SSES PHASE I

Hallandale Beach
PROGRESS. INNOVATION. OPPORTUNITY.

CITY OF HALLANDALE BEACH, FLORIDA

FY 2018

DEP Clean Water SRF Project No. ***

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EXECUTIVE SUMMARY

The City of Hallandale Beach is responsible for the planning, construction and maintenance of its lift stations and collection systems. City crews are responsible for insuring the reliable service of sewage lift stations and accompanying force mains and gravity lines throughout the City of Hallandale Beach. Maintenance and repair of the sewer force main piping and gravity collection system includes excavation and repair of manholes, gravity piping, service connections and force mains.

Wastewater from the City is transmitted through 1,097 manholes, nearly 50 miles of gravity mains and 20 miles of force main piping to the wastewater treatment plant. These pipelines range from 8 to 27 inches in diameter. Sanitary sewer lines serve a vital role in the health and safety of the public, but these collection systems are usually taken for granted because they are out of sight. These systems are designed to convey wastewater from its source to wastewater treatment plants. The City sends its wastewater to Hollywood for treatment. The City's service area comports with the City's corporate limits.

For the City of Hallandale over a third of their flows are infiltration and/or inflow. Since many of the pipes are vitrified clay, over 50 years old and submerged in water most of the year. Age, pipe type, roadway conditions and other factors affect the sewer system capacity by creating the potential for infiltration and inflow into the sewer system, compromising capacity and increasing the potential for overflows. Ongoing infiltration and inflow detection and elimination efforts are required to minimize excess water moving into the system since the total flows through the pipes directly translates to the size of the wastewater bill from the City of Hollywood.

The manholes and clean-outs are required for access and removal of material that may build up in the piping system. Manholes are used where there are changes in direction and/or size of the sewer pipe. They also serve as access sites for workers to perform maintenance or cleaning. Manholes are traditionally pre-cast concrete or brick. Brick was the method of choice until the 1960s. Most of the City's 1097 manholes are brick manholes. In addition, the manhole cover may not seal perfectly, becoming another source of infiltration during a rain event or even from normal irrigation runoff.

A Phase 1 Investigation of the City's sewer system was undertaken. The results are as follows:

- Inspection of 1097 sanitary sewer manholes was performed
- Installation of Elasti-seal in 1097 manholes was performed
- Defender inflow dishes have been installed in1097 manholes – note that a number needed special fits due to a series of riser rings of the configuration of the riser ring (see manholes reports)
- There was no apparent need to repair benches in poor condition or exhibiting substantial leakage
- There was no apparent need to repair manhole walls in poor condition or exhibiting substantial leakage although several liners were noted as leaking

- 800,000 ft of smoke testing was completed in November with 176 openings on the City's right-of-way
- 5% of services had issues noted during smoke testing.
- 176 LDL plugs and caps were installed in the public right-of-way
- Over 100 smoke sources outside the right-of-way were noted that need repairs
- A midnight run identified that 32% of the sewer system should be further investigated for infiltration form pipe breaks or service lines. Of the total, over 80% of the pipes to be televised are 8-inch gravity lines, many of which are dead ends.
- Documentation of all problems in a report to City that identifies problem, location and recommended repair

An estimate for the Phase 2 work –cleaning, televising, lining and service line repairs was just under $3 million. The payback estimated is under 6 years. Note that the Phase 1 work will save a minimum of $320,000 in pipe that does not need to be cleaned or televised in Phase 2.

INTRODUCTION

1.1. Background

The City of Hallandale Beach is located in the southeastern corner of Broward County (see Figure 1-1). The City's water and sewer service area is bounded as follows: on the west by I-95 on the south by Miami-Dade County, on the east by the Atlantic Ocean and on the north by the City of Hollywood. The City's service area is shown in Figure 1-2. It comports with the City's corporate limits. The City of Hallandale Beach is responsible for the planning and implementation of the service area infrastructure needs. The City currently treats water from three wells located in the City, and raw water purchased and transmitted from Broward County. The City sends its wastewater to Hollywood for treatment.

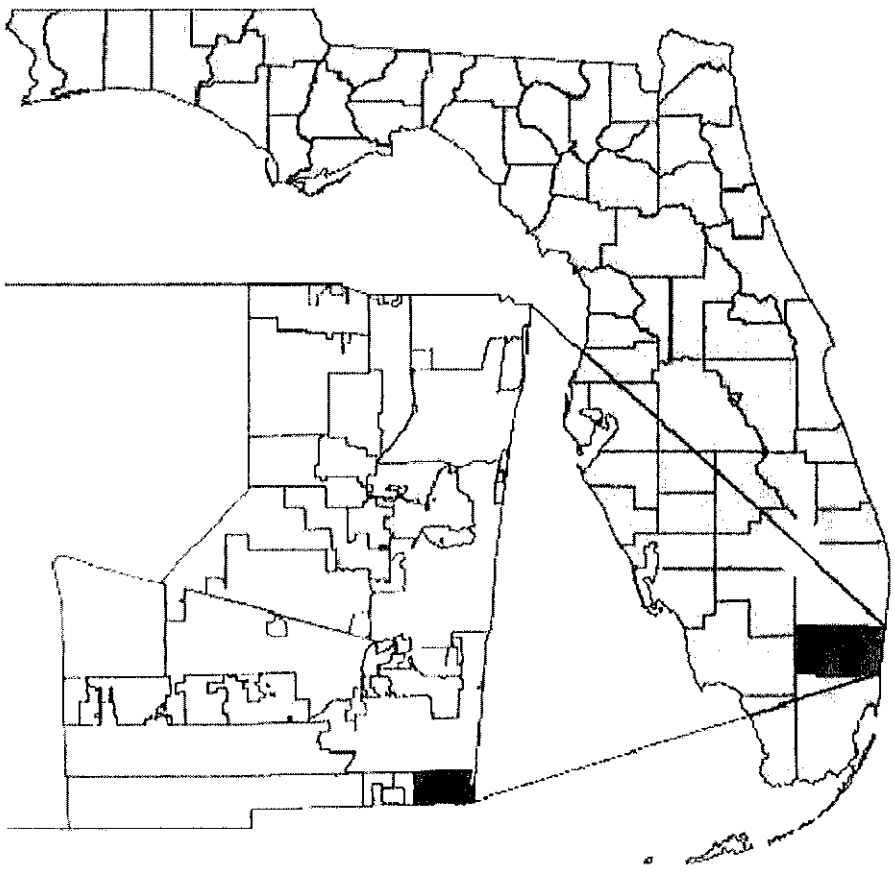


Figure 1.1 Location of Hallandale Beach

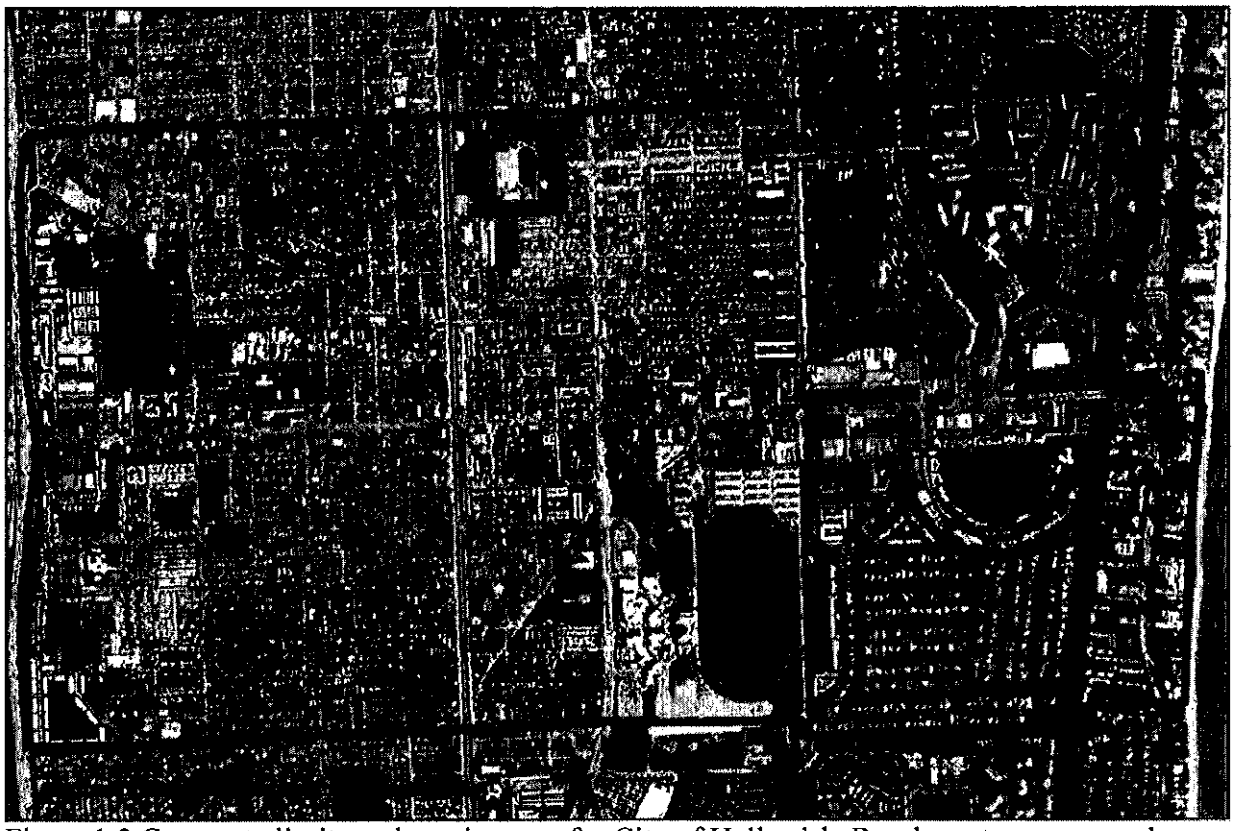


Figure 1.2 Corporate limits and service area for City of Hallandale Beach, water, sewer and storm water systems.

1.2 Financial Basis of the Utility System

The City's water and sewer utility systems were created to develop safe, reliable and financially self-supporting potable water and sanitary wastewater services which meet the water and sewage needs of the residents of the City of Hallandale Beach. In like manner, the stormwater utility has been set up to meet the dual challenge of meeting water quality regulations and reducing flooding. These utilities are intended to ensure that existing and future systems are constructed, operated and managed at the least possible cost to the users with no direct or indirect financial aid from the general fund or taxpayers of the City. As a result, the utilities have been set up as Enterprise Funds, operating as a business, whereby utility service revenues are used to finance operations. The water and sewer systems receive no taxpayer funding for their operations. The revenues in the system are varied and include monthly water and wastewater bill payments, system connection charges, stormwater drainage fees and reserve capacity fees.

Currently, the City of Hallandale Beach is one of seven municipalities that sends wastewater to the City of Hollywood for treatment. These Large User municipalities are:

- Pembroke Pines
- Broward County

- Miramar
- Pembroke Park
- Hallandale Beach
- Dania Beach
- Hollywood

The Large User partnership agreement between the City and the City of Hollywood affects the City since the City's treated wastewater goes to the City of Hollywood's ocean outfall, deep well injection or reuse system. Since the capacity of Hollywood's disposal system has become an issue as a result of legislation passed by the Florida Legislature in 2008 to abandon the ocean outfalls, impacts to Hollywood's disposal capacity affects the City. The City of Hollywood will be passing the costs of compliance for the outfall rule to the City of Hallandale Beach on a proportionate basis based on reserved capacity in the wastewater plant and flow volumes. It is in the interests of the City of Hallandale Beach to reduce its wastewater flow volumes transmitted to Hollywood through the elimination of inflow and infiltration.

1.3 Wastewater Collection

Sanitary sewer lines serve a vital role in the health and safety of the public. These systems are designed to convey wastewater from its source to wastewater treatment plants. These collection systems are usually taken for granted because they are out of sight. Many of our nation's existing sewer lines are old and require maintenance to ensure that they can adequately support the needed capacity. Some sewer systems in this country were built as far back as 100 years ago. Many sewer systems were built well before legislation created more stringent design regulations regarding sanitary sewer collection systems. Modern municipal sewer systems are designed to be more resistant to blockages, structural failures, and collapse.

Gravity sewer collection systems consist of the gravity pipes, manholes, service lines, and clean-outs. Collection system piping throughout North America prior to 1980 was predominately vitrified clay. Since that time, asbestos concrete and various grades of PVC have been used. Ductile iron is rarely used due to the potential for crown corrosion from hydrogen sulfide gas. Vitrified clay pipe has been used for well over one hundred years. The pipe is resistant to deterioration from virtually all chemicals that could be in the water, and from soil conditions. It has a long service life when installed correctly and left undisturbed. However, vitrified clay pipe is brittle, so settling from incorrect pipe bedding, surface vibrations, or freezing can cause the pipe to crack.

Temperature differences between the warm wastewater and cooler soils can cause the exterior pipe surface to be damp. The dampness encourages tree roots to migrate to the pipe, where they may wrap around and damage the pipe. In places that have pipe cracks, roots will enter the pipe, and over the long-term, the pipe will become broken and damaged from the combination of tree roots, vibrations, and freezing. Where the water table elevation is above the pipe level, significant infiltration of groundwater can occur, which overwhelms the capacity of the wastewater treatment plant to handle the volume of wastewater.

Another concern with older vitrified clay pipe is the short joints used – as small as 2 feet prior to 1920 and 4 feet prior to 1960. Field joints were made prior to 1920, and even later. The joints were sealed with cement and cloth "diapers" wrapped around the joint. However, concrete is not water-proof and will tend to crack over time. This particular pipe configuration results in networks with many joints, each of which has the potential to leak. Even today, the vitrified clay joints are short compared to PVC and ductile iron (20 feet and 18 feet respectively), although the joints and materials have improved substantially. Vitrified clay still remains the choice of material to use in industrial areas, where pipe protection is required.

The manholes and clean-outs are required for access and removal of material that may build up in the piping system. Manholes are used where there are changes in direction and/or size of the sewer pipe. They also serve as access sites for workers to perform maintenance or cleaning. Manholes are traditionally pre-cast concrete or brick. Brick was the method of choice until the 1960s. Brick manholes suffer from the same problems as vitrified clay sewer lines – the grout is not waterproof, so the grout can leak significant amounts of groundwater into the manhole. In addition, the manhole cover may not seal perfectly, becoming another source of infiltration during a rain event or even from normal irrigation runoff. Pre-cast concrete manholes limit the number of joints needed, and elastomeric seals placed between successive manhole rings reduce these kinds of leaks. Many utilities will require the exterior of the manholes to have a coal-tar or epoxy covering, which helps to keep the water out.

Cleanouts for service lines are generally located on private property, and typically the utility has limited control over what happens there. Hence the removal or accidental breaking of a cleanout, or a cracking of the service line pipe may be significant causes of inflow to the system. Both are potential sources of inflow during rain events. Simple methods can be used to detect them, and this should be part of ongoing maintenance efforts.

The City operates fifteen pump stations within these three-independent force main networks. The City's wastewater collection system includes a fourth system in the northeast portion of the City. The City has not identified any new developments in this area and therefore it is not expected to be impacted by growth. This fourth collection system includes Pump Station 18 (which is operated by the City of Hollywood) and Pump Station 4. Pump Station 18 was not included in the model runs or the maps below (it is in Hollywood).

Pump Station 16 is no longer in service. Pump Station 17, a private station, is hydraulically linked to the City's wastewater collection system. Flows from this pump station were considered as part of the modeling analysis. An evaluation of the pump station capacity, however, was not included since this pump station is not operated by the City.

The City of Hallandale Beach is responsible for maintenance of its lift stations and collection systems. Maintenance and repair of the sewer force main piping and gravity collection system includes excavation and repair of manholes, gravity piping, service connections and force mains. City crews are responsible for insuring the reliable service of sewage lift stations and accompanying force mains and gravity lines throughout the City of Hallandale Beach. Wastewater from the City is transmitted through 1,097 manholes, nearly 50 miles of gravity mains and 20 miles of force main

piping to the wastewater treatment plant. These pipelines range from 4 to 30 inches in diameter. Table 1.1 summarizes the collection system inventory for the City of Hallandale Beach.

Table 1.1 Summary of Hallandale Beach Sanitary Sewer Infrastructure

Services	6,250	LF
8" Gravity Sewer	213,545	LF
10" Gravity Sewer	44,065	LF
12" Gravity Sewer	12,145	LF
15 or 16 " Gravity Sewer	15,196	LF
18" Gravity Sewer	7,775	LF
21" Gravity Sewer	2,080	LF
24" Gravity Sewer	3,530	LF
30" Gravity Sewer	575	LF
4" Force Main	730	LF
6" Force Main	535	LF
8" Force Main	195	LF
10" Force Main	4,462	LF
12" Force Main	15,910	LF
14" Force Main	13,340	LF
16" Force Main	5,723	LF
20" Force Main	9,315	LF
24" Force Main	680	LF
Manholes	1097	ea.
Small LS	16	ea.
Medium LS	2	ea.
Land	2	ac

Figure 1.3 depicts the City's gravity sewer system. Much of the pipe is clay. Figure 1.4 shows the 15 lift stations owned and maintained by the City. All force mains direct flow ultimately to the City of Hollywood's wastewater collection system through three connection points (see Figure 1.5). Table 1.2 outlines a summary of the lift station information. Table 1.3 outlines the pipe data by basin

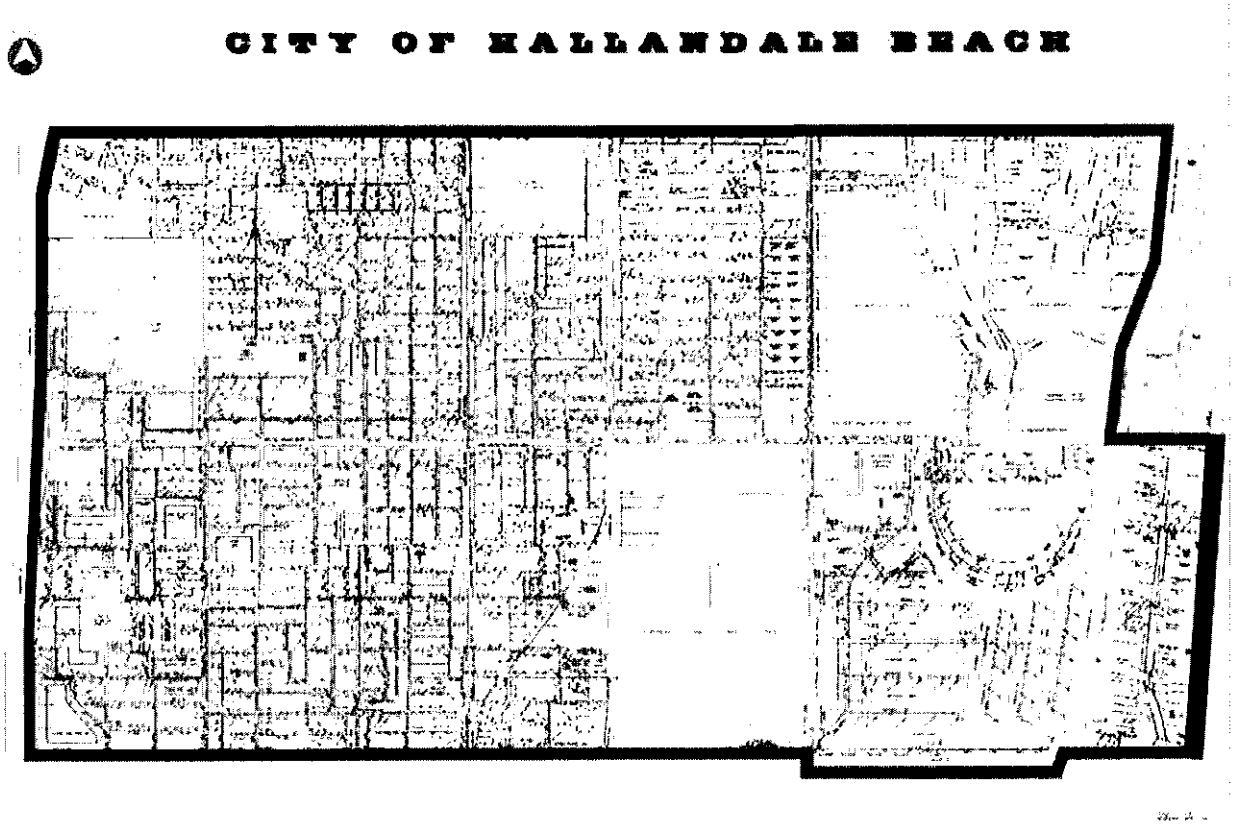


Figure 1.3 Sanitary Sewer System in Hallandale Beach

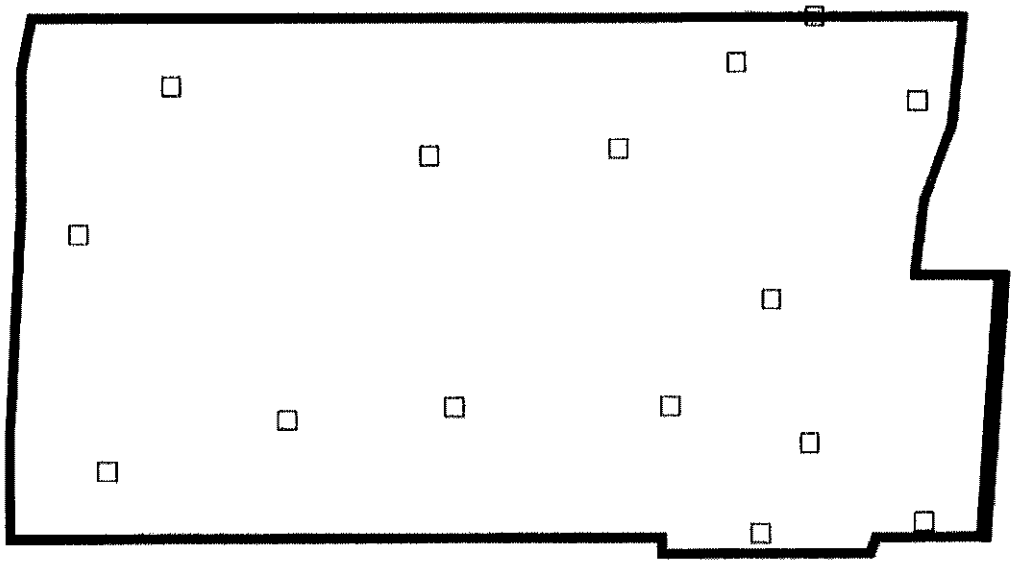


Figure 1.4 Lift Stations for Sanitary Sewer System in Hallandale Beach

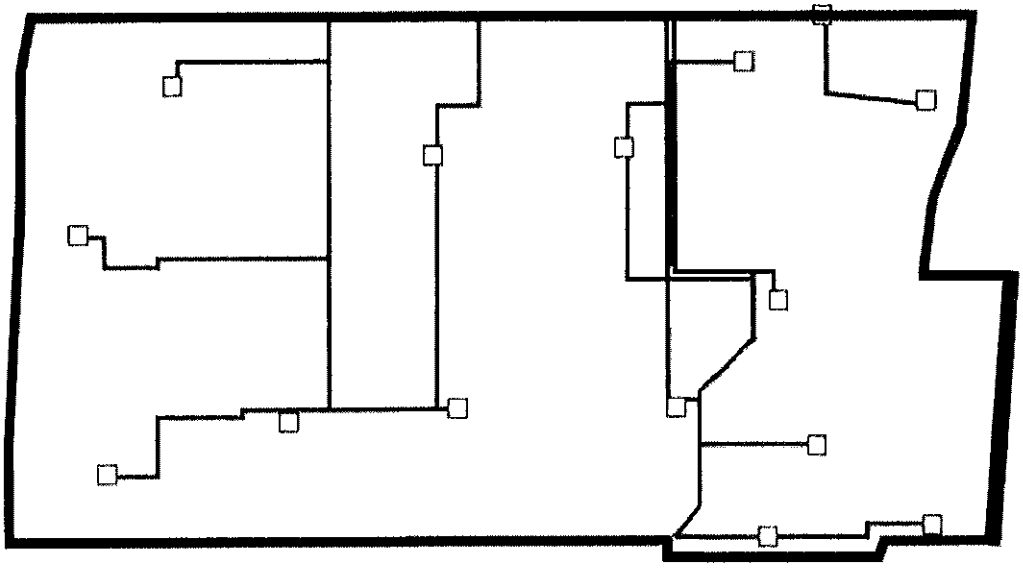


Figure 1.5 Force Mains of the Sanitary Sewer System in Hallandale Beach

Table 1.2 - Summary of Lift Station Information

LS #	Station	Address	Pump Cap 2017?	Pump Cap 2005	Pumps
1	Egret	300 Egret Drive	5000	5000	Fairbanks BS414 60 HP 14.75 imp
2	Diana Dr	Diana/G. Isles Dr.	500	665	Fairbanks 5433M 20 HP 12 imp
3	Beach	3205 S. Ocean Dr.	1570	1570	Ebara 150-DLU-622 30 HP
4	Three Islands	500 Leslie Dr.	1405	1405	Enpo-Cornell 64-DESN-300 25 HP 12 in imp
5	Atlantic Shores	1000 Atlantic Shores	2400	380	Myers 6VC250M4-43 25HP 9.75 Imp
6	NE 12th	1127 NE 4th Ct.	2400	1600	Myers 6VC600M4-43 60HP 11 Imp
7	NE 4th	243 NE 4th Ct.	800	800	Fairbanks 5443825 25 HP 10 imp
8	SE 5th	500 S Old Fed. Hwy.	400	400	Fairbanks 5443825 20 HP 9.5 imp
9	Foster	700 Foster Rd.	1500	1500	Ebara 150-DLU-618 25 HP
10	Sunset E	320 Sunset Dr.	200	375	Barnes 3SE1524L 1.5 HP 6 imp
11	Holiday	426 holiday Dr.	200	360	Barnes 3SE1524L 1.5 HP 6 imp
12	SW 4th	511 SW 4th Ave	1600	1500	Fairbanks 5424 25 HP 14 imp
13	SW 8th	912 SW 8th St.	3045	3045	Fairbanks 5424F 30 HP 16 imp
15	Sunset W	295 NW 10th Terr.	160		Barnes 84608 2.8 HP 6 imp
14	NW10th	490 Sunset Dr.	200	200	Barnes 4SE4524L 4.5 HP 6.5 imp
16	Fire Station		60		Barnes 84608 1.5 HP 6 imp
18	Three Islands (Hollywood)				

Table 1.3 Pipe Data by Lift Station Services Area (per 2005 Master Plan inventory)

corrected LS No.	Station	ADDRESS	MH	8	10	12	15	16	18	21	24	27	30	Total Pipe	Pipe (mi)	In Mi
1	Egret	300 Egret Drive	58	8160	385		1896		2210		460			13,111	2.48	28.10
2	Diana Dr	Diana/G. Isles Dr.	41	2090	3865	230	760	385	2155		75			9,560	1.81	22.02
3	Beach	3205 S. Ocean Dr.	62	2690	2580	430			60	2080	1560			9,400	1.78	25.51
4	Three Islands	500 Leslie Dr.	10		1895	115	50							2,060	0.39	3.99
5	Atlantic Shores	1000 Atlantic Shores	8	2075										2,075	0.39	3.14
6	NE 12th	1127 NE 4th Ct.	124	19365	9520	1550	4565	825						35,825	6.79	66.36
7	NE 4th Cir	243 NE 4th Ct.	91	19830	2720	1350			70		20			23,990	4.54	38.59
8	SE 5th	500 S Old Fed. Hwy.	104	20265	3995	1325	435		55					26,075	4.94	42.71
9	Foster	700 Foster Rd.	240	49545	5010	3060		2080	1870		530			62,095	11.76	106.60
10	Sunset E	320 Sunset Dr.	19	5690										5,690	1.08	8.62
11	Holiday	426 holiday Dr.	6	1625										1,625	0.31	2.46
12	SW 4th	511 SW 4th Ave	224	51240	5060	545		150	200		25			57,220	10.84	89.71
13	SW 8th	912 SW 8th St.	85	15810	2610	970	630	2685			20			22,725	4.30	41.12
14	NW 10th	295 NW 10th Terr.	94	15160	4190	2570		500	645		75			23,140	4.38	40.80
15	Sunset W	490 Sunset Dr.	4		1305									1,305	0.25	2.47
18	Three Islands		13		930		235		510		765	575	730	3,745	0.71	14.73
		TOTAL												299,641	56.8	536.9

The primary method to evaluate sewer condition is by studying the flow rates through the system. Recent data for Broward County shows that 70% of water is returned for sewer in communities without extensive irrigation from the potable water system. Table 1.4 shows the sewer flow rates, compared to water flow rates. Figure 1.6 shows the data graphically. Note that the largest meter was out of service for over a year during 2015. If flows are projected based on that meter being in service, Figure 1.7 results. Based on Figure 1.7, and that 70% of water should be returned to the sewer system, most of the difference is infiltration and/or inflow. For the City of Hallandale over a third of their flows are infiltration and/or inflow. Since many of the pipes are vitrified clay, over 50 years old and submerged in water most of the year, this is not a surprise.

