/AJA, LLC

JULY 31, 2013

City of Jackson, Mississippi
West Bank Interceptor Work Plan

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.

Dan Gaillet, Public Works Director

7-19-13

Date

West Bank Interceptor
Work Plan

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1.0 Introduction

One of the initial requirements of the EPA Consent Decree is to plan and implement rehabilitation of the West Bank Interceptor (WBI), the primary wastewater collector for the City of Jackson. The WBI extends approximately 15 miles along the west bank of the Pearl River from the Savanna Street Wastewater Treatment Plant in south Jackson to the Hines/Madison County line in the north. The WBI ranges in size from 48-inch to 96-inch in diameter.

Through analysis of past and current problems of the WBI as well as the WBI physical characteristics, this ***West Bank Interceptor Work Plan*** was developed to serve as a guide for evaluating the wastewater flow regimes of the WBI, identifying and characterizing the physical condition of the pipeline, and determining the required rehabilitation measures. The Work Plan is provided to establish the framework for conducting and guiding the required evaluation activities.

1.1 Consent Decree Overview

On March 1, 2013, the Consent Decree (CD) agreed to by the City of Jackson, Mississippi, U.S. Environmental Protection Agency (EPA), and the Mississippi Department of Environmental Quality (MDEQ) regarding the wastewater collection and treatment system was entered by the U.S. Court, Southern District of Mississippi. Over a 17½ year timeline, the Consent Decree requires the City to:

- Develop, submit, finalize, and implement plans for the continued improvement of the Wastewater Collection and Transportation System (WCTS) and Wastewater Treatment Plants (WWTPs);
- Eliminate Sanitary Sewer Overflows (SSOs), effluent limit violations (including any violations of the new effluent limits for nutrients), and reporting violations, and
- Minimize Prohibited Bypasses.

The specific requirements of the CD pertaining to the WBI are described below.

1.2 Authority to Promulgate WBI Evaluation Requirements

The City of Jackson Public Works Department (JPWD) established the Wastewater Infrastructure Redevelopment Program in 2004. The Waggoner Engineering/AJA Management and Technical Services joint venture company, WEI/AJA LLC, was retained to assist the City in addressing the requirements of the Consent Decree under their existing Program Management contract for the Wastewater Infrastructure Redevelopment Program. Accordingly, the Program Management team developed the WBI Work Plan to fulfill the requirements of Section VI ¶ (B) 22 set forth in the CD.

1.3 WBI Consent Decree Requirements

As stated in the Consent Decree, the West Bank Interceptor Work Plan shall contain the following, at a minimum:

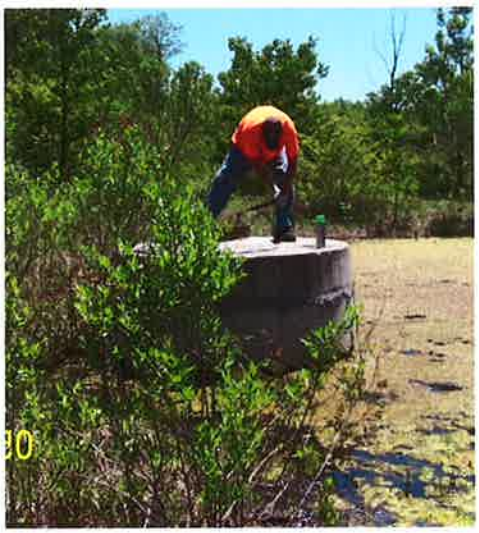
1. The proposed locations selected, and proposed methodologies and criteria that the City will implement and use, to conduct sewage flow monitoring and inspection of the West Bank Interceptor to identify and analyze structural deficiencies in the West Bank Interceptors.

2. The methodologies and procedures the City will implement for monitoring and determining the total dry weather and wet weather (peak) flow rate in the West Bank Interceptor in order to estimate the severity of I/I in the West Bank Interceptor.

3. The methodologies and procedures the City will implement for evaluating and assessing the West Bank Interceptor to enable the City, in the West Bank Interceptor Rehabilitation Plan set forth below, to identify any deficiencies therein and a specific list of proposed remedial measures to correct such deficiencies. The proposed remedial measures shall be performed in two phases. The first phase of such remedial measures shall include cleaning of debris accumulated in the West Bank Interceptor and repairs throughout the length of the West Bank Interceptor that have been evaluated as being necessary to correct a major structural defect, including sources of Excessive I/I. The first phase shall also include total rehabilitation of at least 20% of the total length of the West Bank Interceptor, or a lesser amount as approved by EPA based upon justification by the City in the West Bank Interceptor Work Plan. Examples of these repairs include, but are not limited to, point repairs, manhole repairs, and replacement of sections of sewer pipe or pipe lining of critical segments. The second phase of such remedial measures shall include rehabilitation of those segments throughout the length of the West Bank Interceptor that include long-term repairs necessary for proper "Asset Management" and/or addressing sources of non-Excessive I/I. Examples of these repairs include, but are not limited to, manhole repairs, sewer pipe lining, and replacement or construction of new gravity sewer pipe segments. Asset Management is a continuous process that guides the acquisition, use, and disposal of infrastructure assets to optimize service delivery and minimize costs over the asset's entire life.

1.4 Work Plan Elements

Described in subsequent sections are the specific requirements for developing the necessary data and information necessary to characterize and evaluate the WBI and determine the appropriate rehabilitation measures. An overview of the WBI is provided in Section 2. A detailed description of the proposed WBI flow and rainfall monitoring program and resultant flow characterization is provided in Section 3. Evaluation measures proposed for the pipeline structural condition are contained in Section 4. Remedial measures to be considered for the WBI are described in Section 5, and the implementation plan for the Work Plan requirements is provided in Section 6.



West Bank Interceptor Manholes

2.0 West Bank Interceptor Description

The main wastewater interceptor in the City of Jackson, MS runs parallel to the Pearl River along its west bank, from County Line Road, near the Ross Barnett Reservoir in the north, to the Savanna Street Wastewater Treatment Plant (SSWTP) in the south. The interceptor was designed and built in several phases dating from the 1960s to the mid 1980s. Pipe sizes range from 36 inches at the Madison County origins to the City of Jackson piping that ranges in size from 48 inches in north Jackson to 96 inches near the SSWTP. Prior to entering the SSWWTP Influent Pump Station, the pipe transitions to 108 inch diameter.

2.1 Surface Drainage and Sewershed Basins

The topography of the area around the City of Jackson is interesting due to the fact that a ridge between Clinton and Jackson diverts general surface water drainage to either the Big Black River or the Pearl River watersheds. Surface water from Clinton , Raymond, and points immediately west of Jackson flows towards the Big Black River then to the Mississippi River, while Jackson, Flowood, Ridgeland, and portions of Madison surface drainage flows toward the Pearl River that empties into the Gulf of Mexico, east of the Mississippi River.

The dividing drainage ridge runs along a northeast-southwest line that generally borders the City of Jackson western boundary. The Pearl River is the eastern City of Jackson boundary, and also runs in a northeast to southwest direction. On the east side of the Pearl River is Rankin County which includes the Cities of Pearl, Flowood, and Richland.

In the immediate vicinity of Jackson, most surface streams flow in a general southeast direction to the Pearl River. From south to north, affected drainage basins and similar gravity sewage basins on the Jackson side of the Pearl River are as follows:

1. Big Creek
2. Trahon Creek
3. Caney Creek (its Pearl River confluence is south of the SSWWTP)
4. Hardy Creek (its Pearl River confluence is north of the SSWWTP)
5. Three Mile Creek
6. Lynch Creek
7. Town Creek
8. Belhaven Creek
9. Eubanks Creek
10. Eastover Creek
11. White Oak Creek
12. Hanging Moss Creek
13. Purple Creek

14. Brashear Creek (immediately south of the Ross Barnett Reservoir dam in Hinds County/City of Jackson),
15. Culley Creek which flows into Brashear Creek in Madison County, north of Hinds County/City of Jackson

The exception to the general southeast flow direction is the far northwest area of the City of Jackson where the Presidential Hills wastewater treatment facility is located. The area is located near the Natchez Trace Parkway, US Highway 49 / Medgar Evers Drive and I-220. This area drains toward the northwest into the Bogue Chitto Creek basin which then drains toward the Big Black River.

A third wastewater treatment plant, Trahon-Big Creek WWTP, serves far south Jackson and adjacent portions of Hinds County. This drainage area consists of southwest Jackson and an area south of MS Highway 18 to east of Interstate 55. The area drains in a general southeast direction to the Pearl River, south-southwest of the SSWWTP. The area is drained by Trahon Creek which flows into the Pearl approximately 4 miles SSW of the SSWWTP, and Big Creek which flows to the Pearl River approximately 9 miles SSW of the SSWWTP. The outfall from the Trahon-Big Creek WWTP discharges into Big Creek.

Drainage basins or generalized sewersheds are shown in **Figure 2-1**.

2.2 Construction History

The Jackson west bank interceptor was designed and built in at least nine phases. Designs were completed between 1967 and 1984. Construction was begun after contracts were let, with as-constructed or as-built plans submitted to the City of Jackson between late 1970 and late 1986.

The interceptor crosses all of the previously discussed creeks with the exception of:

- Big Creek
- Trahon Creek
- Caney Creek
- Brashear Creek
- Culley Creek

The interceptor construction is summarized in **Table 2-1.** The table is arranged in sequential order from south to north, from the Savanna Street Wastewater Treatment Plant to the Madison County line at County Line Road. Note that due to the use of several consulting engineering firms, surveying companies, and construction contractors over an approximate 22 year period, station numbering along the path of the primary interceptor is not perfectly continuous.

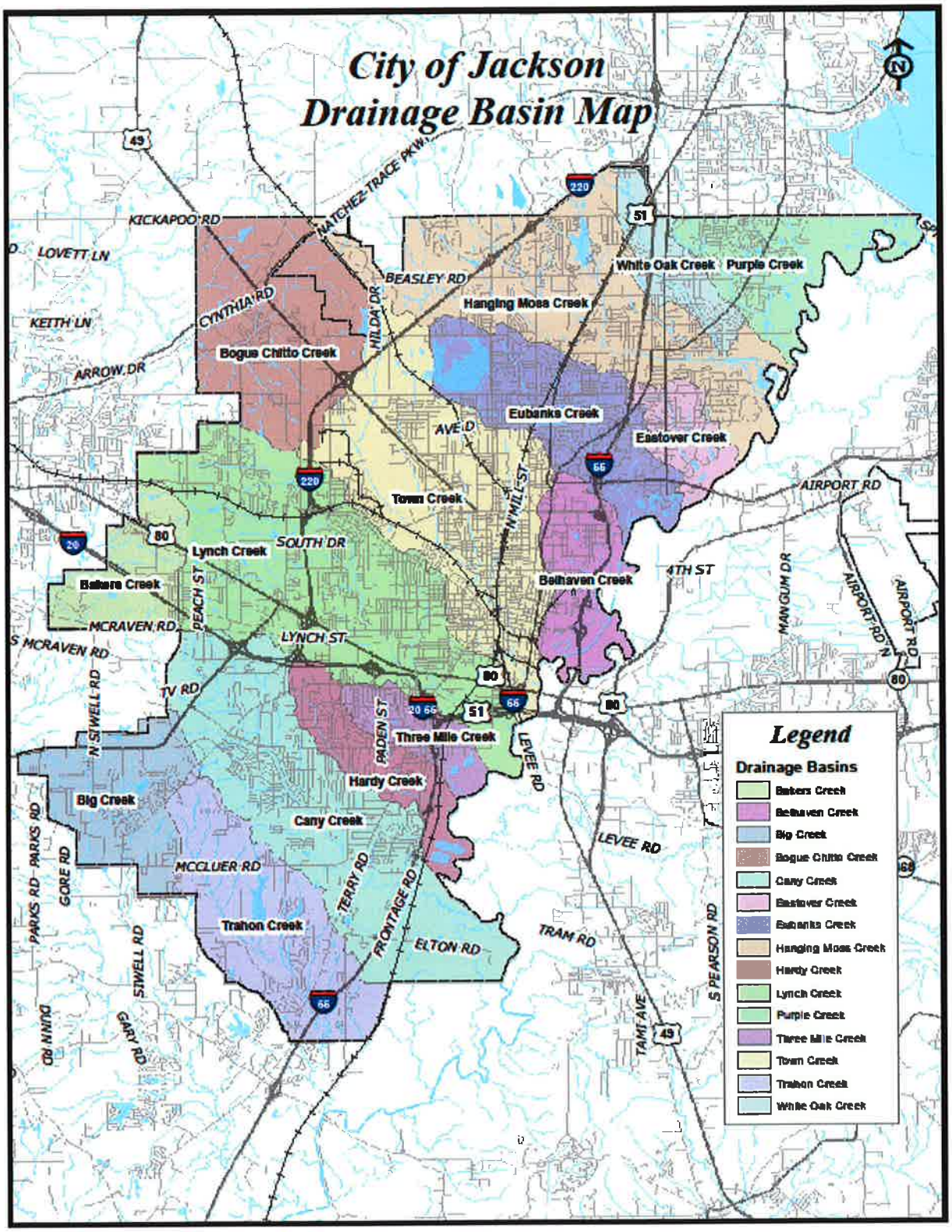


Figure 2-1
City of Jackson, MS Sewersheds

Table 2-1 West Bank Interceptor Characteristics

Project Number	*Diameter (in) & Material*	*Stations*[1]	*As-Built Date (Design Date)*	*Remarks*
Unknown	108" Reinforced Concrete	? to 31+00	Unknown	Savanna St. WWTP Influent Pump Station is at Station 30+00. This segment connects with project Q1177 to the north.
Q1177 /169.5A	96" Reinforced Concrete	31+16.56 to 67+75	Jan 1974 (Sep 1971)	This 96" pipe has a 0.08% slope. It runs parallel (east and south) to the GM&O rail tracks, now abandoned. Included in this segment is a special 15 ft X 16 ft X 48 ft high manhole with a sluice gate. This segment connects with project Q1258 to the north.
Q1258 /169.5B	96" Reinforced Concrete	67+75 to 101+96	Not dated; likely around Dec 1971 (No date; likely after Feb 1967)	This segment, "**Pearl River Interceptor**," crosses Hardy Creek (Sta. 74+00) and Three Mile Creek (Sta. 91+50). It also runs parallel to the now abandoned GM & O rail bed. The 96" pipe slope is 0.06%. Pipe foundation is asphalt black base from Sta. 91+96 to 101+96. This segment connects with project Q1206 to the north.
Q1206 /169.5C	96" Reinforced Concrete	104+00 to 166+75.96	Dec 1970 (Jun 1967)	This segment continues north along the southern right-of-way of the now abandoned GM&O rail bed. The 96" pipe slope is 0.06%. This segment ends immediately south of Lynch Creek where it connects with project Q1254 to the north.
Q1254 /169.5D	84" & 66" Reinforced Concrete	167+90.17 to 214+25 (84" diameter); 214+25 to 226+22.25 (66" diameter)	Jan 1976 (May 1970)	This segment was constructed from Lynch Creek to Town Creek. Slope of the 84" pipe is 0.07%. Both the Lynch Creek and Town Creek pipe crossings are above creek bottoms and are heavy-duty, substantial, weir type structures that are 120 ft wide with 4 pile cap supports at 40 ft intervals with 3 ft high openings beneath concrete protected pipe. The 84" pipe transitions to 66"diameter south of Town Creek, between State Street, US Hwy 80, and the Pearl River. The 66" pipe has a 0.06% slope. This segment connects with project Q1255 south of the railroad bridge near the intersection of Commerce and Rankin Streets.

Table 2-1 West Bank Interceptor Characteristics

Project Number	***Diameter (in) & Material***	***Stations[1]***	***As-Built Date (Design Date)***	***Remarks***
Q1255 /169.5E Contract A	Contract A: 66" unknown pipe type used in tunnel sections. 66" prestressed concrete pressure pipe used in open-cut sections. **Contract B:** 66" reinforced concrete pressure pipe.	229+00 to 304+35.49 overall. **NOTE:** Sta. 266+46 to Sta. 275+21 was a separately built 66" reinforced concrete pressure pipe and manhole with slope of 0.055%, referred to as **Contract B** that crossed I-55 off-ramps to Pearl, Greymont, & Jefferson Streets, near the Mississippi State Fairgrounds.	Nov 1975 (Jun 1970)	The 66" pipe has a 0.055% slope along most of its route. It connects with Contract B under I-55 off-ramps (with slope of 0.055%), then connects with a 480 ft length paralleling Fairground Street at a 0.081% slope, before continuing at 0.055% slope to Lucerne pump station. This contract A and B segment begins north of Town Creek and traverses north beneath the western edge of the West Bank Flood Control Levee (also called Fairgrounds Levee), extends east of the Entergy Substation, through the Mississippi State Fairgrounds and terminates at the Lucerne Street pump station. Both tunnel and open-cut construction techniques were used during construction. The tunnel sections were built inside 90"-96" tunnels from Town Creek to the south side of Silas Brown Street (approximately 1,160 lf), then within a 94"-100" tunnel to immediately south of the Fairgrounds Levee (approximately 1,200 lf). Cut and cover methods were used elsewhere. **Project Q1290/169.5N Contract A**, discussed later in this table, included some of the work originally listed for this project, where it is called Contract B. This segment connects with project Q1358 to the north.

Table 2-1 West Bank Interceptor Characteristics

Project Number	*Diameter (in) & Material*	*Stations[1]*	*As-Built Date (Design Date)*	*Remarks*
Q1358 /183.5	66" & 54" Reinforced Concrete Pipe	10+01.80 to 67+50.02	Apr 1979 (Oct 1975)	This construction segment was labeled "**North Jackson Outfall Sewers-Contract 1**." It extends north from the Lucerne Street pump station, along the west side of Interstate 55 between High Street and the Waterworks curve and terminates at Belhaven Creek. The southern part of this segment has a 66" pipe at 0.045% slope inside a 96" tunnel extending beneath High Street and Foley Street. At the intersection of Moody Street and Foley Street, south of Fortification Street, the segment's pipe changes to 54" diameter at a 0.060% slope. An 84" tunnel contains the pipe beneath Fortification Street and most of its route except where creek crossings occur. The 54" pipe is supported by concrete cradles and is protected from surface scour of a minor creek crossing and Belhaven Creek crossing with concrete encasements of 75' and 160' lengths, respectively. A gate structure terminates the 54" pipe segment on the north side of Belhaven Creek. In addition to the 54" pipe, an older existing segment of 48" sewer, with a slope of 0.05%, parallels the 54" pipe from the 66" pipe in the south (Moody St. – Foley St. intersection) to the gate structure termination (north end of this segment). There is no valve or gate on the 48" pipe. This segment connects with project Q1243 to the north.

Table 2-1 West Bank Interceptor Characteristics

Project Number	*Diameter (in) & Material*	*Stations*[1]	*As-Built Date (Design Date)*	*Remarks*
Q1243 /169.5F	48",60", & 54" Reinforced Concrete Pipe	754+00 to 880+27.65	Feb 1976 (Jun 1973)	In general, this segment of the interceptor runs north from Belhaven Creek, east across Interstate 55, northward to the north right-of-way of Lakeland Drive / MS Hwy 25, east of the Ridgewood Road intersection. Anti-flotation and installation pads with concrete bedding are used on both the 54" and the 60" pipes. A subpart of this construction is one length of 175 feet of 48" pipe, at 0.05% slope, that extends beneath Belhaven Creek to a special manhole connecting the 48" and 60" pipes. A junction box joins the 54" pipe (previous segment) with this segment's 48" and 60" special manhole immediately north of the Belhaven Creek crossing. From north of Belhaven Creek, the 60" sewer segment travels north at a slope of 0.04%. It crosses beneath I-55 inside a 460 foot length of 88" tunnel liner then crosses beneath a railroad bed inside a 185 foot length of 88" tunnel liner. Two special vent-top manholes exist north of the I-55 crossing and north of the railroad pipe crossing. The 60" pipe segment changes to a 54" pipe at 0.05% slope at the Eubanks Creek crossing, located east of Riverside Park Center. A special grade crossing – junction structure exists at Eubanks Creek where the 54" pipe and a 30" pipe join (to the north) and flow into the 60" pipe south of Eubanks Creek. The 54" pipe continues north across Lakeland Drive / MS Hwy 25 where it connects with project Q1290 to the north.

Table 2-1 West Bank Interceptor Characteristics

Project Number	***Diameter (in) & Material***	***Stations[1]***	***As-Built Date (Design Date)***	***Remarks***
Q1290 /169.5N	66" (minor part: **Contract A**) Prestressed Reinforced Concrete Pressure Pipe & 54" (major part) Reinforced Concrete Pipe and Prestressed Reinforced Concrete Pressure Pipe	0+00 to 148+60.09 of the major part. 266+46 to 275+21 of the minor part (for a previous project Q1255 / 169.5E).	Oct 1976 (Jul 1973)	This project, "**The North Jackson Outfall Sewers,**" consisted of two subparts, a minor and a major. The minor subpart, **Contract A**, continued a 66" pipe to the Lucerne Street pump station from previous project Q1255 /169.5E. There was one manhole and a 66" gate valve connected to 66" reinforced concrete pressure pipe from Stations 266+46 to 275+21. The major subpart of this segment began at Station 0+00 where project Q1243 (previous table entry) ended at Station 6+19.50 in Eastover Subdivision, north of the right-of-way to Lakeland Drive / MS-25. The 54" pipe has a slope of 0.037% and extends north to its end at the south side of Hanging Moss Creek. The 54" pipe is concrete encased for approximately 1300 feet. Another stretch of the interceptor used about 3,000 feet of prestressed reinforced concrete pressure pipe, with the last 8 manholes and pipes supported on steel bearing piles at 40 foot centers, ending immediately south of Hanging Moss Creek. This segment connects to project Q1505 to the north.
Q1505 /182.5	54" Reinforced Concrete Pipe & 48" Reinforced Concrete Pressure Pipe	0+00 to 84+70 of 54" pipe; 0+00 to 100+75 of 48" pipe; 24 feet of 36" pipe	Oct 1986 (Apr 1983 – Jul 1984)	This segment is the "Culley-Brashear Regional Sewer Contract 1 – Hinds County Segment." It begins at Hanging Moss Creek, crosses Purple Creek, and extends north across a levee contained golf course to connect with lines on the Madison County side of the interceptor. This segment has a 54" pipe at 0.039% slope to River Rd Subdivision, and a 48"pipe at 0.031% slope to the Madison County Line. A special manhole with sluice gate exists where the 54" pipe connects to 48" pipe. Timber piles 15' to 20' deep support the 48" pipe from the sluice gate manhole to the country club levee. Inside the levee, the 48" concrete pressure pipe is supported on reinforced concrete piers at 20' spacing. From the golf club road

Table 2-1 West Bank Interceptor Characteristics

Project Number	*Diameter (in) & Material*	*Stations*[1]	*As-Built Date (Design Date)*	*Remarks*
				section to the county line, the pipe is supported on natural ground. Approximate segment totals: 8,470 ft of 54" pipe; 10,075 ft of 48" pipe; 24 ft of 36" pipe; 39 manholes (**includes 1 dog-house manhole listed as project Q1660**). This end segment of the City Of Jackson West Bank Interceptor connects to the Madison County wastewater system. The connector in Madison County was a 36" pipe at a 2.83% slope in 1986.