Table 1.4 Wastewater Flow Rates (MGD)

Year	WTP Flows (MGD)	WWTP Flows (MGD)	Est Actual sewer (MGD)	Est. InI (MGD)	Percent
2014	5.50	7.06	3.85	3.21	45%
2015	5.79	6.98	4.05	2.93	42%
2016	6.02	6.84*	4.22	2.62	38%
2017	5.99	6.69**	4.19	2.50	37%

* Estimated costs 2016 - note main meter offline

** 1st half 2017 only

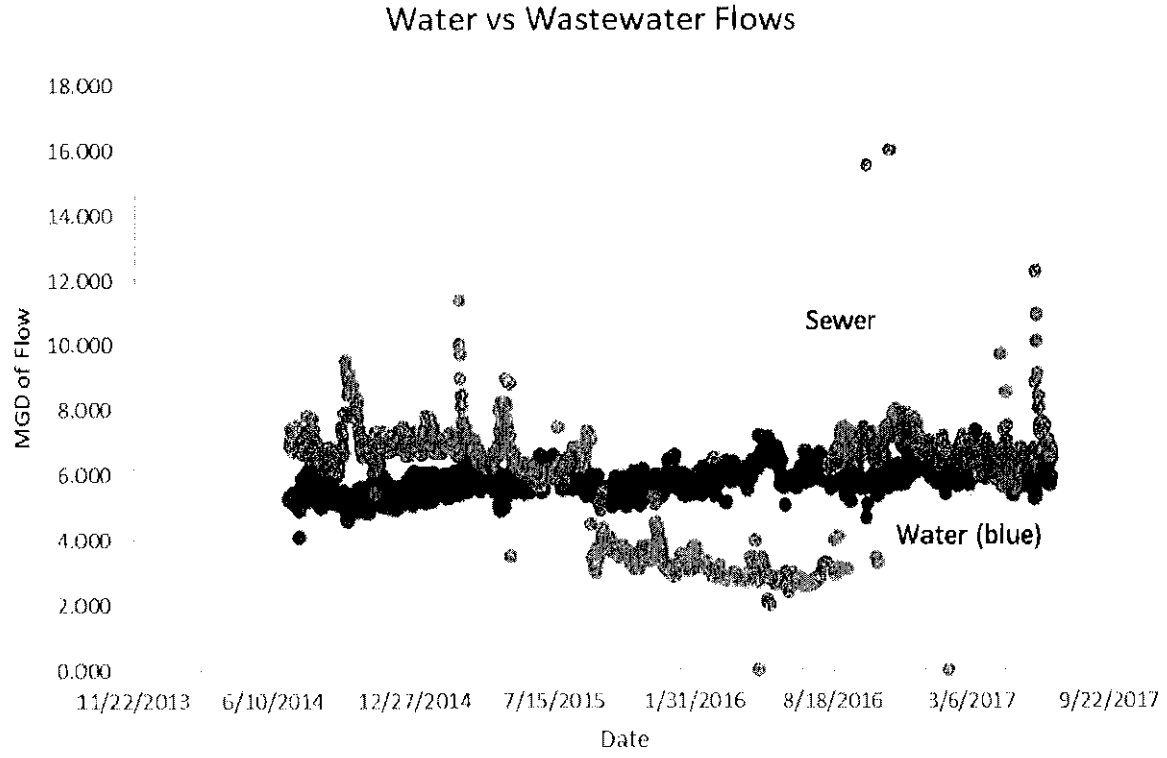


Figure 1.6 Water and Wastewater Flow comparison, 2014-2017 - note largest meter out of service in 2015/16

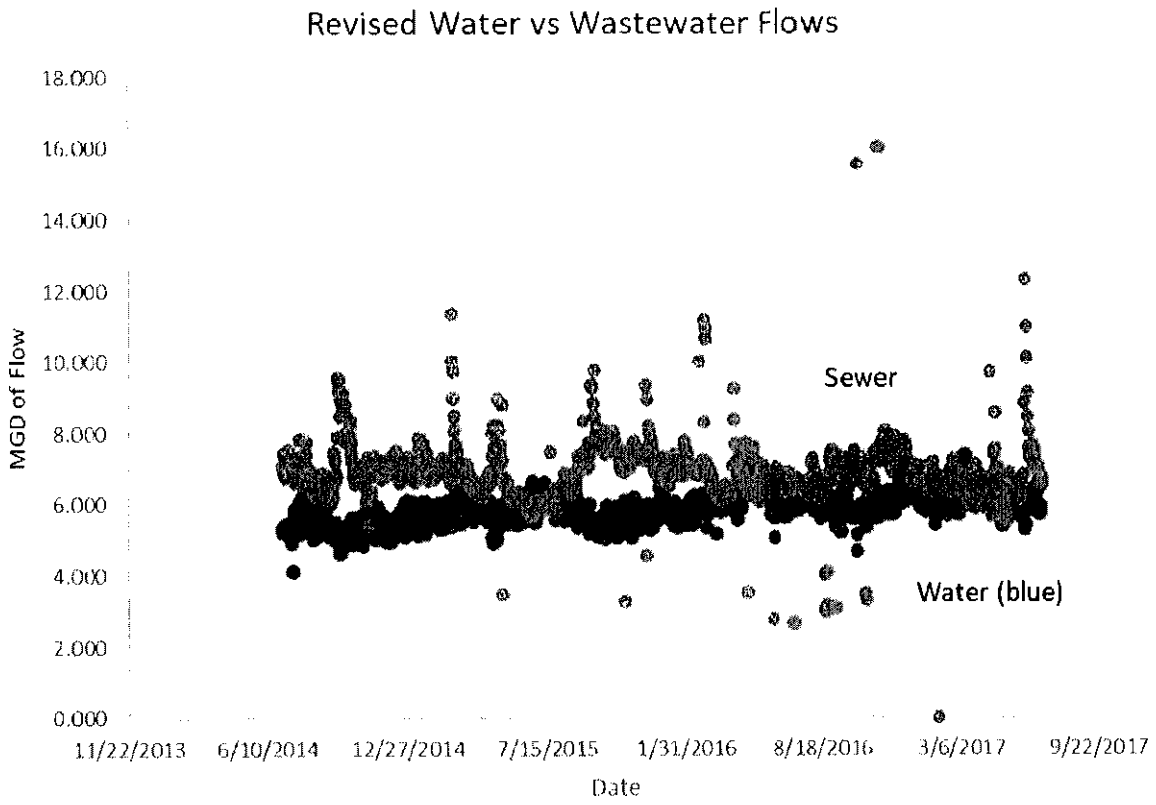


Figure 1.7 Adjusted Water and Wastewater Flow comparison, 2014-2017

Factors that affected the deterioration of sanitary sewer pipe include but are not limited to:

- Pressurized or gravity system
- Age of pipe
- Pipe material
- Pipe diameter
- Length of pipe
- Depth of pipe
- Traffic on the surface
- Vegetation location
- Soil type
- Acidity of the soil

Most of these factors are present in the City. These factors affect the sewer system capacity by creating the potential for infiltration and inflow into the sewer system, compromising capacity and increasing the potential for overflows. Ongoing infiltration and inflow detection and elimination efforts are required to minimize excess water moving into the system since the total flows through the pipes directly translates to the size of the wastewater bill from the City of

Hollywood. Under the Clean Water Act's Capacity, Management, Operations, and Maintenance (CMOM) programs, the City is responsible for maintaining its lift stations and collection systems. Because minimizing excess flows benefits the City financially, correction of leaks and infiltration should be priority projects. Ongoing testing wastewater flows and monitoring lift stations will provide the information needed to determine whether inappropriate amounts of infiltration and inflow are going to the wastewater plant.

Infiltration comes from leaky pipes below the water table. Since the water table is only a few feet below the surface, this is virtually every pipe in the City's sewer system. Infiltration increases the base flow and will be indicated by lower strength wastewater during routine tests of biochemical oxygen demands (BOD) and total suspended solids (TSS). Infiltration is corrected by lining pipes or replacing them. hence the major focus to remove infiltration has been, and continues to be oriented to lining gravity pipe, which includes a significant amount of televising to find the leaks. Lining vitrified clay pipe is possible, thereby extending the life of the pipe.

Inflow is a completely different issue. Where there are peaks in wastewater flows that match rainfall, inflow would appear to be a more likely candidate for the cause of the peaks than infiltration from pipes that are constantly under the water table. Inflow is directly responsible for sanitary sewer overflows. Inflow is surface connection to the sewer system – manhole covers, manhole rings, open cleanouts and broken services. Inflow is caused by surface corrections and is usually identified with smoke testing. Figure 1.8 shows that wastewater flows increase with rainfall, indicating that inflow exists on the system.

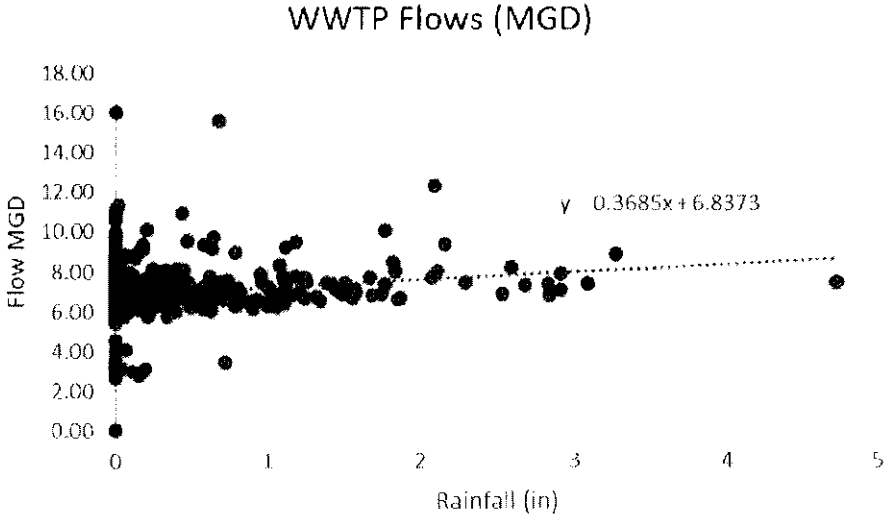


Figure 1.8 Wastewater Flow data – total system versus rainfall, indicating inflow exists on system

Inflow reduction is important not only from the cost savings in the operation of the wastewater treatment plant, but because a portion of the collection system may be inundated as a result of sea level rise and therefore the inflow will be largely salt water. Saltwater will reduce the potential

availability and beneficial uses of reclaimed water because the chlorides will be too high for land application (irrigation of landscape) without reverse osmosis treatment. As a result, by pursuing an effective infiltration and inflow reduction program, the need for advanced, expensive treatment for water reclamation can be avoided initially. USEPA and FDEP have considered the G7 program for solving these problems. The G7 program consists of the following:

- Inspection of all sanitary sewer manholes for damage, leakage, or other problems
- Repair of benches in poor condition or exhibiting substantial leakage
- Repair of manhole walls in poor condition or exhibiting substantial leakage
- Repair/sealing of chimneys in all manholes to reduce infiltration from the street during flooding events
- Installation of dishes in all manholes to prevent infiltration
- Installation of LDL® plugs where manholes in the public right-of-way or other portion of the utility's system may be damaged
- Smoke testing of sanitary sewer system
- Low flow event inspection
- Documentation of all problems in a report to the utility that identifies problems, locations and recommended repairs
- Manhole inspection and dish replacement – this is for manholes where the repairs have previously been made and only the inspection and dish replacement occurs
- Identification of sewer system leaks, including those on private property (via location of smoke on private property during smoke testing)

The investment in infiltration and inflow reduction measures will provide the City with some confidence that flows to the Hollywood regional wastewater treatment plant, and thereby wastewater treatment costs, are as low as possible. After the inflow is corrected, the next step is to perform video inspection, cleaning/relining, and manhole rehabilitation programs to the gravity sewers to keep the wastewater flowing properly. Determining infiltration into the wastewater collection system is accomplished by video camera inspection of gravity sewer lines looking primarily for cracks, breaks, and tree root intrusion into the wastewater collection system, among other sources.

In addition to continued infiltration and inflow reduction, ongoing maintenance includes reading the large user meter and inspecting all lift stations to ensure that pumps and alarms are operating properly. Lift station technicians check all the lift stations. Painting, servicing of equipment and test running of generators are performed as regularly scheduled maintenance. Repairs to controls and alarms are made by the lift station technicians while the mechanical staff repairs pumps, valves and piping as needed.

Repairs include excavation and repair to manholes, gravity piping, service connections and force mains. In addition, new connections, gravity mains and force main piping are installed. The sewer cleaning program involves the cleaning and televised inspection of the gravity lines and manholes, the cleaning and adjustments to the force main air release valves, and response to complaints about stoppages. Parts of this work is contracted to contractors with large scale equipment to correct problems.

In addition, utility crews are responsible for insuring the reliable service of sewage lift stations and accompanying force mains and gravity lines. Ongoing testing of the wastewater and monitoring of the lift stations by the utility provides the data needed to determine whether inappropriate amounts of infiltration are going to the wastewater plant. This testing takes a variety of forms. The first is a review of lift station pump run times, followed by analyses of the influent wastewater quality (i.e. strength).

1.4 Rainfall

Rainfall data was gathered from the DBHYDRO site maintained by the South Florida Water Management District for the City of Hallandale Beach's closest rainfall gage. Based on this gage, Figure 1.9 Ranifall totals July 1 2014 – June 30, 2017. The intensity fo rainfall is also improtant. Figure 1.10 is a rainfall frequency graph. Note large rainfalls have been relatively rare. The largest rainfall was under 5 inches.

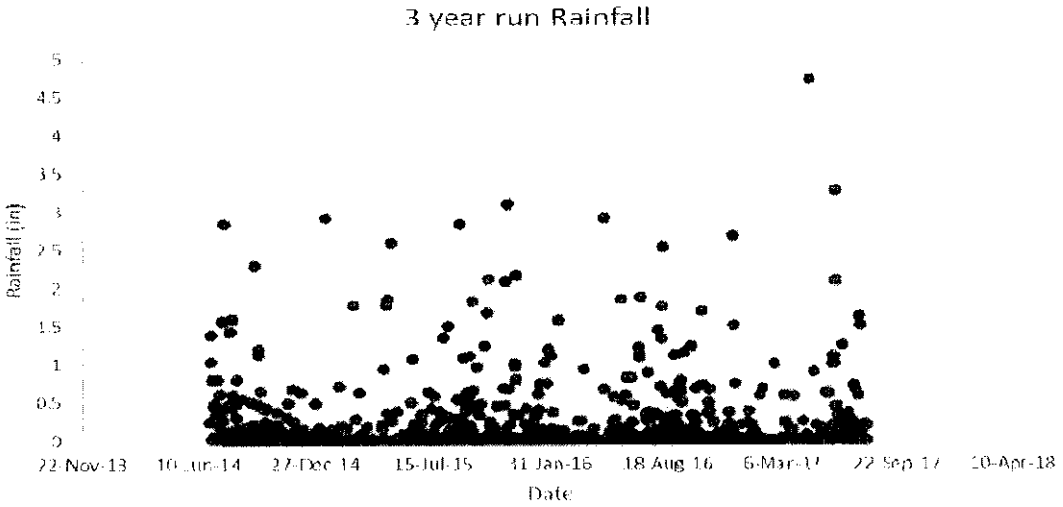


Figure 1.9 Ranifall totals July 1 2014 – June 30, 2017

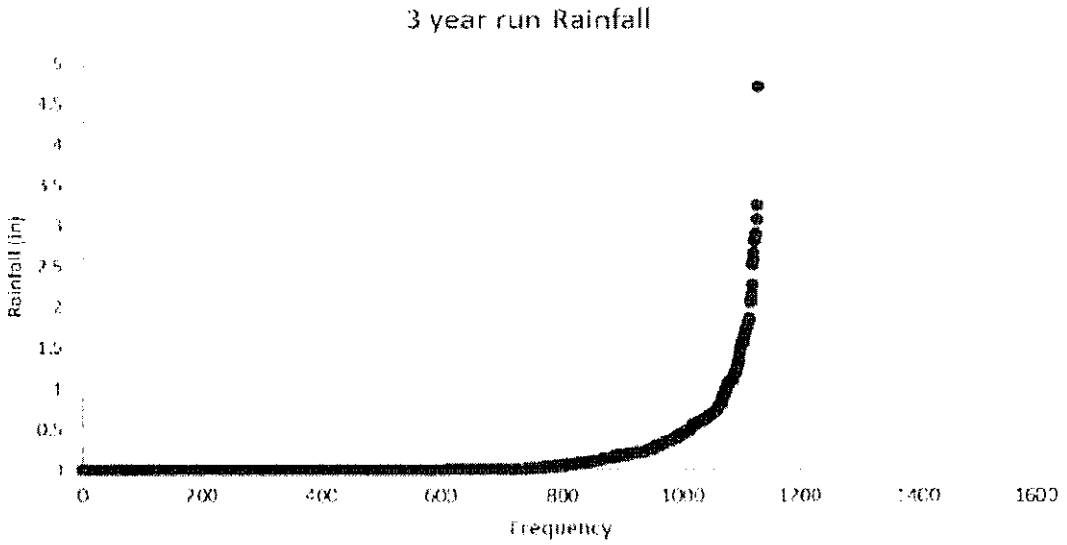


Figure 1.10 - Rainfall Frequency Graph. Note large rainfalls have been relatively rare. The largest rainfall was under 5 inches.

2. Inflow Correction

The City's facilities plan indicated that the City was in need of a comprehensive infiltration and inflow program. The first phase of this work is complete (resulting in this report). The scope of services was as follows:

Task 6 – Manhole Inspection

a. Inspect each manhole with the use of a strong artificial light or reflected sunlight and record the following data –

   i. Manhole designation.
   ii. Manhole size and opening.
   iii. Number and size of holes, if any, in manhole covers.
   iv. Cover defects enabling inflow into the system.
   v. Susceptibility to ponding (whether the cover would become submerged in wet weather).
   vi. Sketch of invert showing direction of flow.
   vii. Construction materials and conditions of cover, frame, rings, corbels, walls, steps, aprons and troughs.
   viii. Quantification of visible sources of infiltration.
   ix. Special problems and conditions, such as surcharges and bypasses.
   x. Type and amount of debris in the manhole.
   xi. Incoming and outgoing sewer lines connected to the manhole.

b. Determine the physical condition of manholes and use information obtained during the physical survey

c. Document the condition with a photo and GPS.

d. Seal the cover/barrel connection with Elasti-seal

e. Document seal

f. Identify problem areas, such as buried manholes, and help verify the sewer maps.

g. Install Defender Dish

h. Provide a letter report for each basin's manholes including the following additional information:

   i. A location map showing the location of each manhole with respect to streets and avenues. The location map shall be of a scale suitable to allow the City and/or its contractors to find the approximate location of the manhole.
   ii. A photograph showing the exact location of the manhole along with the date, address, GPS coordinates.

iii. A summary table for the basin including, for each manhole, the street address, longitude and latitude, description, public/private designation, and page number of associated photo in report. This summary table shall also be provided in electronic format (Microsoft Excel).

i. Safety procedures will be strictly followed during the manhole inspection phase. Traffic will be rerouted by means of traffic cones when manholes are located in the street. After manhole covers are removed, gas detectors will be used to determine the presence of hydrogen sulfide (H_2S) and methane (CH_4) gases if required for manhole entry. Photographs will be taken to document the manhole physical conditions.

Task 4 – Smoke Testing

a. Place door hangers in advance of the smoke testing to advise local residents in English and Spanish of the tests. Use USSI and PUMPS phone numbers for contacts (followed by the City's on the form).

b. Provide adequate notification to City Hall, Public Works/Utilities, the Fire Department and Police Department of the anticipated smoke testing schedule.

c. Ensure that operators who participate in the smoke testing are trained and briefed in the handling of residents and business owners who discover smoke in their buildings or in their yards.

d. Smoke test gravity sewer mains using a high-volume blower, along with smoke canisters or liquid smoke to generate the smoke. Smoke will be non-toxic, odorless, and non-staining.

e. Document each case of smoke coming out of the ground, catch basins, pipes and other sources during the test and record the following information –

   i. Document any smoke (public or private)
   ii. Date and personnel.
   iii. Street address.
   iv. GPS coordinates of the smoke source.
   v. Photograph
   vi. Area and type of surface drained by the leak.

f. Designation as to whether defect is located on public (utility) property or private (customer) property, pursuant to guidance to be provided by the City.

   i. Description of the defect to facilitate follow-up location and repair.
   ii. Digital photograph of smoke coming out of the ground, catch basins, pipes and other sources during the test. To the extent possible, photographs will show the maximum amount of smoke from the leak, the exact source of smoke, and the location of the smoke with reference to some recognizable topographic feature

such as a building.

g. Provide a letter report for each basin including smoke inspection forms and the following additional information:

   i. A location map showing the location of each smoke source with respect to streets and avenues. The location map shall be of a scale suitable to allow the City and/or its contractors to find the approximate location of the smoke source.
   ii. A photograph showing the exact location of the smoke source along with the date, address, GPS coordinates, description of the smoke source, and indication as to whether the smoke source is on private or public property.
   iii. A summary table for the basin including, for each smoke source, the street address, longitude and latitude, description, public/private designation, and page number of associated photo in report. This summary table shall also be provided in electronic format (Microsoft Excel).

Task 5 – Night Flow Isolation

a. Analyze the system and select locations for night flow isolation.

b. Access the manholes during the night flow period and document observations regarding sources and estimated rates of flow.

c. Provide a summary report upon completion with findings and recommendations for follow-up video inspection and/or repair actions as warranted.

The results are as follows:

- Inspection of 1097 sanitary sewer manholes is complete
- Installation of Elasti-seal in 1097manholes is complete
- Defender inflow dishes have been installed in all manholes – note that a number needed special fits due to a series of riser rings of the configuration of the riser ring (see manholes reports)
- There was no apparent need to repair benches in poor condition or exhibiting substantial leakage
- There was no apparent need to repair manhole walls in poor condition or exhibiting substantial leakage
- Smoke testing was completed in November with 174 openings on the City's right-of-way
- Installation of 174 LDL plugs and caps where manholes in the public right-of-way
- Noting 286 smoke sources outside the right-of-way that need repairs
- Documentation of all problems in a report to City that identifies problem, location and recommended repair

The final task was to review the amount of pure infiltration from the midnight survey after a period with limited rainfall. Significant rainfall had not occurred in the prior week. Flows were

estimated using pipe diameters and estimated flow ribbons. Figure 2.1 shows the flow ribbon calculations.

The flow data gathered information after midnight by basin the second week of December. Preliminary estimates were that:

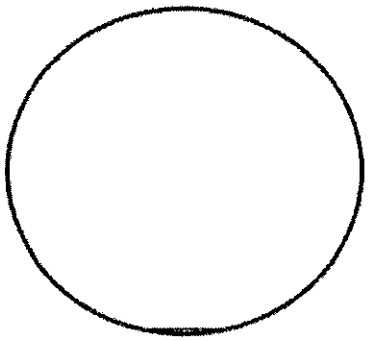
flow. 2-inch-wide flow, 1/4 in deep at 2 ft/s =	0.77917	gpm
flow. 3 inch wide flow, 1/2 in deep at 2 ft/s =	2.3375	gpm
flow. 4 inch wide flow, .75 in deep at 2 ft/s =	4.675	gpm
flow. 6 inch wide flow, 1.25 in deep at 2 ft/s =	28.05	gpm
flow. 8 inch wide flow, 4 in deep at 2 ft/s =	49.8667	gpm

These flows needed to be adjusted based on travel times in the gravity system. To evaluate this numbee based on the USEPA guidelines, the system inventory was gathered from the Facilities plan (Table 1.1) and evaluated in accordance with EPA guidelines (Table 2.1). This calculation shows the pump run times, converted to flow versus the inch-mile calcuation in Table 2.1. The findings showed that The City exceeds these values.

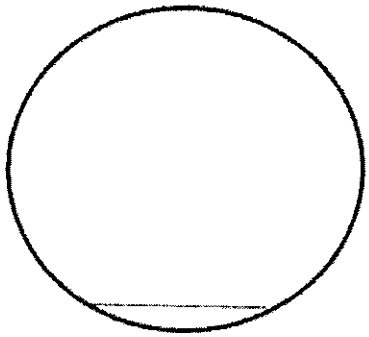
Table 2.1 EPA Infiltration Allowance

Allowance Range (gpd/inch-mile)	Sewage Footage (ft)
2,000-3,000	> 100,000
3,000-5,000	50,000-100,000
5,000-8,000	1,000-50,000

2-inch-wide ribbon is ¼ in deep in pipe



4-inch-wide ribbon is 3/4 in deep in pipe



6-inch-wide ribbon is 1-¼ in deep in pipe

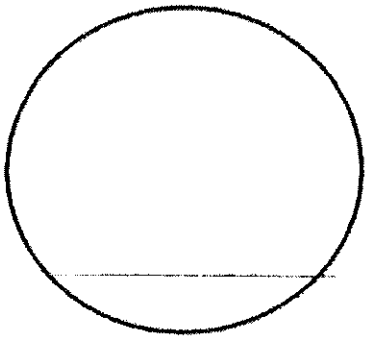


Figure 2.1 Flow Ribbon Calculations

3. Lift Station Flows with Rainfall

Inflow rises with rainfall. 174 openings in public property, 285 openings overall, and 1097 manholes were sealed as a part of Phase 1. The 2018 rainy season should show a decrease in peak flows per basin. However, it is useful to understand two things – the amount of inflow (as compared to rainfall) by lift station service area and the trend. In most cases the inflow increases with time. This can be determined by a positive slope on a regression line. The average runtime can be determined by the intercept. This is the baseflow+infiltration value. From year to year, the slope generally increased (see Table 3.1). An increasing slope shows is that the inflow will increase with time as the surface connections deteriorate. The following sections outline the findings for each lift station basin.

Table 3.1 Statistical Model by Lift Station and Year

LS No	Station	Pump Cap	Avg run time 2014 (d)	slope 2014	Y 2014	Avg run time 2015	slope 2015	Y 2015	Avg run time 2016	slope 2016	Y 2016
1	Egret	5000	0.38	0.05	0.37	0.80	0.05	0.79	0.29	0.09	0.27
2	Diana Dr	500	0.35	0.01	0.35	0.41	0.02	0.41	0.41	0.02	0.40
3	Beach	1570	0.52	-0.01	0.52	0.56	-0.04	0.56	0.53	-0.02	0.52
4	Three Islands	1405	0.05	0.00	0.05	0.10	-0.01	0.10	0.18	-0.04	0.18
5	Atlantic Shores	2400	0.08	0.01	0.08	0.11	0.01	0.10	0.11	0.00	0.11
6	NE 12th	2400	0.09	-0.03	0.09	0.47	0.04	0.46	0.42	-0.01	0.42
7	NE 4th Cir	800	0.02	0.00	0.02	0.39	0.09	0.37	0.41	0.09	0.39
8	SE 5th	400	0.20	0.04	0.19	0.37	0.05	0.30	0.38	0.00	0.37
9	Foster	1500	0.15	0.00	0.15	0.27	0.01	0.27	0.34	0.03	0.33
10	Sunset E	200	0.08	0.04	0.08	0.21	0.04	0.20	0.14	0.07	0.13
11	Holiday	200	0.04	0.01	0.04	0.10	0.00	0.08	0.06	0.02	0.06
12	SW 4th	1600	0.14	0.03	0.14	0.26	0.03	0.26	0.27	0.03	0.27
13	SW 8th	3045	0.05	0.07	0.05	0.11	0.01	0.10	0.19	0.00	0.19
14	NW 10th	160	0.25	0.03	0.25	0.76	-0.03	0.76	0.74	0.10	0.72
15	Sunset W	200	0.08	0.03	0.08	0.16	0.06	0.15	0.19	0.08	0.18

Lift Station 1 - Egret Drive

The Lift Station 1 service area contains 51 manholes that were found, GPSed and sealed. The midnight run indicated points where infiltration as noted (see map in Appendix A). A review of rainfall versus flows from July 1, 2014 to June 30, 2016 indicates that the slope of the line is decreasing, indicating inflow volumes were being controlled (see Figures 3.1 and 3.2). The slope went in 2017 which required further investigation (see Figure 3.3). It appears some very large pump run time (check valve issues) at periods with no rain may have skewed this line. However, there were few openings found on the system so perhaps inflow has been controlled to an extent. The overall trend indicates inflow is present (see Figure 3.4). The average pumps times increased from 2014 to 2017 (to 50.3%).

With respect to the manhole construction types, 45 were precast and 6 were brick. None had steps. All manhole covers and rings were cast iron. A number of the manhole covers have pick-holes (see Table 3.2). Most of the manholes (36) were in good condition. There were 14 manholes in average condition and one in poor condition (#56). Three manholes had leaks noted

at the walls by the invert– 33, 51 and 56. Manhole 56 was in poor condition and had a leak. This manhole needs to be addressed in Phase 2. Figure 3.5 shows the manhole locations.

There were 7 sites that smoke testing indicated were open to the surface (see Figure 3.6). Table 3.3 outlines those sites. Of the 7, three were on private property and not corrected in Phase 1 (449 Alamanda Dr, 701 Layne Blvd and 580 Egret Dr.). The property owners should be advised of the issue and required to make appropriate corrections.

There was major flow coming into Manhole 01-014 that needs investigation. There is an emergency force main for Gulfstream, but this force main was shown on the maps to be tied to the 18" force main from Lift Station #3, not the manhole. There is water adjacent to the manhole, so this should be investigated in the next phase. Pipes to be televised are on Poinciana Dr and Paradise Blvd. The area between Manhole 01-040 and 01-041 needs to be reviewed.

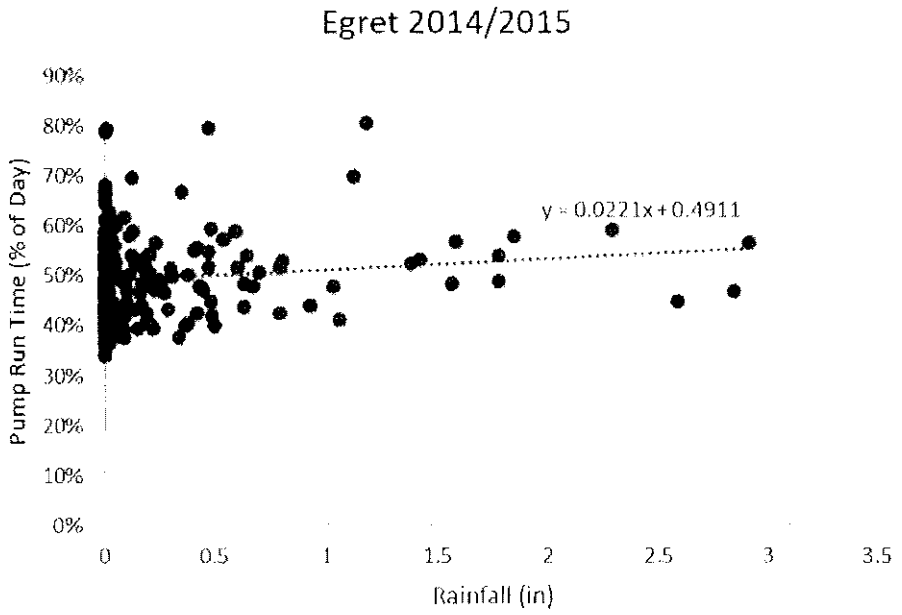


Figure 3.1 – Inflow for 2014-2015 – the increasing slope indicates flows increased with rainfall

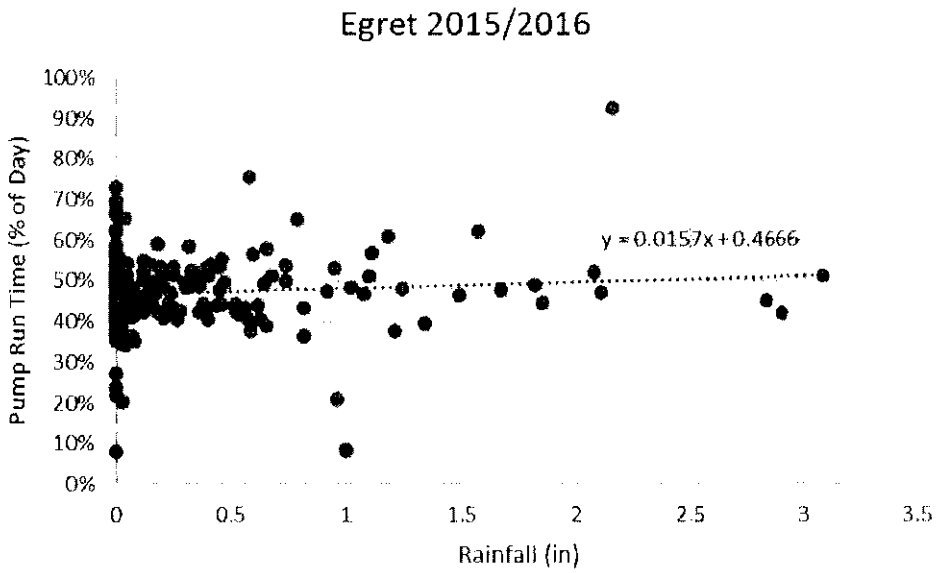


Figure 3.2 – Inflow for 2015-2016 – the increasing slope indicates flows increased with rainfall - Lift Station 1 Service Area

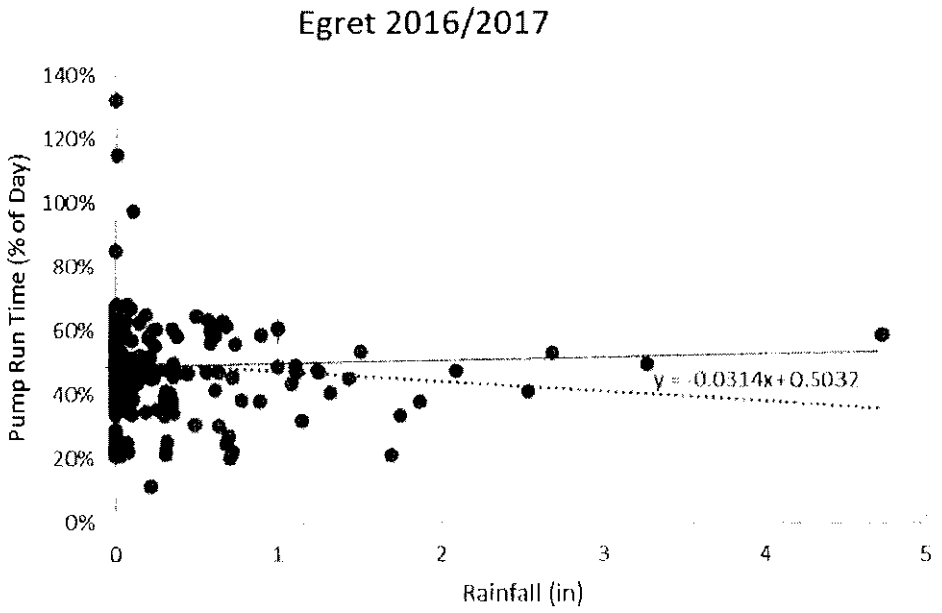


Figure 3.3 – Inflow for 2016-2017 – the regression slope is negative, but note some early high run times. The actual slope (solid line) slope indicates flows increased with rainfall- Lift Station 1 Service Area

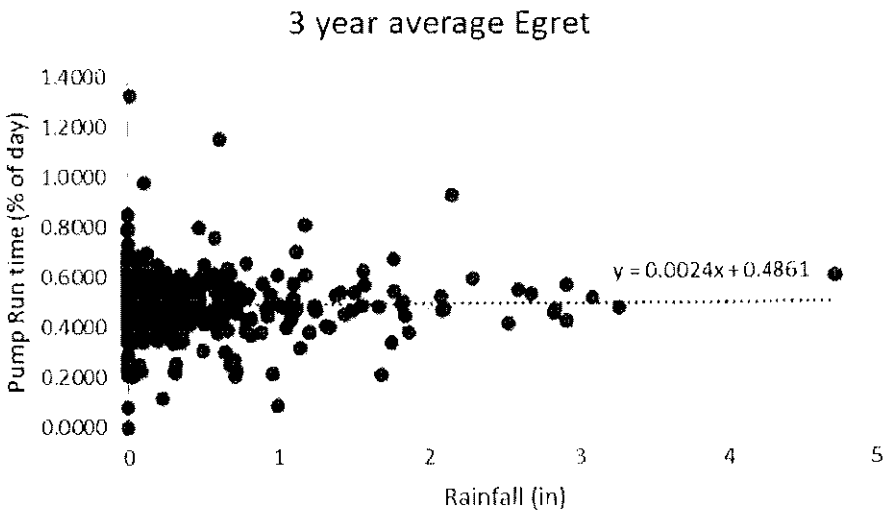


Figure 3.4 – Average graphic foe Inflow for 2014-2017 – the increasing slope indicates flows increased with rainfall - Lift Station 1 Service Area

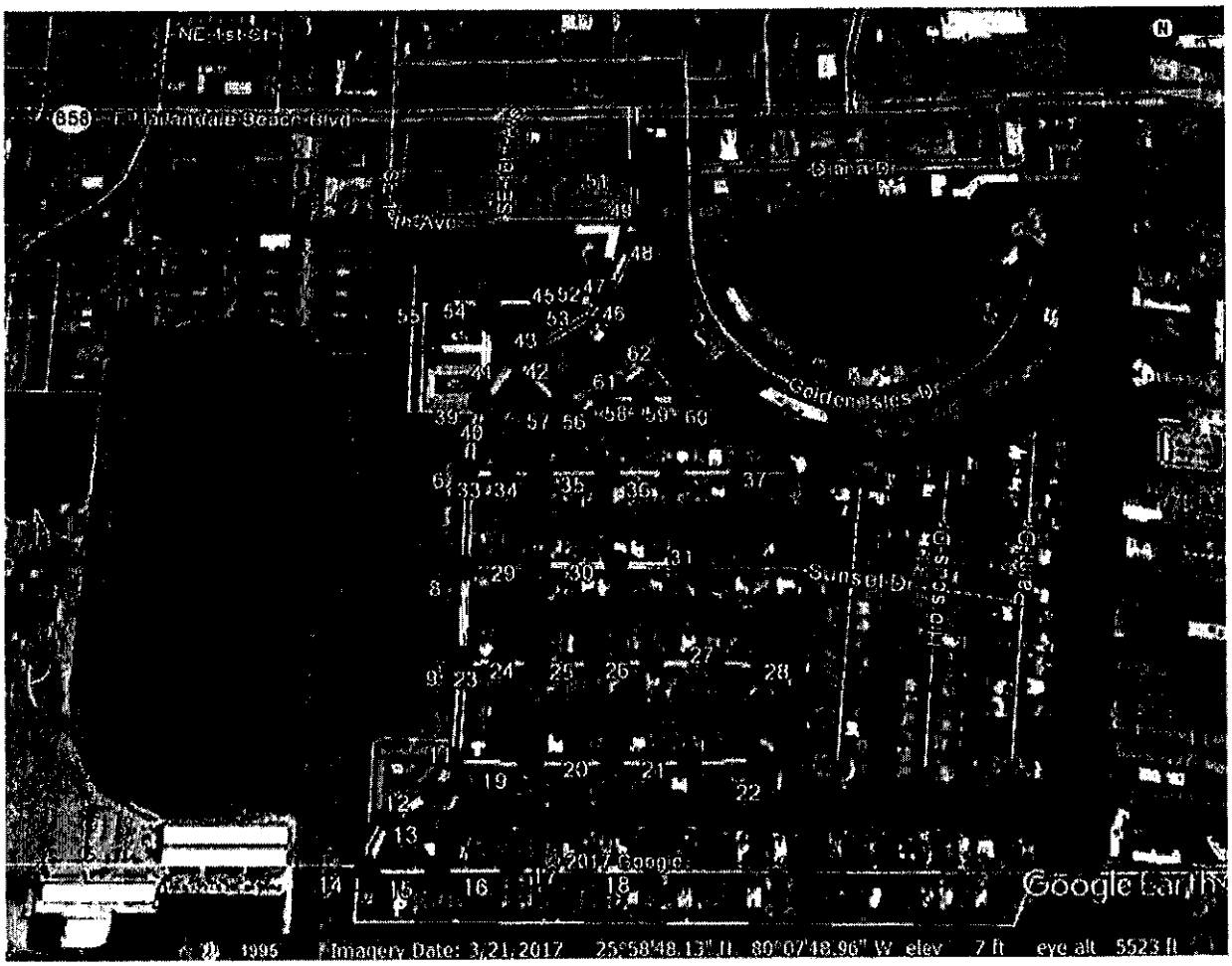


Figure 3.5 – Manholes GPSed - Lift Station 1 Service Area

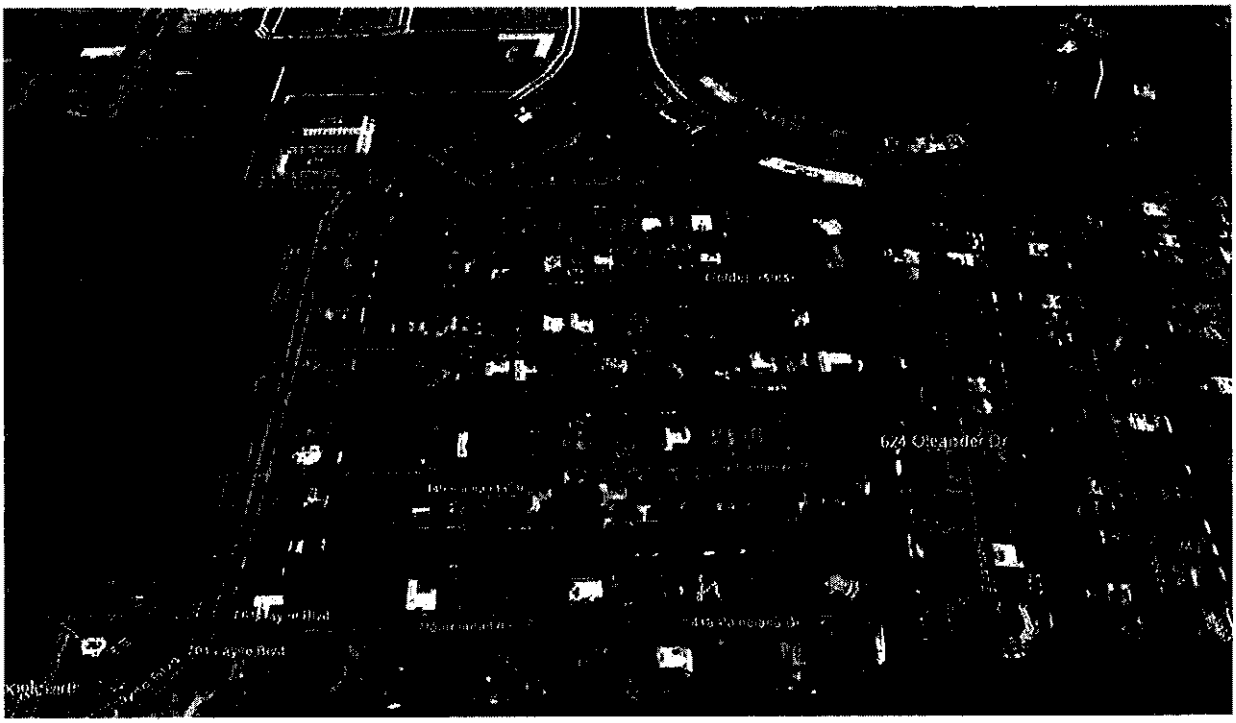


Figure 3.6 Location of Smoke test leaks - Lift Station 1 Service Area

Table 3.2 – Manhole Data - Lift Station 1 Service Area

Manhole ID	Invert	General Condition	Comments
17	Good	Good	Good
14	Good	Good	Good
13	Good	Good	Good
12	Good	Good	Good
21	Good	Good	Good
20	Good	Good	Good
19	Good	Good	Good
16	Good	Good	Good
15	Good	Good	Good
11	Good	Good	Good
28	Good	Good	Good
27	Good	Good	Good
26	Good	Good	Good
25	Good	Good	Good
24	Underwater	Average	Invert underwater
23	Good	Good	Good
9	Good	Good	Good
31	Good	Good	Good has 1 pick hole
30	Good	Good	Good has 1 pick hole
29	Good	Good	Good has 1 pick hole
8	Good	Good	Good has 2 pick holes
37	Good	Good	Good has 1 pick hole
34	Good	Good	Good has 1 pick hole
33	Good	Average	Walls are leaking at invert
36	Good	Good	Good has 1 pick hole
6	Good	Good	Good
39	Good	Good	Good has 1 pick hole
40	Good	Average	Good 1 small pick hole
62	Good	Average	Good 2 large pick holes
61	Good	Average	Good 2 large pic holes
59	Good	Average	Good 2 large pick holes
58	Good	Average	Good 2 large oic holes
57	Good	Good	Good
56	Needs Repair	Poor	Walls leaking near invert has 2 Pick holes
55	Good	Average	Good 2 medium pick holes
54	Good	Average	Good 1 large pick hole
53	Good	Average	Good 1 small pick hole
45	Good	Average	Good 1 small pick hole
52	Good	Average	Good 1 small pick hole
41	Good	Average	Good 1 small pick hole
35	Good	Good	Good has 1 pick hole
42	Good	Good	Good has 2 pick holes
60	Good	Good	Good has 2 pick holes
22	Good	Good	Good
18	Good	Good	Good
43	Good	Good	Good has 2 pick holes
46	Good	Good	Good has 1 pick holes
47	Good	Good	Good has 1 pick holes
48	Good	Good	Good has 1 pick holes
49	Good	Good	Good has 1 pick holes
51	Good	Average	Average Leak in wall by invert has 1 pick hole

Table 3.3 – Smoke test result information - Lift Station 1 Service Area

Lift Station	Street Address	Latitude	Longitude	Comments
1	701 Layne Blvd	25.9762175	-80.1323126	Open 6 inch PvC c/o left of driveway
1	661 Layne Blvd	25.9763707	-80.1324207	Cracked 6 inch PvC c/o left of right driveway
1	418 Poinciana Dr	25.9763477	-80.1290076	Cracked 4 inch PvC c/o left front
1	425 Tamarind Dr	25.9801694	-80.1287359	Open 6 inch PvC c/o right of driveway
1	580 Egret Dr	25.98127322	-80.1325506	Open 6 inch metal c/o in bushes on right side of building can't install LDL plug
1	449 Alamanda Dr	25.97748197	-80.1302094	Open 2 inch metal pipe right of garage by window
1	624 Oleander Dr	25.97784143	-80.1266846	Open 3 inch PvC c/o right property line

Lift Station 2 – Diana Drive

Lift Station 2 service area contains 38 manholes that were found, GPSed and sealed. The midnight run indicated points where infiltration as noted (see map in Appendix A). A review of rainfall versus flows from July 1, 2014 to June 30, 2017 indicates that the slope of the line is increasing, indicating inflow volumes were increasing (see Figures 3.7 to 3.9). There were eight openings found on the system. The overall trend indicates inflow is present (see Figure 3.10). The average pumps times increased from 2014 to 2017 (to about 40%).

With respect to the manhole construction types, 31 were precast and 7 were brick although most of the chimneys included brick. None had steps. All manhole covers and rings were cast iron. A number of the manhole covers have pick-holes (see Table 3.4). Most of the manholes (31) were in good condition. There were 6 manholes in average condition and one in poor condition (#31). Manhole 31 was in poor condition and had a leak at the invert wall. This manhole needs to be addressed in Phase 2. Figure 3.11 shows the manhole locations.

There were 8 sites that smoke testing indicated were open to the surface (see Figure 3.12). Table 3.5 outlines those sites. Of the 8, four were on private property and not corrected in Phase 1 (136, 301 and 401 Golden Isles Dr. and 1930 Hallandale Beach Blvd.). The property owners should be advised of the issue and required to make appropriate corrections.

The midnight run showed that there was a leak coming in above Manhole 02-013, and in the lined areas from Manhole 02-004 to 02-008. This was among several lined areas of the City that had liner issues. piping in this service area needed to be televised. Several areas along Hallandale Beach Blvd and Diplomat Parkway need to be televised.

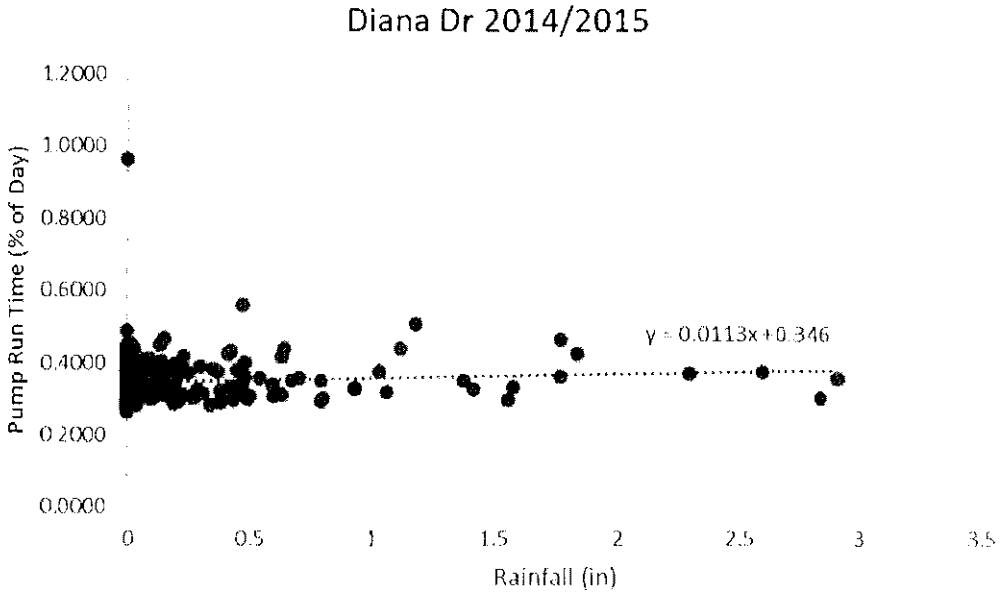


Figure 3.7 – Inflow for 2014-2015 – the increasing slope indicates flows increased with rainfall

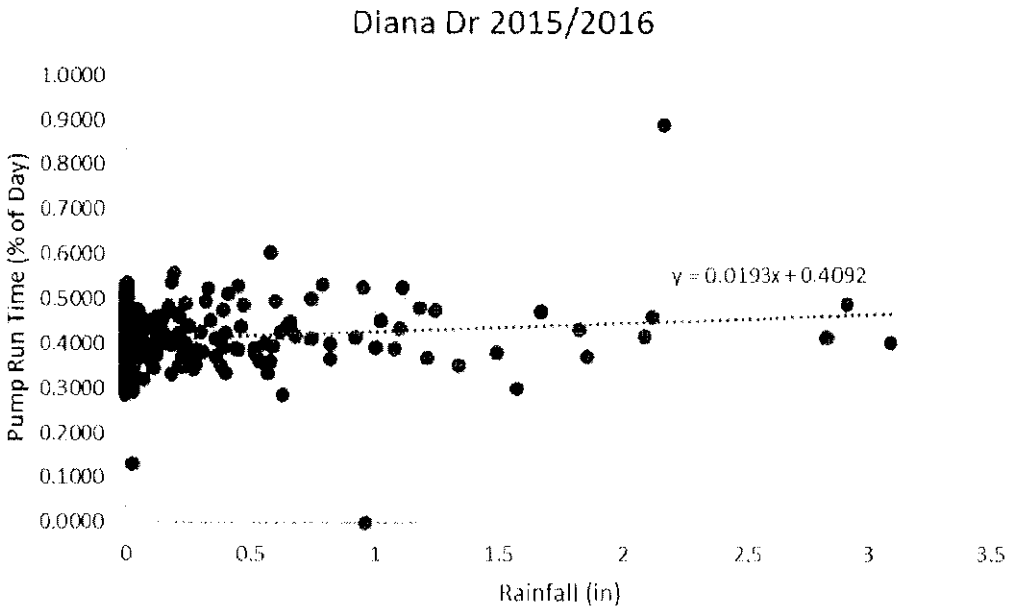


Figure 3.8 – Inflow for 2015-2016 – the increasing slope indicates flows increased with rainfall - Lift Station 2 Service Area

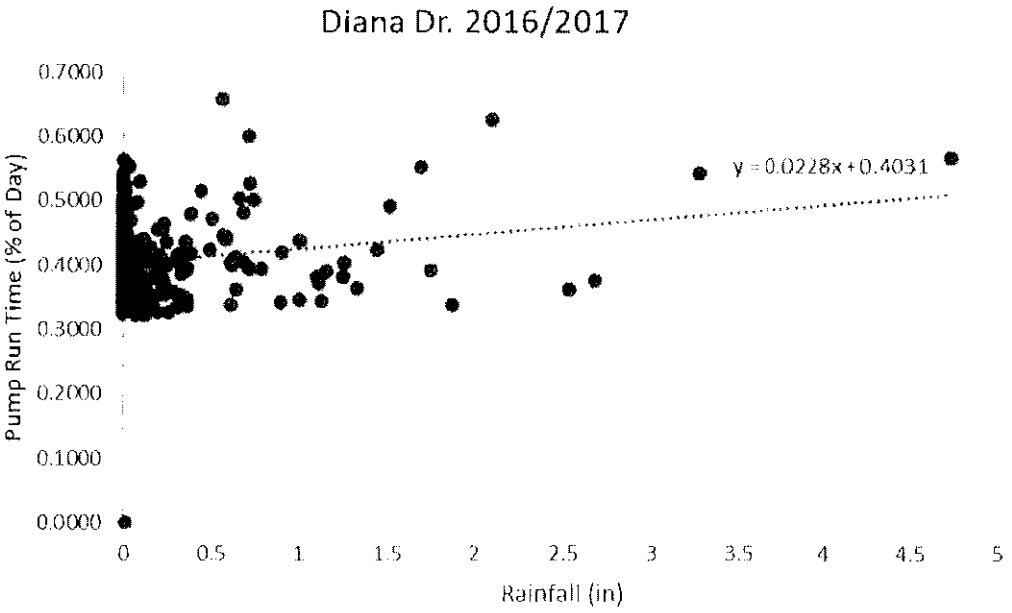


Figure 3.9 – Inflow for 2016-2017 – the regression slope is negative but note some early high run times. The actual slope (solid line) slope indicates flows increased with rainfall - Lift Station 2 Service Area

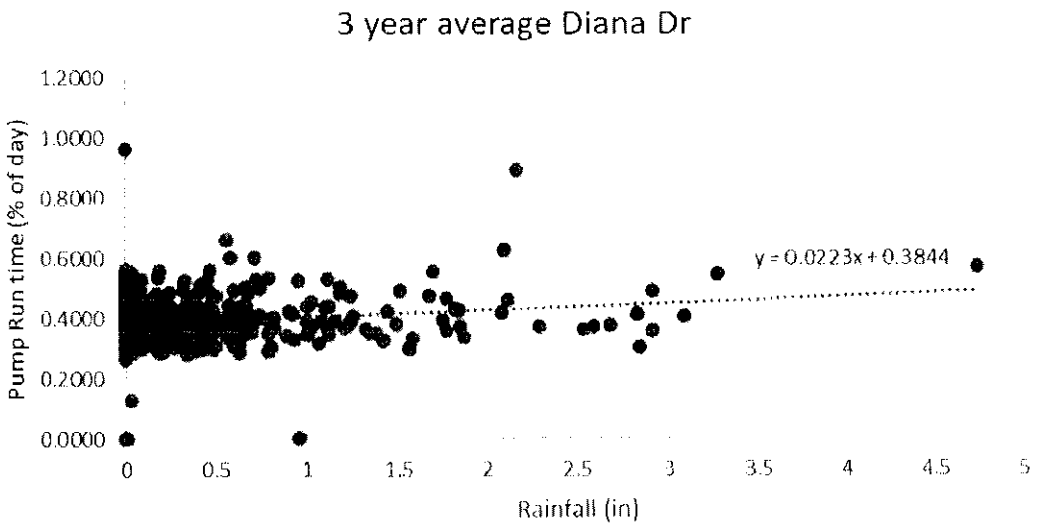


Figure 3.10 – Average graphic foe Inflow for 2014-2017 – the increasing slope indicates flows increased with rainfall- Lift Station 2 Service Area

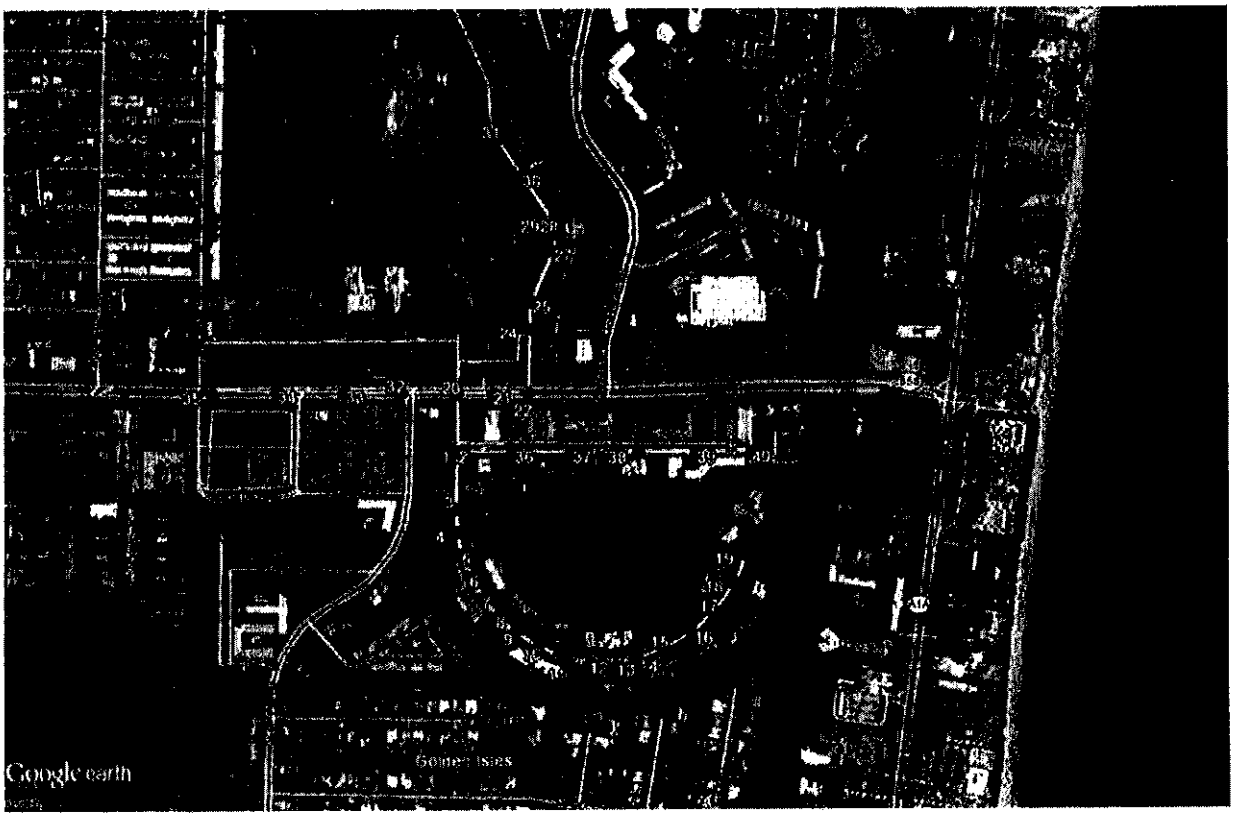


Figure 3.11 – Manholes GPSed - Lift Station 2 Service Area

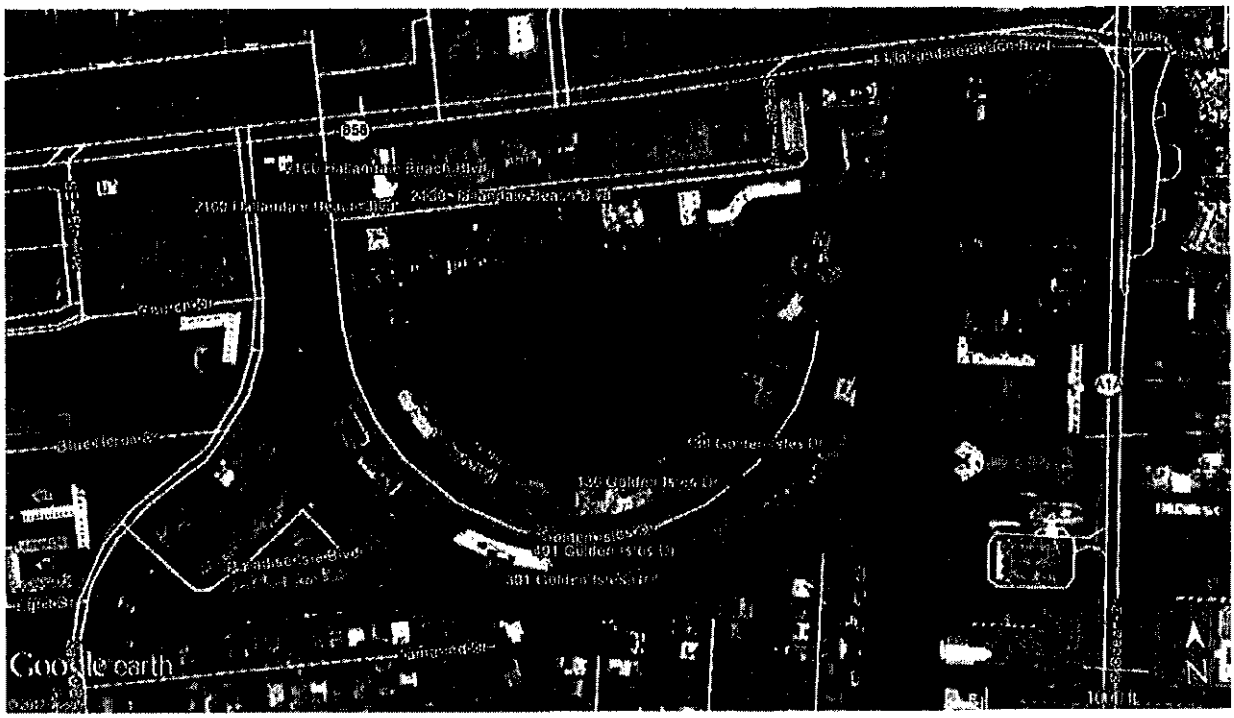


Figure 3.12 - Location of Smoke test leaks - Lift Station 2 Service Area

Table 3.4 – Manhole Data - Lift Station 2 Service Area

Manhole ID	Invert	General Condition	Comments
24	Good	Average	Good 1 large pick hole
25	Good	Average	Good 1 large pick hole
27	Good	Average	Good 1 large pick hole
28	Good	Average	Good 1 large pick hole
29	Good	Average	Good 1 large pick hole
30	Good	Average	Good 1 large pick hole
31	Needs Repair	Poor	Water coming in through invert 1 large pick hole
22	Good	Good	Good 2 large pick holes
19	Good	Good	Good has 2 pick holes
17	Good	Good	Good has 2 pick holes
18	Good	Good	Good has 2 pick holes
16	Good	Good	Good has 1 pick hole
14	Good	Good	Good has 1 pick hole
13	Good	Good	Good has 1 pick hole
12	Good	Good	Good has 2 pick holes
10	Good	Good	Good has 1 pick hole
9	Good	Good	Good has 1 pick hole
8	Good	Good	Good has 1 pick hole
15	Good	Good	Good has 1 pick holes
11	Good	Good	Good has 1 pick holes
6	Good	Good	Good has 1 pick holes
5	Good	Good	Good has 1 pick holes
4	Good	Good	Good has 1 pick holes
3	Good	Good	Good has 1 pick holes
1	Good	Good	Good has 1 pick holes
2	Good	Good	Good has 1 pick holes
36	Good	Good	Good has 1 pick hole
37	Good	Good	Good has 1 pick holes
38	Good	Good	Good has 1 pick holes
39	Good	Good	Good has 1 pick holes
40	Good	Good	Good has 1 pick hole
7	Good	Good	Good has 1 pick hole
34	Good	Good	Good 1 pick hole
32	Good	Good	Good 2 large pick holes
20	Good	Good	Good 2 large pick holes
21	Good	Good	Good 2 large pick holes
33	Good	Good	Good 2 large pick holes
35	Good	Good	Good 2 large pick holes