[1] Station numbering along the path of the primary interceptor is not perfectly continuous.

2.3 West Bank Interceptor Extent

The West Bank Interceptor extends across a total length of approximately 15 miles and collects and transports wastewater from parts of Madison County and from City of Jackson wastewater basins. During the approximate 15 mile journey parallel to the Pearl River, the WBI traverses mostly floodplain terrain near where housing and urban development has occurred. Along its southward trek, it crosses a golf course and its protective levee, city streets, interstate and state highways, major area creek confluences with the Pearl River, and crosses beneath the west bank flood-protection levee for the COJ.

The overall layout of the West Bank Interceptor is shown on **Figure 2-2**.

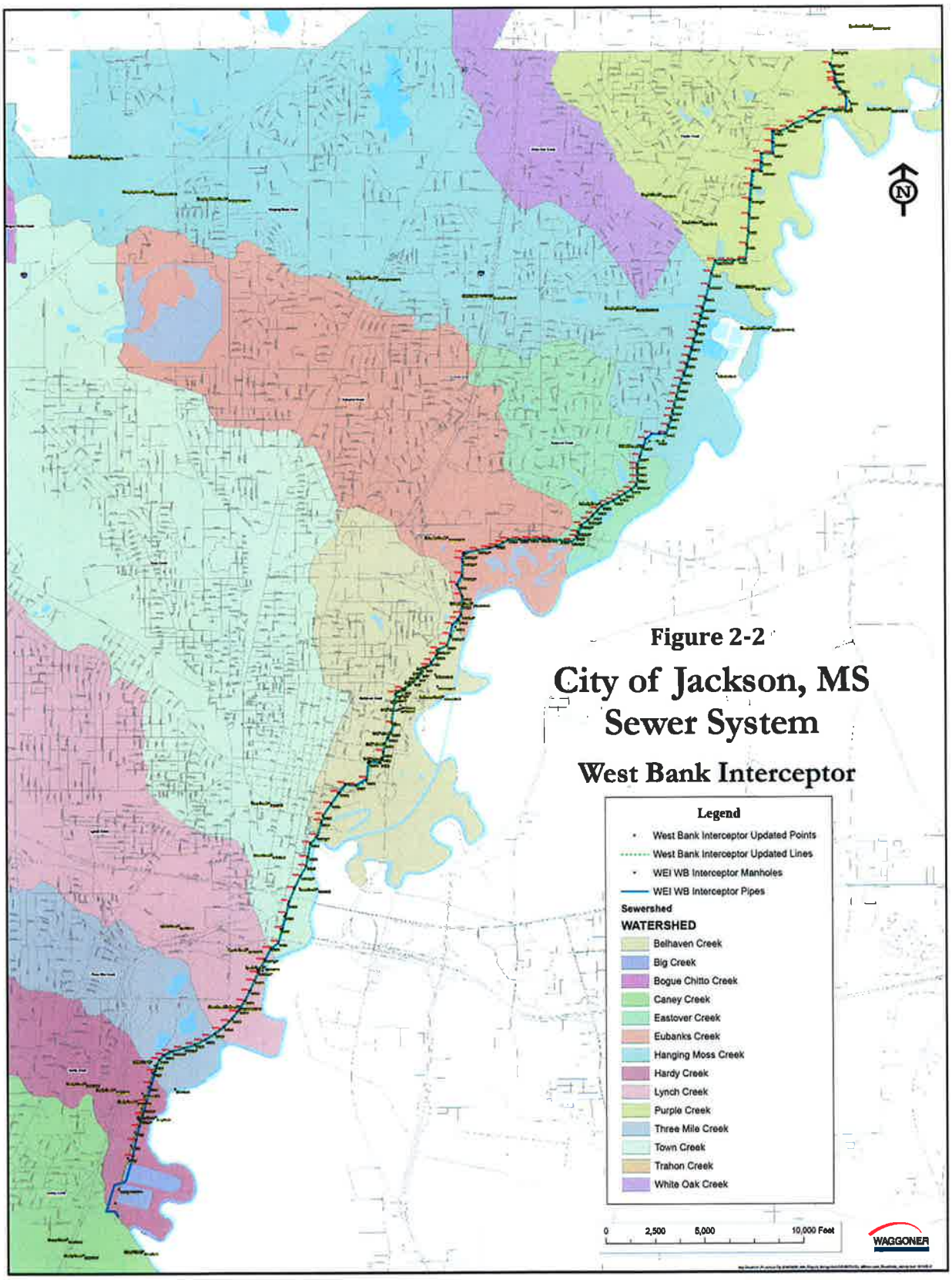


Figure 2-2

City of Jackson, MS Sewer System

West Bank Interceptor

2.4 West Bank Interceptor Pipe Sizes

Table 2-2 summarizes general extents of pipe sizes within the West Bank Interceptor, in a north to south direction. Note that its manholes are numbered for reference in a south to north direction, as done on previous engineering studies.

Table 2-2 WBI Pipe Sizes

Diameter (in)	*Approximate Length (ft)*	*Manhole Numbers*	*Approximate % of Interceptor Length*	*Description*
48	10,445	IT171 to IT148	13.2	Extends from County Line Road to east of Christ United Methodist Church on Old Canton Road.
54 (North)	28,656	IT147 to IT80	36.2	Extends from 2,500 ft east of Christ United Methodist Church, on Old Canton Road, to Eubanks Creek, east of the Mississippi Children's Museum.
60	6,413	IT79 to IT66	8.1	Extends from southwest of Eubanks Creek to Belhaven Creek, west of Interstate 55 and north of Fortification Street.
54 (South) and 48 Parallel	2,496 2,576	IT65 to IT60 IT67A to IT60A	3.2 3.2 (parallel)	This double-barrel segment extends from Belhaven Creek to south of Fortification Street, west of I-55, near the Foley Street-Moody Street intersection. The newer 54" pipe runs parallel to an older existing 48" pipe of 0.05% slope built in the 1960s.
66	11,914	IT59 to IT32	15.0	Extends from south of Fortification Street to immediately south of Town Creek, near the Pearl River.
84	4,678	IT31 to IT25	5.9	Extends from south of Town Creek to immediately south of Lynch Creek, at the Pearl River.
96	13,938	IT24 to IT0	17.6	Extends from south of Lynch Creek to the east side of I-55 and Savanna Street exit, near the Savanna Street Wastewater Treatment Plant.
108	Unknown	IT0	0.8	Extends from east of I-55 and Savanna Street exit to the SSWTP.

2.5 Age of Interceptor Pipes

As of 2013, the WBI piping has a range of ages that can be approximated from as-constructed documentation. Using indicated as-constructed dates and inferred design dates for the various interceptor construction phases, the interceptor's piping was broken into the following general groups:

- Projects that were designed between 1967 and 1977 and constructed before the end of 1977.
- Projects that were designed between 1977 and 1984 and constructed after 1977 to the end of 1986.
- Piping that was altered or rerouted between 1977 and 1979, but has older piping of 1960s vintage. This is primarily a portion of an old 48" pipe segment that was partially replaced with new 54" pipe. The double-barrel (old 48") segment runs parallel to a new 54" pipe segment near Fortification Street.

Five segments of the interceptor piping were created using the preceding grouping criteria:

- Two segments with piping at least 35 years to 45 years old.
- Two segments with piping aged 26 years to 34 years old.
- One segment of older age (the 48" segment that runs parallel to the 54" segment) that is likely greater than 45 years old.

Table 2-3 lists piping age groups by segment, segment length, percentage of interceptor length, and gives a brief description of where the piping is located within the overall interceptor.

The table indicates that:

- Approximately 3% of the interceptor's length is more than 45 years old.
- Approximately 68% of the interceptor's length is 35 to 45 years old.
- The younger aged part of the interceptor, 26 to 34 years old, exists between High Street and Belhaven Creek, and from Hanging Moss Creek to the Madison County line.

Table 2-3
WBI Pipe Age Groupings

Segment	*Pipe Age (Years)*	*Segment Length (ft)*	*Length, % Interceptor Length*	*Interceptor Physical Location*
1	35-45	27,364	34.6	From SSWTP to south of High Street.
1	26-34	5,634	7.1	From south of High Street to Belhaven Creek, west of I-55.
2	35-45	26,617	33.6	From Belhaven Creek to Hanging Moss Creek, north of the old sewage lagoon.
2	26-34	18,926	23.9	From Hanging Moss Creek to the Madison County Line.
3	45+	2,576	3.3	This is the 48" double barrel portion of the interceptor where 54" and 48" lines work in parallel. It extends from a 66" pipe segment to a 60" pipe segment, located west of I-55 that crosses Fortification Street.

During the execution of planned interceptor work, first priority should be given to older parts of the system and areas with known collapses and breakage.

2.6 Proximity to Pearl River

Along the route to the SSWTP, the WBI has several areas where it is currently less than 500 feet from the Pearl River. Areas with this close proximity to the river make it very susceptible to erosion effects and high water table inflow during elevated river stages. Specific areas of concern include:

- South of the Country Club of Jackson golf course where the river is as close as 325 to 350 feet. This is near manholes IT159 to IT161.
- Near Eubanks Creek and the City of Jackson water treatment plant where the river is as close as 450 to 490 feet from the interceptor and where the interceptor is in close proximity to drinking water intakes. This is near manholes IT74 to IT76.
- South of Jefferson Street, from Silas Brown Street to south of the railroad bridge where the river is as close as 130 to 200 feet. This is near manholes IT36 to IT39.
- At Lynch Creek, south of Interstate 20, where the interceptor's creek crossing structure is as close as 125 to 160 feet from the river. This is near manholes IT24 to IT26.
- South of Hardy Creek, from near I-55 and Daniel Lake exit to Caney Creek, where the river is very close to the WBI and the protective levees surrounding the SSWTP. This area is particularly close to manholes IT14 to IT16 and IT3 to IT6.

2.7 Interceptor Exposure at Creek Crossings

Various creek crossing designs and structures were constructed for the WBI. The interceptor crosses several major and minor drainage creeks inside the City of Jackson. These creek drainage basins are also sewer basins. As such, the creek crossings are also junctions of the sewershed collector systems with the WBI. As observed, most of the creek-interceptor crossings are very close to creek confluences with the Pearl River. High river flow conditions at these points most likely generate erosion forces and floating debris and silt- sediment force conditions that may undermine and/or generate substantial external pressures on the interceptor's creek crossing structures.

Specific creek crossings that need monitoring include:

- Purple Creek at the Westbrook Road crossing, from manholes IT139 to IT140.
- Hanging Moss Creek at the Entergy / MP&L right-of-way, near the old sewage lagoon, from manholes IT132 to IT134.
- Near Eastover Subdivision, north of Lakeland Drive, where a lake spillway crosses the interceptor prior to emptying into the Pearl River. This is the Eastover Creek crossing of the interceptor, from manholes IT100 to IT101.
- Eubanks Creek crossing, located south of Lakeland Drive and between the Mississippi Children's Museum and a complex of softball fields, from manholes IT81 to IT82.
- Belhaven Creek crossing located west of I-55, from manholes IT66 to IT67.
- Town Creek crossing, from manholes IT33 to IT35.
- Lynch Creek crossing, almost at the Pearl River, from manholes IT25 to IT26.

2.8 WBI Rehabilitation Projects

Since the end of construction, in 1986, rehabilitation on the WBI has included point repairs at various places along the interceptor, cured-in-place pipe (CIPP) repairs in the vicinity of the state fairgrounds, and sliplining in the vicinity of two major creek crossings. **Table 2-4** summarizes some of this rehabilitation work.

Table 2-4
WBI Rehabilitation Activities Since Construction

Year	*Rehabilitation Description*
1999	Five major emergency point repairs were performed at various locations along the interceptor, each approximately 100 ft long. The repairs were made between the SSWWTP and Lakeland Drive. CIPP repairs were made on the 66" pipe from High Street to the state fairgrounds area.
2002	CIPP repairs were made on approximately 3,000 feet of 66" pipe in the fairgrounds area, from MHs IT44 to IT50.
2005	Sliplined approximately 640 feet of interceptor from Rankin Street across Town Creek, near MHs IT 33-IT35.
2006	Sliplined approximately 640 feet of interceptor across Lynch Creek, near MHs IT24-IT26.

2000 Engineering Report

Some of the preceding rehabilitation projects were implementations of recommendations given in an engineering study that was completed in 2000. The report was titled "City of Jackson, Mississippi Sewer System Evaluation Study, Citywide Flow Monitoring, City Project No. 90504901, August 2000," prepared by Pitometer, Byrd/ Forbes - Severn Trent Services. The study focused on Three Mile Creek and Hardy Creek sewersheds wastewater collection and transport systems and the West Bank Interceptor. Closed circuit television (CCTV) and flow monitoring were used to help analyze portions of the wastewater system. Based on this study's "Data Visualization Maps," specific Priority 1 rehabilitation recommendations for the WBI included:

- Trenchless pipe repair for interceptor pipes between MHs IT23 to IT25, IT30 to IT50, IT59 to IT60, and IT67A to IT134.

- Repair or replacement of manholes that were categorized as in severe condition. These included MHs IT6, IT9 toIT13, IT15, IT33, IT47, IT57, IT58, IT81, IT82, IT95, IT98, and IT129.

2009 Engineering Report

Another engineering report was produced in 2009. Its primary subject was the West Bank Interceptor. It was entitled "SRF Facilities Plan, West Bank Interceptor Sewer Rehabilitation for the City of Jackson, Mississippi Department of Environmental Quality, SRF Project Number C280886-02, City of Jackson Project Number 20505701, July 30, 2009 Revised September 18, 2009," prepared by Southern Consultants, Inc. Jackson, MS.

The report's purpose was to:

- Identify and delineate work needed to restore structural and hydraulic condition to the WBI, and

- Document the severity of deteriorated pipes and manholes, and outline implementable steps to structurally restore the WBI.

The report included development of a seven phased plan to rehabilitate 100% of the WBI. **Table 2-5** summarizes the 2009 proposed rehabilitation phases. For Facility Planning purposes, complete sliplining and manhole rehabilitation were included as the baseline rehab measures for all phases.

Table 2-5
Summary of 2009 Facilities Plan WBI Rehabilitation Phases

Rehabilitation Phase	*WBI Segment*	*Description*	*Estimated Cost, Million 2009 $*	*Proposed Time Frame*
1	SSWWTP to Lynch Creek	~12,415 lf of 96" concrete pipe	$21.911	2009-2010
2	Lynch Creek to MS State Fairgrounds	~4,000 lf of 84" concrete pipe and ~5,250 lf of 66" concrete pipe	$14.425	2011-2012
3	High Street to Eubanks Creek	~ 6,435 lf of 60" concrete and ~2,450 lf of 48" concrete pipe	$12.781	2013-2014
4	Eubanks Creek to Lakeland Drive	~6,420 lf of 54" concrete pipe	$9.426	2017-2018
5	Lakeland Drive to Meadowbrook Rd	~7,900 lf of 54" concrete pipe	$10.767	2019-2020
6	Meadowbrook Rd to Westbrook Rd	~10, 230 lf of 54" concrete pipe	$12.732	2021-2022
7	Westbrook Rd to County Line Rd	~4,500lf of 54" concrete pipe and ~9,800 lf of 48" concrete pipe	$15.512	2023-2024

2013 WBI Rehabilitation Work

Based on the 2009 study, the COJ has retained engineering services that have developed plans, specifications, and designs, and has awarded construction services for implementation of Phase 3. Phase 3 rehabilitation work on the WBI, between High Street and Eubanks Creek, is currently under construction. The work was broken down into two contracts for CIPP/sliplined pipe and manhole rehabilitation repairs and its affiliated operations, such as flow bypasses.

- Contract 1 involves work on the interceptor from the 66" pipe between Mississippi Street and High Street, north to the end of the double barreled 54" and 48" parallel pipe segment, for a total length of 6,435 feet.

- Contract 2 involves work on the 60" pipe segment that terminates at Eubanks Creek for a total length of 2,450 feet.

The schedule for the future rehabilitation phases has been deferred pending completion of the additional WBI investigations required by the Consent Decree.

3.0 Wastewater Flow Characterization

Evaluation of the WBI involves two major components: (1) flow characterization and (2) structural condition assessment. Flow characterization requires implementing a detailed flow and rainfall monitoring program on the WBI. The methodologies and procedures the City of Jackson will use in determining the wastewater flow characteristics for the WBI are described in this section. In characterizing wastewater flows, it is important to understand that evaluation of existing data shows a direct correlation between elevated river stages on the Pearl River and flow entering the Savanna Wastewater Treatment Facility from the WBI. However, no such correlation with flow and local rainfall at the treatment plant has been established.

3.1 Flow and Rainfall Monitoring Program

The City of Jackson is implementing a West Bank Interceptor Flow and Rainfall Monitoring Program to provide the information necessary to characterize dry and wet weather wastewater flows. The data derived from the program will be used in the development and maintenance of a wastewater hydraulic model of the WBI. The model results will be used to characterize the capacity of the West Bank Interceptor and make decisions on needed improvements.

The purpose of the Flow and Rainfall Monitoring Program is to:

- Establish baseline dry weather wastewater flows.
- Measure and quantify wet weather and peak flows.
- Evaluate the magnitude and influence of excessive flow from local rainfall events vs. Pearl River stage elevation.
- Estimate the volume of I/I entering various sewer segments/sewersheds that contribute to the West Bank Interceptor.
- Provide data required for assessment of capacity of various sewer segments.
- Facilitate prioritization of sewersheds for further inspection and analysis.
- Identify rehabilitation measures that will result in I/I reduction.
- Measure flow delivered from inter-governmental users for billing purposes.

The overall Program goal is to provide efficient and effective flow and rainfall data necessary to adequately assess capacity and I/I issues within the wastewater collection system.

3.2 Flow Monitoring Criteria

Flow and rainfall monitoring consists of installing a series of flow meters at strategic locations along the WBI together with a series of rain gauges located in various points within the contributing collection system. Several factors are considered to determine the number of flow meters required to properly characterize the system. The number of meters needed is dependent on the size of the system and the configuration of the sewersheds. The strategic or critical locations for the flow meters were determined through a detailed review of the City's Geographical Information System (GIS) maps.

The target locations for the WBI flow meters are based on the following criteria:

- Entry points of all sewersheds into WBI.
- Wastewater connection points from other local jurisdictions.
- Required isolation points upstream of the meter (for determining I/I).
- Wastewater treatment plants.

Each potential metering site was investigated in the field. Field investigations allow the City to adequately confirm the feasibility of installing the flow meter. Field investigation also ensures that each site is hydraulically suitable for flow monitoring. Selected flow monitoring sites should have a minimum amount of turbulence. Each site was evaluated for specific installation and operational conditions of access, safety, traffic control, structural condition, hydraulic suitability, and level of flow.

The City will employ a qualified specialty contractor to install and operate the flow and rainfall monitoring equipment. The contractor may use a variety of metering technologies, and each location will be evaluated to determine the meter best suited for that location. The contractor will be required to follow a set of standard procedures for installation, maintenance, and calibration of the metering equipment based on the manufacturers' recommended practices. The following criteria will be used in selecting flow meter types at specific locations:

- Pipe size
- Flow ranges
- Hydraulic conditions
- Telemetry method
- Operating principle
- Accuracy
- Monitoring period duration
- Data management
- Cost

The proposed specifications for the City's Flow and Rainfall Monitoring Program are provided in **Appendix A.**

3.3 Preliminary WBI Flow Meter Locations

There are a total of 29 locations proposed for installation of meters on the West Bank Interceptor. Meters placed on the interceptor line will confirm the total flows conveyed in the interceptor system at key locations. Many of these are basin meters which will capture flows incrementally along the interceptor from sewershed connections points along the interceptor line.

The City maintains a GIS map that identifies locations of permanent and temporary flow meters and rainfall monitoring sites established in the City's Wastewater Collection System. Temporary and long-term flow monitoring sites are mapped in GIS, and are correlated with each sub basin. **Table 3-1** lists the proposed basin meters, approximate locations, and other pertinent information. The proposed locations of the flow meters are shown on **Figure 3-1**.

Rain gauges measure rainfall intensity for specific durations throughout the monitoring period, which is necessary to properly analyze wet weather flows. Rainfall data will be synchronized with flow monitoring data. Four rain gauges are proposed to be installed in the system at various points along the WBI and/or the contributing sewersheds. The location of the rain gauges will be determined by the City in consultation with the selected flow monitoring contractor.

3.4 Flow Monitoring Data Analysis

Flow meter, rain gauge, and river stage data will be used to estimate the amount of I/I entering the WBI. The data will also be used to assess capacity availability in the sewer system and to prioritize upgrades and rehabilitation improvements to provide additional capacity, as needed. Flow and rainfall monitoring data will be used to develop Rain Dependent Inflow and Infiltration (RDI/I) parameters and hydrographs for analysis. River dependent I/I will also be determined to the extent practicable, since I/I in the WBI appears to correlate with river stage. These RDI/I parameters and hydrographs will also be utilized in the hydraulic modeling program.