Table 3.5 – Smoke test result information - Lift Station 2 Service Area

Lift Station	Street Address	Latitude	Longitude	Comments
2	136 Golden Isles Dr	25.98195255	-80.1245041	Light smoke coming from 6 inch PvC c/o in left driveway can't install LDL plug
2	130 Golden Isles Dr	25.98223917	-80.1242163	Open 4 inch PvC c/o left front in bushes
2	301 Golden Isles Dr	25.98118446	-80.1263681	Open 3 inch metal c/o right side of parking lot
2	401 Golden Isles Dr	25.98142534	-80.1269775	Manhole smoking
2	1930 Hallandale Beach Blvd	25.98517542	-80.1280971	Open 4 inch metal c/o behind building in driveway
2	2100 Hallandale Beach Blvd	25.9851884	-80.1282911	Open 4 inch PvC c/o back right corner of building
2	2100 Hallandale Beach Blvd	25.98525099	-80.1281709	Open 4 inch PvC c/o right of building in road
2	2100 Hallandale Beach Blvd	25.98546589	-80.1283142	Possible open 4 inch c/o under metal cover right side of building by drive-

Lift Station 3 - Beach Station

The Lift Station 3 service area contains 43 manholes that were found, GPSed and sealed. The midnight run indicated points where infiltration as noted (see map in Appendix A). A review of rainfall versus flows from July 1, 2014 to June 30, 2017 indicates the decreasing regression slope, which requires further review (see Figures 3.13 to 3.15). Note it is less than prior years meaning there are openings or tidal issues. Eliminating some large run times with no rainfall, each year indicates flows increased slightly with rainfall (see Figure 3.16). Note station leaks at high tides in the parking area and the top. The top needs to be sealed and raised as a part of the next phases of the project. However, there were no sites that smoke testing indicated were open to the surface, but there were very large flows from all the condos on the beach. Pumps ran over 50% of the time.

Figure 3.17 shows the manhole locations. With respect to the manhole construction types, 43 were precast and 6 were brick. None had steps. All manhole covers and rings were cast iron. A number of the manhole covers have pick-holes (see Table 3.6). Most of the manholes (27) were in good condition. There were 14 manholes in average condition and two in poor condition (32 and #52). Manhole 34 has high concentrations of roots coming out of had leaks noted at the walls. Manhole 34 is in immediate need of repair and will be addressed in Phase 2. Manhole 52 was in poor condition and had a small leak around 4-inch pipe. This manhole needs to be addressed in Phase 2 as well. Steps in manhole #66 need to be repaired or removed. Steps are in good condition in Manhole 59. Those are the only two manholes with steps.

The beach piping is hard to evaluated due to the density of development. The City was televising parts of the area when this project was underway. The south end of the system was surcharged. Lift Station #3 has a top that is too low and leaks water at high tides. The parking lot piping is indicated as leaking but was submerged. Clean water was entering Manholes 03-044, in South Beach Park, and)3-035 (mineral deposits). Adult diapers were found in Manhole 03-033. Flows were entering from the west of Manhole 03-069.

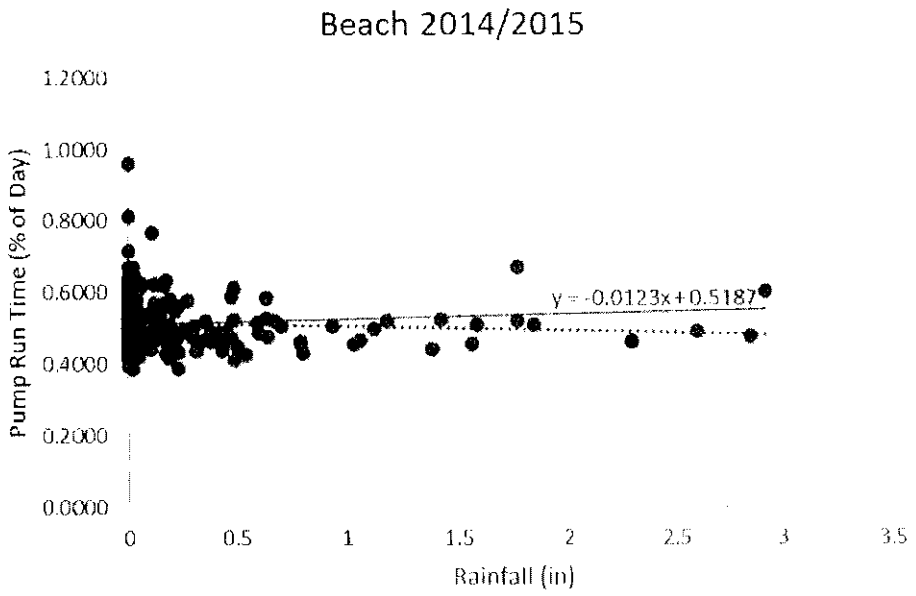


Figure 3.13– Inflow for 2014-2015 – the decreasing regression slope requires further review. Eliminating some large run times with no rainfall, indicates flows increased with rainfall (solid line). Note station leaks at high tides - Lift Station 3 Service Area

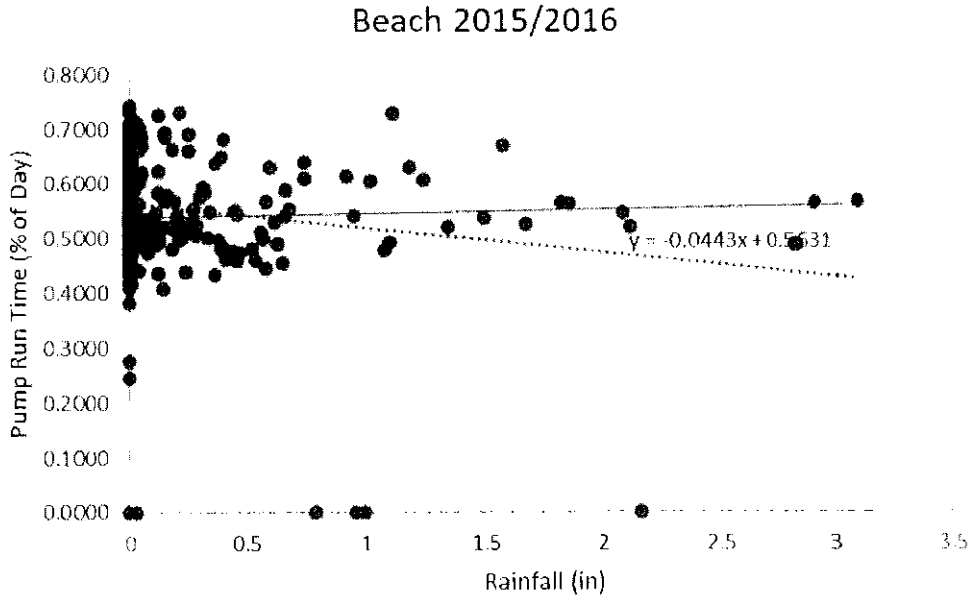


Figure 3.14 – Inflow for 2015-2016 – the decreasing regression slope requires further review. Eliminating some large run times with no rainfall, indicates flows increased with rainfall (solid line). Note station leaks at high tides. - Lift Station 3 Service Area

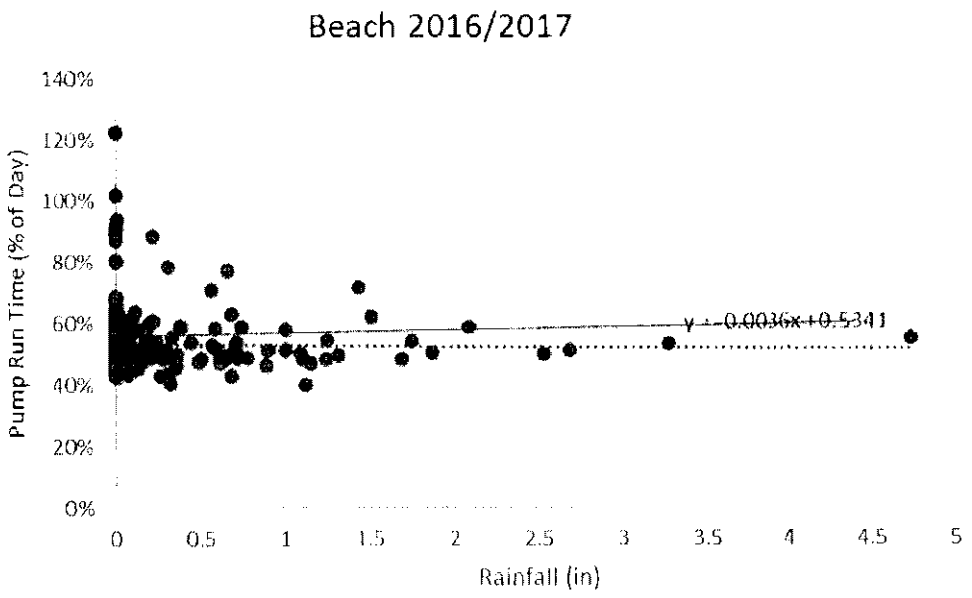


Figure 3.15 – Inflow for 2016-2017 – the slight decreasing regression slope requires further review. Note it is less than prior years. Eliminating some large run times with no rainfall, indicates flows increased with rainfall (solid line). Note station leaks at high tides. - Lift Station 3 Service Area

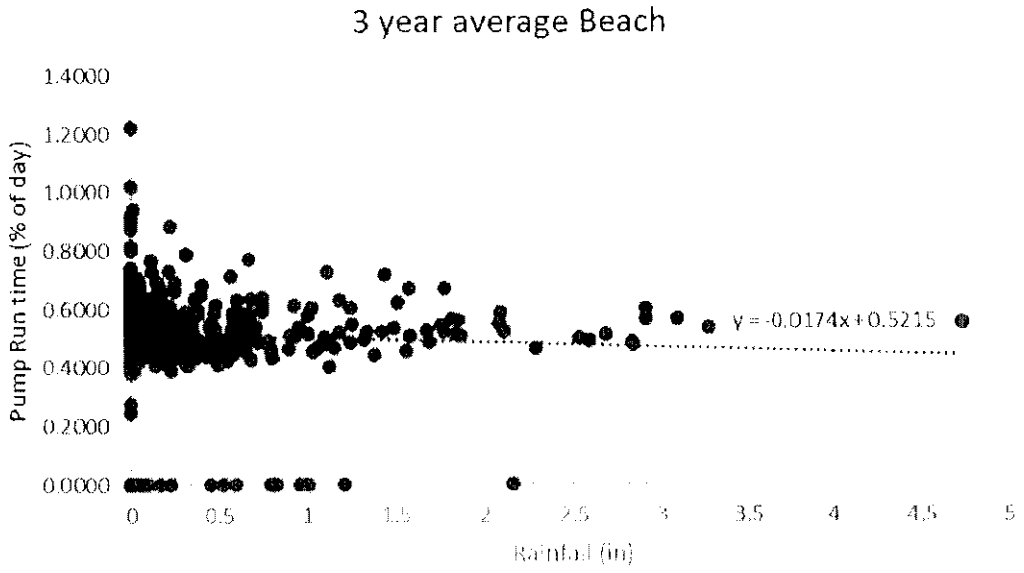


Figure 3.16– Average graphic foe Inflow for 2014-2017 – the increasing slope indicates flows increased with rainfall - Lift Station 3 Service Area

Figure 3.17 – Manholes GPSed - Lift Station 3 Service Area

Table 3.6 – Manhole Data - Lift Station 3 Service Area

Manhole ID	Manhole Walls	General Condition	Comments
3	Good	Average	Good 1 large pick hole
4	Good	Good	Good 1 pick hole
5	Good	Good	Good has 2 pick hole
7	Good	Average	Good 1 large pick hole
8	Good	Average	Good 1 large pick hole
9	Good	Average	Good 1 large pick hole
11	Good	Good	Good 1 pick hole
12	Good	Average	Good 1 large pick hole
13	Good	Good	Good has 2 pick hole
14	Good	Good	Good has 2 pick hole
15	Good	Average	Good 1 large pick hole
16	Good	Average	Good 1 large pick hole
18	Good	Average	Good 1 large pick hole
24	Good	Good	Good 1 pick hole
25	Good	Average	Good 1 large pick hole
29	Good	Average	Good 1 large pick hole
30	Good	Average	Good 1 large pick hole
31	Good	Average	Good 1 large pick hole
34	Good	Poor	Roots coming out of wall 1 large pick hole
35	Good	Good	Good has 1 pick hole
36	Good	Good	Good has 1 pick hole
37	Good	Good	Good has 1 pick hole
39	Good	Good	Good has 1 pick hole
40	Good	Good	Good has 1 pick hole
43	Good	Good	Good has 1 pick hole
44	Good	Average	Good 1 large pick hole
45	Good	Good	Good has 1 pick hole
46	Good	Good	Good has 1 pick holes
48	Good	Good	Good has 1 pick hole
49	Good	Good	Good has 1 pick hole
50	Good	Good	Good has 1 pick hole
51	Good	Good	Good has 1 pick hole
52	Good	Poor	Slight leak around 4 inch pipe 1 large pick hole
54	Good	Good	Good has 2 pick hole
55	Good	Good	Good has 1 pick hole
57	Good	Good	Good has 1 pick hole
59	Good	Good	Good has 1 pick hole
60	Good	Good	Good has 1 pick hole
62	Good	Average	Good 1 large pick hole
65	Good	Good	Good has 1 pick hole
66	Good	Good	Good has 1 pick hole
69	Needs Repair	Good	Good 1 pick hole
67A	Needs Repair	Good	Good has 1 pick hole

Lift Station 4 – Three Islands

The Lift Station 4 service area contains 10 manholes that were found, GPSed and sealed. The midnight run indicated points where infiltration as noted (see map in Appendix A). A review of rainfall versus flows from July 1, 2014 to June 30, 2017 indicates an increasing slope that indicates flows increased with rainfall n2014-2015 (Figure 3.18). The data for 2015-2016 is suspect as one of the pumps was not registering during the year (Figure 3.19). Inflow for 2016-2017 – the regression slope is negative but note some early high run times (Figure 3.20). The average graphic for Inflow for 2014-2017 – the slope indicates the system is tight (Figure 3.21). The average pumps times increased from 2014 to 2017 (for 15 to over 29%).

Figure 3.22 shows the manhole locations. With respect to the manhole construction types, 9 were precast and 1 were brick. None had steps. Three were submerged (MH #1-3). All manhole covers and rings were cast iron. A number of the manhole covers have pick-holes (see Table 3.7). Eight of the manholes were in good condition. Two manholes (Manholes #2 and 3) are in poor condition. Manhole #3 was clearly backed up and needs attention.

There was one site that smoke testing indicated was open to the surface. The only opening was across from 930 NE 27th Ave. The property owners should be advised of the issue and required to make appropriate corrections. The midnight run showed that most of the piping in this service area needed to be televised.

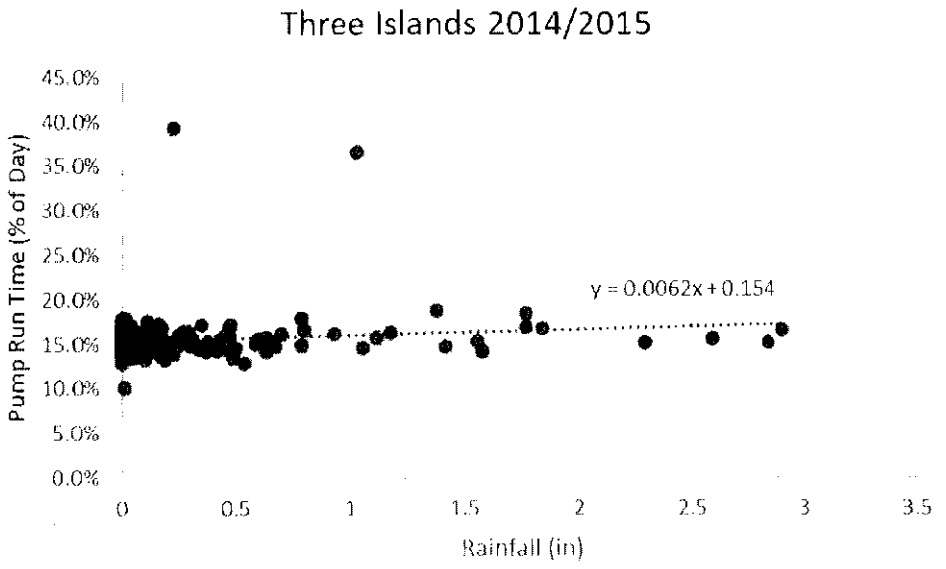


Figure 3.18 – Inflow for 2014-2015 – the increasing slope indicates flows increased with rainfall - Lift Station 4 Service Area

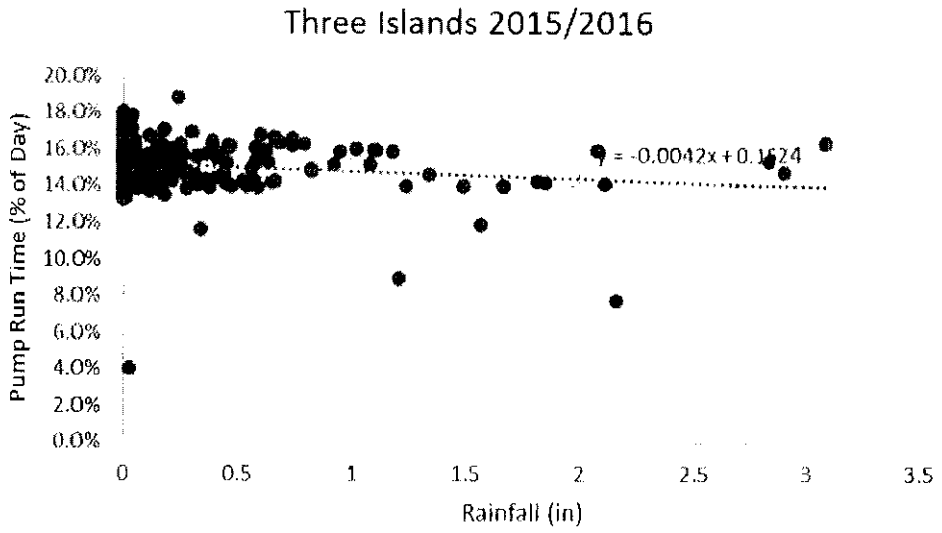


Figure 3.19– Inflow for 2015-2016 – The data is suspect as one of the pumps was not registering during the year. - Lift Station 4 Service Area

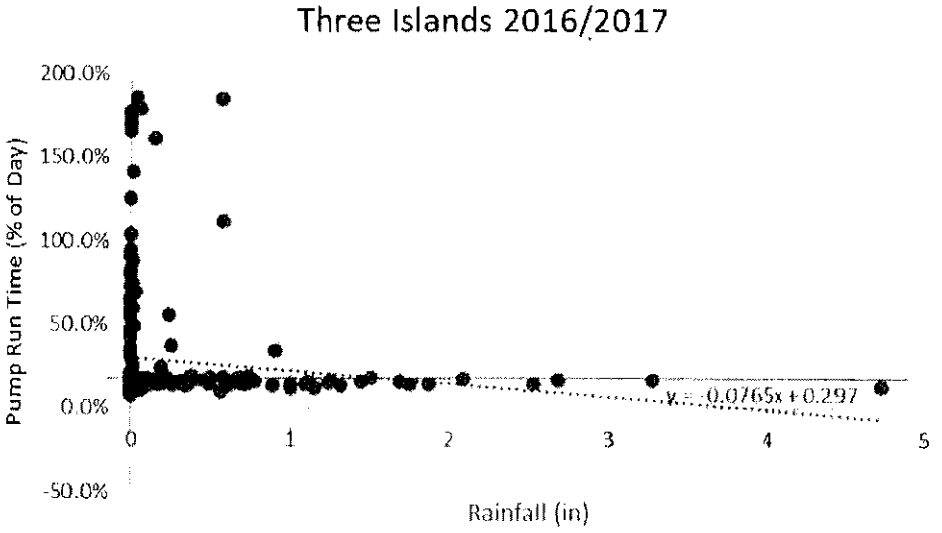


Figure 3.20 – Inflow for 2016-2017 – the regression slope is negative, but note some early high run times. The actual slope (solid line) slope indicates flows increased with rainfall - Lift Station 4 Service Area

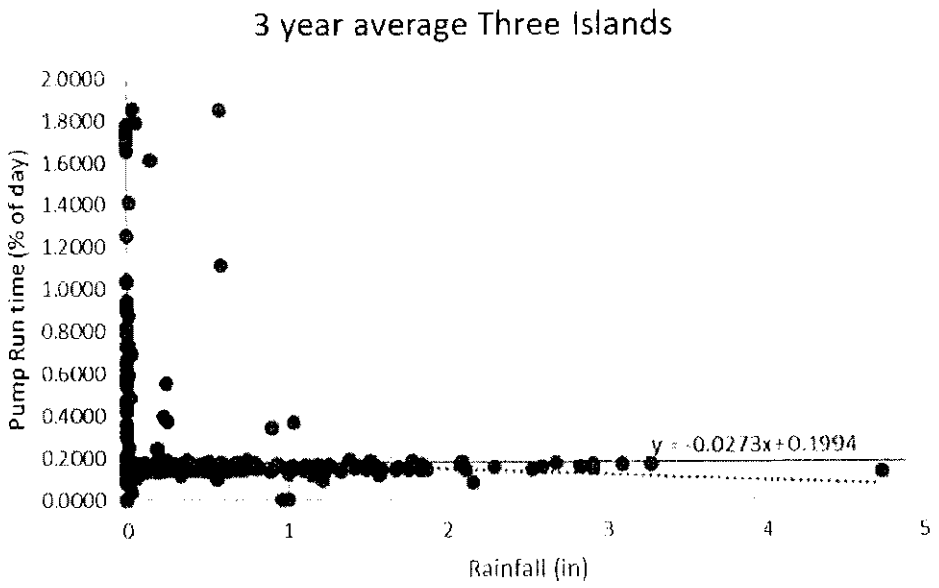


Figure 3.21 – Average graphic for Inflow for 2014-2017 – the slope indicates the system is fairly tight. - Lift Station 4 Service Area

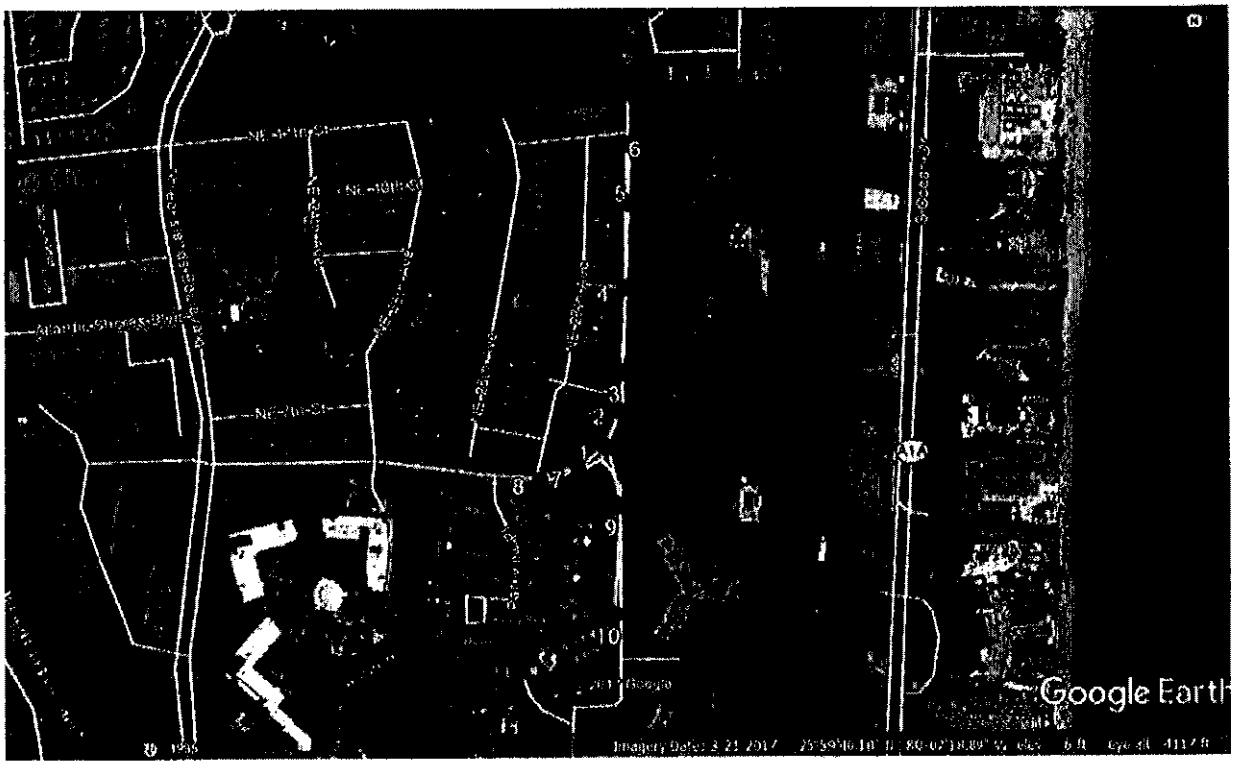


Figure 3.22 – Manholes GPSed - Lift Station 4 Service Area

Table 3.7 – Manhole Data - Lift Station 4 Service Area

Manhole ID	Manhole Walls	General Condition	Comments
4	Good	Average	Good 1 large pick hole
3	Underwater	Poor	Manhole back up 1 large pick hole
2	Underwater	Poor	Invert underwater 1 large pick hole
1	Underwater	Average	Inever underwater 1 large pick hole
9	Good	Average	Good 1 large pick hole
10	Good	Average	Good 1 large pick hole
7	Good	Average	Good 1 large pick hole
8	Good	Average	Good 1 large pick hole
6	Good	Average	Good
5	Good	Average	Good 1 large pick hole

Lift Station 5 – Atlantic Shores

The Lift Station5 service area contains 8 manholes that were found, GPSed and sealed. The midnight run indicated points where infiltration as noted (see map in Appendix A). A review of rainfall versus flows from July 1, 2014 to June 30, 2017 indicates that the slope of the line is increasing, indicating inflow volumes are increasing each year (see Figures 3.23-3.25). The overall trend indicates inflow is present (see Figure 3.26). The average pumps times increased from 2014 to 2017 (to 9.8%).