The City will utilize the flow, rainfall, and river monitoring data to established baseline flow quantities, to estimate the volume of I/I entering various sewer segments/sewersheds, to assess capacity availability in various sewer segments (which is used in conjunction to calibrating a hydraulic model for capacity assessment), and to prioritize sanitary sewersheds for rehabilitation.

Data Interpretation

Data to be generated by the flow monitoring program will include hydrographs, data plots, and scattergraphs. Flow hydrographs and depth and velocity data plots will be used to review the consistency and reliability of the measured data under wet weather conditions. Analysts will first observe how a meter responds to the rainfall event and note the magnitude of peak flows and the shape of the generated hydrographs. A pattern between

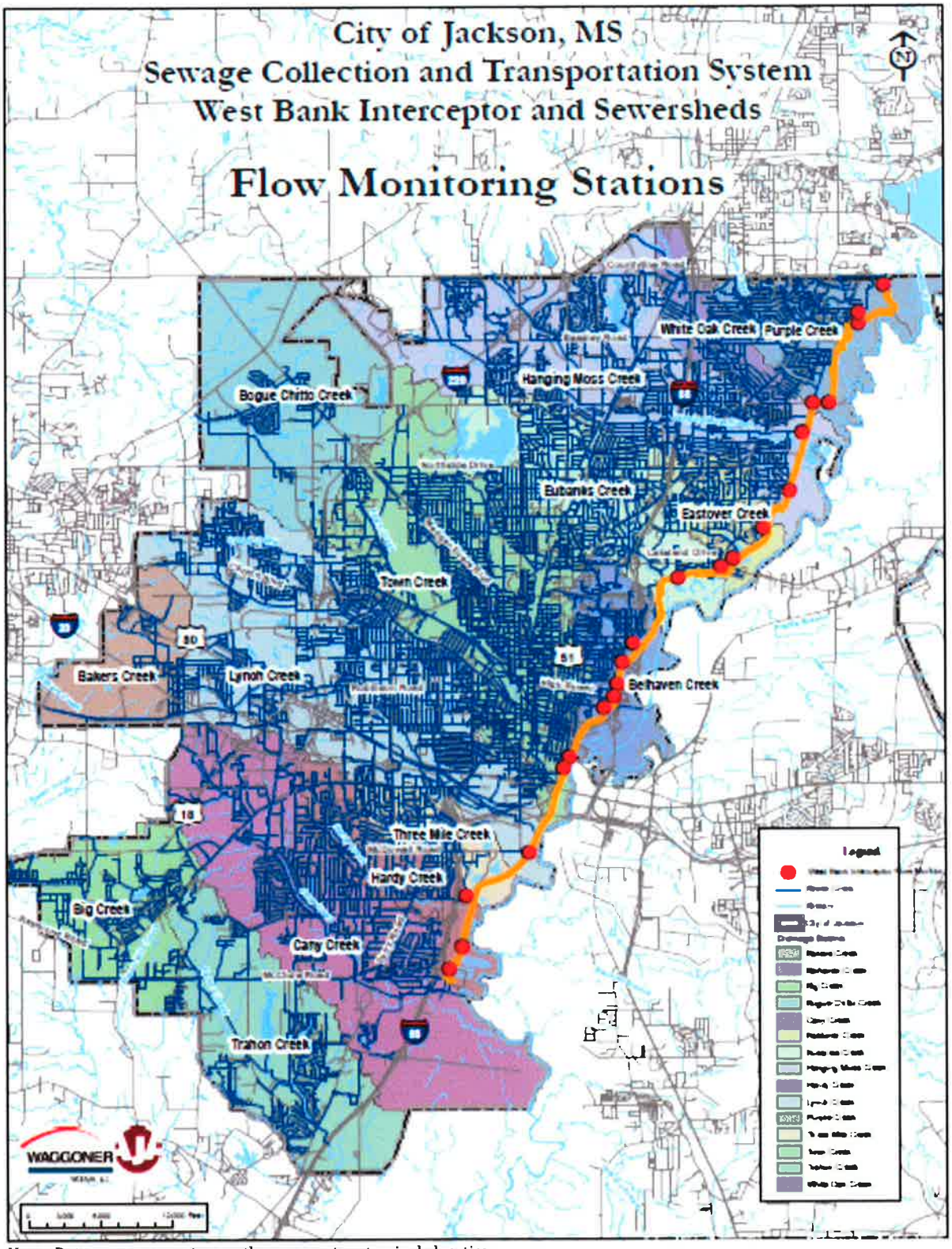
wet weather response and the total rainfall is then determined. The depth and velocity data plot also provides information regarding sewer system behavior under various wet weather conditions. Analysts will establish the hydraulic pattern at a specific meter site based on depth and velocity relationships and look for consistent behavior during various rainfall events. If a portion of the data being reviewed is out of character, the analyst will alert field crews to investigate.

A scattergraph is generated as a graphical tool that depicts a relationship between flow depth and velocity under actual conditions. This graph will be used to characterize flows upstream and downstream of the monitoring sites. The graph is also used to interpret hydraulic conditions and assess sewer capacity. This type of flow monitoring analysis provides information regarding the reaction of the wastewater sewer system during storm events and helps identify system deficiencies.

Table 3-1
West Bank Interceptor Flow Monitoring Locations

Site	*Drainage*	*MH ID*	*Pipe Size, in*	*Location Notes*
1	WBI	IT0171	48	On golf course near maintenance building
2	Purple Creek	PL0544	15	Winged Foot Circle behind residence
3	WBI	IT0156	48	
4	WBI	IT0140	54	
5	Purple Creek	PL0027	36	
6	Hanging Moss Cr	HM0606	48	Requires gate key for entry
7	WBI	IT0120	54	Manhole has bolted lid
8	WBI	IT0120	12	
9	Hanging Moss Cr	HM0100A	12	
10	Eastover Creek	EA0002	18	
11	Eubanks Creek	EU0069	TBD	
12	WBI	IT0085	54	
13	Eubanks Creek	EU0068	30	
14	Belhaven Creek	BH0221	36	
15	Belhaven Creek	BH0138	27	
16	Belhaven Creek	BH0074T	12	In Honda dealership across from service entrance
17	Belhaven Creek	BH0074A	15	In Honda dealership sewer easement
18	WBI	IT0055	66	Behind Shoney's parking lot
19	WBI	IT0047	15	In Fairgrounds parking lot
20	WBI	IT0040	66	Near Hemphill Construction yard off Jefferson Street
21	Town Creek	TN4006	48	
22	Town Creek	TN4006	10	
23	Town Creek	TN4131	27	
24	Town Creek	TN4017	54	
25	Lynch Creek	LY0004	48	North side of Pilot Truck Stop parking lot
26	WBI	IT0019	96	South end of Gallatin Street
27	Three Mile Cr	TM0007A	36	East side I55 frontage road near gas metering station
28	Hardy Creek	HM0005A	36	East side I55 frontage road near Exit 92A food sign
29	WBI	IT0001	96	North end of Savanna St. WWTP

Figure 3-1
Proposed Flow Monitoring Sites



Note: Dots may represent more than one meter at a single location.

Flow Monitoring Results Reporting

The City's flow monitoring contractor will be required to furnish a Flow Monitoring Program Report on a monthly basis. The monthly report will include site reports for each station (per meter). The report will also be required to include the following information:

- Purpose of flow monitoring, location and type of flow meters used.
- Dry weather analysis (including calculated base flows and diurnal patterns).
- Wet weather analysis (including locations impacted by I/I and to what degree).
- Evaluation of whether data can be used for capacity assessment.
- Tables and figures necessary to explain the results and findings.
- Conclusions and recommendations.
- Hydrographs and tabular data for each station for the monitoring period.
- Frequency of flow meter inspection, service, and calibration.
- Frequency of downloading flow monitoring data.
- Base groundwater infiltration.
- RDI/I.
- Surcharged pipes.
- Capacity restrictions.
- Sanitary sewer overflows (SSOs).

Performance trends will be evaluated to decide what actions are necessary to maintain system performance within controllable limits and to determine whether system performance is operating within predicable limits.

Flow and Rainfall Data Analysis

Multiple rain events of varying intensities will be monitored to accurately assess the inflow response of the system for each event. Information obtained during the monitoring period will be used to determine the following:

- Average Dry Weather Flow (ADWF) and Peak Dry Weather Flow (PDWF).
- Average Wet Weather Flow (AWWF) and Peak Wet Weather Flow (PWWF).
- Peak inflow rates.
- Total I/I volume.

In addition, not all wet season storm events will furnish the necessary I/I data to measure and model the system responses to significant rainfall events. In dry winters, it may be necessary to extend flow monitoring activities for a longer time period or additional season. It is anticipated that rainfall and flow monitoring at sewershed entry points will produce a good correlation between I/I and rainfall events. However, as noted previously, the major influence on the WBI is likely the river stage which is regulated by reservoir discharge of

rainfall coming to the reservoir from a vast area of the Pearl River basin lying upstream of the Ross Barnett Reservoir.

Data Acquisition and Review

During daily data analysis, an engineer or technician trained and experienced in flow and rainfall monitoring techniques will determine the quality of the data by observing the flow monitoring data over time and confirming the observed data with results of field calibrations. Computer software will be used for more accurate analysis and to generate a detailed report. Rain data for each month will also be compared to the calibration sheet to determine if the sensor is malfunctioning.

Flow level and velocity data will be obtained by the flow monitoring meter on 15-minute intervals during the monitoring period. Data may be captured at 5-minute intervals due to high flow variability or possible other reasons. Data will be downloaded from the meters remotely via telemetry to a central data storage system. Downloaded data will be reviewed for data quality. Sensor failures or damage and/or suspected loss of data quality will be documented in a log and corrective measures will be taken (e.g., replace meter, sensor, batteries, or take other actions as needed).

3.5 Quality Assurance

The City of Jackson Flow and Rainfall Monitoring Program will incorporate formal quality control/quality assurance procedures. The integrity of the data is important whether for billing, capacity analysis or I/I investigations. To maintain the monitors in proper operation, the QA/QC checks include periodic procedures to demonstrate that readings produced by the monitors can be validated. The lack of proper QA/QC procedures, limited on-site data reviews, and lack of proper and detailed field verifications often results in lower-quality data as well as data losses. Therefore, QA/QC checks will be performed throughout the program. A well-designed flow monitoring approach will provide for the collection of quality data to successfully apply to hydraulic modeling. The selected model calibration and verification rainfall events will be developed from the flow and rainfall monitoring data.

To validate the quality of the data collected by the monitoring equipment, flow meters will be calibrated once a month in the field and the results documented. The monthly field verification or as-needed interim visits will include data review. QA/QC checks of the data and site visits will be immediately conducted if problems are observed with erratic data or unexplained changes in the data values.

3.6 Maintenance and Calibration

Site Inspection and Maintenance

Field verification is an important activity in collecting accurate data and assuring minimum loss of data due to malfunctioning equipment or accumulation of debris at the monitoring site. Field inspections will be conducted at least monthly or more frequently if needed. Meter calibration will be confirmed on site with measurements taken using an independent

device. Meter maintenance requirements are extremely site sensitive. Some sites will require minimal maintenance visits, while others will be continually affected by silt and debris build-up.

The flow meters and rain gauges will be maintained in the field per the manufacture's and City's guidelines and as needed to ensure that the meters are properly functioning and recording quality data. Meter maintenance may include cleaning and/or adjustment of sensors, and replacement of batteries, desiccant or other equipment components as needed.

Calibration Procedures

Field calibration is the process of independent verification of the flow meters. Field calibration of all meters will be conducted to verify the accuracy and repeatability of the recorded data. Field calibration includes entry into the meter manhole and measurement of the flow depth and flow velocity (using a portable velocity meter). Field calibration will be completed monthly, at a minimum, and as necessary based on data review and diagnostics. Field calibration measurements gathered throughout the monitoring period will be used to perform any adjustments to meter recorded depth or velocity data.

3.7 Wastewater Flow Characterization

Flow Data Analysis

Flow data will be analyzed on a site by site basis. Analysis of each site will be performed using the flow calculated by the continuity equation:

$$Q = V * A$$

Where:

Q = Flow

V = Velocity

A = Cross sectional flow area

If the continuity equation is not applicable, then flow will be calculated using the open channel Manning flow equation:

$$Q = 1.49/n\ R^{2/3}\ S^{1/2}\ A$$

Where:

Q = Flow

n = Pipe roughness

R = Hydraulic radius

S = Hydraulic grade Line

A = Cross sectional flow area

Dry Weather Analysis

A dry weather period will be established for each site to show its normal hydraulic behavior. Based on the rainfall data, the interval during a period of little or no rainfall and after all flow monitoring sites return to normal flow levels following a previous rainfall event will be used to characterize dry weather flows and determine the ADWF and PDWF.

Wet Weather Analysis

There are two aspects to wet Weather Analysis. The first aspect of the wet weather analysis is carried out in the same manner as that for the dry weather period. The response of the monitoring sites to rainfall in terms of observed peak flow rate and flow depth will be described and compared to the observed peak flow rate and flow depth for the dry weather period, and the PWWF value will be determined. The second aspect of the analysis quantifies the rainfall-dependent inflow/infiltration (RDI/I) observed at each monitoring site.

In determining the wet weather response of a site, all rain events during a monitoring period will be reviewed. The rain event that will be chosen will be determined based on the response of each rain gauge and the relationship to the flow monitoring site. Any increase of flow over the dry weather average at each site in response to wet weather will be noted as RDI/I.

Infiltration/Inflow

Inflow is defined as the component of wastewater consisting of extraneous water that is discharged into a sewer system from sources such as sump pumps, roof leaders, cellar/foundation drains, drains from springs and swampy areas, manhole covers, catch basins, cross-connections from storm drains, cooling water discharges, and other inlets. Inflow differs from infiltration in that it is the result of direct connections of extraneous flow sources into the collection system and, generally, is not linked to fluctuations in the groundwater table. Inflow is largely the result of wet weather (storm water) influences on the sewer system. During dry weather, the quantity of inflow is generally expected to approach zero. During storm events, inflow may rapidly impact the sewer system causing the wastewater flow to increase. The increase in wastewater flow due to inflow may terminate a short time after the storm event or it may influence the sewer system for a prolonged period depending on the type of inflow sources which exist in the system. It is not uncommon for inflow to elevate wastewater flows for a number of days.

Infiltration, in contrast, is water that enters the system through structural defects. One aspect of the Program will be to evaluate the relative contribution of inflow vs. infiltration to the extent practicable. The I/I variability will also be assessed. Consistent with the requirements of the Consent Decree, the criterion for "Source of Excessive I/I" will be developed based on reasonable interpretation of the observed data. I/I sources that are deemed excessive will be targeted for remediation as further described in Section 5.

4.0 WBI Condition Assessment

A primary focus of the City of Jackson wastewater infrastructure redevelopment program is the investigation of sources of infiltration/inflow and identification defects for which a failure could lead to extensive service disruptions and environmental damage. A risk-based condition assessment program will be implemented by the City to identify the specific wastewater collectors that present these types of risk. The WBI is the main trunk line which carries wastewater to the City's main WWTP. Therefore, it is considered a high risk component of the City of Jackson sewer system. The objective of the WBI condition assessment is to quantify the structural condition, performance, and/or progression of deterioration (i.e. remaining service life) of the system. The criteria that will be used for the WBI structural assessment, structural deficiency evaluation, and proposed evaluation methodology are described below.

4.1 Condition Assessment Overview

A variety of processes have been developed for performing condition assessments, ranging from simple to complex. These processes generally follow a similar progression of steps: setting objectives for the condition assessment, identification of assets and available data, asset inspection, data analysis, and decision making. **Figure 4-1** illustrates the basic steps in the condition assessment process.

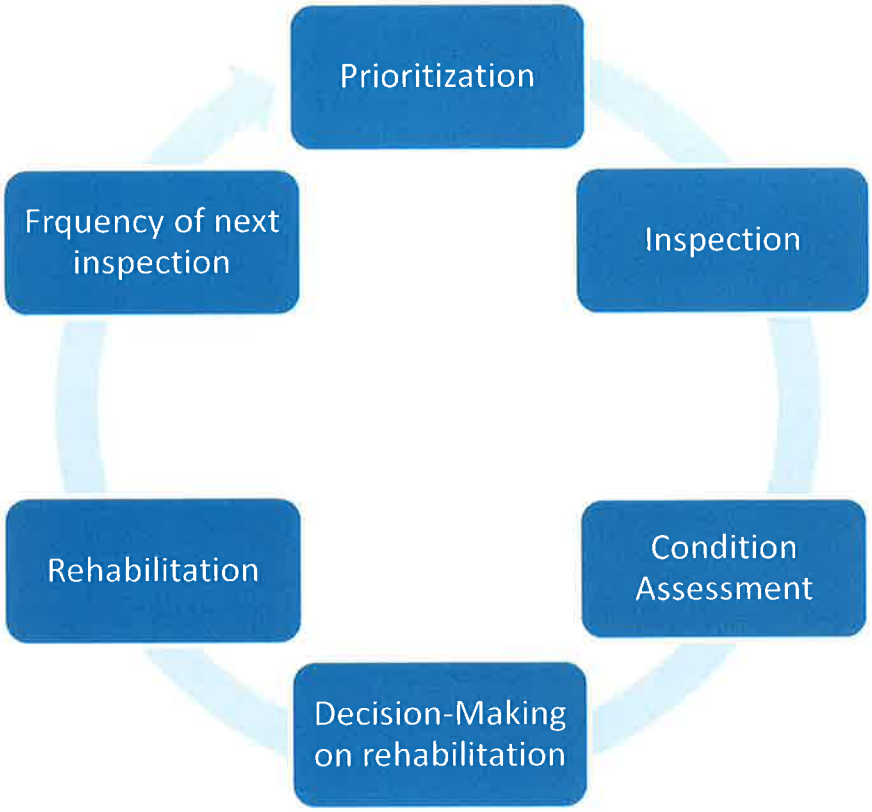


Figure 4-1
Condition Assessment Flow Chart

Specific benefits that the condition assessment program will provide include:

- Avoided emergency repair costs.
- Avoided costs of extended service disruptions due to a catastrophic failure.
- Avoided restoration costs due to environmental and property damage from a catastrophic failure.
- Avoided public health costs (i.e. injury, death, disease transmission) from catastrophic failure.
- Improved planning and prioritization of rehabilitation and replacement projects based on condition assessment information and improved estimates of service life.
- Avoided costs of premature pipe replacement or rehabilitation.

4.2 Structural Assessment Criteria

The data resulting from inspection is intended to quantify the level of service and/or structural defects. Analysis of WBI structural defects identified using the inspection techniques will be performed by coding defects in accordance with the National Association of Sewer Service Companies (NASSCO) Pipeline Assessment and Certification Program (PACP) and the associated Manhole Assessment and Certification Program (MACP). This is an accepted standardized coding system intended to provide consistent defect ratings. PACP and MACP employ visual inspection of manholes and pipeline video to objectively prioritize maintenance, repair, or replacement requirements. Structural pipe defects and hydraulic restrictions encountered during the inspection will be ranked by severity level based on the potential to negatively impact the hydraulic capacity of the WBI. Following data analysis, the condition assessment results will be used to make decisions on rehabilitation, replacement and/or further inspection. These will be presented in the subsequent ***West Bank Interceptor Rehabilitation Plan*** that will be completed in 2015.

For wastewater collection systems, analysis of inspection data generally involves coding the defects based on both the type and severity of defects. The PACP coding system categorizes defects and features into five sections: continuous defect coding, structural defect coding, operational and maintenance coding, construction features coding, and miscellaneous features coding. For each type of defect, the PACP uses a combination of capital letters to describe the type of defect and a number to rank the severity of the defect. An example is "FL," for a longitudinal fracture. Defect codes are recorded on a standardized form along with pertinent system data including defect type, continuous distance of the defect, severity, size, circumferential location (clock location), joint number, image/video reference number, and comments.

A brief description of the PACP defect coding system is described below:

- **Continuous Defect Coding –** Defects that run along the sewer, such as longitudinal fractures and cracks, or occur at regular intervals along the pipe.

- **Structural Defect Coding –** Coding to define the type of defects that are related to structural degradation of the pipe due to various reasons, such as cracks, fractures, breaks, holes, deformation, collapse, joint failure, and others.

- **Operational and Maintenance Defect Coding –** Coding to define defects related to lack of maintenance on the pipe system, such as deposits, roots, infiltration, obstacles, and others.

- **Construction Features Coding –** Coding to define construction features located in or around the pipe system, such as pipe tap, intruding seal material, pipe lateral, and manholes.

- **Miscellaneous Features Coding –** Classifications for coding of miscellaneous features.

A numerical grading system is also used define the severity of pipe defects. Condition grades for structural defects and operation and maintenance defects are assigned based on the risk of further deterioration or failure. The numerical system uses numbers ranging from 1 to 5 with 1 being the best and 5 being the worst. The severity ranking considers the immediate defect, risk of failure, and rate of deterioration.

- **Grade 5** – Pipe segment has failed or will likely fail within the next five years. Pipe segment requires immediate attention.

- **Grade 4** – Pipe segment has severe defects with the risk of failure within the next five to ten years.

- **Grade 3** – Pipe segment has moderate defects. Deterioration may continue, but not for ten to twenty years.

- **Grade 2** – Pipe segment has minor defects. Pipe is unlikely to fail for at least 20 years.

- **Grade 1** – Pipe segment has minor defects. Failure is unlikely in the foreseeable future.

An overview of the PACP defect coding system is shown on **Figure 4-2**. To properly apply the PACP coding system, the City of Jackson will use trained evaluators who have current NASSCO certification.