Figure 3.27 shows the manhole locations. With respect to the manhole construction types, all 8 were brick. None had steps. All manhole covers and rings were cast iron. A number of the manhole covers have pick-holes (see Table 3.8). All of the manholes were in good condition. There were 14 manholes in average condition. None appeared to leak.

There was 1 site that smoke testing indicated were open to the surface - 719 Diplomat Pkwy (see Figure 3.28). It was located in the grass on private property. The property owners should be advised of the issue and required to make appropriate corrections.

The midnight run indicated major flows entering in the piping south of Manhole #05-004 indicating a need to televise the upper end of this system.

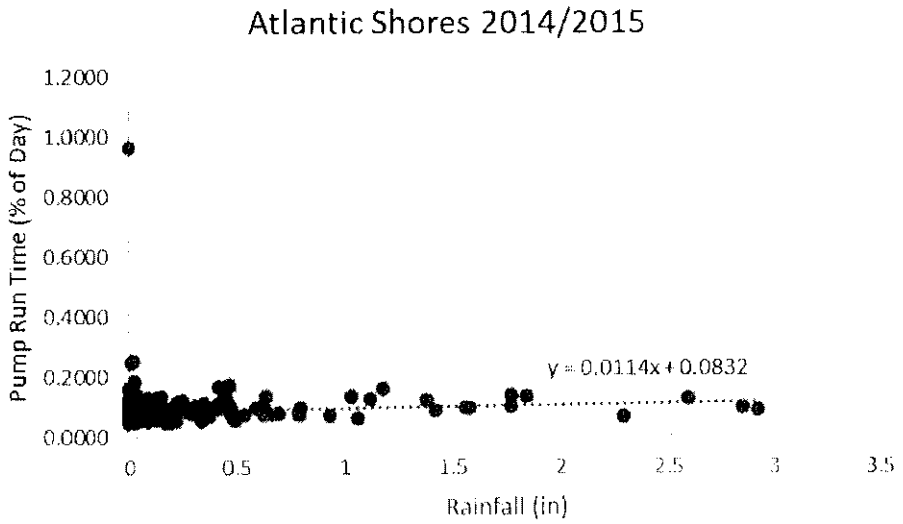


Figure 3.23 – Inflow for 2014-2015 – the increasing slope indicates flows increased with rainfall - Lift Station 5 Service Area

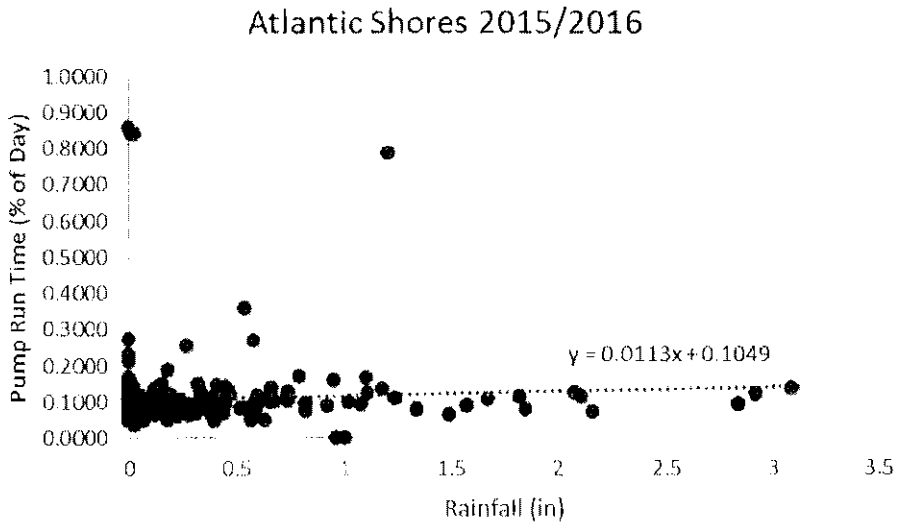


Figure 3.24– Inflow for 2015-2016 – the increasing slope indicates flows increased with rainfall - Lift Station 5 Service Area

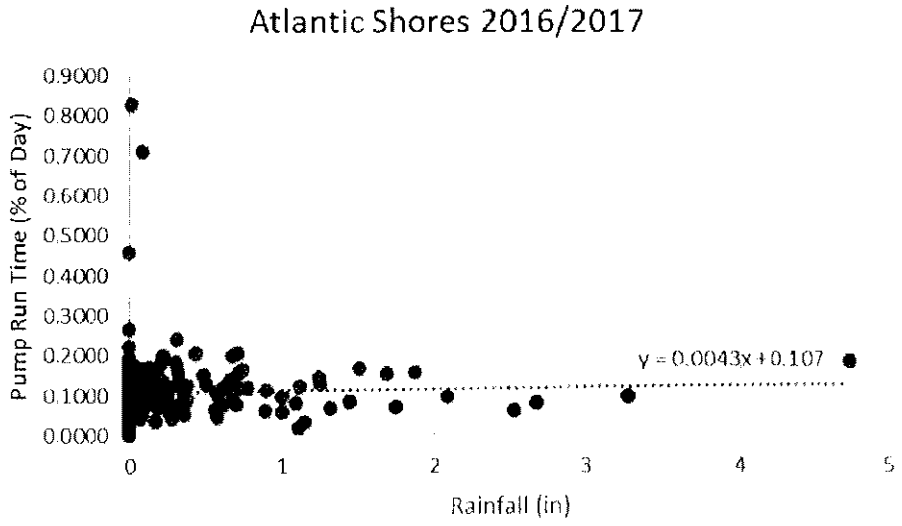


Figure 3.25 – Inflow for 2016-2017 – the regression slope is negative, but note some early high run times. The actual slope (solid line) slope indicates flows increased with rainfall - Lift Station 5 Service Area

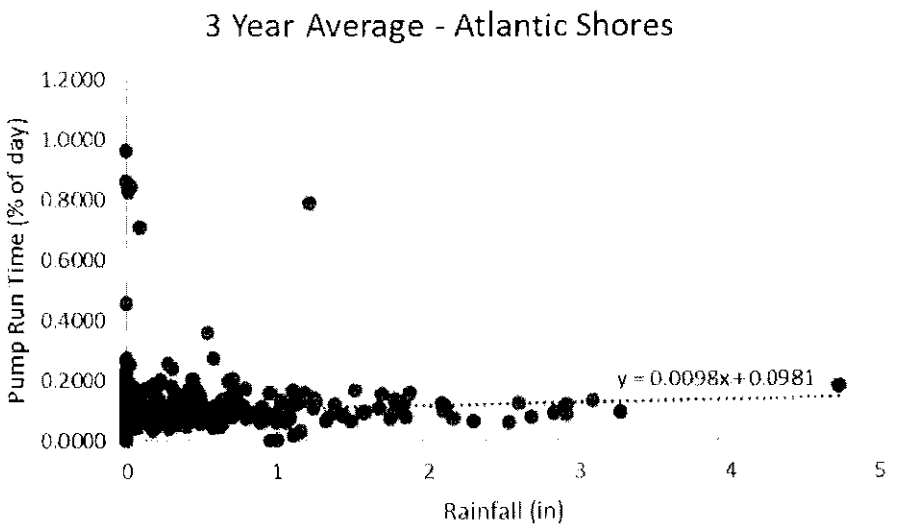


Figure 3.26 – Average graphic foe Inflow for 2014-2017 – the increasing slope indicates flows increased with rainfall - Lift Station 5 Service Area

Figure 3.27 – Manholes GPSed - Lift Station 5 Service Area

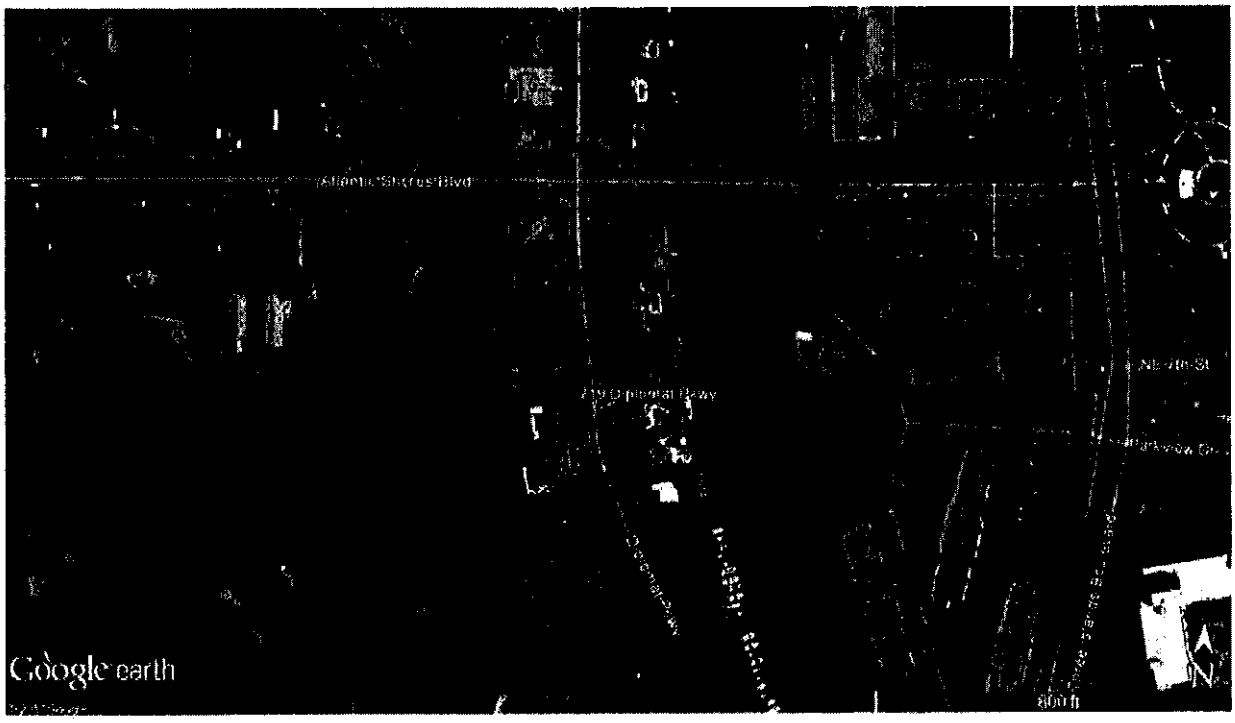


Figure 3.28 Location of Smoke test leaks - Lift Station 5 Service Area

Table 3.8 – Manhole Data - Lift Station 5 Service Area

Manhole ID	Invert	General Condition	Comments
10	Good	Average	Good 1 large pick hole
8	Good	Average	Good 1 large pick hole
4	Good	Average	Good 1 large pick hole
6	Good	Average	Good 1 large pick hole
4A	Good	Average	Good 1 large pick hole
9	Good	Average	Good 1 large pick hole
1	Good	Average	Good 1 large pick hole
2	Good	Average	Good 1 large pick hole

Lift Station 6 – NE 11th /NE 4th

The Lift Station 6 service area contains 125 manholes that were found, GPSed and sealed. The midnight run indicated points where infiltration as noted (see map in Appendix A). A review of rainfall versus flows from July 1, 2014 to June 30, 2017 indicates that the slope of the line is increasing each year, indicating inflow volumes are increasing (see Figures 3.29 to 3.31). There were 15 openings found on the system. The overall trend indicates inflow is present (see Figure 3.32). The average pumps times increased from 2014 to 2017 (nearly 44%).

Figure 3.33 shows the manhole locations. With respect to the manhole construction types, 12 were precast and 113 were brick. None had steps. All manhole covers and rings were cast iron. A number of the manhole covers have pick-holes (see Table 3.9). None had steps. Most of the manholes (21) were in good condition. There were 100 manholes in average condition and four in poor or very poor condition (#126, 82, 78, and 124). Manhole 124 is blocked and needs to have excessive grease removed Manhole #82 was in poor condition and had a leak in the invert. Manhole 126 had water coming through the walls. Manhole #78 has been badly damaged by hydrogen sulfide and is full of grease. These 4 manholes need to be addressed in Phase 2. The inverts of manholes #30, 79 and 130 were submerged.

There were 15 sites that smoke testing indicated were open to the surface (see Figure 3.34). Of the 15, eleven were on private property and not corrected in Phase 1 (1025 Hallandale Beach Blvd, 1124 NE 5th St, 814 NE 4th St NS 1016 NE 4th St). The property owners should be advised of the issue and required to make appropriate corrections.

The midnight run indicated many issues throughout the area. The condos along NE 12th Ave all contribute major flows after 1:00 am for no apparent reason. Lights were off. These private systems need to be televised under the City's ordinance prohibiting excessive inflow and infiltration into the system. They are major contributors of water. Much of the area was lined previously, especially the north end. The liners were noted to be leaking and flows existed – probably indicating service line leaks. Half the pipe in this service areas needs to be reviewed. A lot of grease, sand, debris, mineral and even jewelry was found in manholes in the is service area.

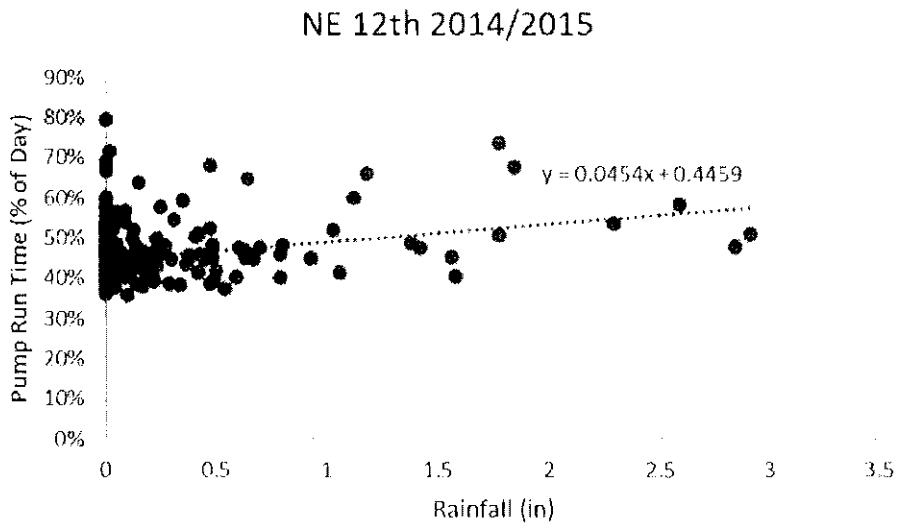


Figure 3.29– Inflow for 2014-2015 – the increasing slope indicates flows increased with rainfall - Lift Station 6 Service Area

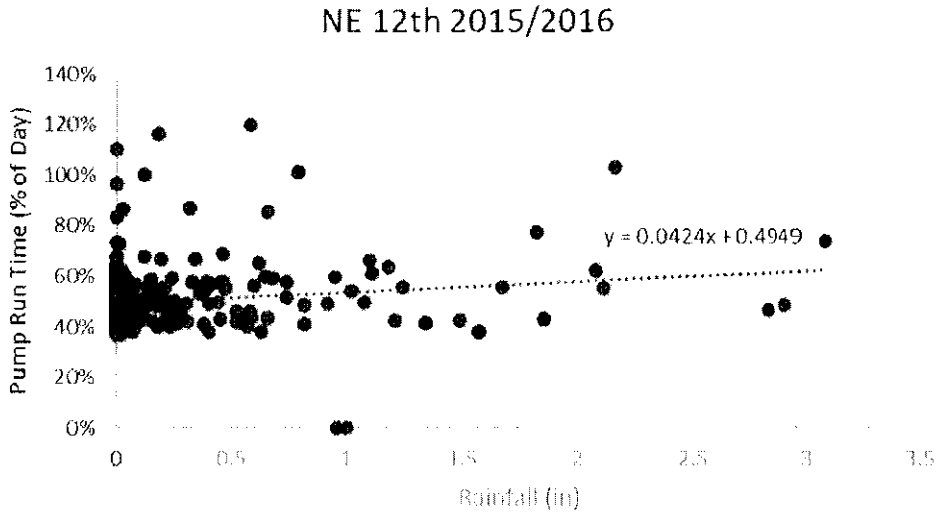


Figure 3.30– Inflow for 2015-2016 – the increasing slope indicates flows increased with rainfall - Lift Station 6 Service Area

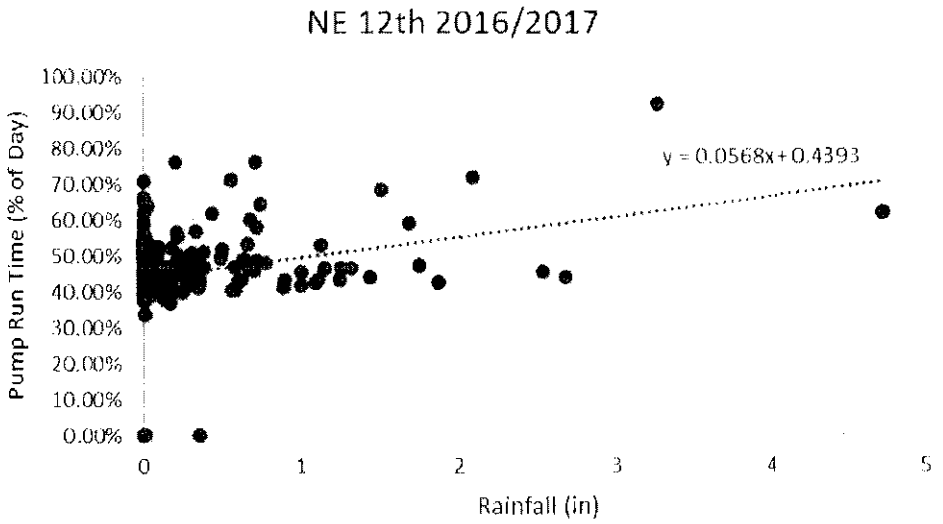


Figure 3.31 – Inflow for 2016-2017 – the regression slope is negative, but note some early high run times. The actual slope (solid line) slope indicates flows increased with rainfall - Lift Station 6 Service Area

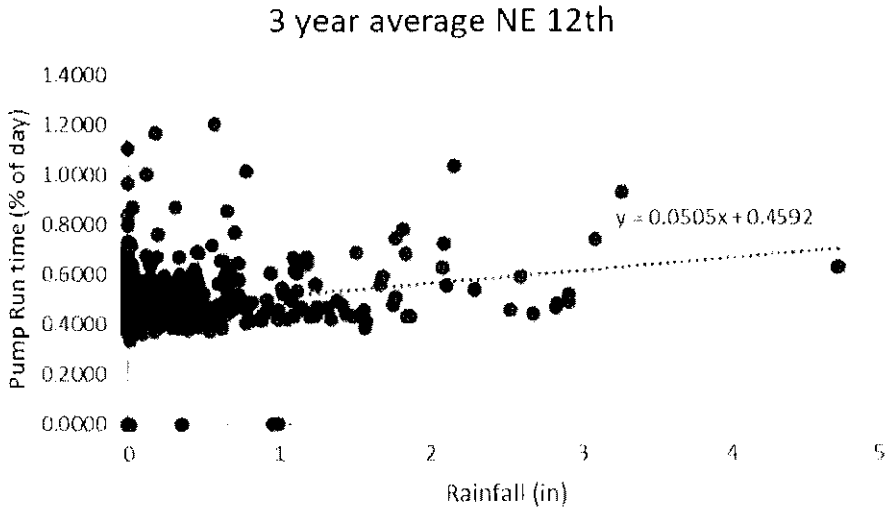


Figure 3.32 – Average graphic foe Inflow for 2014-2017 – the increasing slope indicates flows increased with rainfall - Lift Station 6 Service Area

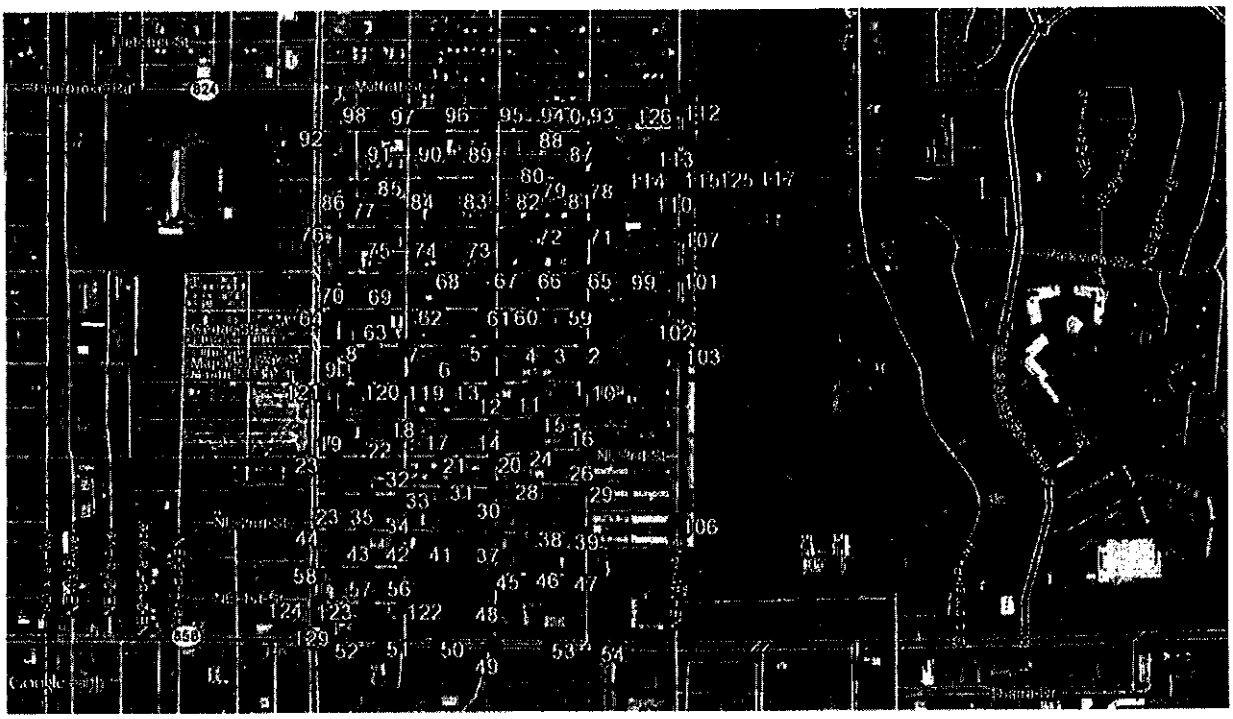


Figure 3.33 – Manholes GPSed - Lift Station 6 Service Area

Figure 3.34 Location of Smoke test leaks - Lift Station 6 Service Area

Table 3.9 – Manhole Data - Lift Station 6 Service Area

Manhole ID	Invert	General Condition	Comments
117	Good	Average	Good 1 large pick hole
116	Good	Average	Good
132	Good	Average	Good
125	Good	Average	Good 1 large pick hole
115	Good	Average	Good 1 large pick hole
114	Good	Average	Good 1 large pick hole
113	Good	Average	Good 1 large pick hole
112	Good	Average	Good 1 large pick hole
126	Good	Poor	Some coming through walls 2 large pick hole
093A	Good	Average	Good 1 large pick hole
93	Good	Average	Good 1 large pick hole
94	Good	Average	Good 1 large pick hole
95	Good	Average	Good 1 large pick hole
96	Good	Average	Good 1 large pick hole
97	Good	Average	Good 1 large pick hole
98	Good	Average	Good 1 large pick hole
92	Good	Average	Good 1 large pick hole
91	Good	Average	Good 1 large pick hole
90	Good	Average	Good 1 large pick hole
87	Good	Average	Good 1 large pick hole
88	Good	Average	Good 1 large pick hole
89	Good	Average	Good 1 large pick hole
85	Good	Average	Good 1 large pick hole
86	Good	Average	Good 1 large pick hole
84	Good	Average	Good 1 large pick hole
83	Good	Average	Good 1 large pick hole
82	Needs Repair	Poor	Water coming in through invert 1 large pick hole
130	Underwater	Average	Invert underwater 1 large pick hole
79	Underwater	Average	Invert underwater 1 large pick hole
78	Good	Very Poor	1 large pick hole h2s build up on walls
71	Good	Average	Good 1 large pick hole
72	Good	Average	Good 1 large pick hole
73	Good	Average	Good 1 large pick hole
74	Good	Average	Good 1 large pick hole
75	Good	Average	Good 1 large pick hole
80	Underwater	Average	Invert underwater 1 large pick hole
76	Good	Average	Good 1 large pick hole
70	Good	Average	Good 1 large pick hole
99	Good	Average	Good 1 large pick hole
65	Good	Average	Good 1 large pick hole
68	Good	Average	Good 1 large pick hole
59	Good	Average	Good 1 large pick hole
60	Good	Average	Good 1 large pick hole
61	Good	Average	Good 1 large pick hole

Manhole ID	Invert	General Condition	Comments
61	Good	Average	Good 1 large pick hole
62	Good	Average	Good 1 large pick hole
63	Good	Average	Good 1 large pick hole
64	Good	Average	Good 1 large pick hole
9	Good	Average	Good 1 large pick hole
8	Good	Average	Good 1 large pick hole
7	Good	Average	Good
6	Good	Average	Good 1 large pick hole
5	Good	Average	Good 1 large pick hole
4	Good	Average	Good 1 large pick hole
3	Good	Average	Good 1 large pick hole
2	Good	Average	Good 1 large pick hole
1	Good	Average	Good 1 large pick hole
10	Good	Average	Good 1 large pick hole
11	Good	Average	Good 1 large pick hole
77	Good	Average	Good 2 small pick hole
12	Good	Average	Good one large pick hole
13	Good	Average	Good one large pick hole
119	Good	Average	Good one large pic hole
120	Good	Average	Good one large pick hole
121	Good	Average	Good one large pick hole
19	Good	Average	Good one large pick hole
18	Good	Average	Good one large pick hole
17	Good	Average	Good one large pick hole
15	Good	Average	Good 1 large pick hole
14	Good	Average	Good 1 large pick hole
16	Good	Average	Good
26	Good	Average	Good Good 1 large pick hole
29	Good	Average	Good 1 large pick hole
28	Good	Average	Good 1 large pick hole
27	Good	Average	Good 1 large pick hole
25	Good	Average	Good 1 large pick hole
24	Good	Average	Good 1 large pick hole
20	Good	Average	Good 1 large pick hole
21	Good	Average	Good 1 large pick hole
22	Good	Average	Good 1 large pick hole
23	Good	Average	Good 1 large pick hole
36	Good	Average	Good 1 large pick hole
35	Good	Average	Good 1 large pick hole
34	Good	Average	Good 1 large pick hole
80	Good	Average	Good
32	Good	Average	Good 1 large pick hole
33	Good	Average	Good 1 large pick hole
31	Good	Average	Good 1 large pick hole

Manhole ID	Invert	General Condition	Comments
30	Underwater	Average	Invert underwater 1 large pick hole
128	Good	Average	Good
39	Good	Average	Good Good 1 large pick hole
38	Good	Average	Good 1 large pick hole
37	Underwater	Average	Good 1 large pick hole
42	Good	Average	Good 1 large pick hole
43	Good	Average	Good 1 large pick hole
44	Good	Average	Good 1 large pick hole
56	Good	Average	Good
57	Good	Average	Good 1 large pick hole
41	Good	Good	Good Good 1 large pick hole
58	Good	Good	Good Good 1 large pick hole
122	Good	Good	Good Good 1 large pick hole
123	Good	Good	Good Good 1 large pick hole
48	Good	Good	Good Good 1 large pick hole
45	Underwater	Good	Underwater Good 1 large pick hole
47	Good	Good	Good Good 1 large pick hole
46	Good	Good	Good Good 1 large pick hole
106	Good	Good	Good Good 1 large pick hole
110	Good	Good	Good 1 large pick hole
107	Good	Good	Good Good 1 large pick hole
101	Good	Good	Good Good 1 large pick hole
100	Good	Good	Good Good 2 large pick hole
102	Good	Good	Good 1 large pick hole
103	Good	Good	Good 1 large pick hole
54	Good	Good	Good 1 large pick hole
53	Good	Good	Good 1 large pick hole
81	Good	Average	Good 1 large pick holes
129	Good	Average	Good 1 large pick holes
124	Needs Repair	Poor	1 large pick holes grease blocking inflow and out flow
49	Good	Good	Good 2 large pick holes
50	Good	Good	Good 2 large pick holes
51	Good	Good	Good 2 large pick holes
52	Good	Good	Good 2 large pick holes
53b	Good	Average	Good 1 large pick hole
69	Good	Average	Good 1 large pick holes
67	Good	Average	Good 1 large pick holes
66	Good	Average	Good 1 large pick holes

Table 3.10 – Smoke test result information - Lift Station 6 Service Area

Street Address	Latitude	Longitude	Comments
			Open 4 inch PvC c/o in planters garden
819 NE 8th St	25.99414833	-80.1397767	center of yard
822 NE 8th St	25.993925	-80.1395983	Smoking 4 inch PvC c/o right of driveway
808 NE 7th St	25.9930743	-80.139963	Cracked 4 inch PvC c/o left front
1124 NE 5th St	25.99162675	-80.1367851	Broken 4 inch PvC c/o right of the c/o can't install LDL plug broke at 'T'
813 NE 4th St	25.99055167	-80.1396367	Open 4 inch PvC c/o left at property line
814 NE 4th St	25.99009333	-80.139875	Open 4 inch PvC c/o center of yard by sidewalk
813 NE 4th St	25.9902469	-80.1398236	Cracked 4 inch PvC c/o right front
1016 NE 4th St	25.9901635	-80.1377568	Open 3 inch metal c/o front of front porch
221 NE 11th Ave	25.98906833	-80.1377517	Open 4 inch PvC c/o right of driveway
818 NW 2nd Ct	25.9887008	-80.1394655	Open 4 inch metal c/o left side of house
1425 Atlantic Shores Blvd	25.9953753	-80.1335184	Cracked 4 inch metal c/o front of parking spot 114
1025 Hallandale Beach Blvd	25.98592893	-80.1368849	Open 4 inch PvC c/o in front of plaza sign in meter box
1107 NE 1st Ct	25.9872793	-80.1369497	Cracked 4 inch PvC c/o right of driveway
728 NE 1st St	25.98644333	-80.140505	Open 4 inch PvC c/o left front by power poles in open lot
728 Ne 1 St	25.98644167	-80.1405057	4 in ldl installed

Lift Station 7 –NE 4th Ct

The Lift Station 7 service area contains 83 manholes that were found, GPSed and sealed. The midnight run indicated points where infiltration as noted (see map in Appendix A). A review of rainfall versus flows from July 1, 2014 to June 30, 2017 indicates that the slope of the line is increasing each year, indicating inflow volumes are increasing (see Figures 3.35-3.37). There were 25openings found on the system. The overall trend indicates inflow is present (see Figure 3.38). The average pumps times increased from 2014 to 2017 (nearly 40%).