Figure 4-2

NASSCO'S PIPELINE ASSESSMENT & CERTIFICATION PROGRAM (PACP)©

Section 4—Continuous Defect Coding

"TRULY" 4-1

"Truly" continuous defects run along the sewer without any interruption for more than three feet (1 meter).
Examples:
- Longitudinal Fractures
- Longitudinal Cracks

"REPEATED" 4-1

"Repeated" continuous defects occur at regular intervals along the sewer. These occur at pipe joints and include:
- Encrustation
- Open Joints
- Circumferential Fractures

Code Changes in Version 6.0.1

Added:
Buckling Wall (KW), Buckling Dimpling (KD), and Buckling Inverse Curvature (KI)

Section 5—Structural Defect Coding (Module 6A)

C CRACK 5-1
- CL Longitudinal 5-2
- CC Circumferential 5-2
- CM Multiple 5-2
- CS Spiral 5-2
- CH Hinge 5-2

F FRACTURE 5-7
- FL Longitudinal 5-7
- FC Circumferential 5-7
- FM Multiple 5-7
- FS Spiral 5-7
- FH Hinge 5-7

B BROKEN 5-15
- BSV -Soil Visible Beyond Defect 5-15
- BVV -Void Visible Beyond Defect 5-15

H HOLE 5-17
- HSV -Soil Visible Beyond Defect 5-17
- HVV -Void Visible Beyond Defect 5-17

D DEFORMED 5-19
- DV Deformed Vertically (brick) 5-19
- DH Deformed Horizontally (brick) 5-19

X COLLAPSE 5-23
- XP Pipe Collapse 5-23
- XB Brick Collapse 5-23

J JOINT 5-26
- JO Joint Offset (Displaced) 5-26
- JS Joint Separated (Open) 5-26
- JA Joint Angular 5-26

S SURFACE DAMAGE 5-31
- SRI Roughness Increased 5-31
  - SRI - M - Mechanical
  - SRI - C - Chemical
  - SRI - Z - Not Evident

S SURFACE DAMAGE 5-31
- SAV Aggregate Visible 5-31
  - SAV - M - Mechanical
  - SAV - C - Chemical
  - SAV - Z - Not Evident

S SURFACE DAMAGE 5-31
- SAP Aggregate Projecting 5-31
  - SAP - M - Mechanical
  - SAP - C - Chemical
  - SAP - Z - Not Evident

S SURFACE DAMAGE 5-31
- SAM Aggregate Missing 5-31
  - SAM - M - Mechanical
  - SAM - C - Chemical Attack
  - SAM - Z - Not Evident

S SURFACE DAMAGE 5-31
- SRV Reinforcement Visible 5-31
  - SRV - M - Mechanical
  - SRV - C - Chemical Attack
  - SRV - Z - Not Evident

S SURFACE DAMAGE 5-31
- SRP Reinforcement Projecting 5-31
  - SRP - M - Mechanical
  - SRP - C - Chemical Attack
  - SRP - Z - Not Evident

S SURFACE DAMAGE 5-31
- SRC Reinforcement Corroded 5-31
  - SRC - M - Mechanical
  - SRC - C - Chemical Attack
  - SRC - Z - Not Evident

S SURFACE DAMAGE 5-31
- SMW Missing Wall 5-32
  - SMW - M - Mechanical
  - SMW - C - Chemical Attack
  - SMW - Z - Not Evident

S SURFACE DAMAGE 5-31
- SSS Surface Spalling 5-32
  - SSS - M - Mechanical
  - SSS - C - Chemical Attack
  - SSS - Z - Not Evident

S SURFACE DAMAGE 5-31
- SZ Other 5-32
  - SZ - M - Mechanical
  - SZ - C - Chemical Attack
  - SZ - Z - Not Evident

S SURFACE DAMAGE 5-31
- SCP Corrosion (metal pipe) 5-32
  - *no modifiers used

K BUCKLING 5-45
- KW Wall 5-45
- KD Dimpling 5-46
- KI Inverse Curvature 5-46

LF LINING FAILURE 5-49
- LFD Detached Lining 5-49
- LFDE Detective End 5-49
- LFB Blistered Lining 5-49
- LFCS Service Cut Shifted 5-49
- LFAC Abandoned Connection 5-49

LF LINING FAILURE 5-49 (continued)
- LFOC Overcut Service 5-49
- LFUC Undercut Service 5-49
- LFBK Buckled Lining 5-49
- LFW Wrinkled Lining 5-49
- LFAS Annular Space 5-49

LF LINING FAILURE 5-50
- LFBU Bulges 5-50
- LFDC Discoloration 5-50
- LFDL Delamination 5-50
- LFRS Resin Slug 5-50
- LFPH Pinholes 5-50
- LFZ Other 5-50

WF WELD FAILURE 5-67
- WFL Longitudinal 5-67
- WFC Circumferential 5-67
- WFM Multiple 5-67
- WFS Spiral 5-67
- WFZ Unidentified 5-67

RP POINT REPAIR 5-71
- RPR Pipe Replaced 5-69
  - RPR - D - Defective 5-69
- RPP Patch Repair 5-69
  - RPP - D - Defective 5-69

RP POINT REPAIR 5-71
- RPL Localized Pipeliner 5-69
  - RPL - D - Defective 5-69
- RPZ Other 5-69
  - RPZ - D - Defective 5-69

BRICKWORK 5-77
- DB Displaced 5-75
- MB Missing 5-75
- DI Dropped Invert 5-75

BRICKWORK 5-77
- MM Missing Mortar 5-75
  - S - Small 5-75
  - M - Medium 5-75
  - L - Large 5-75

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Figure 4-2 (continued)

NASSCO'S PIPELINE ASSESSMENT & CERTIFICATION PROGRAM (PACP)©

Section 6—Operational and Maintenance (Module 6B)

D	DEPOSITS	6-1
DA	Attached	6-1
DAE	-Encrustation	6-2
DAG	-Grease	6-2
DAR	-Ragging	6-2
DAZ	-Other	6-2

D	DEPOSITS	6-1
DB	Settled	6-1
DBF	-Fine	6-2
DBGV	-Gravel	6-2
DBC	-Hard/Compacted	6-2
DBZ	-Other	6-2

D	DEPOSITS (continued)	6-1
DN	Ingress	6-1
DNF	-Fine (silt & sand)	6-1
DNGV	-Gravel	6-1
DNZ	-Other	6-1

R	ROOTS	6-7
RF	Fine	6-7
RFB	-Barrel	6-7
RFL	-Lateral	6-7
RFC	-Connection	6-8

R	ROOTS	6-7
RT	Tap	6-7
RTB	-Barrel	6-7
RTL	-Lateral	6-7
RTC	-Connection	6-8

R	ROOTS	6-7
RM	Medium	6-7
RMB	-Barrel	6-7
RML	-Lateral	6-7
RMC	-Connection	6-8

R	ROOTS	6-7
RB	Ball	6-7
RBB	-Barrel	6-7
RBL	-Lateral	6-7
RBC	-Connection	6-8

I	INFILTRATION	6-13
IS	Stain	6-13
IW	Weeper	6-13
ID	Dripper	6-13
IR	Runner	6-13
IG	Gusher	6-13

OB	OBSTACLES/ OBSTRUCTIONS	6-19
OBB	Brick or Masonry	6-19
OBM	Pipe Material in Invert	6-19
OBI	Object protruding through wall	6-19

OB	OBSTACLES/ OBSTRUCTIONS	6-19
OBJ	Object wedged in joint	6-19
OBC	Object through connection/junction	6-19
OBP	External Pipe Cable	6-19

OB	OBSTACLES/ OBSTRUCTIONS	6-19
OBS	Built into structure	6-20
OBN	Construction Debris	6-20
OBR	Rocks	6-20
OBZ	Other	6-20

V	VERMIN	6-31
VR	Rat	6-31
VC	Cockroach	6-31
VZ	Other	6-31

G	GROUT TEST & SEAL	6-33
GTP	Grout Test Passed	6-33
GTP - J - Joint		6-33
GTP - L - Lateral		6-33
GTF	Grout Test Failed	6-33

G	GROUT TEST & SEAL	6-33
GTU	Grout Test Unable	6-33
GTU - J - Joint		6-33
GTU - L - Lateral		6-33
GRT	Grout Test Location	6-33

Section 7—Construction Features Coding (Module 6C)

T	TAP	7-1
TF	Factory Made	7-1
TFI	-Intruding	7-2
TFA	-Active	7-2
TFC	-Capped	7-2
TFB	-Abandoned	7-2
TFD	-Defective	7-2

T	TAP	7-1
TB	Break In/Hammer	7-2
TBI	-Intruding	7-2
TBA	-Active	7-2
TBC	-Capped	7-2
TBB	-Abandoned	7-2
TBD	-Defective	7-2

T	TAP	7-1
TS	Saddle	7-2
TSI	-Intruding	7-2
TSA	-Active	7-2
TSC	-Capped	7-2
TSB	-Abandoned	7-2
TSD	-Defective	7-2

T	TAP	7-1
TR	Rehabilitated	7-2
TRI	-Intruding	7-2
TRA	-Active	7-2
TRC	-Capped	7-2
TRB	-Abandoned	7-2
TRD	-Defective	7-2

IS	INTRUDING SEALING MATERIAL	7-9
ISSR	Sealing Ring	7-9
ISSRH	-Hanging	7-9
ISSRB	-Broken	7-9
ISSRL	-Loose	7-9

IS	INTRUDING SEALING MATERIAL	7-9
ISGT	Grout	7-9
ISZ	Other	7-9

L	LINE (of sewer)	7-11
LL	Left	7-11
LLU	Left Up	7-11
LLD	Left Down	7-11
LR	Right	7-11

L	LINE (of sewer)	7-11
LRU	Right Up	7-11
LRD	Right Down	7-11
LU	Up	7-11
LD	Down	7-11

A	ACCESS POINT	7-13
AMH	Manhole	7-13
AWA	Wastewater Access	7-13
ADP	Discharge Point	7-13
ATC	Tee Connection	7-13

A	ACCESS POINT	7-13
AOC	Other Special Chamber	7-13
AM	Meter	7-13
AWW	Wet Well	7-14
AJB	Junction Box	7-14

A	ACCESS POINT	7-13
ACO	Clean Out	7-14
ACOM	-Mainline	7-14
ACOP	-Property	7-14
ACOH	-House	7-14

A	ACCESS POINT	7-13
ACB	Catch Basin	7-14
AEP	End of Pipe	7-14

Section 8—Miscellaneous Features Coding (Module 6D)

M	MISCELLANEOUS FEATURES	8-1
MCU	Camera Underwater	8-1
MGO	General Observation	8-1
MGP	General Photograph	8-1
MSC	Shape/Size Change (Sewer Dimension/Vertical/ Horizontal)	8-1
MJL	Joint Length Change	8-1

M	MISCELLANEOUS FEATURES	8-1
MLC	Lining Change	8-2
MMC	Material Change	8-2
MSA	Survey Abandoned	8-2
MWL	Water Level	8-2
MWLS	-Sag	8-2

M	MISCELLANEOUS FEATURES	8-1
MWM	Water Mark	8-2
MY	Dye Test	8-2
MYV	-Dye Visible	8-3
MYN	-Not Visible	8-3

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4.3 Proposed Evaluation Methodology

The primary purpose of the condition assessment will be to define the current condition of the West Bank Interceptor in order to detect and evaluate the progression of deterioration and to make informed decisions regarding rehabilitation. The evaluation methodology to be employed by the City of Jackson is described below.

Condition Assessment Methods

A number of inspection techniques may be employed to inspect the WBI. The proposed methodologies that may be used to assess the condition of the West Bank Interceptor are summarized below.

- **Manhole inspection** performed by trained personnel to provide qualitative and quantitative information about observed defects and coding according to MACP standards.

- **Closed Circuit Television (CCTV)** using a tethered CCTV camera capable of providing pan, tilt, and zoom inspection to provide visual data on leaks, observable structural defects, location of service laterals, and sediment and debris accumulation (above the water line).

- **Sonar Inspection** using equipment capable of identifying debris levels and pipe defects below the flow line.

- **Smoke/Gas Testing** to identify leaks, the presence of broken pipes, improperly sealed laterals, illegal lateral drains, and cross connections between different systems.

- **Dye testing** to trace the flow of effluent through the sewer system and to check if stormwater drains are connected to sanitary sewers through illegal or unrecorded connections.

- **ROW/Easement Inspection** to identify displaced manhole covers, rings, or above-ground cone sections; ground surface instabilities; and damaged creek crossings.

Additionally, if necessary, more specialized techniques may be employed if required on a site specific basis. These techniques could laser profiling, infrared thermography, and electrical/electromagnetic technologies.

Closed Circuit Television Inspection

Inspection of sewer infrastructure by means of CCTV equipment will be performed to determine the location and extent of any obstructions and/or defects such as offset joints, protruding tees, broken pipe, and other pipe defects that may permit groundwater infiltration/inflow or cause structural deficiency within the system. Records will note the existence of any significant defects. Typically, a large percentage of the system can be inspected without cleaning the pipe; however, some segments may require cleaning prior to

CCTV inspection to enable the passage of the camera through the pipe or to remove obstructions that may impede proper inspection.

The schedule to perform investigations will be such that system overflows are prevented. If normal or high flows interfere with the collection of accurate data, the work will be scheduled during low flow periods or by-pass pumping around the site would be used.

CCTV inspections will be performed on one manhole-to-manhole pipe segment at a time. The CCTV camera will be moved through the line along the axis of the pipe in order to properly capture the data. A record will be made when each manhole-to-manhole pipe segment is televised and will include at a minimum:

- Location of each point of leakage
- Location of each service connection or other pipe entering the televised line
- Location and degree of offsets
- Location of any damaged sections, and nature of damage
- Location of buried structures or blind junctions
- Location and amount of any deflection in alignment or grade of pipe; also the total length of pipe sag
- Pipe materials, diameter, and distance between pipe joints
- Date, city, manhole-to-manhole segment, reference manhole number, name of operator, and inspector
- Segment length
- Video Filename

Proper documentation of the data is essential; therefore, all pipe and manhole inspections will be made by NASSCO certified operators and data will be documented using PACP and MACP standard and protocols accordingly.

Specialty Inspections

Specialty inspections may be performed in the areas where conditions warrant. CCTV and/or laser inspections may be used above the flow line and sonar inspections below the flow line within the sewer pipe. The intent of the inspection is to obtain data on the full circumference of the pipeline regardless of flow level. In cases where large diameter pipe may contain large deposits of debris, sonar may be used to quantify the debris below the flow line.

Typically, CCTV and sonar are used for pipes with 25%-75% flow. Pipes with greater than 75% flow typically will require sonar only. A laser evaluation of a segment may be used when the pipe contains less than 30% flow and access to both manholes is available.

Manhole Inspection

The purpose of manhole condition assessment is to determine the physical condition, location, and possible sources of I/I in all manholes included within the WBI system.

Information obtained during the physical survey will be utilized in determining rehabilitation costs and methods.

Each manhole assessment will be performed by determining the dimensional configuration and physical condition of the base, channel(s), barrel, corbel, connections, cone, ring and cover of the structure and location of possible sources of I/I. The arrangement in the manhole will be characterized with a drawing that indicates the invert and direction of flow.

Condition Assessment with Internal Images

Typically, manhole inspections are performed by the technician entering the manhole and documenting the defects accordingly. However, advances in technology enables manhole condition assessment to be performed by using a high resolution, pole-mounted viewing camera with lighting, or a 3D scanner with a high resolution digital camera equipped with a specially designed distortion-free wide-angle lense. Digital high-resolution photographs will be taken to show general surrounding view(s) to identify the above ground location and other GIS map features, plan view looking down at the invert, and major defects within the manhole.

Documentation

Data that will be obtained during the manhole condition assessment will generally consist of the following:

1. General Information
   - Manhole number
   - Basin name
   - Address/ Location description
   - Surface conditions, etc.
2. Manhole Characteristics
   - For each section of a manhole — type, shape, materials, depth and size
   - Cover vent hole number and size
   - Relation to grade
   - Inflow dish
   - General configuration
3. Pipe Data
   - Size, shape, material, liner, depth and clock position
   - Flow depth
   - Indication if drop pipe and/or parallel line
4. Manhole Sketch showing incoming and outgoing pipes with connecting points.
5. General Inspection Data
   - Inspector name, assessment date, status of inspection, method of inspection, weather condition

- Presence of flusher valves
- Evidence of surcharge, groundwater, ponding and debris

6. Defects in manholes
   - Location and nature of visible defects and obstructions (i.e., indication of structural conditions or special problems in the pipe connection/manhole)
   - Root growth and type in manhole wall/base (if any)
   - Evidence of leaks and locations, along with measured or estimated sources of extraneous flows (i.e. identification and quantification of I/I)
   - pecial problems and/or conditions such as overflows, bypasses, etc.

7. Type and depth of debris and deposition in the manhole (if any).

8. Photographic documentation
   - High-resolution digital color photographs shall be taken for each manhole assessed, including above ground features and conditions in the vicinity of the manhole, plan view from surface of manhole invert, elevation view of each incoming and outgoing sewer, and all observed defects and obstructions.
   - Reference to location for each photograph shall be indicated on sketches. Photographs taken within the manhole shall indicate the depth below the ground surface and clock reference, relative to North at 12 o'clock. Each photograph filename shall be entered into an electronic database in the appropriate corresponding record.

Smoke Testing

Smoke testing is used to detect I/I sources in sewer systems when evidence of excessive I/I exists. This test identifies the location of illicit connections into the sewer system, e.g. downspouts, yard drains, building foundation drains, and storm sewers. The smoke testing program will include procedures for public notification and record keeping. The program will define how line segments are to be isolated and the maximum amount of line to be tested at one time. Weather conditions can affect smoke testing; therefore, no testing will be performed during rain, snow, and periods of high winds. Written records will be further documented with photographs.

Dyed Water Flooding

Dyed water flooding is used in addition to smoke testing to identify sources of I/I by injecting dye into areas where ground conditions remain moist, causing the smoke testing to be ineffective. Dye tablets can be inserted into suspected direct or indirect connections to sewer system to determine possible cross connections or areas allowing inflow to enter the system. CCTV equipment may be required to assist in the evaluation process. Written records of the dye testing results will be further documented with photographs.

ROW/Easement Inspection

Inflow may enter the system through displaced manhole covers, rings, and/or above ground cone sections; sections of pipe located in close proximity of waterways where the

stability of the soil has been compromised; and/or damaged creek crossings. Therefore, an above ground inspection of the entire WBI system will be conducted to identify observable problems with these surface features.

Assessment Methodology

Data and information required for the internal condition assessment will be obtained through a series of detailed field inspections of the WBI performed by a qualified contractor. Detailed condition assessment specifications were developed to provide requirements and guidelines for the field evaluation activities and are included in **Appendix B** for sanitary sewer inspection and **Appendix C** for manhole inspections. It is the intent of the evaluation to inspect all 180 manholes along the WBI.

Interpretation of the flow monitoring results and the structural defect categorization of the WBI pipe and manholes to determine the required rehabilitation measures is described in Section 5.

5.0 WBI Remedial Measures

This section describes the remedial measures that will be evaluated to correct deficiencies identified on the West Bank Interceptor. The specific remedial measures to be used will be determined as part of the subsequent ***West Bank Interceptor Rehabilitation Plan*** that will be prepared upon completion of the evaluation activities.

5.1 WBI Evaluation

The principal WBI evaluation methods consist of flow and rainfall monitoring to quantify I/I, and the detailed condition assessment of WBI pipe, manholes, and other appurtenances, as further described below.

Flow Monitoring

Flow and rainfall monitoring of the WBI will be performed over a proposed one-year period beginning in the fall of 2013. Expected results from the evaluation program are:

- Baseline dry weather wastewater flows.
- Measurement and quantification of wet weather and peak flows.
- Estimated volume of I/I entering various sewer segments/sewersheds that contribute to the West Bank Interceptor.
- Required data for capacity assessment of individual WBI segments.
- Information sufficient to prioritize sewersheds for further evaluation and analysis.

The techniques that will be used to evaluate the flow and rainfall data were described in Section 3.

Condition Assessment

The condition assessment of the WBI will consist of CCTV of the line, detailed review of the collected video by NASSCO-certified technicians, identification of observable defects, and rating of the defects according to the NASSCO PACP standards, together with results of other more specialized inspections where required for site specific areas. This will include smoke testing, dye testing, and ROW/easement inspection as described in Section 4. Inspection logs for all manholes will also be generated that will delineate the defects for each manhole.

Remedial Measures Identification

Upon completion of the flow monitoring and condition assessment activities, the condition assessment data and the flow monitoring results will be evaluated in depth by the

engineering team to determine the required rehabilitation measures needed to restore each segment of the WBI.

Risk Evaluation

Based on the degree of defects observed and the quantity of I/I identified, each major segment of the WBI will be prioritized for repair. Appropriate prioritization criteria will be developed and included in the ***West Bank Interceptor Rehabilitation Plan***. The criteria will facilitate ranking of each segment according to selected risk parameters such as:

1. SSO frequency, volume, and location
2. I/I severity
3. Environmental and public health risk
4. Potential impact of failure
5. Expected results of ongoing or scheduled rehab activities
6. Maintenance history
7. Pipe age and material

and/or other criteria that may subsequently be developed. Rating factors will be assigned to each of the risk parameters to reflect the degree of risk and impact. The results of this ranking procedure will be used to determine the rehabilitation actions that will be implemented for each major segment of the WBI.

Cost Effectiveness Evaluation

Additionally, detailed cost effectiveness criteria will be developed and used in the evaluation as an aid in evaluating the rehabilitation measures. The cost effectiveness criteria to be used will be developed as part of the ***West Bank Interceptor Rehabilitation Plan***. The criteria will serve as an aid in determining the most cost effective means of correcting or alleviating excessive I/I conditions detected in the system.

The cost effectiveness criteria will allow comparison of the cost of possible solutions and combinations of solutions, including treatment plant enlargement, WBI capacity enlargement, offline storage, and I/I abatement through rehabilitation or pipe replacement. The results of this evaluation step will allow accurate comparison of the cost of conveyance and treatment vs. the cost of rehabilitation and I/I reduction.

The objective will be to determine the most cost effective solution that provides the greatest return for the required financial outlay. The estimated cost of ongoing maintenance and/or increased maintenance attributed to defects not eliminated will be included in the

evaluation, as well as the cost of continued deterioration of the system due to existing defects. The final wet weather control measures selected will represent the least cost combination of conveyance improvements, treatment plant peak flow capacity improvements, and sewer rehabilitation measures.

5.2 Phase I Remedial Measures

The first phase of the WBI rehabilitation will consist of cleaning and debris removal, where required, and all repairs necessary to correct major structural defects and sources of excessive I/I. Phase I remedial measures must be completed within six years of approval of the Work Plan. The cleaning and repair procedures that are anticipated to be used for the Phase I WBI rehabilitation are described below.

Debris Cleaning

Debris cleaning will be performed in pipe and manhole areas that are identified or indicated by various innovative and mature technologies such as the acoustic portable Sewer Line Rapid Assessment Tool, conventional Closed Circuit Television (CCTV), or more sensitive CCTV-Sonar technologies during assessment activities performed on the interceptor.

Debris that is detected usually consists of siltation due to infiltration of soil materials or settled solids from wastewater, floatable grease blockages, broken pieces of the wastewater infrastructure, or miscellaneous debris that passes through the infrastructure network.

Table 5-1 indicates typical sewer cleaning methods.[1] The cost of each type of debris locating technology increases in the order listed.

[1] *The O & M in CMOM: Operation and Maintenance, A Reference for Utility Operators*, Version 2.3A, Water Environment Federation, Alexandria, VA.

Table 5-1 Sewer Debris Cleaning Methods

General Cleaning Category	***Cleaning Method***	***Description***
MECHANICAL	**Rodding**	• Uses an engine and a drive unit with continuous rods or sectional rods. • As blades rotate they break up grease deposits, cut roots, and loosen debris. • Rodders also help thread the cables used for TV inspections and bucket machines. • Most effective in lines up to 12 inches in diameter.
	Bucket Machine	• Cylindrical device, closed on one end with 2 opposing hinged jaws at the other. • Jaws open and scrape off the material and deposit it in the bucket. • Partially removes large deposits of silt, sand, gravel, and some types of solid waste. • Must guard against catching the bucket within the line.
HYDRAULIC	**Balling**	• A threaded rubber cleaning ball that spins and scrubs the pipe interior as flow increases in the sewer line. • Removes deposits of settled inorganic material and grease build-up. • Most effective in sewers ranging in size from 5-24 inches.
	Flushing	• Introduces a heavy flow of water into the line at a manhole. • Removes floatables and some sand and grit. • Most effective when used in combination with other mechanical operations, such as rodding or bucket machine cleaning.
	Jetting	• Directs high velocities of water against pipe walls. • Removes debris and grease build-up, clears blockages, and cuts roots within small diameter pipes. • Efficient for routine cleaning of small diameter, low flow sewers.
	Scooter	• Round, rubber-rimmed, hinged metal shield that is mounted on a steel framework on small wheels. The shield works as a plug to build a head of water. • Scours the inner walls of the pipe lines. • Effective in removing heavy debris and cleaning grease from line.

Table 5-1 Sewer Debris Cleaning Methods

General Cleaning Category	***Cleaning Method***	***Description***
HYDRAULIC (continued)	**Root Cutters**	• Rotating cutter head. • Hydraulically propelled. • Effective in removing roots, debris, encrustations, or grease depending on the cutter head used.
	Chain Cutters	• Rapidly rotating cutting chains. • Suitable for cleaning 4" pipe (laterals). • Hydraulically propelled. • Effective in removal of roots, grease, and mineral deposits.
	Milling Cutters	• Cylindrical cutter head near the pipe I.D. • Hydraulically propelled. • Effective in removing tough deposits such as hard grease, concrete, scale, and protruding laterals.
	Kites, Bags, and Poly Pigs	• Similar in function to the ball. • Rigid rims on bag and kite induce a scouring action. • Effective in moving accumulations of decayed debris and grease downstream.
	Silt Traps	• Collect sediments at convenient locations. • Must be emptied on a regular basis as part of the maintenance program.
	Grease Traps and Sand/Oil Interceptors	• As required by Jackson Pretreatment Ordinance
CHEMICALS	*Review Material Safety Data Sheets (MSDS) and follow manufacturer's procedures on the proper use of chemicals. Follow local ordinance to properly disposal of chemicals used in the operation.* *Care should be exercised to ensure that root treatment chemicals do not create a biological imbalance at the treatment plant.*	• Used to control roots, grease, odors (H2S gas), concrete corrosion, rodents and insects. • *Root Control* - longer lasting effects than power rodder (approximately 2-5 years). • *H2S gas* - some common chemicals used are chlorine (Cl2), hydrogen peroxide (H2O2), pure oxygen (O2), air, lime ($CaOH_2$), sodium hydroxide (NaOH), and iron salts. • *Grease and soap problems* - some common chemicals used are bioacids, digester, enzymes, bacteria cultures, catalysts, caustics, hydroxides, and neutralizers.

Structural Defect Repair Methods

Structural defects in both manholes and pipes can be rehabilitated or replaced as determined from the structural condition inspections / assessments.

Manhole Rehabilitation

Many products are available for use in manhole rehabilitation, with each having benefits as well as limitations and disadvantages. The approach that will be taken by the City of Jackson will be to make a clear determination, for each manhole, of the repairs required to achieve long term rehabilitation. The repair needs will then serve as a guide in selecting the appropriate repair methods. Generally, where cost effective the approach will be to perform a full service repair to eliminate further concerns about the manhole. However, in some cases, interim patches may be performed where required to reduce I/I quickly.

With regard to products, investigation of rehabilitation options will include cementitious materials, epoxy, poly ureas, CIPP options, fiberglass, HDPE and other materials available. Special attention will be paid to caveats in installation requirements, exceptions in warranty specifications, warranty periods, material installation thickness requirements and, perhaps the most important element, the preparation requirements/specifications for the product.

Methods of manhole rehabilitation that may be used on the WBI include, but are not limited to:

- Shotcreting
- Grouting
- Structural lining
- Non-structural lining
- Total replacement
- Element specific repairs such as connections, ladders, landings, asphalt or concrete pavement, etc.

Table 5-2 indicates typical defects and rehabilitation methods that will be evaluated for rehabilitation of WBI manholes.[2]

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[2] *Guidelines for Condition Assessment and Rehabilitation of Large Sewers*, Zhao, McDonald, and Kleiner, Institute for Research in Construction, National Research Council Canada, Ottawa, Canada, 2001.

Table 5-2 Manhole Rehabilitation Methods

Manhole Defect	*Applicable Rehabilitation Methods*						
	Shotcreting	*Mortar Grouting*	*Chemical Grouting*	*Structural Lining*	*Non-structural Lining*	*Total Replacement*	*Element Specific Repairs*
Structural							
Vertical Fracture		X	X	X		X	
Horizontal Fracture		X	X				
Broken				X		X	
Crack	X	X	X		X		
Deformed						X	
Collapse						X	
Surface Damage	X			X	X		
Frame Damage							X
Cover Damage							X
Ground Surface Settlement							X
Serviceability							
Roots		X	X				X
Unsafe Ladder							X
Unsafe Landing							X
Connection Fault		X	X				
Infiltration		X	X				

In selecting the applicable rehabilitation methods, considerations for microbial induced corrosion (MIC) must also be entered into the evaluation equation. MIC is caused by the creation of hydrogen sulfide gas that forms sulfuric acid and attacks the pipe. Additionally, it should be noted that in specification review, many repairs may be considered incidental to the rehabilitation process. (i.e., grouting would be incidental to full manhole relining with cementitious or epoxy materials.)

Pipe Rehabilitation

Pipe rehabilitation technologies for decreasing excessive I/I and increasing pipe capacity include various lining techniques, grouting, and in extreme cases, complete replacement or construction of a parallel relief sewer.

There are numerous considerations that must be evaluated when choosing the correct remediation process for mainline and lateral sewers. The most pressing is capacity reduction. Sliplining and Pipe Jacking create the greatest cross sectional reduction. CIPP options, especially UV cured CIPP offer the least cross sectional reduction, while also increasing the Mannings coefficient (reducing friction). Fold and Form options do not typically provide much structural enhancement, and special attention should be taken to lateral connections since fold and form liners do not eliminate annular space between the new and existing pipes.

A stepwise approach is required to properly address excess I/I. Groundwater is persistent, and will change course over time to travel the path of least resistance. Eliminating one source of infiltration may simply redirect the water to the next easiest access point. With long term monitoring in place, evaluation of "stacked" processes can be performed to determine efficacy of the prescribed rehabilitation utilized. Mainline rehabilitation will redirect groundwater to manholes and service laterals. Manhole rehabilitation will intensify the attack on service laterals, since the service connection to the mainline is the lowest point on the system not yet rehabilitated. Service lateral rehabilitation may be an option as well, though is often complicated by access issues, easement considerations, and the return on investment. For the City of Jackson, service lateral rehabilitation will be addressed under a Supplemental Environmental Project.

In low lying areas, consideration will be given to providing the groundwater an engineered path of least resistance, essentially "French draining" the groundwater to a nearby creek or stream. This reduces the pressure on the mainline sewer, manholes, lateral connection, and the service laterals within the low lying area.

Several technologies are available that may be utilized in the WBI rehabilitation work, however, each has limitations on capabilities. **Table 5-3** lists current pipe rehabilitation technologies that will be considered for the WBI together with their limitations.

Table 5-3 Pipe Rehabilitation Technologies

Technology	***Pipe Diameter Range, Inches***	***Maximum Installation Range, Feet***	***Types of Material[1]***
Sliplining			
• Continuous	4-64	990	PE, PVC, PP, PE/EPDM
• Discrete segments	12-160	5600	PE, PVC, PP, GRP
• Diameter reduction sliplining	4-40	330	PE, PP
• Fold & form sliplining	4-24	1980	PE, PVC, FRP
Cured-In-Place			
• Felt based	4-110	3300	Non-woven polyester, woven polyester
• Woven hose	4-110	3300	Elastomeric membrane
• Membrane (non-structural)	4-110	3300	Elastomeric membrane
• UV cured CIPP	4-50	750	Woven fiberglass
• Spiral wound PVC	6-120	3000	PVC
• Ambient/Steam/Hot Water Cured service lateral lining	4-8	200	Non-woven felt
• Ambient/Steam/Hot Water Cured mainline to service connection seal	4-24	300	Non-woven felt, fiberglass/felt

Table 5-3 Pipe Rehabilitation Technologies

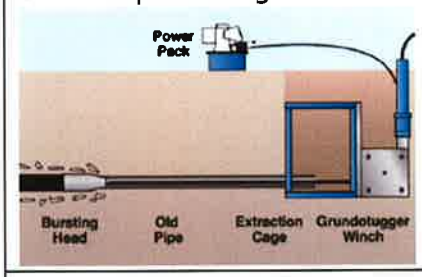
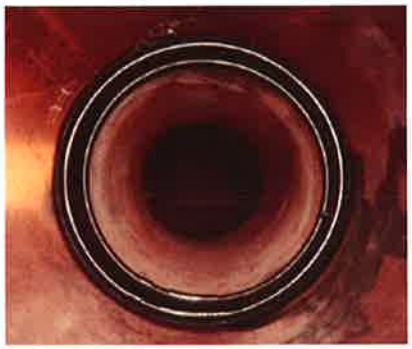
Technology	***Pipe Diameter Range, Inches***	***Maximum Installation Range, Feet***	***Types of Material[1]***
Pipe Replacement			
• Open Cut	Any	Unlimited	All
• Pipe Bursting 	2-48	495	PE, PVC, DI, VC
• Horizontal Drilling	2-48	5000	PE, PVC, DI, Steel
• Pipe Jacking	24-96	3000	RCP, PVC, GRP
• Auger Boring	4-72	330	DI, Steel
• Full Tunneling	36 and above	Unlimited	Concrete
• Micro Tunneling	12 and above	825	Concrete, DI, PE, PVC, Steel, VC

Table 5-3 Pipe Rehabilitation Technologies

Technology	***Pipe Diameter Range, Inches***	***Maximum Installation Range, Feet***	***Types of Material[1]***
Pipe Repair			
• Internal Joint Seals 			
• UV Cured CIPP Patch Repair	16 and above	Unlimited	EPDM
• Ambient Cured CIPP Patch Repair	6 thru 36 6 thru 24	Unlimited Unlimited	Woven Fiberglass Non-Woven Felt
• Panel & Section Linings	48 and above	Unlimited	GRP, GRC, Ferro-cement
• Chemical Grouting (non-structural)	Person access required	Unlimited	Acrylates, urethane foam, urethane gel

[1]**Note:** PE=polyethylene, PVC=polyvinyl chloride, PP=polypropylene, PE/EPDM= polyethylene/ethylene propylene diene monomer, DI=ductile iron, GRP=glass reinforced plastic, GRC=glass reinforced concrete, VC=vitrified clay

Rehab Technology Selection

During conduct of WBI evaluation activities, appropriate options will be considered for rehabilitation. Selection of the best option(s) will be based on existing technology, best practices, and the best engineering judgment and experience. A general methodology that considers system problems, their locations, and structural condition will be used as a guide in selection of the appropriate rehabilitation options. A flow chart for the WBI rehabilitation evaluation approach is shown on **Figure 5-1**.

Phase I Rehabilitation Plan Formulation

The initial WBI remediation phase will consist of implementing and completing the required structural repairs and rehabilitation measures to restore at least 20 percent of the total WBI length, as required by the Consent Decree. If it is determined that less than 20 percent of the total WBI length contains major structural defects and excessive I/I, then adequate justification will be provided in the ***West Bank Interceptor Rehabilitation Plan*** for rehabilitation of less than 20 percent of the total length, as allowed in the Consent Decree (§VI.B.22.c).

5.3 Phase II Remedial Measures

Phase II remedial measures consist of the long-term repairs required on the WBI necessary for proper asset management and/or addressing sources of non-excessive I/I. The Phase II remedial measures must be completed within 14.5 years of Work Plan approval. The approach that will be taken by the City of Jackson to address the Phase II remedial measures are described below.

Asset Management

Asset Management is a continuous process that guides the acquisition, use, and disposal of infrastructure assets to optimize service delivery and minimize costs over the asset's entire life. As part of the Consent Decree activities, the existing City of Jackson asset management practices will be further refined, updated, and expanded to address the wastewater facilities needing repair or improvement as identified in the Consent Decree. The City's asset management program will be used in developing the ***Financing and Cost Analysis Program*** that will be issued by September 1, 2014.

Phase II remedial measures required for the WBI will be developed to support the proper long-term maintenance and management of the WBI, which is a critical asset within the City's wastewater system infrastructure.

Required Long-Term Repairs

Results of the long-term flow monitoring program and the detailed condition assessment will be used by the City of Jackson to identify Phase II long-term repairs required for the WBI. A Facilities Plan for rehabilitation of the entire WBI was prepared by the City in 2009. This Facility Plan included a series of seven projects to rehabilitate the WBI, indicating that the entire 15 mile length required at least some repairs. The need for these repairs will be confirmed and quantified, and any resulting long-term repairs required will be described in the ***West Bank Interceptor Rehabilitation Plan*** that will be issued by September 1, 2015.

Phase II Repair Methods

Any of the pipe repair or pipe replacement methods listed on Tables 5-1 and 5-2 could potentially be included as part of the Phase II WBI repairs. Based on evaluations performed to date it does not appear that any additional sections of the WBI will require complete replacement. Phase II required repairs will likely be limited to secondary sources of I/I identified as being cost effective to remove. These repairs will likely consist of additional manhole rehabilitation and sewer relining. The precise Phase II repairs required will be described in the forthcoming ***West Bank Interceptor Rehabilitation Plan***.

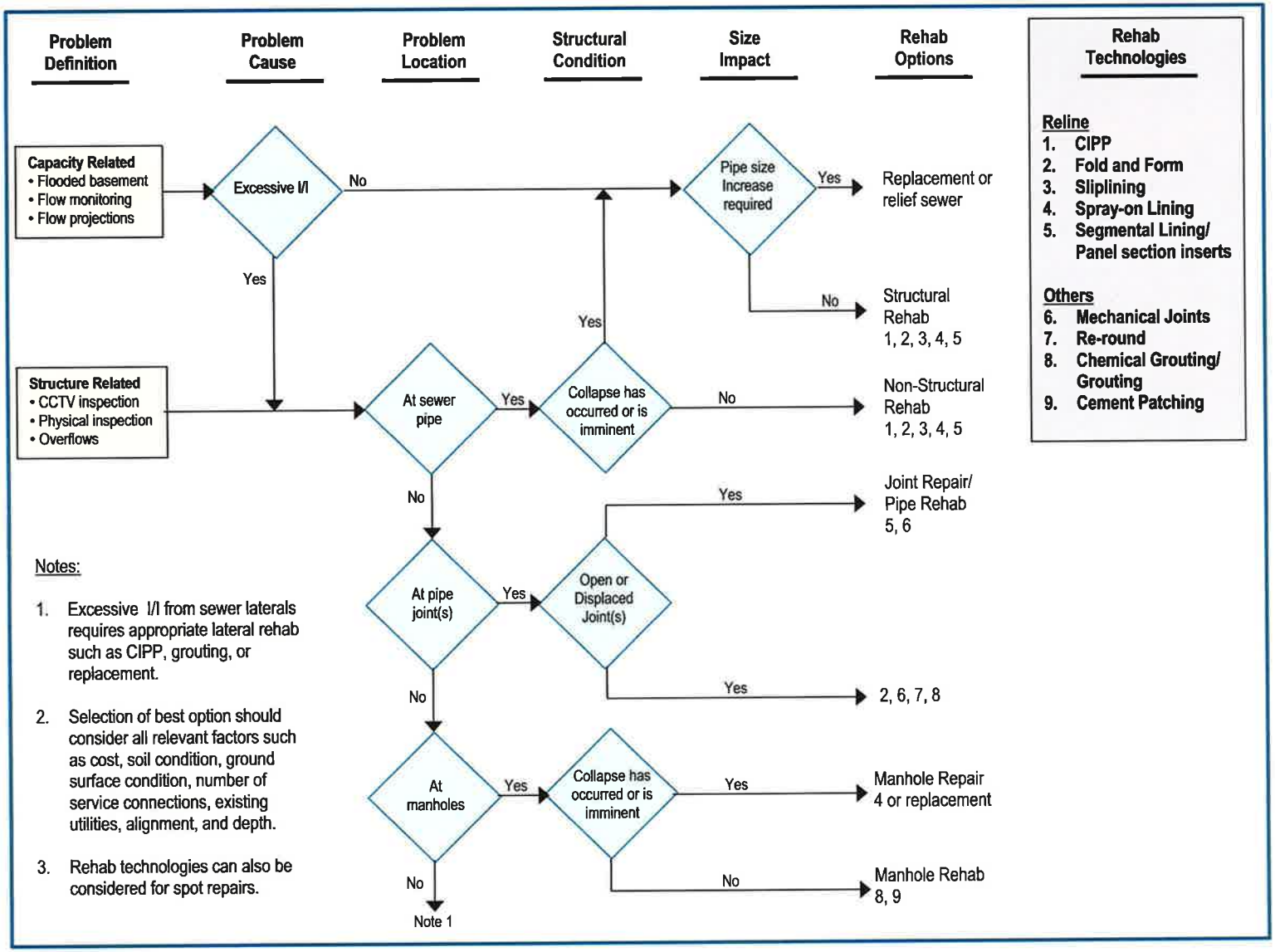


Figure 5-1

Wastewater System Rehabilitation Options

6.0 WBI Work Plan Implementation

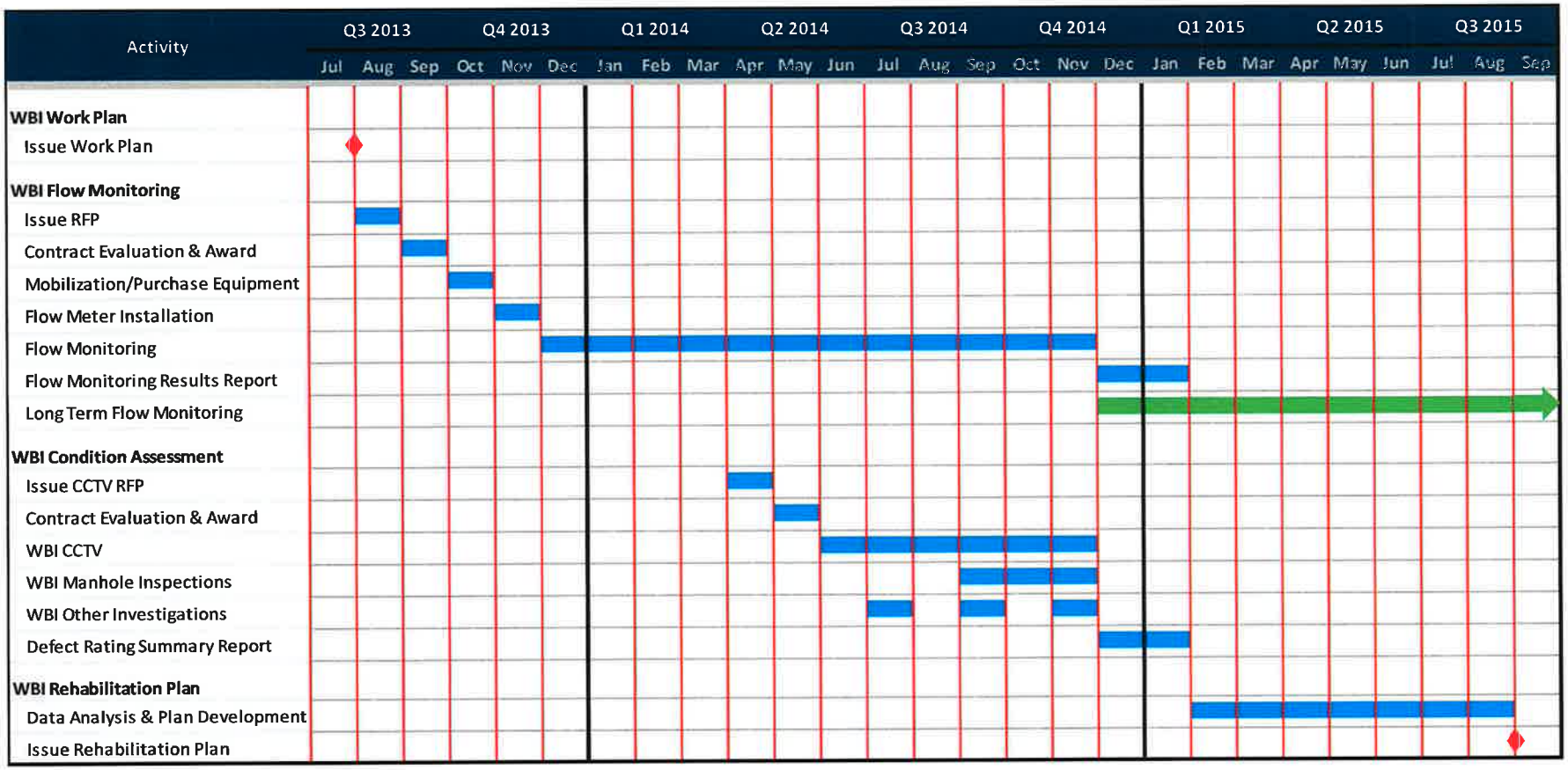
The ***West Bank Interceptor Work Plan*** is designed to serve as a guide in implementing the required WBI investigative activities that will:

- Characterize and quantify infiltration/inflow.
- Identify flow capacity limitations.
- Identify structural condition of entire interceptor, manholes, and appurtenances.