Figure 3.39 shows the manhole locations. With respect to the manhole construction types, 2 were precast and 81 were brick. None had steps. All manhole covers and rings were cast iron. A number of the manhole covers have pick-holes (see Table 3.11). Most of the manholes (45) were in good condition. There were 36 manholes in average condition and two in poor or very poor condition (#32 and 92). Manhole #92 is full of grease. These manholes need to be addressed in Phase 2. Manhole #32 has roots in the invert. These manholes need to be addressed in Phase 2. The inverts of manholes #1, 7, 37 and 43 were submerged. There is a dish in the bottom of Manhole #59.

There were 23 sites that smoke testing indicated were open to the surface (see Figure 3.40). Table 3 outlines those sites. Of the 23, 10 were on private property and not corrected in Phase 1 (the unhightlighted locations on Table 3.40). The property owners should be advised of the issue and required to make appropriate corrections.

The midnight run in this service area indicated leakage around the dog track despite being after hours. Cedar St., Maple St, NE 2nd Ave and NE 1st Ave were other significant areas of concern.

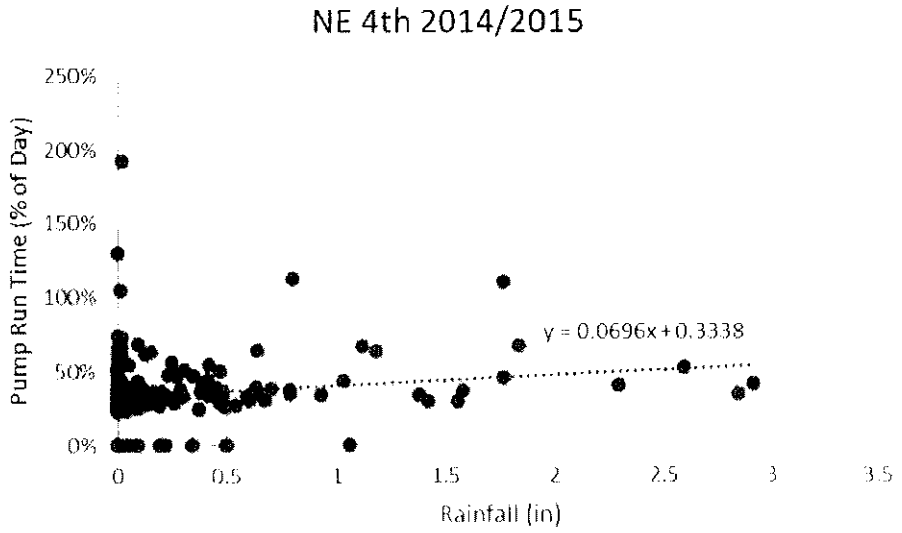


Figure 3.35 – Inflow for 2014-2015 – the increasing slope indicates flows increased with rainfall - Lift Station 7 Service Area

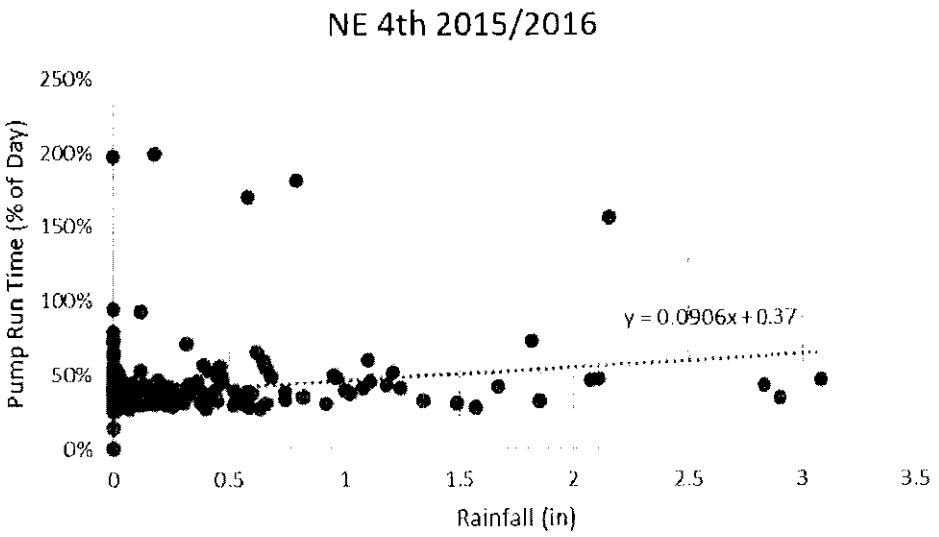


Figure 3.36 – Inflow for 2015-2016 – the increasing slope indicates flows increased with rainfall - Lift Station 7 Service Area

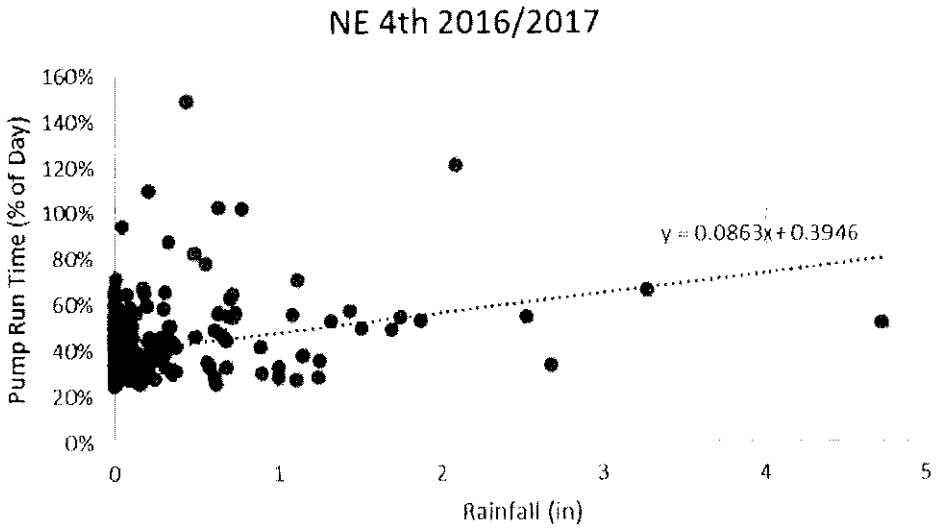


Figure 3.37 – Inflow for 2016-2017 – the regression slope is negative, but note some early high run times. The actual slope (solid line) slope indicates flows increased with rainfall - Lift Station 7 Service Area

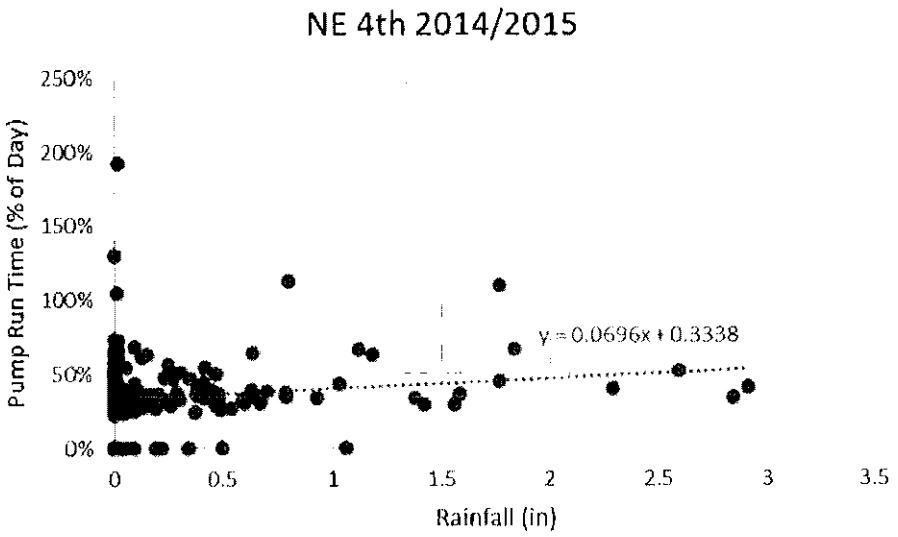


Figure 3.38 – Average graphic foe Inflow for 2014-2017 – the increasing slope indicates flows increased with rainfall - Lift Station 7 Service Area

Figure 3.39 – Manholes GPSed - Lift Station 7 Service Area

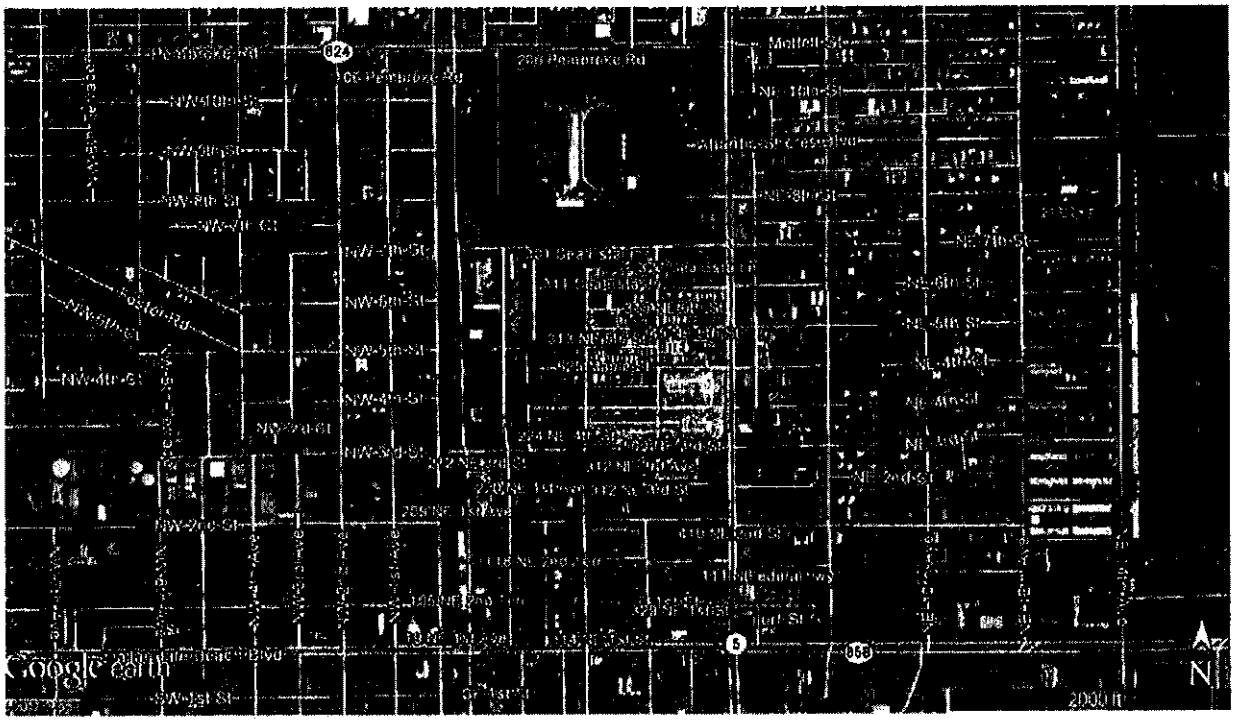


Figure 3.40 Location of Smoke test leaks - Lift Station 7 Service Area

Table 3.11 – Manhole Data - Lift Station 7 Service Area

Manhole ID	Invert	General Condition	Comments
10	Good	Good	Good 1 large pick hole
9	Good	Good	Good 1 large pick hole
8	Good	Good	Good 1 large pick hole
14	Good	Good	Good 1 large pick hole
13	Good	Good	Good 1 large pick hole
12	Good	Good	Good 1 large pick hole
11	Good	Good	Good 2 large pick holes
7	Underwater	Good	Underwater 1 large pick hole
1	Underwater	Good	Good 1 large pick hole
18	Good	Average	Good 1 large pick hole
17	Good	Average	Good 1 large pick hole
16	Good	Average	Good 1 large pick hole
15	Good	Average	Good 1 large pick hole
2	Good	Average	Good 1 large pick hole
3	Good	Average	Good 2 large pick holes
4	Good	Average	Good 1 large pick hole
5	Good	Average	Good 1 large pick hole
6	Good	Average	Good 1 large pick hole
38	Good	Average	Good 1 large pick hole
37	Underwater	Average	Good 1 large pick hole
42	Good	Average	Good 1 large pick hole
43	Underwater	Average	Good 1 large pick hole
44	Good	Average	Good 1 large pick hole
45	Good	Average	Good 1 large pick hole
46	Good	Average	Good 1 large pick hole
21	Good	Good	Good 1 large pick hole
20	Good	Good	Good 1 large pick hole
70	Good	Good	Good 1 large pick hole
69	Good	Good	Good 1 large pick hole
68	Good	Good	Good 1 large pick hole
67	Good	Good	Good 1 large pick hole
65	Good	Good	Good 1 large pick hole
47	Good	Good	Good 1 large pick hole
66	Good	Good	Good 1 large pick hole
77	Good	Good	Good 1 large pick hole
78	Good	Good	Good 1 large pick hole
79	Good	Good	Good 1 large pick hole
80	Good	Good	Good 1 large pick hole
86	Good	Average	Good 1 large pick hole
85	Good	Average	Good 1 large pick hole
84	Good	Average	Good 1 large pick hole
90	Good	Average	Good 1 large pick hole
89	Good	Average	Good 1 large pick hole
83	Good	Average	Good 1 large pick hole

Manhole ID	Invert	General Condition	Comments
87	Good	Average	Good 1 large pick hole
82	Good	Average	Good 1 large pick hole
75	Good	Average	Good 1 large pick hole
81	Good	Average	Good 1 large pick hole
49	Good	Average	Good 1 large pick hole
51	Good	Average	Good 1 large pick hole
50	Good	Average	Good 1 large pick hole
60	Good	Average	Good 1 large pick hole
61	Good	Average	Good 1 large pick hole
62	Good	Average	Good 1 large pick hole
63	Good	Average	Good 1 large pick hole
76	Good	Good	Good 1 large pick hole
74	Good	Good	Good 1 large pick hole
71	Good	Good	Good 1 large pick hole
72	Good	Good	Good 1 large pick hole
36	Good	Good	Good 1 large pick hole
35	Good	Good	Good 1 large pick hole
34	Good	Good	Good 1 large pick hole
33	Good	Good	Good 1 large pick hole
22	Good	Good	Good 2 large pick holes
23	Good	Good	Good 1 large pick hole
24	Good	Good	Good 1 large pick hole
25	Good	Good	Good 1 large pick hole
26	Good	Good	Good 1 large pick hole
27	Good	Good	Good 1 large pick hole
59	Good	Good	Good 1 large pick hole Dish in bo
58	Good	Good	Good 1 large pick hole
57	Good	Good	Good 1 large pick hole
56	Good	Good	Good 1 large pick hole
54	Good	Good	Good 1 large pick hole
55	Good	Average	Good 1 large pick hole
32	Needs Repair	Poor	1 large pick hole roots in invert
31	Good	Average	Good 1 large pick hole
92	Needs Repair	Poor	Grease build up in invert 1 large
91	Good	Average	Good 1 large pick holes
53	Good	Good	Good 1 large pick hole
52	Good	Good	Good 1 large pick hole
29	Good	Good	Good 1 pick hole
30	Good	Good	Good 1 pick hole

Table 3.12 – Smoke test result information - Lift Station 7 Service Area

Street Address	Latitude	Longitude	Comments
106 Pembroke Rd	25.9961313	-80.1478251	Cracked 4 inch PvC c/o left front of bowling alley by yellow pole under metal cover
106 Pembroke Rd	25.9962564	-80.1478433	Cracked 4 inch PvC c/o in left side of parking lot
200 Pembroke Rd	25.99647161	-80.1470423	Open 4 inch PvC c/o front center by sidewalk
212 NE 3rd St	25.9890926	-80.1463874	Cracked 6 inch PvC c/o right front of entrance by green electric box
301 Sea Esta Ln	25.99275	-80.1454309	Open 2 inch metal c/o back right corner of house
318 NE 6th St	25.9920644	-80.1447685	Cracked 4 inch PvC c/o 10ft front of right side door
325 Maple St	25.9911827	-80.1450006	Cracked 4 inch PvC c/o in center of empty lot left of address
224 NE 4th St	25.9898961	-80.1457451	Cracked 6 inch PvC c/o right of sidewalk by front door
312 NE 3rd Ave	25.9890301	-80.1455124	Service line break right of left entrance by power line stake
410 NE 2nd St	25.9878329	-80.1435691	Open 4 inch PvC c/o back left corner of yard
111 N Federal Hwy	25.9871791	-80.1430947	Grease trap smoking around cover behind building by dumpster
105 NE 2nd Terr	25.9866822	-80.1463448	Cracked 4 inch PvC c/o left front
220 NE 1st Ave	25.9886037	-80.1477572	Possible c/o under cement cover front of suite 218
209 NE 1st Ave	25.9884722	-80.147977	Open 4 inch metal c/o front of stairs to front door
500 NE 3rd St	25.9892627	-80.1435552	Open 6 inch PvC c/o behind house inside fence can't install LDL plug
311 Sea Esta Ln	25.99268199	-80.1450593	Illegal connection
327 Sea Esta Ln	25.99268958	-80.1444836	Service line break back right of trailer
313 NE 5th St	25.99167929	-80.1451505	Open 3 inch PvC c/o back right of trailer
345 NE 5th St	25.99149264	-80.144419	Open 2 inch PvC pipe left at property line
312 NE 3rd St	25.98871899	-80.1454048	Light smoke coming from 6 inch PvC c/o right front of building by trees can't installed LDL plug
329 NE 1st St	25.98651846	-80.1445131	Open 4 inch PvC c/o right property line
314 NE 1st St	25.98617139	-80.1449687	Open 4 inch metal c/o 100ft up driveway on right side
118 NE 2nd Terr	25.98758159	-80.1461839	Open 4 inch PvC c/o right of house
19 NE 1st Ave	25.98614882	-80.1479598	Open 4 inch metal c/o right front of building

Lift Station 8 –SE 5th

The Lift Station 8 service area contains 95 manholes that were found, GPSed and sealed. The midnight run indicated points where infiltration as noted (see map in Appendix A). A review of rainfall versus flows from July 1, 2014 to June 30, 2017 indicates that the slope of the line is increasing each year, indicating inflow volumes are increasing (see Figures 3.41-3.43). There were 10 openings found on the system. The overall trend indicates inflow is present (see Figure 344). The average pumps times increased from 2014 to 2017 (35 to 38%).

Figure 3.45 shows the manhole locations. With respect to the manhole construction types, 35 were precast and 60 were brick. None had steps. All manhole covers and rings were cast iron. A number of the manhole covers have pick-holes (see Table 3.13). None had steps. Most of the manholes (94) were in good condition. There was 1 manhole in average condition and none in poor or very poor condition. The inverts of manholes #1, 2, 6, 11, 55, and 72-75 were submerged.

There were 10 sites that smoke testing indicated were open to the surface (see Figure 3.46). Table 3.14 outlines those sites. Of the 10, 9 were on private property or related to stormwater and not corrected in Phase 1 (the unhightlighted locations on Table 3.46). The property owners should be advised of the issue and required to make appropriate corrections.

The midnight run in this service area indicated that about 40% of the piping needed to be televised. Much of it was shallow, dead end piping that had no reason to have flow after midnight. Areas were widely scattered.

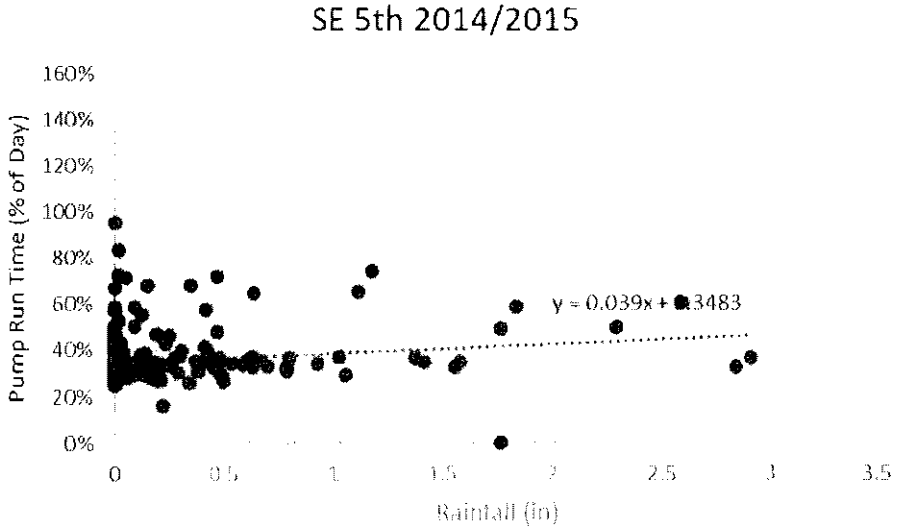


Figure 3.41 – Inflow for 2014-2015 – the increasing slope indicates flows increased with rainfall - Lift Station 8 Service Area

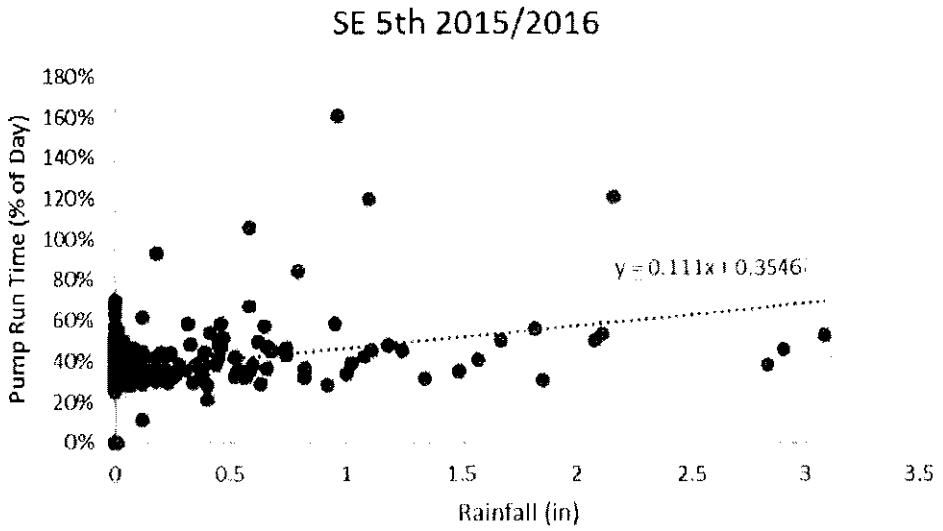


Figure 3.42 – Inflow for 2015-2016 – the increasing slope indicates flows increased with rainfall - Lift Station 8 Service Area

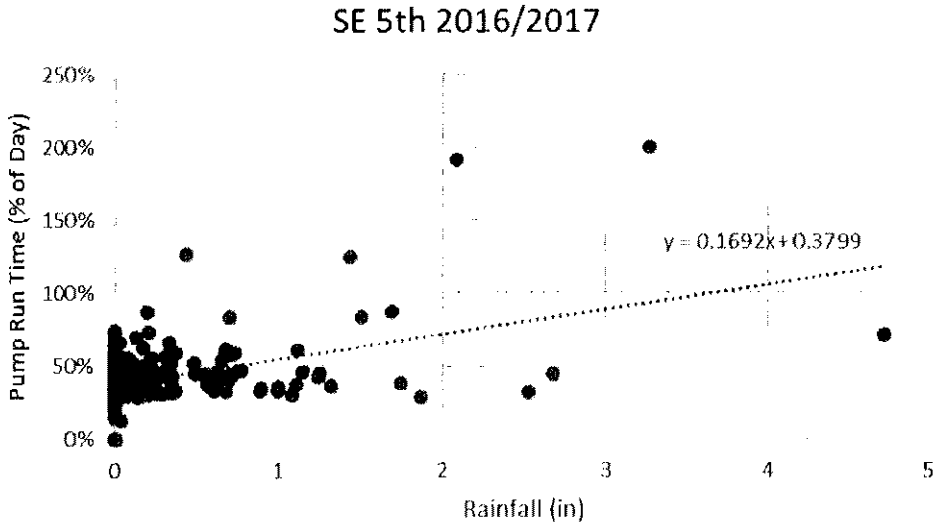


Figure 3.43 – Inflow for 2016-2017 – the regression slope is negative, but note some early high run times. The actual slope (solid line) slope indicates flows increased with rainfall - Lift Station 8 Service Area

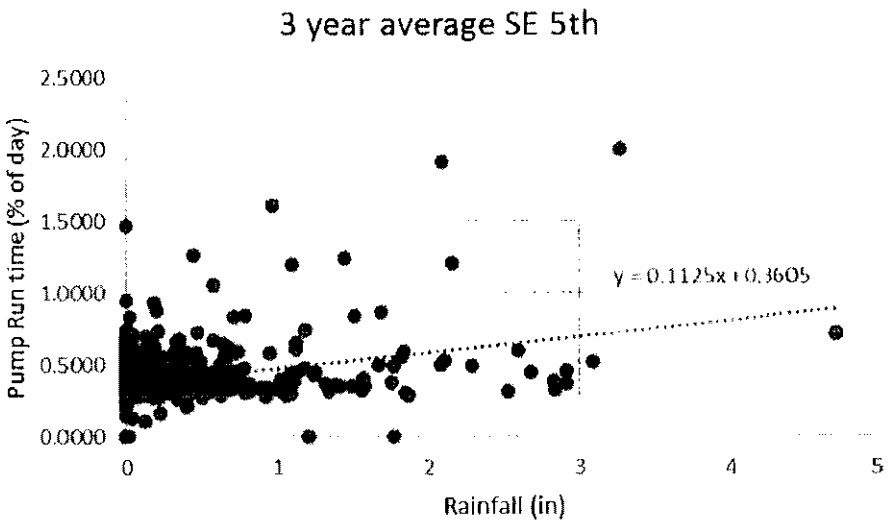


Figure 3.44 – Average graphic foe Inflow for 2014-2017 – the increasing slope indicates flows increased with rainfall - Lift Station 8 Service Area