The results of the investigations will be used to identify rehabilitation measures required for the WBI in the ***West Bank Interceptor Rehabilitation Plan*** to be completed in 2015. These will be further defined as Phase I and Phase II remedial measures. Phase I measures will consist of those required to rehabilitate at least 20 percent of the total interceptor length. Phase II measures will be long-term repairs required to properly maintain the WBI in the future as well as remove secondary sources of I/I (where it is found to be cost effective). The WBI evaluation results will also be used to prioritize the contributing areas for more intensive Sewershed Evaluation Surveys (SSESs), together with identification of rehabilitation measures required within each sewershed.

The implementation schedule for the West Bank Interceptor evaluation activities is shown on **Figure 6-1**.

Figure 6-1
West Bank Interceptor Evaluation Schedule



Appendix A

Wastewater Flow and Rain Monitoring Information System

Specifications

WASTEWATER FLOW AND RAIN MONITORING INFORMATION SYSTEM SPECIFICATIONS

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WASTEWATER FLOW AND RAIN MONITORING INFORMATION SYSTEM SPECIFICATIONS

1. General Requirements

1.1 Purpose

1.1.1 The water/sewer division of the City of Jackson, Mississippi, herein referred to as the Owner, has determined that it will be necessary to perform ongoing permanent flow monitoring to address specific needs of the wastewater collection system management.

1.2 Network Overview and Scope

1.2.1 Wastewater Flow Monitors

1.2.1.1 The Owner will have wastewater flow monitors installed within the collection system at twenty-nine (29) locations. Each of the flow monitors will be networked into a system and provide the Owner with vital information on the hydraulic performance of the wastewater system as indicated in Section 3.

1.2.1.2 The Owner will contract with a Service Provider to deliver, install, and maintain flow monitors for the aforementioned flow monitoring program. The Service Provider shall supply all hardware for each flow monitoring location consisting of hardware as specified in Section 4.

1.2.2 Rain Gauges

1.2.2.1 The Owner will have rain gauge monitors installed at Four (4) locations relative to the flow monitors in the collection system. Each of the rain gauges will be networked into the system and, in conjunction with the flow monitoring network, provide the wastewater division with critical information correlating rainfall with system-wide sewer flow as indicated in Section 3.

1.2.2.2 The Owner will contract with a Service Provider to deliver, install, and maintain rain gauge monitors for the aforementioned flow monitoring program. The Service Provider shall supply all hardware for each rain monitoring location consisting of hardware as specified in Section 4.

1.2.3 Uptime – The Owner understands that data is critical and that any loss of data may negatively impact the Owner. Therefore, the Service Provider shall meet minimum criteria for system-wide Uptime as specified in Section 3.

1.2.4 Data Analysis

1.2.4.1 The Owner understands that flow data collected from a wastewater environment requires review for accuracy, issuing of work orders to maintain equipment, and identification and editing of data irregularities.

1.2.4.2 The Service Provider shall use the specifications for Data Analysis indicated in Section 3.6.

1.2.4.3 The Service Provider shall provide reports as specified in Section 5.

1.2.5 Software

1.2.5.1 The Service Provider shall deliver a means to interrogate the flow monitoring data, including generating graphs and accessing reports prepared by the Service Provider.

1.2.5.2 The Service Provider shall provide evidence that the software to be delivered will meet or currently meets the specifications in Section 6.

1.2.6 Service Provider Qualifications – The flow monitoring Service Provider shall meet the qualifications as listed in Section 2.

2. Service Provider Qualification and Proposal Requirements

2.1 Service Provider Evidence of Certification

2.1.1 Quality Management System – The Service Provider shall design and produce product according to a documented Quality Management System of procedures and work instructions.

2.1.2 The Service Provider shall include specific evidence that the current certification was performed on each area required under the scope of services:

2.1.2.1 Manufacture – If the Service Provider is not the manufacturer of the equipment, evidence of the manufacturer's current certification for quality manufacturing processes shall be provided.

2.1.2.2 Equipment Installation and Maintenance procedures – The Service Provider shall provide evidence that they maintain and enforce quality processes and safety standards for all field service work.

2.1.2.3 Data Analysis procedures – The Service Provider shall provide evidence that they maintain and enforce a quality process for ensuring data integrity in all data analysis.

2.1.2.4 Software Development process – The Service Provider shall provide evidence that they maintain and enforce a quality process for customer requirements, software design, testing, deployment, and support for all software to be provided.

2.1.2.5 Customer Service / Support – The Service Provider shall provide evidence that they maintain and enforce a quality process for handling customer service, problem resolution, and feedback.

2.1.3 Service Provider Obligations – The flow monitoring and rain gauge service provider shall be responsible for providing evidence of the following:

2.1.3.1 Availability of Parts, Warranties, and Service

2.1.3.1.1 If the Service Provider is not also the manufacturer of the equipment, then the Service Provider shall provide a letter or other proof of ability to do business with the manufacturer of the hardware to be installed.

2.1.3.1.2 The Service Provider shall be responsible for providing all equipment and materials necessary to perform the work specified.

2.1.3.2 The Service Provider shall provide proof of availability and training of labor and services required to properly install and place into operation the integrated sewer flow monitoring network, including:

2.1.3.2.1 Evidence of being able to supply the services of factory trained service and installation personnel to troubleshoot and maintain the equipment.

2.1.3.2.2 Evidence of qualifications for personnel who will install all components of the permanent network and perform all electronic, electrical, start-up and field optimization procedures required to place the complete system in fully acceptable operation.

2.2 Detailed Technical Submittals

2.2.1 A complete technical submittal, with descriptive brochures and engineering data covering the items of equipment offered, shall be submitted with the proposal. The Technical Submittals shall describe in detail how the service provider's system complies with each specification requirement of this document.

2.2.2 Copies of typical charts, hydrographs, tabulations and reports from projects of similar scope and complexity shall be included. Any deviations from the specifications must be noted in the Deviations from Specifications section.

2.3 Service Provider Resumes

2.3.1 The flow-monitoring service provider shall submit resumes of the proposed project managers, engineers, instrument technicians and other key personnel in his employ who would perform the proposed work.

2.3.2 Each resume shall reflect the competency of staff for this permanent network project, noting past experience of similar scope and complexity.

2.4 Service Provider Experience

2.4.1 The Owner acknowledges that the wastewater system, consisting of sewer lines and manholes, is a hostile environment for collecting flow information requiring a manufacturer with extensive knowledge and expertise.

2.4.2 Responding firms shall demonstrate qualifications by providing references of five (5) other flow monitoring projects:

> 2.4.2.1 Which service provider has commissioned telemetered flow monitoring and rain gauge equipment comparable in design, construction and use to the units specified
>
> 2.4.2.2 At least three (3) of which have a similar number of networked flow monitors

2.4.3 For each project submitted as a reference the number of units, the year installed and accepted, and the current status (active, partially active, or inactive) must be specified.

2.4.4 Service Provider shall have a minimum of five (5) years of successful, documented experience in the assembly and installation of networked telemetered flow monitoring and rain gauge equipment, and in gravity sewer flow monitoring applications.

2.4.5 The references shall consist of names, titles, addresses, and telephone numbers of individuals who have responsibility for operation of flow monitoring equipment that has been manufactured by the service provider and is comparable in design, construction and use to the units specified that the service provider has furnished.

2.5 Other Service Provider Qualifications

2.5.1 Manufacturer's Qualifications – The Service Provider shall submit satisfactory evidence of having adequate plant, equipment and technical experience to furnish the equipment and services expeditiously, and of having the financial capability to meet obligations incident to the work.

2.5.2 Operations and Maintenance Qualifications – The Service Provider shall submit satisfactory evidence of having the manpower, facilities, equipment and a program to offer the operations and data processing services required by this specification.

2.5.3 Patent and Hold Harmless Certifications – The Service Provider shall submit certification that they hold or have license to all applicable patents and shall indemnify and save harmless the Owner from all liabilities, judgments, costs, damages and expenses which may result from the infringement of any patents, trademarks, and copyrights by reason of the use of any proprietary materials, devices, equipment or processes incorporated in or used in the performance of the work under this contract.

2.5.4 Safety Qualifications – The Service Provider shall certify compliance with 20 CFR 1910.146 (OSHA confined space safety regulations) and all safety requirements involved with the project. The service provider shall submit a copy of his confined space entry procedures and safety procedures.

2.5.4.1 The service provider shall be responsible for taking all necessary safety precautions in the performance of its services. Due to the requirement to enter active sewer lines to fulfill this contract, the service provider is advised that the sewer and manhole environment may be oxygen deficient and may contain toxic and/or explosive gas vapors and liquids, as well as the health hazards associated with contact with raw wastewater.

2.5.4.2 The service provider is further advised that night activities may be associated where minimum flow levels are involved.

2.5.4.3 The service provider shall follow all applicable Federal, State, local and OSHA Regulations for manhole work and confined space entry.

3. Scope of Services

3.1 Site Selection and Installation

3.1.1 The Owner has selected sites for the installation of all equipment.

3.1.2 The Service Provider shall install equipment in optimum locations for best accuracy and reliability results. Prior to the installation of equipment each site will be inspected and documented.

3.1.3 Each site will be inspected to determine hydraulic suitability. This shall require descending the manhole to ensure adequate inspection.

3.1.3.1 The Service Provider may recommend that a designated monitoring location be changed to take advantage of more favorable hydraulics at upstream or downstream locations.

3.1.3.2 Site inspection shall include the accurate measurement of pipe or channel geometry, silt, and the location of installed equipment for use in flow calculations. The service provider shall not rely on as-built drawings for the determination of pipe geometry or slopes.

3.2 Telemetered Access

3.2.1 The Owner understands that the immediate use of flow data is important to uptime, rapid identification of data irregularities, and maintenance.

3.2.2 The Service Provider shall provide a method for remote (telemetry) access the flow monitors. The Service Provider shall install all telemetry equipment and ensure it is operational.

3.2.3 The Service Provider may use any third party telemetry service, such as local phone service provider and shall be responsible for all charges for phone, cellular or other telemetry directly.

3.2.4 The Service Provider shall provide software to communicate with the equipment as specified in Section 6.

3.3 Confirmation of Data Accuracy

3.3.1 On Location Confirmation of Accuracy

3.3.1.1 Confirmation of accuracy must be measured in the Owner's sewers at every site to ensure reliability of monitored data at that location.

3.3.1.2 The Owner will not accept any options or proposals from the service provider to waive confirmations.

3.3.1.3 Number of confirmations – the Owner will require the service provider to perform a minimum of two (2) manual depth and velocity measurements at every site in order to confirm that the sensors are actually measuring accurate depths and accurate velocities.

3.3.1.4 Calibrations will be conducted at each site monthly to ensure accuracy. Calibration includes verification using portable velocity meter at each site.

3.3.2 Method of confirmation

3.3.2.1 Initial confirmation of the flow meters shall involve a minimum of two (2) in-manhole measurements taken on different days. Confirmation will compare manual readings to sensor readings for all depth and velocity sensors. Attempts shall be made to have these measurements done at flow levels that span typical dry daily flows.

3.3.2.2 The confirmation checks shall be summarized in depth-to-discharge format on tables. Each confirmation shall consist of an instantaneous depth of flow and velocity measurement.

3.4 Operation and Maintenance Services

3.4.1 The Service Provider shall provide all spare parts at the Service Providers expense to maintain the equipment. Price proposals which do not include an adequate spare parts budget will not be considered.

3.4.2 The Service Provider shall provide a fixed price for twelve (12) months of complete maintenance of the network with options for yearly extensions.

3.5 Data Uptime

3.5.1 Each flow monitor and rain gauge site shall be maintained to assure a minimum up-time of ninety percent (90%).

3.5.2 The Service Provider shall provide at least three references of projects similar in size and scope where a minimum of 90% system-wide Uptime was achieved.

3.6 Data Analysis

3.6.1 Qualification – The Service Provider shall provide at least three references of projects similar in size and scope where data analysis was performed.

3.6.2 The Service Provider shall review all collected data monthly for the purpose of identification and editing of data irregularities.

3.6.3 Backup copies of raw data shall be maintained by the Service Provider for the duration of the contract.

3.6.4 Review of the data editing shall be performed by an analyst with a minimum of 3 years of experience with the specified equipment.

3.6.5 Weekly Data Review shall be performed by the Service Provider to ensure that the equipment is operational and properly logging data. The Service Provider shall be responsible for issuing maintenance work orders based on this review.

3.6.6 Finalization of data shall be completed according to the specification for Information Deliverables in Section 5.

4. Detailed Equipment Specifications

4.1 Flow Monitoring Equipment

4.1.1 Minimum Flow Monitor Requirements

4.1.1.1 A data logger and programmable sensor command unit installed at the sewer manhole location with enough memory to ensure that a adequate data at 15 minute intervals can be stored. The data logger shall support a circular buffer with the oldest data only being written over once the memory is filled.

4.1.1.2 Clock – Unit shall have battery-backed crystal controlled hardware real-time clock/calendar.

4.1.1.3 A communications device to allow for remote communications via telephone or wireless media

4.1.1.4 On-Site Communications – Shall be capable of being configured to support on-site RS232 serial communications or a telephone line simulator.

4.1.1.5 Temperature Range – Shall function within specifications between 0 and 60^0 C.

4.1.1.6 Connectors – All sensor connector cables will be fitted with U.S. Mil Spec gold plated contacts for environmental sealing.

4.1.1.7 An ultrasonic depth sensor with cable connection to the data logger should have capability of accurately measuring a minimum depth of 0.75 inches in 0.02 inch increments.

4.1.1.7.1 Temperature Compensation - Range readings must be compensated for the changes of the speed of sound in air. Sensor temperature readings must be available to user for both diagnostic as well as logging purposes.

4.1.1.8 A velocity sensor with cable connection to the data logger capable of accurately measuring velocity from -5 to 20 feet per second (fps)

4.1.1.8.1 Range - -5.0 to +20 feet per second (fps)

4.1.1.8.2 Resolution - 0.04 fps

4.1.1.8.3 Accuracy - +/- 0.8% Full Scale – 0.0 to 5.0 fps, +/- 1.2% Full Scale – 5.0 to 10.0 fps, +/- 2.8% Full Scale 10.0 to 15.0 fps

4.1.1.9 A pressure sensor with cable connection to the data logger capable of accurately measuring depth in surcharge conditions for standard sewer pipes.

4.2 Rain Gauge

4.2.1 The aforementioned data logger shall be able to accept data from an industry standard rain tipping bucket.

4.2.2 The equipment shall be able to measure 0.1 inches (1mm) per tip of bucket.

4.2.3 The tipping bucket shall be a corrosion resistant funnel collector with tipping bucket assembly.

4.3 Sampler Interface

4.3.1 The equipment housing shall be a waterproof, NEMA 6, IP67, pressurized marine grade aluminum cylinder to ensure that the electronics are protected from the harsh sewer environment.

4.3.2 Power

4.3.2.1 Battery – The equipment shall be able to use non-rechargeable alkaline batteries with a minimum life of one year at 15-minute sample rate (logging depth and velocity).

4.3.2.2 External Power – The equipment shall have capability of being powered by an external DC power input.

4.3.2.3 Electronics – Shall utilize low power (CMOS) logic.

4.3.3 Error Checking

4.3.3.1 The equipment shall measure and record internal temperature and voltage.

4.3.3.2 Data Security – A remote unit shall not respond unless the correct identification is transmitted

4.3.3.3 Data Reliability – All information shall be transmitted with parity and check digits.

4.3.3.4 Data Integrity - All communications shall have adequate error detection and correction to ensure that no data from the logger is corrupted or lost during communications.

4.3.3.5 Transmission Error – Parity bits and check digits shall be transmitted with each block of data. Acknowledgements shall be required for every transmission, with retransmissions if errors are detected.

4.3.4 Lightning Protection – If standard voice-grade telephone communication is provided, then the equipment shall have transient suppressors installed on the incoming telephone line to protect the logger against nominal lightning surges.

4.4 Equipment programmable settings and data validation

4.4.1 The equipment shall have a programmable Data Recording Interval at standard intervals of 1, 2, 2.5, 5, 15, and 30 minutes or 1, 2, 12, or 24 hours.

4.4.2 The equipment shall support the configuration of the data logger switching into a faster data sampling and recording interval once a user-defined trigger has been exceeded.

4.4.3 The equipment shall have programmable options to control samplers and rain totaling.

4.4.4 The equipment shall include the ability to cross-reference pressure sensor readings with ultrasonic sensor readings to ensure pressure sensor accuracy. The equipment shall also be able to provide a composite depth during surcharged conditions.

4.4.5 The equipment shall include the ability to establish a depth to velocity relationship against which to reference all depth and velocity readings. Data points that do not match the established depth to velocity relationship shall not be logged in memory until a second or third re-firing of the sensors confirms the legitimacy of the data point.

4.4.6 The equipment shall support advanced software filtering to help compensate for adverse monitoring conditions such as waves, foam, noise, etc.

5. Flow Information Deliverables

5.1 Monthly Report

5.1.1 Service Provider will attend monthly progress meeting with client.

5.1.2 Service provider will submit monthly reports to the Client presenting the data collected during each monthly flow-monitoring period.

5.1.3 Monthly reports shall consist of a graphical presentation of flow depth, velocity and quantity data for each monitoring location. Graphical presentations shall include a scattergraph presentation of flow depth and velocity data as well as a hydrograph presentation of flow depth, velocity, and quantity data, along with available rainfall data.

5.1.4 Monthly reports shall consist of a tabular summary of flow depth, velocity, and quantity data for each monitoring location. Tabular summaries shall include minimum, average, and maximum values for flow depth, velocity and quantity data, along with flow quantity and rainfall totals for the monthly reporting period.

5.1.5 Monthly reports shall consist of a narrative summary of observed flow conditions at each monitoring location.

5.1.6 Monthly reports shall include flow depth, velocity, and quantity data, along with associated rainfall data from each monitoring location in a format compatible with Microsoft® Excel.

5.1.7 Monthly report shall be provided to the client no later than 15 days following the conclusion of each month.

5.1.8 Monthly report shall be provided on recordable CD-Rom or other electronic medium approved by the Client in a format compatible with Microsoft® Office or Adobe® Acrobat® Reader

5.2 Flow analysis report

5.2.1 Service provider will assist the Client with I/I analysis and reporting.

5.2.2 Service provider will assist with Summary of RDII (Rainfall Dependent Inflow / Infiltration) precipitation events for each flow monitored location.

6. Software

6.1 General

6.1.1 The Service Provider shall install and maintain all software required for the scope of services.

6.1.2 Because the Owner does not want to be limited by operating system requirements, the Service Provider shall provide software accessible using Internet Explorer and available to any personnel requiring access.

6.1.3 The Service Provider shall be responsible for purchasing any computers, purchasing any third party software licenses, hosting the application, maintaining physical system, ensuring network security, and providing reliable access to the system.

6.1.4 The Service Provider shall be responsible for all system maintenance, data uploads, database maintenance, and software defect repairs.

6.1.5 The Service Provider shall provide at least three references of other users of the proposed software.

6.2 User Permissions and Security

6.2.1 The Software shall have secure access by password and user name for authorized personnel.

6.2.2 The Software shall support per-user permissions to ensure that the Owner can restrict certain features to authorized users. Specifically, the Software shall support restrictions for (at a minimum):

6.2.2.1 Alarm acknowledgement

6.2.2.2 Raw data access (Vs. processed data)

6.3 Geographical Information

6.3.1 Owner will provide a collection system map derived from GIS data and including geographic information the Owner requires to be displayed.

6.3.2 Each monitoring location shall be represented on the map. The Software shall provide a method to navigate to data for any location from the map.

6.3.3 The software shall provide an indication on a map of the alarming location.

6.4 Web Accessible Data

6.4.1 The Service Provider shall provide access to the data via a password protected website.

6.4.2 The website shall have the capability to generate scattergraphs for data at each monitored location.

6.4.3 The website shall have the capability to generate hydrographs for data at each monitored location.

6.4.4 The website shall have the capability to generate data files in the (*.csv) file format.

6.4.5 The software shall be able to contain attached information deliverables for each location in the system. The Service Provider shall attach these information deliverables and ensure they are available.

6.5 Telemetry

6.5.1 The software shall have the capability of remotely communicating with the equipment specified in Section 4.

6.5.2 The Owner shall have the ability to issue a data collection command in order to obtain data in near real time.

6.6 Alarm and Event Reporting

6.6.1 The software shall be able to receive event notification actions generated by the equipment specified in Section 4.

6.6.1.1 Supported events (minimum)

6.6.1.1.1 Proportional Flow Loss

6.6.1.1.2 High Depth

6.6.1.1.3 High-high Depth

6.6.1.1.4 Battery low voltage warnings

6.6.1.1.5 Sensor failure warnings

6.6.1.2 The software shall provide an audible indication that an alarm condition is active.

6.6.2 Alarm Response

6.6.2.1 The software shall maintain a log of all historical alarms.

6.6.2.2 The software shall provide a method for the Owner to acknowledge alarms, and shall provide restrictions to ensure that only those users who have been granted permission to do so may acknowledge an alarm.

6.6.2.3 The Software shall provide a method for flexible alarm escalation. The System shall notify via phone, email, or email compatible pager those personnel specified for the alarming location if an alarm has not been acknowledged after a specified period of time.

6.6.3 The Service Provider shall provide with their submittal an approach to minimize false alarms.

6.6.3.1 The submittal shall include a method of Automatic Data Processing which minimizes flow data irregularities in the data to allow for identification of real flow events.

6.6.3.2 The submittal shall include a method of "smart" alarming to minimize false alarms and account for changing diurnal flow patterns.

6.6.3.3 The submittal shall include a detailed description of the Service Provider's staffed support center's procedure for assisting the Owner's personnel in identification and resolution of alarm issues. This shall include, at a minimum:

6.6.3.3.1 Maximum allowable response time for open issues

6.6.3.3.2 Method for issuing field service directives for maintenance

6.7 Training and Support

6.7.1 The Service Provider shall provide training on the use of the software to the Owner.

6.7.2 The Service Provider shall provide telephone support to the Owner using personnel experienced in troubleshooting problems with the specified software.

Appendix B

Sanitary Sewer Television and Sonar Inspection Specifications

SECTION 001510

SANITARY SEWER TELEVISION AND SONAR INSPECTION

PART 1 - GENERAL

1.1 WORK THIS SECTION

A. The work of this section is to determine the internal physical condition of the sewer main, locate physical defects, locate service connections and locate possible sources of infiltration and inflow.

1.2 REFERENCES

A. Codes, Specifications, and Standards
   1. NASSCO – National Association of Sewer Service Companies

B. Testing and Materials Standards (None Cited)

C. Related Sections
   1. Section 01520, Sanitary Sewer Cleaning
   2. Section 02600, Wastewater Flow Control

1.3 DEFINITIONS

A. Television Inspection: Operation necessary to complete a true-color audio-visual inspection for verification of existing internal pipe conditions including pipe materials, pipe grade, connections, cracks, leaking joints, seepage and roots. Contractor shall furnish all labor, materials, equipment, tools, and other incidental services for closed circuit television inspection. (CCTV)

B. Sonar Inspection: Operation necessary to complete an inspection for verification of existing internal pipe conditions including amount of debris in the bottom. Sonar inspection will supplement, not replace CCTV. Contractor shall furnish all labor, materials, equipment, tools, and other incidental services for sonar inspection. Sonar inspection of a particular pipe will only be conducted when approved in writing by the City.

C. MPEG: MPEG (pronounced M-peg), which stands for Moving Pictures Expert Group, is the nickname given to a family of International Standards used for coding audio-visual information in a digital compressed format. For the purposes of this specification, MPEG shall be defined as an ISO-MPEG Level 4 standard (MPEG- 4) digital audio-visual coding having a minimum resolution of 500 lines. All video files shall be named using .mpg or .wmv as the file extension.

D. External Hard Drive: For the purposes of this specification, an external hard drive is a peripheral auxiliary device that connects to the computer via a high-speed interface cable. The interface cable allows the external hard drive to communicate with the computer so that data may be passed back and forth. The most common types of interfaces are USB and Firewire. The Contractor will deliver all inspection databases, digital reports and media to the City on an external hard drive that is compatible with the Data Administrator's desktop system.

E. Sonar/Tiscit: Operation necessary to complete both a CCTV and sonar inspection for verification of existing internal conditions. Both the CCTV and sonar will be displayed together on the audio visual documentation. Contractor shall furnish all labor, materials, equipment, tools, and other incidental services for the sonar/tiscit inspection.

1.4 EXPERIENCE

A. Supervisor of the field crews performing these functions shall have the proper training in these types of equipment and monitoring functions and have a minimum of three (3) years experience in performing such assignments including safe work practices, etc.

B. Field crew leaders performing these functions shall have the proper training in these types of equipment and monitoring functions and have a minimum of two (2) years experience in performing such assignments including safe working practices, etc.

C. The Contractor shall provide the City with written documentation (certification) that the supervisor, field crew leader and all crewmembers responsible for these assignments have the proper training and the requisite experience.

D. No crewmembers shall enter confined spaces without the necessary certified training.

E. The required experience shall be documented in the Contractor's Request For Proposal submittal.

1.5 MEASUREMENT AND PAYMENT

A. No separate payment will be made for television inspection when that inspection is associated with the installation of cured-in-place-pipe (CIPP). The work and materials being considered as incidental to and part of the CIPP unit bid prices. Contractor will be required to submit both a Pre-Lining and Post-Lining inspection, and these inspections must comply with the same technical standards and specifications as required by all DWM CCTV Condition Assessment surveys.

B. No separate payment will be made for the training and certification of Contractor personnel for NASSCO's Pipeline Assessment and Certification Program (PACP).

C. Payment for lateral inspection shall be made at the unit bid price. The television inspection shall be measured by linear foot from the starting point of the inspection to the stopping point of the inspection. Payment will be full compensation for furnishing all labor, tools, and equipment necessary to perform all work. Payment for lateral inspection shall be made under Inspection Services, Television Inspection, Lateral Inspection (Launch or Push), per linear foot.

D. Payment for pipe television inspection shall be made at the unit price bid. Television inspection shall be measured by linear foot of pipe line from center of the upstream manhole to center of the downstream manhole. Payment will be full compensation for furnishing all labor, tools, and equipment necessary to perform all work. Payment for television inspection shall be made under Inspection Services, Television Inspection, Pipe Diameter (size), per linear foot.

E. Payment for pipe Sonar/Tiscit inspection shall be made at the unit price bid. Sonar/Tiscit inspection shall be measured by linear foot of pipe line from center of the upstream manhole to

center of the downstream manhole. Payment will be full compensation for furnishing all labor, tools, traffic control and equipment necessary to perform all work. Payment for Sonar/Tiscit inspection shall be made under Inspection Services, Television Inspection, Sonar/Tiscit, Pipe Diameter (size), per linear foot.

F. Payment for removal of protruding service lines shall be made at the unit price bid. Payment will be full compensation for furnishing all labor, tools, traffic control and equipment necessary to perform all work. Payment for removal of protruding service lines shall be made under Inspection Services, Television Inspection, Removal Protruding Service, per each.

G. The Contractor shall allow in the rates and provide at no additional cost, a vehicle when required by the City, together with a driver, to assist with visual reconnaissance surveys and/or inspections. The vehicle shall be suitable for carrying the survey team and laborers and shall be equipped with the following:
   1. Equipment for easing and lifting manhole covers.
   2. Pipe safety equipment.
   3. Road safety equipment.
   4. Protective clothing for the survey/inspection teams comprising coveralls, boots, gloves, hard hats, etc.

1.6 RESPONSIBILITY FOR OVERFLOWS/SPILLS AND DAMAGE TO PROPERTY AND UTILITY

A. It shall be the responsibility of the Contractor to schedule and perform the Work in a manner that does not cause or contribute to the incidence of overflows, spills or basement backups of sewage from the sewer system.

B. In the event that the Contractor's activities contribute to overflows or spills, the Contractor shall immediately take appropriate action to contain and stop the overflow, clean up the spillage, disinfect the area affected by the spill, and notify the City Engineer in a timely manner.

C. The Contractor shall indemnify and hold harmless the City for any fines or third-party claims for personal or property damage arising out of a spill or overflow that is fully or partially the responsibility of the Contractor, including the legal, engineering, and administrative expenses of the City in defending such fines and claims.

D. Any damage to public or private property due to the work performed by the Contractor is the responsibility of the Contractor. Any damage to the sewer lines/laterals caused by the Contractor's equipment or operation shall be repaired in a manner approved by the City Engineer at the Contractor's expense. Any equipment stuck or left in the sewer line/lateral shall be retrieved by the Contractor within twenty-four (24) hours at the sole expense of the Contractor. Any damage to the Contractor's equipment is the Contractor's responsibility. If the equipment that is stuck or left in the sewer line/lateral causes a sanitary sewer overflow (SSO)/spill, then the Contractor is liable for that SSO/spill. The City reserves the right to make any repairs or retrieve any equipment and charge the Contractor accordingly.

PART 2 - PRODUCTS

2.1 GENERAL

A. The Contractor shall furnish the mobile television/sonar inspection studio, television camera, sonar, audio-visual digital encoding equipment / software, and other necessary equipment, materials, power, labor, and technicians as needed to perform the television inspection.

B. The television/sonar inspection equipment shall be capable of inspecting a minimum of 1,500 feet of pipe, when entry into the line can be accessed from the upstream and downstream manhole. When entry is at one end only, the inspection equipment shall be capable of inspecting seven hundred and fifty (750) feet by a self-propelled unit. The inspection equipment shall be capable of clearly televising the interior of a 6-inch and larger diameter pipes.

C. The television/sonar equipment shall be transported in a stable condition through the pipe line main under inspection. Throughout the inspection, the camera equipment shall be positioned with the camera directed along the longitudinal axis of the pipe. When the television/sonar equipment is towed by winch and bond through the pipe line, all winches shall be stable with either locking or ratcheting drums. All winches shall be inherently stable under loaded conditions. The bonds shall be steel or of an equally non-elastic material to ensure the smooth and steady progress of the camera/sonar equipment. The bonds shall be oriented in such a manner as to enable unhindered extension or retraction through the line. All effort shall be made to prevent damage to the pipe during the television/sonar inspection. In the case where damage is caused by the Contractor, for any reason, such as would be caused by incorrect deployment of bonds or retrieval of lodged equipment, the cost of repair or remedy shall be borne by the Contractor.

D. The Contractor shall divert wastewater flow in accordance with the requirements of Section 02600, Wastewater Flow Control.

E. The studio shall be of sufficient size to accommodate four people for the purpose of viewing the television/sonar monitor while the inspection is in progress. The studio shall be insulated against noise and extremes in temperature, and shall be provided with means of controlling external and internal sources of light in a manner capable of ensuring that the monitor screen display is in accordance with the requirements of these Specifications. The City or its representative shall have access to view the television/sonar screen at all times. The central control panel and television camera and sonar control shall be located in the studio. The studio shall be mounted on a mobile vehicle (truck or trailer), which allows safe and orderly movement of the inspection equipment throughout the job site.

F. The television camera used for the pipe line inspection shall be one specifically designed and constructed for pipeline inspection. The camera shall be waterproof and shall be operative in any conditions that may be encountered in the inspection environment. The Contractor shall provide a color pan and tilt camera to facilitate the inspection of service laterals, sewer mains, and manhole defects. The television camera shall be capable of 360° rotational scan indicating any salient defects. The tilt arc must not be less than 225° unless otherwise approved by the City. The adjustment of focus and iris shall provide a minimum focal range of 3 inches in front of the camera's lens. The distance along the pipe in focus from the initial point of observation shall be a minimum of twice the vertical height of the pipe. The illumination must be such as to allow an even distribution of the light around the perimeter without the loss of contrast, flare out of

picture, or shadowing. The view seen by the television camera shall be transmitted to a monitor of not less than 11 inches in size. The television camera shall be capable of receiving and transmitting a picture having not less than a resolution of 500 lines. The travel speed of the television inspection camera (through the pipe) shall be uniform and shall not exceed the maximum speed directed by the City of 30 feet per minute.

G. The Contractor shall test the television inspection equipment to verify the picture quality. The Marconi Regulation Chart No. 1 or the equipment manufacturer's recommendation shall be used to clearly differentiate between the following colors: white, yellow, cyan, green, magenta, red, blue and black.

H. The television inspection equipment shall be of such quality as to enable the following to be achieved:
   1. Color: With the monitor adjusted for correct saturation, the six colors plus black and white shall be clearly resolved with the primary and complementary colors in order of decreasing luminance.
   2. Linearity: The background grid shall show squares of equal size, without convergence/divergence over the whole of picture. The center circle shall appear round and have the correct height/width relationship (+/-5%).
   3. Resolution: The live picture must be displayed on a digital capable of providing a clear, color, stable image free of electrical interference with a minimum resolution of not less than 500 lines.
   4. Color Consistency: To ensure that the camera shall provide similar results when used with its own illumination source, the lighting shall be fixed in intensity prior to commencing the survey. In order to ensure color consistency no variation in illumination shall take place during the inspection.

I. The City may periodically check both the live and video picture color consistency against the calibration charts. Any differences will necessitate re-survey of the new length or lengths affected, at the Contractor's expense.

J. The closed circuit television monitor display shall incorporate an automatically updated record in feet and tenths of a foot of the distance along the line from the cable calibration point to the center point of the camera or center point of the transducer, whichever unit is being used. The relative positions of the two center points should also be noted. The Contractor shall use a suitable metering device that enables the cable length to be accurately measured; this shall be accurate to +/-1% or 3 inches whichever is greater. The Contractor shall calibrate the footage meter on a regular basis and demonstrate that the tolerance is being achieved by tape measurement between manholes on the surface. This taped measurement must be included on a quality control form which will be completed and submitted by the Contractor depicting the level of accuracy achieved.

K. If the Contractor fails to meet the required standard of accuracy, the City will instruct the Contractor to provide a new device to measure the footage. The City may at their discretion instruct the Contractor in writing, to re-survey those lengths of pipe first inspected with the original measuring device, at no additional expense to the City.

L. All recordings and collected data made during the television inspection shall become the property of the City and shall be submitted to the City upon completion of the television inspection.

PART 3 - EXECUTION

3.1 GENERAL

A. Television/Sonar Inspection: The Contractor shall inspect pipelines with pan and tilt conventional television imagery and/or sonar as specified so as to record all relevant features and defects of the pipeline under inspection. Inspection of pipelines shall be carried out utilizing the City approved formats only. Cleaning shall be performed in accordance with the requirements of Section 01520, Sanitary Sewer Cleaning. Pipes should be sufficiently clean so as to allow for clear viewing of all of the interior surfaces of the lines during television inspection. A PACP certified technician or supervisor shall control operation of television equipment and encoding of inspection. Should Contractor utilize any personnel to actually document the inspection results that is not PACP certified, those inspections shall be refused and re-survey shall be completely at the Contractor's expense.

B. Inspection shall be documented using NASSCO's Pipeline Assessment and Certification Program (PACP). Inspection data will be reviewed by PACP certified technicians and all identified defects will be coded in conformance with PACP standards. Defect codes will be reported on standardized forms together with defect type, continuous distance of defect, severity, size, circumferential location (clock location), joint number, image/video reference number, and comments.

C. If television/sonar inspection of an entire section cannot be successfully performed from one manhole, a reverse setup shall be performed to obtain a complete inspection. REVERSE SETUPS shall be considered as subsidiary to the unit price bid for CCTV inspection. The objective of this project is to inspect the maximum amount of the sanitary sewer and it is likely that a number of reverse set-ups will be required in order to maximize the pipeline footage inspected.

D. Each pipe length, i.e. the length of pipe between two consecutive manholes, shall be entered on separate work order headers electronically. Thus where a Contractor elects to "pull through" a manhole during a CCTV and/or Sonar Survey, a new coding sheet shall be started at the manhole "pulled or walked through" and the footage re-set to zero on the coding sheet. Where a length of pipe between consecutive manholes is surveyed from each end (due to an obstruction or structural failure) two coding sheets should be used. Where a length of pipe between two consecutive manholes cannot be surveyed or attempted for practical reasons a (complete header) coded sheet shall be made out defining the reason for abandonment. At the start of each pipe length being surveyed or inspected and each reverse set-up, the length of pipeline from zero footage, the entrance to the pipe, up to the cable calibration point shall be recorded and reported in order to obtain a full record of the pipe length. All reverse set-ups, blind manholes, and buried manholes shall be logged on a separate log. Video digits shall be recorded so that every recorded feature has a correct elapsed time stamp and footage. Each log shall make reference to the start Manhole (Access Point, Manhole-AMH) and finish Manhole (Access Point, Manhole-AMH) unless abandonment took place because of blockage. Manhole ID numbers shall be indicated in the remarks column of the detail report. Only the field "Direction of Inspection" and the order of the start and finish manholes as listed on the observations section of the inspection will be utilized to indicate reverse setups. All CCTV Setup should have an above ground measurement and be documented in the Additional_Info field.

E. The Contractor shall provide a complete television inspection of both the upstream and downstream manholes beginning at the top of each manhole and panning down to inspect the entire manhole. Contactor shall also stop and pan each service lateral as standard procedure.

F. Whenever prevailing conditions allow, the camera head shall be positioned to reduce the risk of picture distortion. In circular pipes, the camera lens shall be positioned centrally (i.e. in prime position) within the pipe. In non-circular pipes, picture orientation shall be taken at mid-height, unless otherwise agreed, and centered horizontally. In all instances the camera lens shall be directed along the longitudinal axis of the pipe when in prime position. A positioning tolerance of ±10% of the vertical pipe dimension shall be allowed when the camera is in prime position.

G. All television inspections shall be performed during low flow conditions. The City reserves right to refuse any television inspection that does not produce an effective survey of the pipe because of high flow conditions or for any other reason.

H. The following guidelines concerning the use of CCTV and Sonar shall be followed, subject to the review and approval of the City Engineer:
   1. Generally CCTV alone shall be used for internal condition assessment where the depth of flow of sewage is less than 25% of the overall sewer diameter at the start of the survey. The City may instruct the Contractor, in writing, to either continue CCTV alone or in conjunction with the bypass pumping should the depth of flow increase beyond the 25% level but not greater than 40% of overall sewer diameter at any time throughout the length.
   2. Generally CCTV combined with Sonar shall be used for internal condition assessment where the depth of flow of sewage varies from 25% to 75% of overall sewer diameter for sewers greater than 24 inches in diameter. Where the sewer is less than 24 inches in diameter and depth of flow of sewage exceeds 25% but is less than 75% of overall sewer diameter, the City shall instruct the Contractor to either: (a) continue using CCTV (where depth of flow is only marginally greater than 25% of overall diameter) or (b) use Sonar (by damming or plugging the sewer so that the depth of flow exceeds 75% of overall diameter).
   3. Generally Sonar alone shall be used where depth of flow in the sewer exceeds 75% of overall diameter and the level of the flow will be artificially increased, without the risk of flooding, to ensure that the pipe is completely surcharged.

I. Each survey/inspection unit shall have on call equipment available to carry out the flushing, rodding and jetting of pipes as and when such procedures are deemed to be necessary.

3.2 DIGITAL VISUAL RECORDING

A. Video Recording: Continuous digital video recordings of the inspection view as it appears on the television monitor shall be taken. The recording shall also be used as a permanent record of defects. The recording shall be MPEG-4. The digital video encoding shall include video information that can be reproduced with a video image equal or very close to the quality of the original picture on the television monitor. The replay of the recorded video information shall be free of electrical interference and shall produce a clear, stable image.

B. The recording and monitoring equipment shall have the built-in capability to allow the City to instantly review the video quality of the recordings at all times during the inspection. The size and position of the data display shall be such as not to interfere with the main subject of the picture.

At the start of each survey, the following minimum information shall be clearly displayed on the viewing monitor:

1. Automatic update of the camera's footage position in the line from adjusted zero
2. Pipe dimensions
3. Upstream Manhole Number
4. Downstream Manhole Number
5. Pipe ID of Pipe being surveyed
6. Date of survey
7. Road name/location
8. Direction of survey
9. Time of start of survey
10. Sewer use
11. Material of construction of the pipe

Once the survey of the pipeline is under way, the following minimum information shall be continually displayed:

1. Automatic update of the camera's footage position in the sewer line from adjusted zero (0).
2. Upstream Manhole Number
3. Downstream Manhole Number
4. Direction of survey

C. Separate MPEG-4 files shall be created for each pipe. In case of a reverse setup, such inspection shall be stored in a separate inspection record and MPEG file. MPEG files shall be written to External Hard Drive media for delivery to the City.

D. Footage and corresponding time elapsed shall be logged throughout survey/inspection for all relevant defects and construction features encountered unless otherwise agreed.

E. MPEG files shall be named according to the following file specification:

TV_[PIPEID]_[Direction]_[MMDDYYYY]_[IncrementalNumber].mpg

F. The incremental number shall be used if multiple inspections are performed for the same line, such as a reverse inspection setup.

G. Manhole ID numbers will be provided to the Contractor by the City in a personal geodatabase or shape files.

H. The City, at its sole discretion, reserves the right to refuse any MPEG, on the basis of poor image quality, excessive bit rates, inconsistent frame rates or any other characteristics that may affect usability by the City.

I. All continuous defects shall incorporate a start and finish abbreviation in the inspection.

J. Photographs shall be taken of all defective laterals and pipeline defects.

K. All data submittals will be in a single PACP version 4 (or later) database. All inspections shall be contained within one database.

L. All data submittals shall also contain a directory of all inspections and the corresponding Segment Grade and Quick rating Scores for Structural, Operation and Maintenance, and Overall.

3.3 TELEVISION / SONAR INSPECTION REPORTS

A. The Contractor shall complete a television/inspection inspection report for each pipeline segment. These reports shall be per the format and defect codes of NASSCO's Pipeline Assessment and Certification Program (PACP) including the Scoring for Structural, Operation and Maintenance and Overall. Prior to beginning work, the Contractor shall submit a hardcopy sample of the television inspection report to the City for approval. All reports shall be exported in electronic format and delivered with the monthly invoice, database and media submittal.

B. In addition to recording the defects for the pipes and manholes, the Contractor shall also record attribute data as work order header fields in their inspections. Attachments A, B, and C define each of the proper NASSCO PACP and City of Jackson assigned field usage codes.

3.4 DELIVERABLES

A. Electronic PACP database shall be submitted to the City. The electronic database must contain all the data required by this specification.

B. Television/Sonar Inspection Reports shall be submitted to the City. Corresponding Mpeg videos shall also be submitted to the city as outlined by this specification.

C. The Contractor shall complete work on each asset as assigned. Upon start of work, the Contractor shall receive work orders as assigned by the Project Manager. The Contractor shall maintain and synchronize the status of each rehabilitation work order issued

3.5 DATA QUALITY CONTROL PROCEDURES

A. The Contractor shall operate a quality control system, to be approved by the Department, which will effectively gauge the accuracy of all survey reports produced by the operator.