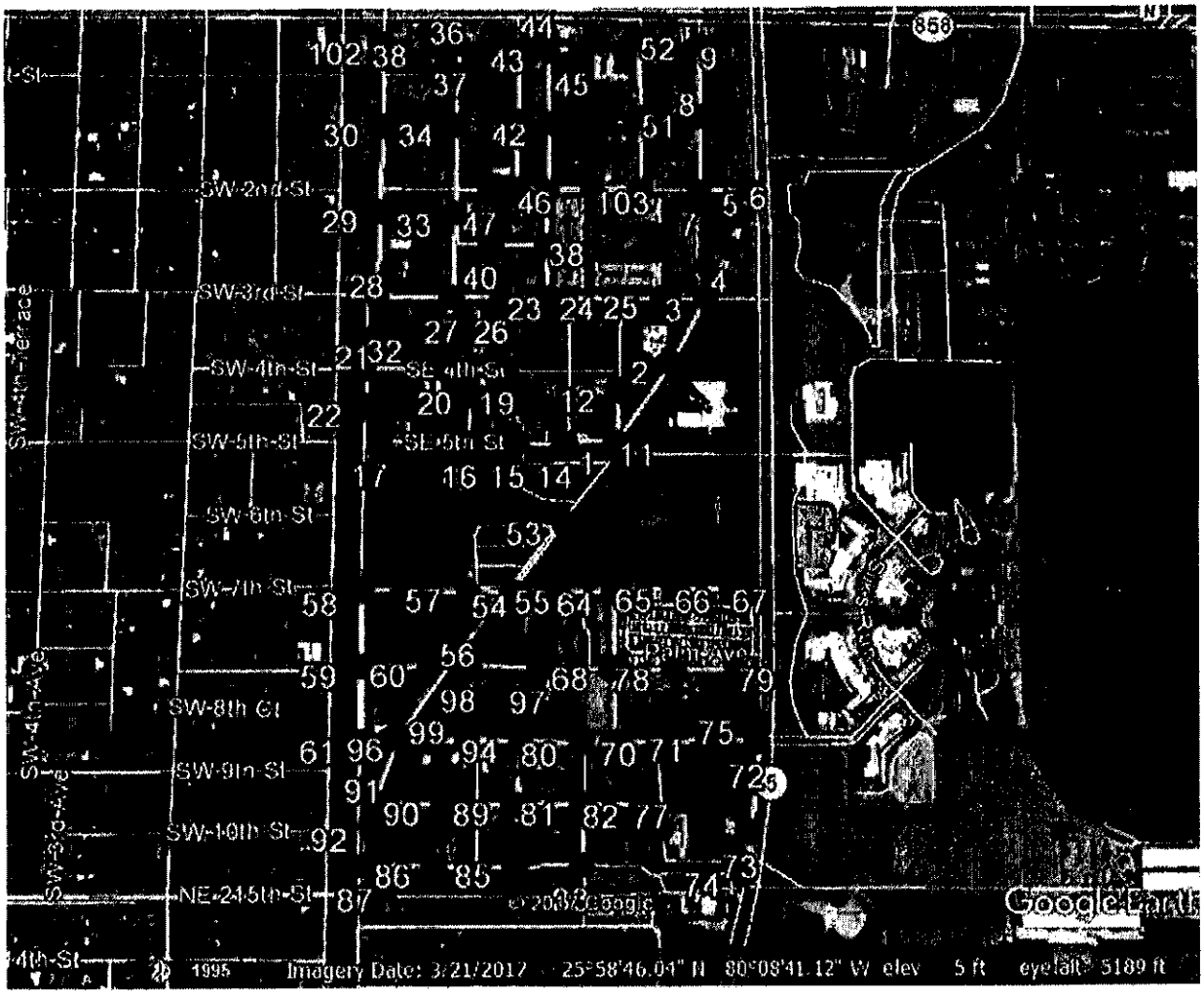


Figure 3.45 – Manholes GPSed - Lift Station 8 Service Area

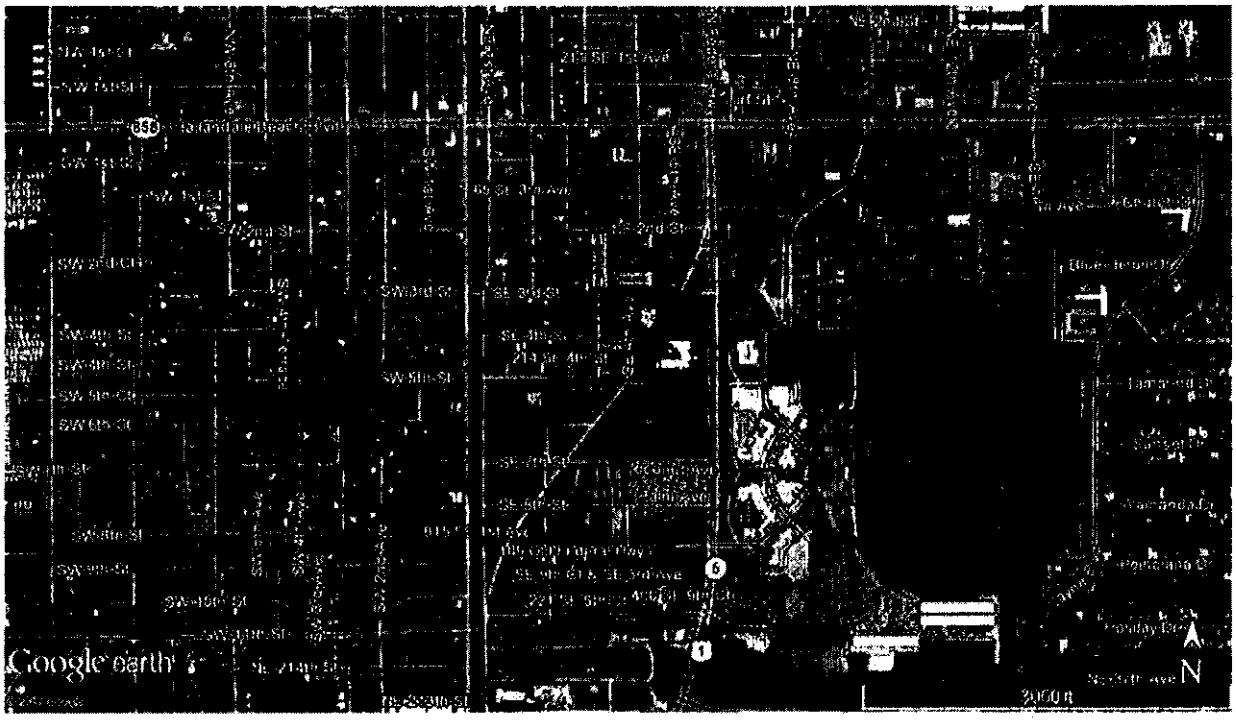


Figure 3.46 Location of Smoke test leaks - Lift Station 8 Service Area

Table 3.13 – Manhole Data - Lift Station 8 Service Area

Manhole ID	Invert Condition	General Condition	Comments
1	Underwater	Good	Good 1 large pick hole
2	Underwater	Average	Invert underwater
3	Good	Good	Good has 1 pick hole
4	Good	Good	Good has 1 pick hole
5	Good	Good	Good has 1 pick hole
6	Underwater	Good	Good 1 large pick hole
7	Good	Good	Good has 1 pick hole
8	Good	Good	Good has 1 pick hole
9	Good	Good	Good has 1 pick hole
10	Good	Good	Good has 1 pick hole
11	Underwater	Good	Good 1 pick hole
12	Good	Good	Good has 1 pick hole
14	Good	Good	Good has 1 pick hole
15	Good	Good	Good has 1 pick hole
16	Good	Good	Good has 1 pick hole
17	Good	Good	Good has 1 pick hole
19	Good	Good	Good has 1 pick hole
20	Good	Good	Good has 1 pick hole
21	Good	Good	Good 1 pick hole
22	Good	Good	Good 1 pick hole
23	Good	Good	Good 1 pick hole
24	Good	Good	Good has 1 pick hole
25	Good	Good	Good has 1 pick hole
26	Good	Good	Good 1 pick hole
27	Good	Good	Good 1 pick hole
28	Good	Good	Good 1 pick hole
29	Good	Good	Good
30	Good	Good	Good
32	Good	Good	Good 1 pick hole
33	Good	Good	Good has 1 pick hole
34	Good	Good	Good has 1 pick hole
35	Good	Good	Good has 1 pick hole
36	Good	Good	Good has 1 pick hole
37	Good	Good	Good has 1 pick hole
38	Good	Good	Good has 1 pick hole
39	Good	Good	Good has 1 pick hole
40	Good	Good	Good has 1 pick hole
41	Good	Good	Good has 1 pick hole
42	Good	Good	Good has 1 pick hole
43	Good	Good	Good has 1 pick hole
44	Good	Good	Good has 1 pick hole
45	Good	Good	Good has 1 pick hole
46	Good	Good	Good has 1 pick hole
47	Good	Good	Good has 1 pick hole

Manhole ID	Invert Condition	General Condition	Comments
48	Good	Good	Good has 1 pick hole
49	Good	Good	Good has 1 pick hole
50	Good	Good	Good has 1 pick hole
51	Good	Good	Good has 1 pick hole
52	Good	Good	Good has 1 pick hole
53	Good	Good	Good has 1 pick hole
54	Good	Good	Good has 1 pick hole
55	Underwater	Good	Good has 1 pick hole Underwater
56	Good	Good	Good has 1 pick hole
57	Good	Good	Good has 1 pick hole
58	Good	Good	Good has 1 pick hole
59	Good	Good	Good has 1 pick hole
60	Good	Good	Good has 1 pick hole
61	Good	Good	Good has 1 pick hole
62	Good	Good	Good has 1 pick hole
64	Good	Good	Good has 1 pick hole
65	Good	Good	Good has 1 pick hole
66	Good	Good	Good has 1 pick hole
67	Good	Good	Good has 1 pick hole
68	Good	Good	Good has 1 pick hole
69	Good	Good	Good has 1 pick hole
70	Good	Good	Good has 1 pick hole
71	Good	Good	Good has 1 pick hole
72	Underwater	Good	Good 1 large pick hole
73	Underwater	Good	Good 1 large pick hole
74	Underwater	Good	Good 1 large pick hole
75	Underwater	Good	Good 1 large pick hole
77	Good	Good	Good has 2 pick holes
78	Good	Good	Good has 1 pick hole
79	Good	Good	Good has 2 pick holes
80	Good	Good	Good has 1 pick hole
81	Good	Good	Good has 1 pick hole
82	Good	Good	Good has 2 pick holes
83	Good	Good	Good has 2 pick holes
85	Good	Good	Good has 1 pick hole
86	Good	Good	Good has 1 pick hole
87	Good	Good	Good has 2 pick holes
89	Good	Good	Good has 1 pick hole
90	Good	Good	Good has 1 pick hole
91	Good	Good	Good has 2 pick holes
92	Good	Good	Good
94	Good	Good	Good has 1 pick hole
95	Good	Good	Good has 1 pick hole
96	Good	Good	Good has 1 pick hole

Table 3.14 – Smoke test result information - Lift Station 8 Service Area

Street Address	Latitude	Longitude	Comments
400 SE 9th Ct	25.9753918	-80.1440164	Cracked 2 inch metal c/o in grass front of door 7
221 SE 9th Ct	25.97560624	-80.14513144	Storm water crossover in driveway
407 SE 9th Ct	25.9755797	-80.1436918	Storm water crossover
SE 9th Ct & SE 3rd Ave	25.97562194	-80.14464534	Storm water crossover
109 Old Federal Hwy	25.9763658	-80.1473281	Cracked 3 inch metal c/o left side of building 10ft front of window
815 SE 1st Ave	25.97673851	-80.14762759	Smoke coming from underneath dumpster
815 SE 1st Ave	25.9764948	-80.1476488	Smoke from outlet socket in building
214 SE 4th St	25.98090782	-80.14573069	Open 3 inch metal c/o right of house
211 SE 1st Ave	25.98252881	-80.14763852	Cracked 3 inch PvC c/o front of building in mulch by propane tank
65 SE 3rd Ave	25.9842477	-80.1453079	Open 6 inch PvC c/o in backyard in fence can't access

Lift Station 9 - Foster Rd

The Lift Station 8 service area contains 234 manholes that were found, GPSed and sealed. The midnight run indicated points where infiltration as noted (see map in Appendix A). A review of rainfall versus flows from July 1, 2014 to June 30, 2017 indicates that the slope of the line is increasing each year, indicating inflow volumes are increasing (see Figures 3.47-3.49). There were 81 openings found on the system – by far the worst area in the City. The overall trend indicates inflow is present (see Figure 3.50). The average pumps times increased from 2014 to 2017 (25 to 39%).

Figure 3.51 shows the manhole locations. With respect to the manhole construction types, 217 were precast and 17 were brick. None had steps. All manhole covers and rings were cast iron. A number of the manhole covers have pick-holes (see Table 3.15). None had steps. A few of the manholes (36) were in good condition. There were 219 manholes in average condition and one in poor or very poor condition (#80 – water was coming in through the wall seams). The inverts of manholes #1, 39, 42 and 44 were submerged.

There were 81 sites that smoke testing indicated were open to the surface (see Figure 3.52). Table 3 outlines those sites. Of the 81, 45 LDL plugs and cleanout caps were installed. The rest were on private property or related to stormwater and not corrected in Phase 1 (the unhightlighted locations on Table 3.16). The property owners should be advised of the issue and required to make appropriate corrections.

Service area 9 was an area with a lot of both inflow and infiltration. Many shallow lines showed flow during the midnight run. These dead ends largely should not have flowed. The area east of the cemetery was particularly poor. Areas under Pembroke Road showed flows – some were not accessible due to traffic. The high school has two lines discharging large flows (half full pipe) at 3:00 am. In Manholes #09-10 and 09-011. That needs further investigation. The water was clear. Overall this area showed significant leakage after hours. A commercial laundry was noted (leaked sheets into the City's system (since corrected).

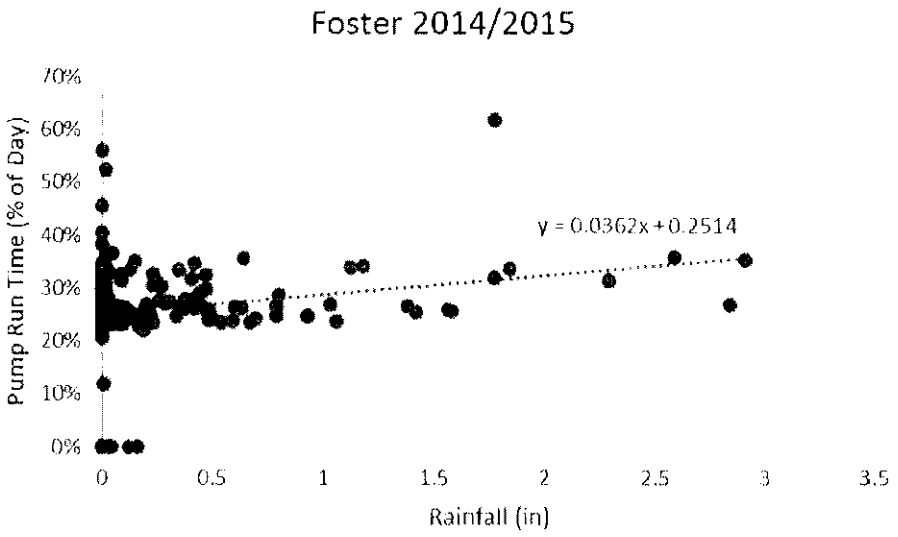


Figure 3.47 – Inflow for 2014-2015 – the increasing slope indicates flows increased with rainfall - Lift Station 9 Service Area

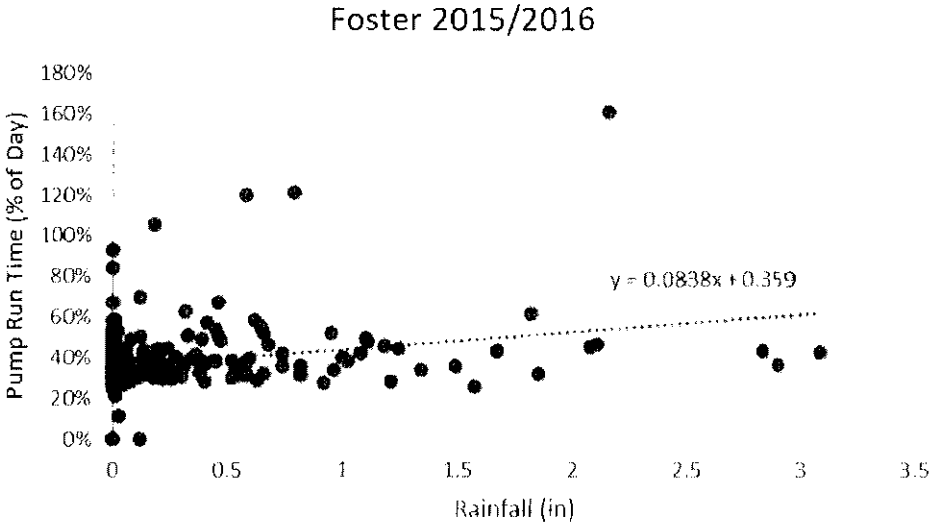


Figure 3.48 – Inflow for 2015-2016 – the increasing slope indicates flows increased with rainfall - Lift Station 9 Service Area

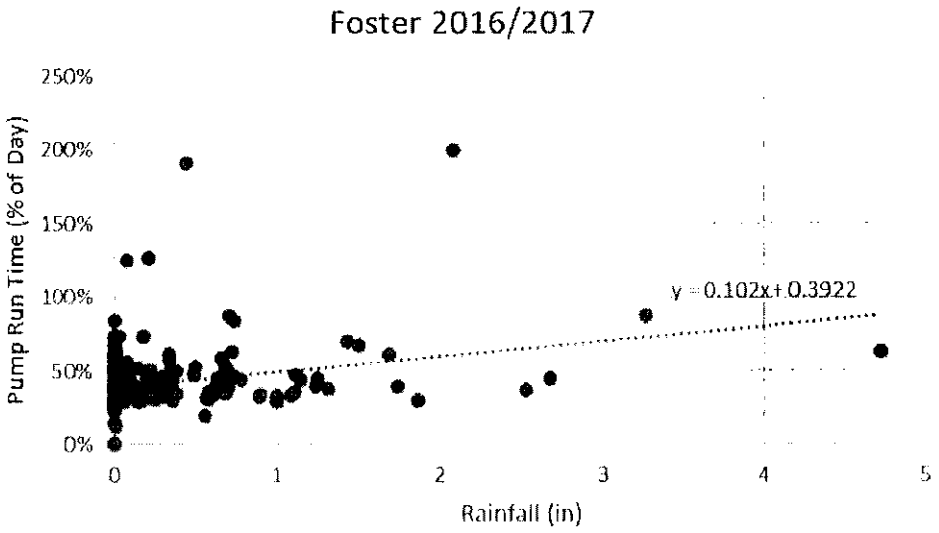


Figure 3.49 – Inflow for 2016-2017 – the regression slope is negative, but note some early high run times. The actual slope (solid line) slope indicates flows increased with rainfall - Lift Station 9 Service Area

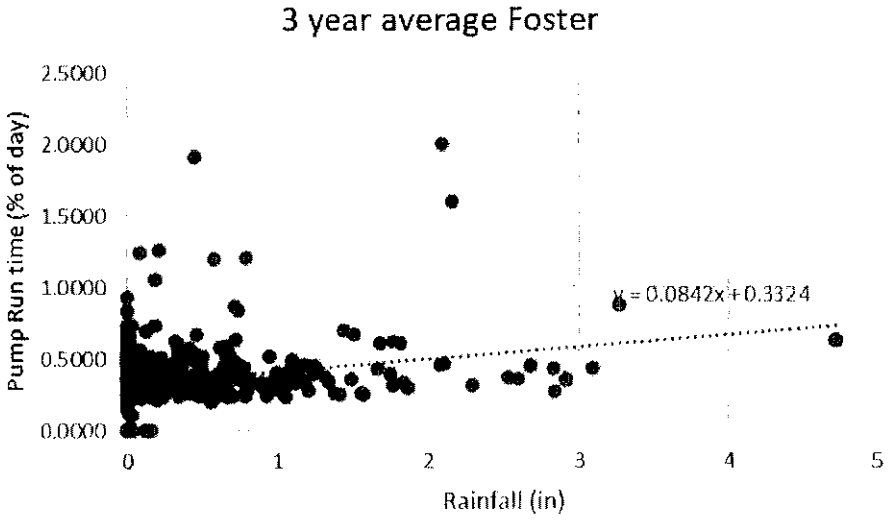


Figure 3.50 – Average graphic foe Inflow for 2014-2017 – the increasing slope indicates flows increased with rainfall - Lift Station 9 Service Area

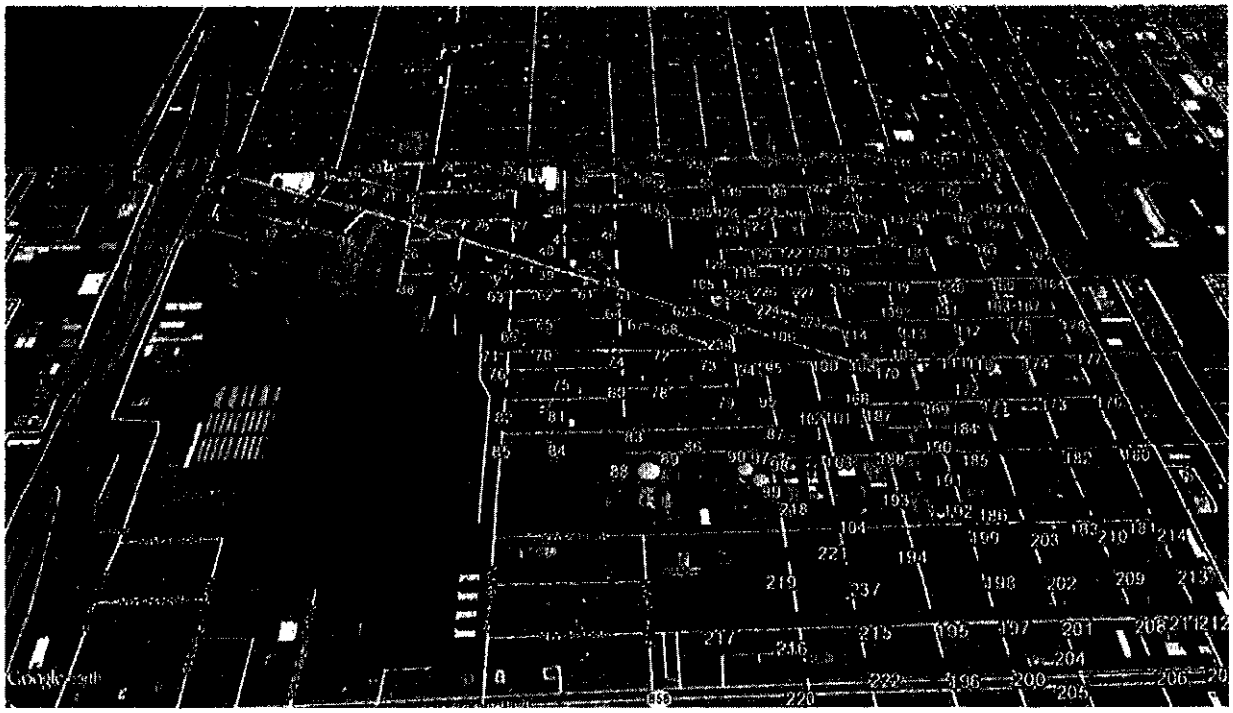


Figure 3.51 – Manholes GPSed - Lift Station 9 Service Area

Figure 3.52 - Location of Smoke test leaks - Lift Station 9 Service Area

Table 3.15 – Manhole Data - Lift Station 9 Service Area

Manhole ID	Invert	General Condition	Comments
155	Good	Average	Good 2 large pick hole
156	Good	Average	Good 2 large pick hole
159	Good	Average	Good 2 large pick hole
158	Good	Average	Good 2 large pick hole
143	Good	Average	Good 2 large pick hole
137	Good	Average	Good 2 large pick hole
135	Good	Average	Good 2 large pick hole
136	Good	Average	Good 2 large pick hole
125	Good	Average	Good 2 large pick hole
123	Good	Average	Good 2 large pick hole
124	Good	Average	Good 2 large pick hole
128	Good	Average	Good two small pick holes
129	Good	Average	Good two small pick holes
126	Good	Average	Good two small pick holes
127	Good	Average	Good two small pick holes
122	Good	Average	Good two small pick holes
120	Good	Average	Good two small pick holes
119	Good	Average	Good two small pick holes
119	Good	Average	Good two small pick holes
130	Good	Average	Good two small pick holes
235	Good	Average	Good two small pick holes
131	Good	Average	Good two small pick holes
133	Good	Average	Good two small pick holes
134	Good	Average	Good two small pick holes
105	Good	Average	Good two small pick holes
50	Good	Average	Good two small pic holes
105	Good	Average	Good two small pick holes
118	Good	Average	Good two small pick holes
117	Good	Average	Good two small pick holes
116	Good	Average	Good two small pick holes
58	Good	Average	Good
57	Good	Average	Good
56	Good	Average	Good
48	Good	Average	Good
47	Good	Average	Good
46	Good	Average	Good
49	Good	Average	Good
52	Good	Average	Good two small pick holes
53	Good	Average	Good 2 large pick holes
54	Good	Average	Good 2 large pick holes
149	Good	Average	Good 2 large pick holes
148	Good	Average	Good 2 large pick holes
147	Good	Average	Good 2 large pick holes
146	Good	Average	Good 2 large pick holes

Manhole ID	Invert	General Condition	Comments
239	Good	Average	Good 2 large pick holes
238	Good	Average	Good 2 large pick holes
144	Good	Average	Good 2 large pick holes
150	Good	Average	Good 2 large pick holes
157	Good	Average	Good 2 large pick holes
162	Good	Average	Good 2 large pick holes
161	Good	Average	Good two small pick holes
160	Good	Average	Good two small pick holes
142	Good	Average	Good two large pick holes
140	Good	Average	Good two large pick holes
138	Good	Average	Good two large pick holes
115	Good	Average	Good two large pick holes
114	Good	Average	Good two large pick holes
223	Good	Average	Good two large pick holes
227	Good	Average	Good two small pick holes
226	Good	Average	Good two small pick holes
225	Good	Average	Good two large pick holes
224	Good	Average	Good two small pick holes
166	Good	Average	Good two small pick holes
165	Good	Average	Good two small pick holes
164	Good	Average	Good two small pick holes
167	Good	Average	Good two small pick holes
178	Good	Average	Good two small pick holes
177	Good	Average	Good two small pick holes
176	Good	Average	Good two small pick holes
173	Good	Average	Good two small pick holes
236	Good	Average	Good two small pick holes
174	Good	Average	Good two small pick holes
175	Good	Average	Good two small pick holes
163	Good	Average	Good two small pick holes
112	Good	Average	Good two small pick holes
141	Good	Average	Good two small pick holes
110	Good	Average	Good 2 large pick holes
111	Good	Average	Good 2 large pick holes
172	Good	Average	Good 2 large pick holes
171	Good	Average	Good 2 large pick holes
184	Good	Average	Good 2 large pick holes
185	Good	Average	Good 2 large pick holes
186	Good	Average	Good 2 large pick holes
203	Good	Average	Good 2 large pick holes
202	Good	Average	Good 2 large pick holes
201	Good	Average	Good 2 large pick holes
208	Good	Average	Good 2 large pick holes
211	Good	Average	Good 2 large pick holes

Manhole ID	Invert	General Condition	Comments
209	Good	Average	Good 2 large pick holes
210	Good	Average	Good 2 large pick holes
183	Good	Average	Good 2 large pick holes
182	Good	Average	Good two large pick holes
180	Good	Average	Good two large pick holes
181	Good	Average	Good two large pick holes
214	Good	Average	Good two large pick holes
213	Good	Average	Good two large pick holes
212	Good	Average	Good two large pick holes
12	Good	Good	Good has 2 pick holes
197	Good	Average	Good two large pick holes
17	Good	Good	Good has 2 pick holes
200	Good	Average	Good two large pick holes
14	Good	Good	Good has 2 pick holes
198	Good	Average	Good two large pick holes
199	Good	Average	Good two large pick holes
15	Good	Good	Good has 1 pick hole
192	Good	Average	Good two large pick holes
10	Good	Good	Good has 2 pick holes
191	Good	Average	Good two large pick holes
190	Good	Average	Good two large pick holes
188	Good	Average	Good two large pick holes
11	Good	Good	Good has 2 pick holes
189	Good	Average	Good two large pick holes
21	Good	Good	Good has 2 pick holes
193	Good	Average	Good two large pick holes
20	Good	Good	Good has 2 pick holes
194	Good	Average	Good two large pick holes
19	Good	Good	Good has 2 pick holes
195	Good	Average	Good two large pick holes
196	Good	Average	Good two large pick holes
187	Good	Average	Good two large pick holes
168	Good	Average	Good two large pick holes
139	Good	Average	Good two large pick holes
113	Good	Average	Good two large pick holes
109	Good	Average	Good two large pick holes dish in bottom of manhole
170	Good	Average	Good two large pick holes
169	Good	Average	Good two large pick holes
107	Good	Average	Good two large pick holes
106	Good	Average	Good two large pick holes
93	Good	Average	Good two large pick holes
94	Good	Average	Good two large pick holes
95	Good	Average	Good two large pick holes
100	Good	Average	Good two large pick holes

Manhole ID	Invert	General Condition	Comments
102	Good	Average	Good two large pick holes
101	Good	Average	Good two large pick holes
103	Good	Average	Good two large pick holes
104	Good	Average	Good two large pick holes
221	Good	Average	Good two large pick holes
237	Good	Average	Good two large pick holes
215	Good	Average	Good two large pick holes
222	Good	Average	Good two large pick holes
95	Good	Average	Good two large pick holes
97	Good	Average	Good two large pick holes
98	Good	Average	Good two large pick holes
216	Good	Average	Good two large pick holes
219	Good	Average	Good two large pick holes
218	Good	Average	Good one large pick hole
99	Good	Average	Good two large pick holes
217	Good	Average	Good two large pick holes
108	Good	Average	Good two large pick holes
90	Good	Average	Good two large pick holes
89	Good	Average	Good two large pick holes
88	Good	Average	two large pick holes rock blocking invert
87	Good	Average	Good two large pick holes
85	Good	Average	Good
84	Good	Average	Good two large pick holes
83	Good	Average	Good two large pick holes
86	Good	Average	Good two large pick holes
79	Good	Average	Good two large pick holes
78	Good	Average	Good two large pick holes
77	Good	Average	Good two large pick holes
80	Good	Poor	two large pick holes water coming in through wall seams
81	Good	Average	Good two large pick holes
82	Good	Average	Good two large pick holes
74	Good	Average	Good two large pick holes
75	Good	Average	Good two large pick holes
76	Good	Average	Good two large pick holes
71	Good	Average	Good two large pick holes
70	Good	Average	Good two large pick holes
69	Good	Average	Good two large pick holes
72	Good	Average	Good two large pick holes
73	Good	Average	Good two large pick holes
234	Good	Average	Good two large pick holes
66	Good	Average	Good two large pick holes
65	Good	Average	Good two large pick holes
64	Good	Average	Good two large pick holes
67	Good	Average	Good two large pick holes

Manhole ID	Invert	General Condition	Comments
68	Good	Average	Good two large pick holes
62	Good	Average	Good two large pick holes
63	Good	Average	Good
42	Underwater	Average	Good two large pick holes
43	Good	Average	Good two large pick holes
61	Good	Average	Good two large pick holes
44	Underwater	Average	Good two large pick holes
45	Good	Average	Good two large pick holes
38	Good	Average	Good 2 large pick holes
37	Good	Average	Good 2 large pick holes
36	Good	Average	Good 2 large pick holes
3	Good	Average	Good 2 large pick holes
4	Good	Average	Good 2 large pick holes
5	Good	Average	Good 2 large pick holes
6	Good	Average	Good 2 large pick holes
9	Good	Average	Good 2 large pick holes
8	Good	Average	Good 2 large pick holes
7	Good	Average	Good 2 large pick holes
28	Good	Average	Good 2 large pick holes
29	Good	Average	Good 2 large pick holes
27	Good	Average	Good 2 large pick holes
30	Good	Average	Good 2 large pick holes
31	Good	Average	Good 2 large pick holes
32	Good	Average	Good 2 large pick holes
26	Good	Average	Good 2 large pick holes
41	Good	Average	Good 2 large pick holes
40	Good	Average	Good 2 large pick holes
91	Good	Average	Good two large pick holes
623	Good	Average	Good two large pick holes
39	Underwater	Average	Good two large pick holes
1	Underwater	Average	Good two large pick holes
220	Good	Good	Good has 2 pick holes
204	Good	Good	Good has 2 pick holes
207	Good	Average	Good 2 large pick holes
206	Good	Average	Good 2 large pick holes
205	Good	Average	Good 2 large pick holes
18	Good	Average	Good 2 large pick holes
23	Good	Average	Good 2 large pick holes
24	Good	Average	Inflow dish in the bottom of manhole 2 large pick holes
25	Good	Average	Good 2 large pick holes
35	Good	Average	Good 2 large pick holes
34	Good	Average	Good 2 large pick holes
59	Good	Average	2 large pick holes inflow dish in hole
60	Good	Average	Good 2 large pick holes