B. The system shall be such that the accuracy of reporting is a function particularly of:
   1. The number of faults not recorded (omissions).
   2. The correctness of the coding and classification of each fault recorded.

C. The minimum levels of accuracy to be attained under the various survey headings are as follows:
   1. Header Accuracy 95%
   2. Detail Accuracy 95%

D. The Contractor's data quality control program shall include routine outside auditing of the work completed by a qualified subcontractor. The qualified subcontractor shall meet the minimum specified Contract requirements for the performance of the work and shall be approved in writing by the Department. The accuracy of the Contractor's data shall be based on the percentage of the data confirmed correct by the subcontractor. The minimum acceptable accuracy of the data shall be 95%. The general sequence of the auditing shall be as follows:
   1. The Contractor shall randomly select one day per month, typically in the first week of the month, and the work performed during this day shall be reviewed and/or repeated by the qualified subcontractor.

2. If the work is greater than or equal to 95% accurate, no further outside auditing will be required for the month unless requested by the Department at their sole discretion. The cost for this audit is included in the allowances specified in the Bid Form.
   If the work is less than 95% accurate, the Contractor shall at his own expense repeat and/or correct the work and have the work re-audited by the qualified subcontractor.
3. If this work is still less than 95% accurate, the Contractor shall repeat and/or correct and have the work re-audited, at his own expense, until the work is greater than or equal to 95% accurate.
4. When this re-audited work is found to be greater than or equal to 95% accurate, the Contractor shall have the work of another randomly selected day in the same month reviewed and/or repeated by the qualified subcontractor at the Contractor's own expense.
5. Steps 2 through 5 shall be repeated at the Contractor's own expense until the selected data is 95% accurate on the initial audit.
6. The occurrence of five randomly selected days not achieving 95% accuracy on initial subcontractor review will constitute cause for dismissal.
7. If the contractor successfully meets the 95% accuracy requirement for the initial randomly selected day for two consecutive months (Step 2 above), the contract may subsequently audit one day every other month. The Contractor may continue auditing one day every other month until the initial randomly selected day does not meet 95% accuracy, at which time it must resume auditing one day every month.

E. The Contractor shall perform this QA/QC analysis on all data recorded before the data is submitted to the City. The Contractor shall provide a summary report of the results of the Quality Assurance analysis with each data submission.

F. The data submissions shall undergo the same random review checks for Quality when submitted to the City. Should accuracy levels fall below 95%, the data submittal will be refused and no payment will be released. Contractor will be required to correct or re-do inspections until 95% level of accuracy is reached. Continuous data submittal refusals for quality under 95% will constitute cause for dismissal.

3.6 DOCUMENTATION

A. The Contractor shall complete work on each asset as assigned via the City's Computerized Work Order Management system. Upon start of work, the Contractor shall receive work orders as assigned by the Project Manager. The Contractor shall maintain and synchronize the status of each rehabilitation work order issued.

END OF SECTION

AttachmentA_01510_PACPWorkHeader.xls
AttachmentB_01510_ValidCodes.xls
AttachmentC_01510_PACPHeaderFormExpl.doc

Appendix C

Manhole Condition Assessment

Specifications

SECTION 001530

MANHOLE CONDITION ASSESSMENT

PART 1 - GENERAL

1.1 WORK THIS SECTION

A. The purpose of manhole condition assessment (MCA) is to locate a manhole, document all incoming and outgoing pipes, and determine its physical dimensions, materials, structural condition, maintenance concerns, and sources of infiltration/inflow. NASSCO's MACP manhole condition assessment codes will be utilized. Manhole condition assessments will be conducted on every manhole in the project basin, unless otherwise noted.

1.2 REFERENCES

A. Codes, Specifications, and Standards
NASSCO – National Association of Sewer Service Companies

B. Testing and Materials Standards (None Cited)

C. Related Sections
1. Section 01510, Sanitary Sewer Television-Sonar Inspection
2. Section 01520, Sanitary Sewer Cleaning
3. Section 01540, Survey
4. Section 01570, Temporary Field Flow Monitoring
5. Section 02600, Wastewater Flow Control

1.3 DEFINITIONS

A. Buried Manhole: A manhole on a pipe, which is not visible at ground surface. All buried manholes on the sanitary systems shall be reported for raising following their location. Subsequently, the raised manholes shall be inspected.

B. Designated Manhole(s): Manholes identified by City to be assessed. For the purpose of this contract, Designated Manholes shall be all manholes on the sanitary sewer systems including new manholes, raised manholes, buried manholes, and unmapped manholes discovered during the project.

C. Manhole: A subsurface structure where one or more pipes meet, with person access from the ground surface.

D. Manhole Structure: Reference to and all activities relevant to manhole structures throughout the text shall also be taken to include junction boxes, inspection chambers, drop shafts, sumps, and all other auxiliary structures appurtenant to the sanitary sewer systems.

E. Mapped Manhole: A manhole that appears on the City's sewer system maps.

F. Raised Manhole: A manhole in which the frame and cover has been raised above their previous level.

G. Unburied Manhole: A manhole on a pipe to be assessed formerly buried below ground surface.

H. Unmapped Manhole: A manhole not included on the City's sewer system maps. An unmapped manhole is also known as an uncharted manhole.

I. Exposed Manhole: A manhole in which the frame and cover are above normal levels above ground, i.e., more than 18-inches above ground level on any side.

1.4 EXPERIENCE

A. Supervisor of the field crews performing these functions shall have the proper training in these types of equipment and monitoring functions and have a minimum of three (3) years experience in performing such assignments including safe work practices, etc.

B. Field crew leaders performing these functions shall have the proper training in these types of equipment and monitoring functions and have a minimum of two (2) year experience in performing such assignments including safe working practices, etc.

C. The Contractor shall provide the City with written documentation (certification) that the supervisor, field crew leader and all crewmembers responsible for these assignments have the proper training and the requisite experience.

D. No crewmembers shall enter confined spaces without the necessary certified training.

E. The required experience shall be documented in the Contractor's Request For Proposal submittal.

1.5 MEASUREMENT AND PAYMENT

A. Payment for manhole condition assessment shall be made at the unit price bid. Manhole condition assessments shall be per each manhole inspected. Payment will be full compensation for furnishing all labor, tools, traffic control and equipment necessary to perform all work. Payment for Manhole Condition Assessments shall be made under Inspection Services, Manhole Condition Assessment, per each.

1.6 RESPONSIBILITY FOR OVERFLOWS/SPILLS AND DAMAGE TO PROPERTY AND UTILITY

A. It shall be the responsibility of the Contractor to schedule and perform the Work in a manner that does not cause or contribute to incidence of overflows, spills or basement backups of sewage from the sewer system.

B. In the event that the Contractor's activities contribute to overflows or spills, the Contractor shall immediately take appropriate action to contain and stop the overflow, clean up the spillage, disinfect the area affected by the spill, and notify the City Engineer in a timely manner.

C. The Contractor shall indemnify and hold harmless the City for any fines or third-party claims for personal or property damage arising out of a spill or overflow that is fully or partially the responsibility of the Contractor, including the legal, engineering, and administrative expenses of the City in defending such fines and claims.

D. Any damage to public or private property due to the work performed by the Contractor is the responsibility of the Contractor. Any damage to the sewer lines/laterals caused by the Contractor's equipment or operation shall be repaired in a manner approved by the City Engineer at the Contractor's expense. Any equipment stuck or left in the sewer line/lateral shall be retrieved by the Contractor within twenty-four (24) hours at the sole expense of the Contractor. Any damage to the Contractor's equipment is the Contractor's responsibility. If the equipment that is stuck or left in the sewer line/lateral causes a sanitary sewer overflow (SSO)/spill, then the Contractor is liable for that SSO/spill. The City reserves the right to make any repairs or retrieve any equipment and charge the Contractor accordingly.

PART 2 – PRODUCTS/EQUIPMENT

2.1 GENERAL

A. Digital photographs shall be taken with a 3.0 mega pixel color camera, minimum.

B. The Contractor will provide high-powered hand held spotlights and mirrors (to direct natural sunlight into the manhole) to properly illuminate the interior of the manhole when a Top Side Inspection is performed.

C. The Contractor shall ensure that the camera is centered in the middle of circular pipe lines and manhole risers at all times during inspection. Using a steel tape or graduated survey rod, the manhole depths are to be measured from the invert to the manhole frame to the nearest .10-inch.

D. The camera shall be equipped with an optic telephoto lens with sufficient magnification that the effects of pixelization do not degrade the farthest image.

E. The light source will be adjustable to allow an even distribution of light around the sewer and manhole perimeter without loss of contrast, flare out of picture, or shadowing.

F. The telescopic pole must be capable of lowering the camera to a depth of at least 20 feet inside the manhole.

G. It is the responsibility of the Contractor to comply with OSHA regulations. The Contractor must provide all equipment required to comply with the regulations and guidelines.

H. The Contractor shall provide all labor, material, supplies, equipment, transportation, traffic control, etc., necessary to complete the manhole condition assessments.

PART 3 - EXECUTION

3.1 GENERAL

A. Manholes to be assessed (designated manholes):
   1. The Contractor shall identify all designated manholes on the sewer systems to be assessed and confirm the manhole referencing system to be used throughout the survey and for all subsequent reporting. The Contractor shall inspect and record both mapped and unmapped manholes as well as buried and unburied manholes in addition to designated manholes.
   2. The visible portion of each main entering designated manholes shall also be inspected, when accessible, to assess overall structural and service condition and possible forms of infiltration.
   3. For manholes without a pre-assigned Manhole ID number the contractor shall assign a temporary unique identifier number from a series assigned by the City.
   4. When buried manholes are discovered, Contractor will alert the City, and submit report of all buried manholes, their location and surface cover.
   5. When active infiltration is identified, Contractor will advise the City in writing of manholes encountered that require sealing.
   6. When a broken manhole cover and/or casting are identified, Contractor will advise the City in writing of the location of such broken cover and/or casting.
   7. Inspection data shall be submitted to the city in an approved database. Digital data and high resolution digital photographs will be delivered to the City on external hard drives.
   8. Digital photographs shall be named in the following format:
      a. [LandLot][ManholeID][Type Designation][PhotoIncrementalNumber].jpg
         Type Designation – A for Area Photo, I for Internal Photo, P for Pipe Photo and F for MH Defect Photo.

B. Ground Level - manhole assessment procedures:
   1. Manholes less than 20 feet deep, with all mains less than 48 inches in diameter, will be inspected from the ground level without entry into the manhole.
   2. The manhole interior structure shall be manually inspected using high-level illumination. High-resolution digital photographs with approved picture quality shall be taken of observed defects as well as all other relevant features. Information gathered shall provide a full illustration of the condition of the manhole's interior as well as each main entering or leaving the manhole.
   3. If required to properly document the manhole condition the Contractor shall employ a pole mounted lights and camera.
   4. The Contractor shall take digital photos as described in this section, complete the assessment report, make map verifications, and record map corrections as necessary.

C. Man Entry - manhole assessment procedures: (This procedure only utilized when approved in writing by the City. Must receive written approval for each manhole.)
   1. Manholes that are 20 feet deep and greater will be inspected using the man entry condition assessment method. Also, manholes with any main 48-inches in diameter and greater or with offset manholes, overflow weirs, or other unique features precluding effective ground level assessment will be inspected using this method.
   2. The manhole interior structure shall be manually inspected using high-level illumination. High-resolution digital photographs with approved picture quality shall be taken of observed defects as well as all other relevant features. Information gathered shall provide

a full illustration of the condition of the manhole's interior as well as each main entering or leaving the manhole.

3. Confined Space safety procedures must be employed.
4. The Contractor shall take digital photos as described in this section, complete the assessment report, make map verifications, and record map corrections as necessary.

3.2 DOCUMENTATION

A. The following data will be recorded by the Contractor and submitted in the form of electronic data, including all text, updated maps and digital photos. Submitted data shall incorporate the following:

1. Manhole Facility ID Number
2. Date of condition assessment
3. Status of the manhole as inspected, buried, or un-located manhole
4. Type of manhole lid
5. Number and size of holes, if any, in manhole cover
6. Deficiencies in the ring and cover
7. Whether or not the manhole is subject to ponding and the size of the runoff/ponding area.
8. Location of manhole (street address, cross streets, etc)
9. Depth to manhole invert (nearest 0.1 foot)
10. Manhole construction materials and conditions of the walls, steps, benches, troughs.
11. Clock reference of each manhole defect (outgoing main at 6:00 o'clock)
12. Manhole ID number and clock reference of each main (outgoing main at 6:00 o'clock)
13. Size, material, condition and depth of each main.
14. Location and nature of visible defects and obstruction, i.e., indication of structural conditions or special problems in the main/manhole
15. Root growth and type in manhole wall/base, if any
16. Evidence of leaks and locations, along with measured or estimated sources of extraneous flows, i.e., identification and quantification of visible inflow and infiltration source
17. Special problems and conditions, such as overflows, bypasses, etc.
18. Plan and profile drawings of the manhole. Include the invert showing direction of flow of the incoming and outgoing main(s), defects, etc.
19. Presence of any water flushing valves
20. Type and depth of debris and deposition in the manhole
21. Evidence of surcharge and the level of the surcharge

3.3 PHOTOGRAPHIC DOCUMENTATION PROCEDURES

A. A set of high-resolution digital color photographs shall be taken for each manhole assessed, showing:

1. Above ground features and conditions in the vicinity of the manhole to be assessed – photo to be taken looking downstream with manhole in immediate foreground
2. View from surface, of manhole invert – outgoing pipe at 6:00 o'clock.
3. Any structural defects, evidence of leakage, obstructions, roots, mortar loss, evidence of hydrogen sulfide attack, etc.
4. Each photograph filename shall be entered into the electronic database in the appropriate record that it is associated with.
5. Digital photographs of all in/out pipes in the manhole shall also be submitted.

3.4 DELIVERABLES

A. Electronic database with inventory and condition data, along with photographs of each shall be submitted to the City. The electronic database must contain all the data required by this specification.

B. Data Collection Methods: Electronic data must be delivered in the prescribed method for uploading to the City's Mapping System. However, the Contractor may use whatever method he chooses to collect the data. Electronic copies of blank data tables will be provided to Contractor at the Project – Kickoff Meeting.

C. The Contractor shall complete work on each asset as assigned. Upon start of work, the Contractor shall receive work orders as assigned by the Project Manager. The Contractor shall maintain and synchronize the status of each rehabilitation work order issued.

3.5 QUALITY CONTROL PROCEDURES

A. The Contractor shall operate a quality control system, to be approved by the designated project manager, which will effectively gauge the accuracy of all survey reports produced by the operator.
   1. The system shall be such that the accuracy of reporting is a function particularly of:
   2. The number of faults not recorded (omissions).
   3. The correctness of the coding and classification of each fault recorded.

B. The minimum levels of accuracy to be attained under the various survey headings are as follows:
   1. Inspection Accuracy 95%
   2. GPS Accuracy 95%

C. The Contractor's data quality control program shall include routine outside auditing of the work completed by a qualified subcontractor. The qualified subcontractor shall meet the minimum specified Contract requirements for the performance of the work and shall be approved in writing by the project manager. The accuracy of the Contractor's data shall be based on the percentage of the data confirmed correct by the subcontractor. The minimum acceptable accuracy of the data shall be 95%.

   The general sequence of the auditing shall be as follows:
   1. The project manager shall randomly select one day per month, typically in the first week of the month, and the work performed during this day shall be reviewed and/or repeated by the qualified subcontractor.
   2. If the work is greater than or equal to 95% accurate, no further outside auditing will be required for the month unless requested by the project manager at his sole discretion. The cost for this audit is included in the allowances specified in the Bid Form.
   3. If the work is less than 95% accurate, the Contract shall at his own expense repeat and/or correct the work and have the work re-audited by the qualified subcontractor.
   4. If this work is still less than 95% accurate, the Contractor shall repeat and/or correct and have the work re-audited, at his own expense, until the work is greater than or equal to 95% accurate.

5. When this re-audited work is found to be greater than or equal to 95% accurate, the Contractor shall have the work of another randomly selected day in the same month reviewed and/or repeated by the qualified subcontractor at the Contractor's own expense.
6. Steps 2 through 5 shall be repeated at the Contractor's own expense until the selected day is 95% accurate on the initial audit.
7. The occurrence of five randomly selected days not achieving 95% accuracy on initial subcontractor review will constitute cause for dismissal.
8. If the contractor successfully meets the 95% accuracy requirement for the initial randomly selected day for two consecutive months (Step 2 above), the contractor may subsequently audit one day every other month. The Contractor may continue auditing one day every other month until the initial randomly selected day does not meet 95% accuracy, at which time it must resume auditing one day every month.
9. The Contractor shall perform this QA/QC analysis on all data recorded before the data is submitted to the City. The Contractor shall provide a summary report of the results of the Quality Assurance analysis with each data submission.
10. The data submissions shall undergo the same random review checks for Quality when submitted to the City. Should accuracy levels fall below 95%, the data submittal will be refused and no payment will be released. Contractor will be required to correct or re-do inspections until 95% level of accuracy is reached. Continuous data submittal refusals for quality under 95% will constitute cause for dismissal.

3.6 COLLAPSING MANHOLES, COLLAPSING PIPES

A. Any manhole with severely compromised structural integrity and posing a hazard or threat of personal injury to the public must be reported to the City immediately for remedial action. Written confirmation of the report, including all details of the defect/hazard shall be made to the City within 24 hours of the discovery of the problem.

B. The Contractor must protect any manhole with conditions that pose a threat of personal injury to the public until the City arrives at the job site.

3.7 BOLTED COVERS

A. For all bolt-down style manhole covers, upon completion of the assessment, all bolts that were removed must be put back in place using sealing gaskets as necessary.

END OF SECTION

Appendix C

Manhole Condition Assessment

Specifications

SECTION 001530

MANHOLE CONDITION ASSESSMENT

PART 1 - GENERAL

1.1 WORK THIS SECTION

A. The purpose of manhole condition assessment (MCA) is to locate a manhole, document all incoming and outgoing pipes, and determine its physical dimensions, materials, structural condition, maintenance concerns, and sources of infiltration/inflow. NASSCO's MACP manhole condition assessment codes will be utilized. Manhole condition assessments will be conducted on every manhole in the project basin, unless otherwise noted.

1.2 REFERENCES

A. Codes, Specifications, and Standards
NASSCO – National Association of Sewer Service Companies

B. Testing and Materials Standards (None Cited)

C. Related Sections
1. Section 01510, Sanitary Sewer Television-Sonar Inspection
2. Section 01520, Sanitary Sewer Cleaning
3. Section 01540, Survey
4. Section 01570, Temporary Field Flow Monitoring
5. Section 02600, Wastewater Flow Control

1.3 DEFINITIONS

A. Buried Manhole: A manhole on a pipe, which is not visible at ground surface. All buried manholes on the sanitary systems shall be reported for raising following their location. Subsequently, the raised manholes shall be inspected.

B. Designated Manhole(s): Manholes identified by City to be assessed. For the purpose of this contract, Designated Manholes shall be all manholes on the sanitary sewer systems including new manholes, raised manholes, buried manholes, and unmapped manholes discovered during the project.

C. Manhole: A subsurface structure where one or more pipes meet, with person access from the ground surface.

D. Manhole Structure: Reference to and all activities relevant to manhole structures throughout the text shall also be taken to include junction boxes, inspection chambers, drop shafts, sumps, and all other auxiliary structures appurtenant to the sanitary sewer systems.

E. Mapped Manhole: A manhole that appears on the City's sewer system maps.

F. Raised Manhole: A manhole in which the frame and cover has been raised above their previous level.

G. Unburied Manhole: A manhole on a pipe to be assessed formerly buried below ground surface.

H. Unmapped Manhole: A manhole not included on the City's sewer system maps. An unmapped manhole is also known as an uncharted manhole.

I. Exposed Manhole: A manhole in which the frame and cover are above normal levels above ground, i.e., more than 18-inches above ground level on any side.

1.4 EXPERIENCE

A. Supervisor of the field crews performing these functions shall have the proper training in these types of equipment and monitoring functions and have a minimum of three (3) years experience in performing such assignments including safe work practices, etc.

B. Field crew leaders performing these functions shall have the proper training in these types of equipment and monitoring functions and have a minimum of two (2) year experience in performing such assignments including safe working practices, etc.

C. The Contractor shall provide the City with written documentation (certification) that the supervisor, field crew leader and all crewmembers responsible for these assignments have the proper training and the requisite experience.

D. No crewmembers shall enter confined spaces without the necessary certified training.

E. The required experience shall be documented in the Contractor's Request For Proposal submittal.

1.5 MEASUREMENT AND PAYMENT

A. Payment for manhole condition assessment shall be made at the unit price bid. Manhole condition assessments shall be per each manhole inspected. Payment will be full compensation for furnishing all labor, tools, traffic control and equipment necessary to perform all work. Payment for Manhole Condition Assessments shall be made under Inspection Services, Manhole Condition Assessment, per each.

1.6 RESPONSIBILITY FOR OVERFLOWS/SPILLS AND DAMAGE TO PROPERTY AND UTILITY

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11. Clock reference of each manhole defect (outgoing main at 6:00 o'clock)
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14. Location and nature of visible defects and obstruction, i.e., indication of structural conditions or special problems in the main/manhole
15. Root growth and type in manhole wall/base, if any
16. Evidence of leaks and locations, along with measured or estimated sources of extraneous flows, i.e., identification and quantification of visible inflow and infiltration source
17. Special problems and conditions, such as overflows, bypasses, etc.
18. Plan and profile drawings of the manhole. Include the invert showing direction of flow of the incoming and outgoing main(s), defects, etc.
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   1. The system shall be such that the accuracy of reporting is a function particularly of:
   2. The number of faults not recorded (omissions).
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   1. Inspection Accuracy 95%
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6. Steps 2 through 5 shall be repeated at the Contractor's own expense until the selected day is 95% accurate on the initial audit.
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B. The Contractor must protect any manhole with conditions that pose a threat of personal injury to the public until the City arrives at the job site.

3.7 BOLTED COVERS

A. For all bolt-down style manhole covers, upon completion of the assessment, all bolts that were removed must be put back in place using sealing gaskets as necessary.

END OF SECTION