Manhole ID	Invert	General Condition	Comments
55	Good	Average	Good 2 large pick holes
33	Good	Average	Good 2 large pick holes
229	Good	Average	Good 2 large pick holes
230	Good	Average	Good 2 large pick holes
232	Good	Average	Good 2 large pick holes
231	Good	Average	Good 2 large pick holes
233	Good	Average	Good 2 large pick holes
152	Good	Average	Good
151	Good	Average	Good 2 large pick holes
153	Good	Average	Good 2 large pick holes
145	Good	Good	Good 2 pick holes
2	Good	Average	Underwater 2 pick hole
154	Good	Average	Good 2 large pick holes
132	Good	Good	Good 2 small pick holes

Table 3.16 – Smoke test result information - Lift Station 9 Service Area

Street Address	Fixed	Latitude	Longitude	Comments
100 NW 10th St		25.995663	-80.1499169	Possible open 4 inch PvC c/o in fence left front of house
100 NW 5th Ave		25.98648274	-80.15327797	Open 4 inch PvC c/o back left property line
1000 Foster Rd	1000 Foster Rd	25.99452809	-80.16216427	Open 4 inch PvC c/o left of house by window
101 NW 10th St	101 Nw 10 St	25.99532612	-80.14977846	Open 4 inch PvC c/o in sidewalk left side of brown fence
1020 Foster Rd	1020 Foster Rd	25.99521781	-80.16353002	Open 4 inch PvC c/o left front by sidewalk
1025 NW 8th St		25.994712	-80.1640615	Open 4 inch PvC c/o left of driveway
1029 NW 8th St		25.9947684	-80.16439141	Smoke entered building
104 NW 9th St		25.9947274	-80.1499668	Smoke in building
1045 NW 7th Ct		25.9941795	-80.1646294	Open service line in open lot to the right
107 NW 4th Ave		25.98636333	-80.15249	Open 4 inch PvC c/o left at property line
107 NW 4th Ave		25.98636667	-80.15245167	Open 4 inch PvC c/o left at property line
107 Pembroke Rd	107 Pembroke Rd	25.9964313	-80.1502302	Open 4 inch PvC c/o right front in cement
124 NW 2nd Ave	124 Nw 2nd Ave	25.9873677	-80.1504209	Cracked 4 inch PvC c/o center left of parking spot 124B light smoke
124 NW 5th Ave		25.9871081	-80.1533143	Cracked 4 inch PvC c/o right side of house under 2nd window in fence
203 NW 3rd Ave		25.9879566	-80.1514233	Smoke in building
206 NW 4th Ave		25.98817	-80.15227167	Open 4 inch PvC c/o in parking lot left of front door
208 NW 1st Ave		25.9881938	-80.149306	Possible c/o under cover cemented down front of meter room
208 NW 2nd Ave	208 Nw 2nd Ave	25.988258	-80.1503353	Cracked 3 inch PvC c/o in fence left side of house front of second window
212 NW 2nd Ave		25.98846333	-80.15034333	Open 2 inch pipe right side of house by window
212 NW 2nd Ave		25.98848167	-80.15027333	Possible service line break left side of house by sidewalk
219 NW 3rd Ave		25.9886417	-80.1516638	Open 4 inch PvC c/o front of meter room center of building
3 NW 4th St	3 Nw 4 St	25.99003069	-80.1501957	Open 4 inch PvC c/o right front of building
30 NW 10th St	30 Nw 10 St	25.99561972	-80.14956443	Open 4 inch PvC c/o in driveway
300 NW 5th Terr	300 Nw 5 Terr	25.98927567	-80.15382107	Cracked 4 inch PvC c/o behind house by A/C
302 NW 3rd Ave		25.98973014	-80.15152335	Open 6 inch PvC c/o left of driveway
302 NW 8th St		25.99370232	-80.15172344	Open 4 inch PvC c/o behind house by fence
308 NW 7th Ct		25.99365039	-80.15217432	Open hole smoking
309 NW 1st Ave	309 Nw 1st Ave	25.98953257	-80.14959957	Open 4 inch PvC c/o right front
309 NW 2nd Ave	309 Nw 1st Ave	25.9898145	-80.1506827	Open 4 inch PvC c/o right front in fence
309 NW 4th Ave	309 Nw 4 Ave	25.989556	-80.1527351	Open 4 inch PvC c/o left of front door
402 NW 5th Ave		25.9901102	-80.1531731	Cracked 3 inch service line right side of house
404 NW 8th St		25.99371841	-80.15335727	Open 4 inch metal c/o left of house by window
412 NW 10th St	412 Nw 10 St	25.9955832	-80.1535754	Smoke from under driveway left side
412 NW 10th St	412 Nw 10 St	25.99562483	-80.15366645	Light smoke coming from 4 inch c/o left front
416 NW 3rd Ave	416 Nw 3rd Ave	25.99074097	-80.15139466	Open 4 inch PvC c/o behind building by concrete pad
416 NW 3rd Ave		25.99079658	-80.15136793	Open hole smoking
420 NW 7th Ct	420 Nw 7 Ct	25.99325456	-80.15355712	Open 4 inch PvC c/o left at property line
501 NW 10th St	501 Nw 10 St	25.995447	-80.1537413	Cracked 4 inch PvC c/o left of driveway
505 NW 5th St	505 Nw 5 St	25.99083101	-80.15375047	Open 4 inch PvC c/o center of yard by sidewalk
505 NW 5th St	505 Nw 5 St	25.990795	-80.15379667	Open 4 inch PvC c/o right of front door
513 NW 3rd Ave	513 Nw 3rd Ave	25.9914846	-80.1517599	Cracked 3 inch PvC c/o under right window
514 NW 6th Ave	514 Nw 6 Ave	25.9913071	-80.1546348	Cracked 4 inch PvC c/o right front

Street Address	Fixed	Latitude	Longitude	Comments
532 NW 3rd Ct	533 Nw 3rd Ct	25.9897179	-80.1546187	Smoke from under cement slab left side of house by A/C
533 NW 3rd Ct		25.9892373	-80.1545419	Open 4 inch PvC c/o back left corner of backyard
				4 inch PvC c/o broke at 'T' underground under 1st window
594 NW 9th St		25.9947234	-80.1539554	left side of house
600 NW 6th St		25.9919772	-80.1526207	Smoke from under sidewalk back left of yard
621 NW 6th Ct	621 Nw 6 Ct	25.99143167	-80.155645	Open 4 inch PvC c/o center of yard by sidewalk
621 Pembroke Rd	621 Pembroke Rd	25.99613516	-80.15583168	Open 4 inch PvC c/o right of lot by sidewalk
629 NW 9th Ct	629 Nw 9th Ct	25.99489522	-80.15642321	Open 3 inch PvC c/o center of yard by sidewalk
648 NW 3rd Ct	648 Nw 3 Ct	25.98960926	-80.15613439	Open 4 inch PvC c/o right of front door
				Light smoke coming from 3 inch PvC c/o center of building
660 NW 4th Ct	660 Nw 4 Ct	25.99049167	-80.15661667	by window
691 NW 3rd Ct		25.9894509	-80.1547703	Open hole smoking right front inside fence
	713 Nw 5 St			
	718 Nw 9 Ct			
725 NW 7th Ave		25.9934021	-80.1569006	Open 4 inch PvC c/o center of building
728 NW 8th Ct		25.99487268	-80.15765043	Open 4 inch PvC c/o right front
				Open 4 inch PvC c/o across the street from address 5ft left
737 NW 6th St	737 Nw 6th St	25.9919211	-80.1580377	of storm drain
744 NW 5th Ct		25.9913064	-80.158134	Possible c/o in fence right side of house under 3rd window
744 NW 7th St	744 Nw 7th St	25.9926863	-80.1582855	Cracked 4 inch PvC c/o left of driveway by tree
756 NW 5th Ct		25.9911522	-80.1586516	Storm water crossover in grass by stop sign
				Open 2 inch pipe in open right lot 15ft off front right
756 NW 5th St		25.9908954	-80.1584945	corner of house
757 NW 5th St		25.990706	-80.1586105	Storm water crossover over in grass by sidewalk
803 NW 9th St	803 Nw 9 St	25.99439106	-80.1592159	Open 4 inch PvC c/o in valve box
816 NW 4th Ave	816 Nw 4 Ave	25.99422716	-80.15246337	Open 4 inch PvC c/o right front by sidewalk
818 NW 7th Terr	818 Nw 7 Terr	25.994276	-80.1579849	Open 6 inch PvC c/o across the street in grass
836 NW 10th St	836 Nw 10th St	25.99523732	-80.16044153	Open 4 inch PvC c/o left front in grass
839 NW 7th St	839 Nw 7th St	25.9929146	-80.1605437	Open 4 inch PvC c/o under right window
842 NW 8th St	842 Nw 8 St	25.99355488	-80.16056237	Open 4 inch PvC c/o back right of building
				Illegal connection in driveway - draining into c/o left front
843 NW 7th St		25.9929472	-80.1605755	of driveway
845 NW 10th St	845 Nw 10th St	25.9953925	-80.160767	Cracked 4 inch PvC c/o front of right window
846 NW 8th St		25.9938237	-80.1606527	Open 3 inch PvC c/o front center of building
889 Foster Rd		25.9943228	-80.1603986	Smoke from under square cover right side of business
896 NW 9th St	896 Nw 9th St	25.9944561	-80.1606057	Open 4 inch PvC c/o left front
902 NW 6th Terr	902 Nw 6th Terr	25.9952356	-80.1559462	Cracked 4 inch PvC c/o right of driveway
904 NW 6th Terr	904 Nw 6th Terr	25.9954212	-80.1559129	Cracked 4 inch PvC c/o right front
908 NW 10th St		25.9953392	-80.1614459	Possible 4 inch PvC c/o in fence back right of house
942 NW 10th St	942 Nw 10th St	25.99566305	-80.16200935	Cracked 4 inch PvC c/o across the street by white wall
956 NW 10th St	956 Nw 10th St	25.9956124	-80.1618863	Cracked 4 inch PvC c/o across the street by white wall
Across from 713 NW 5th St		25.990905	-80.15722167	Across from address center of lot
				Open 4 inch PvC c/o 100ft left of intersection in grass by
Foster Rd & Dixie Hw	Intersection Of Dixie I	25.9913882	-80.1487116	sidewalk
Foster Rd & NW 1st A	Foster Rd And Nw 1 A	25.99104476	-80.14986481	Storm water crossover
Foster Rd & NW 1st Ave		25.991059	-80.1497093	Storm water crossover over drain by fire hydrant
				Open 4 inch PvC c/o in lot off 1st Ave 20ft from storm
Foster Rd & NW 1st Ave		25.9912529	-80.1496682	drain in grass

Lift Station 10 – Sunset East

The Lift Station 10 service area contains 18 manholes that were found, GPSed and sealed. The midnight run indicated points where infiltration as noted (see map in Appendix A). A review of rainfall versus flows from July 1, 2014 to June 30, 2017 indicates that the slope of the line is increasing each year, indicating inflow volumes are increasing (see Figures 3.53-3.55). There were 10 openings found on the system. The overall trend indicates inflow is present (see Figure 3.56). The average pumps times increased from 2014 to 2017. There were no sites that smoke testing indicated were open to the surface.

Figure 3.57 shows the manhole locations. With respect to the manhole construction types, all were precast. None had steps. All manhole covers and rings were cast iron. A number of the manhole covers have pick-holes (see Table 3.17). All were in good condition.

The midnight run showed that only the piping on North Palm Dr. needed to be televised. However, there were heavy mineral deposits on the walls in Manhole 10-003 indicating it many need to be sealed.

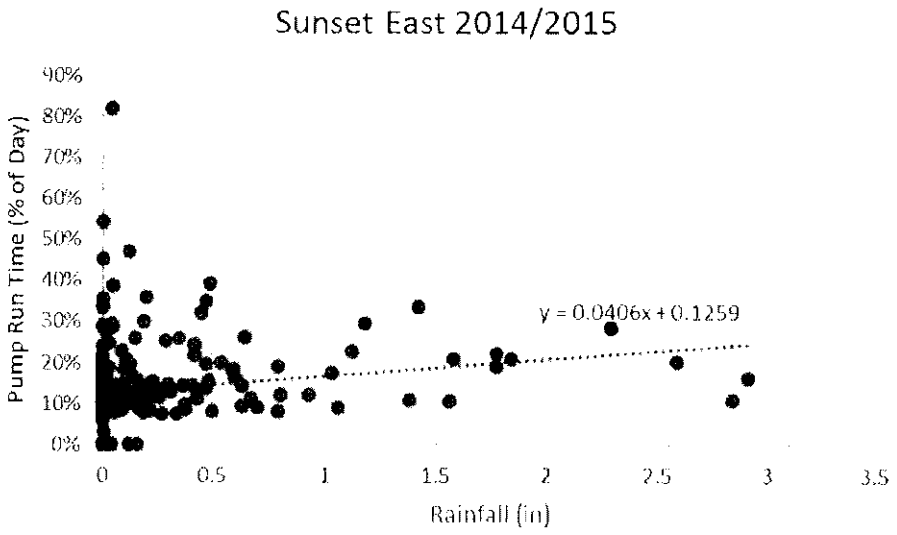


Figure 3.53 – Inflow for 2014-2015 – the increasing slope indicates flows increased with rainfall - Lift Station 10 Service Area

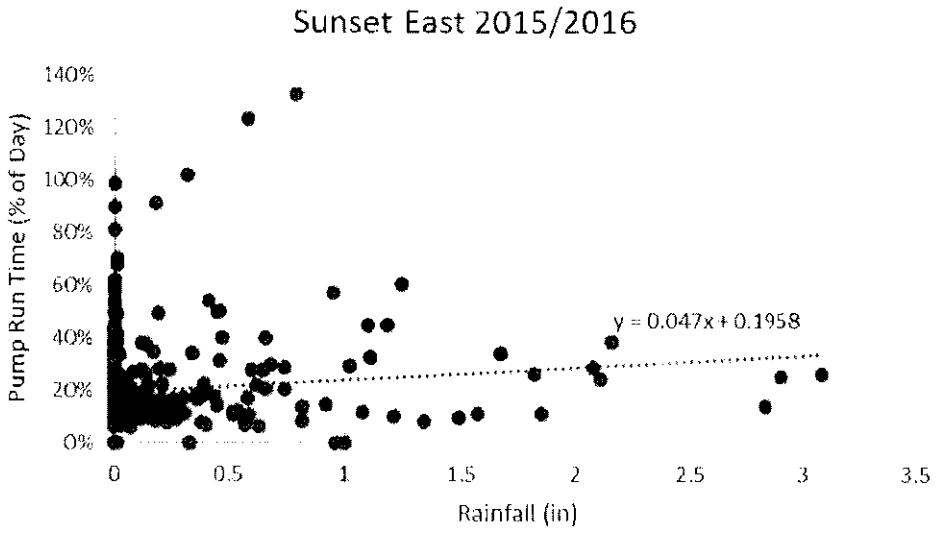


Figure 3.54 – Inflow for 2015-2016 – the increasing slope indicates flows increased with rainfall - Lift Station 10 Service Area

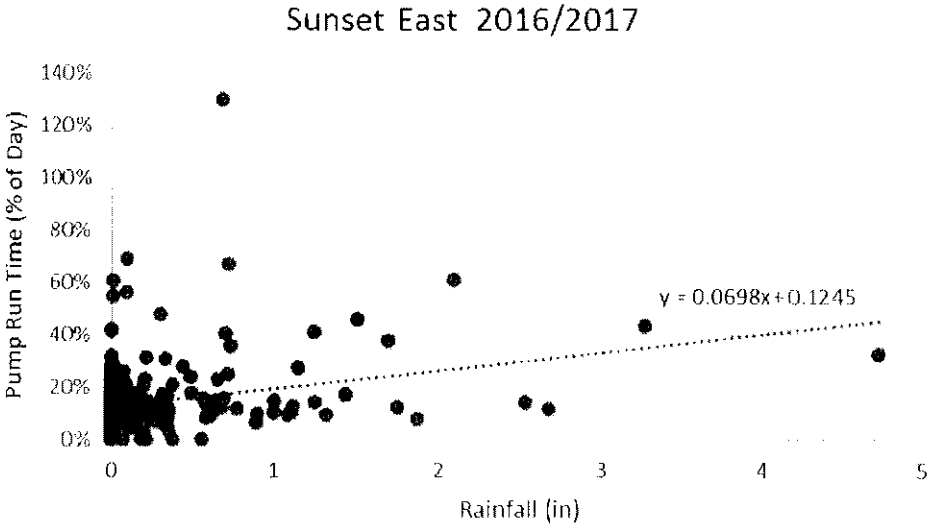


Figure 3.55 – Inflow for 2016-2017 – the regression slope is negative, but note some early high run times. The actual slope (solid line) slope indicates flows increased with rainfall - Lift Station 10 Service Area

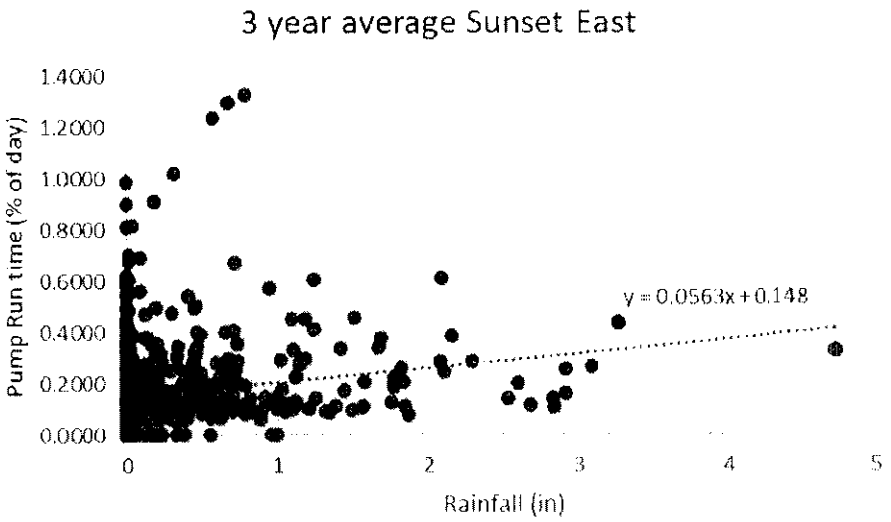


Figure 3.56 – Average graphic foe Inflow for 2014-2017 – the increasing slope indicates flows increased with rainfall - Lift Station 10 Service Area

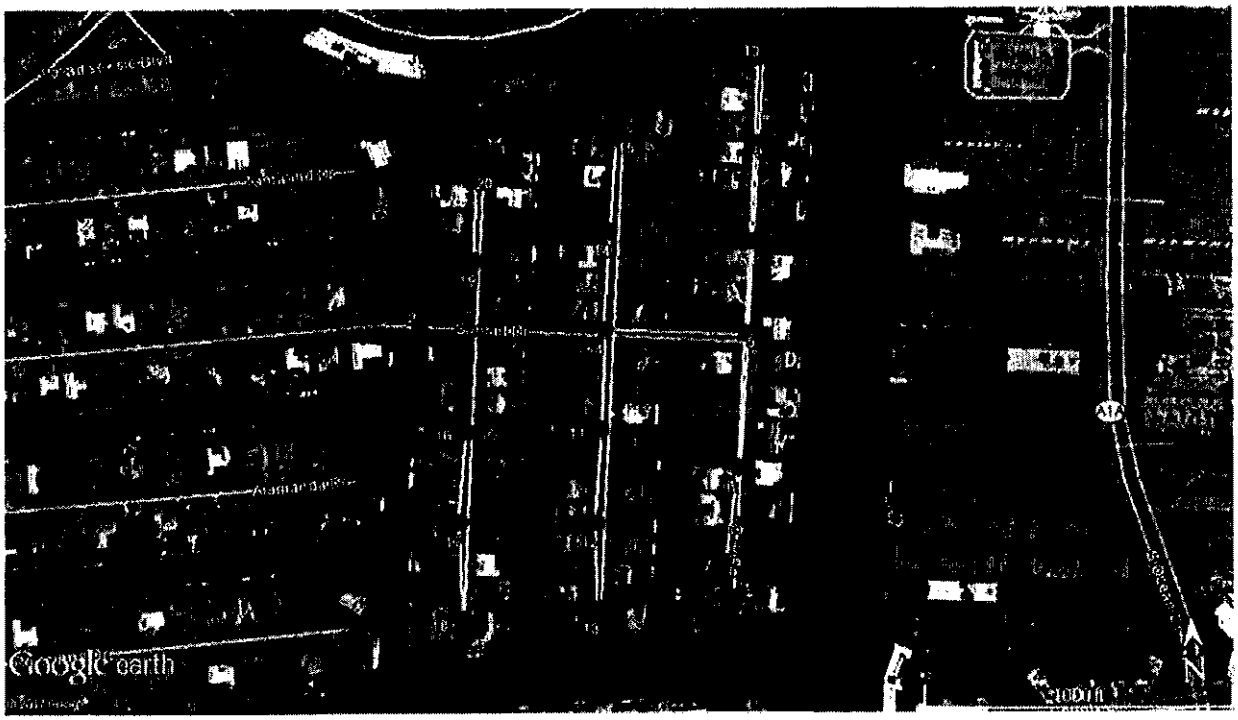


Figure 3.57 – Manholes GPSed - Lift Station 10 Service Area

Table 3.17 – Manhole Data - Lift Station 10 Service Area

Manhole ID	Invert	General Condition	Comments
16	Good	Good	Good
2	Good	Good	Good has 1 pick hole
10	Good	Good	Good has 2 pick holes
13	Good	Good	Good has 2 pick holes
4	Good	Good	Good
20	Good	Good	Good
19	Good	Good	Good Lid has 1 pick hole
17	Good	Good	Good 1 pick hole
9	Good	Good	Good
8	Good	Good	Good
7	Good	Good	Good
5	Good	Good	Good
15	Good	Good	Good
14	Good	Good	Good
12	Good	Good	Good
11	Good	Good	Good
18	Good	Good	Good Lid has 1 pick hole
6	Good	Good	Good has 2 pick holes

Lift Station 11 – Holiday

The Lift Station 11 service area contains 6 manholes that were found, GPSed and sealed. The midnight run indicated points where infiltration as noted (see map in Appendix A). A review of rainfall versus flows from July 1, 2014 to June 30, 2017 indicates that the slope of the line is increasing each year, indicating inflow volumes are increasing (see Figures 3.63-3.65). There were 10 openings found on the system. The overall trend indicates inflow is present (see Figure 3.66). The average pumps times increased from 2014 to 2017. There were no sites that smoke testing indicated were open to the surface.

Figure 3.67 shows the manhole locations. With respect to the manhole construction types, all were precast. None had steps. All manhole covers and rings were cast iron. A number of the manhole covers have pick-holes (see Table 3.18). All but Manhole #1 were in good condition. Manhole #1 invert was submerged and has a metal pipe in the wall that needs to be repaired.

The midnight run showed that all of the piping in this service area along Holiday Drive needed to be televised. Major flow entered between Manholes 11-003 and 11-004. Note the area is on an island and saltwater can enter during high tides.

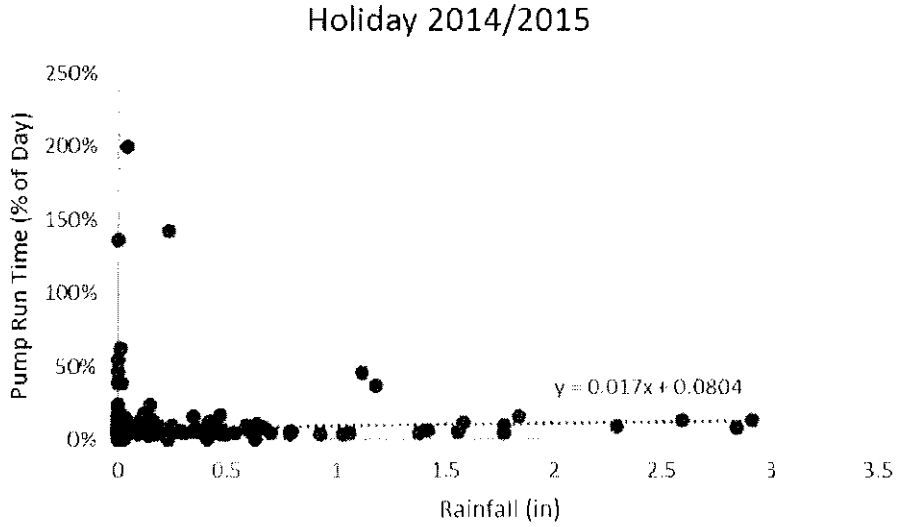


Figure 3.63 - Inflow for 2014-2015 – the increasing slope indicates flows increased with rainfall - Lift Station 11 Service Area

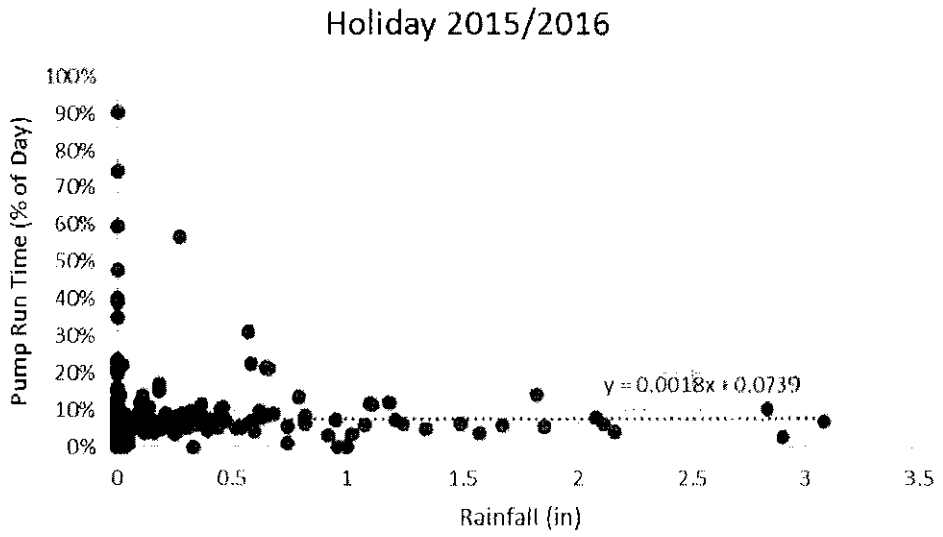


Figure 3.64 – Inflow for 2015-2016 – the increasing slope indicates flows increased with rainfall - Lift Station 11 Service Area

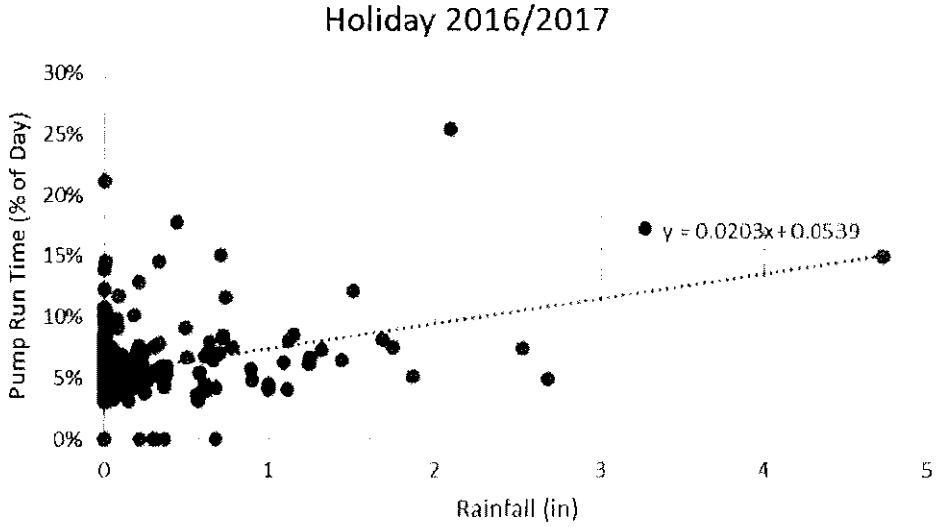


Figure 3.65 – Inflow for 2016-2017 – the regression slope is negative, but note some early high run times. The actual slope (solid line) slope indicates flows increased with rainfall - Lift Station 11 Service Area

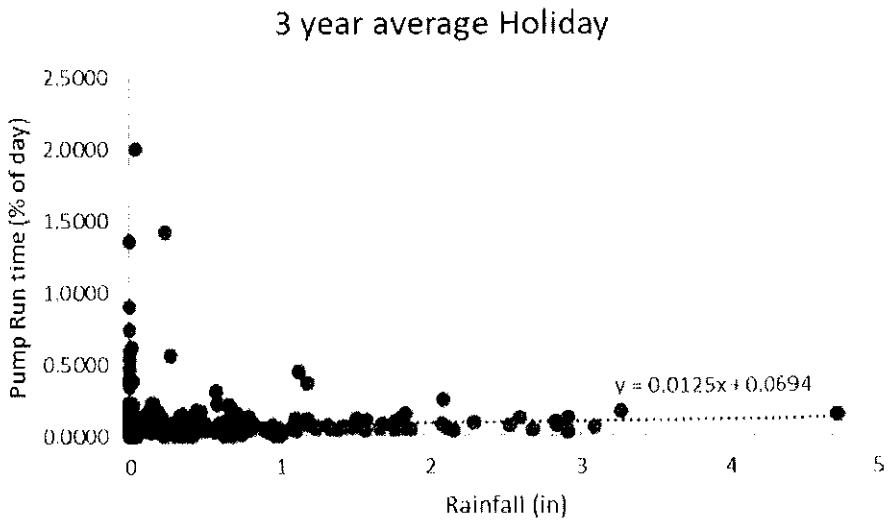


Figure 3.66 – Average graphic foe Inflow for 2014-2017 – the increasing slope indicates flows increased with rainfall - Lift Station 11 Service Area

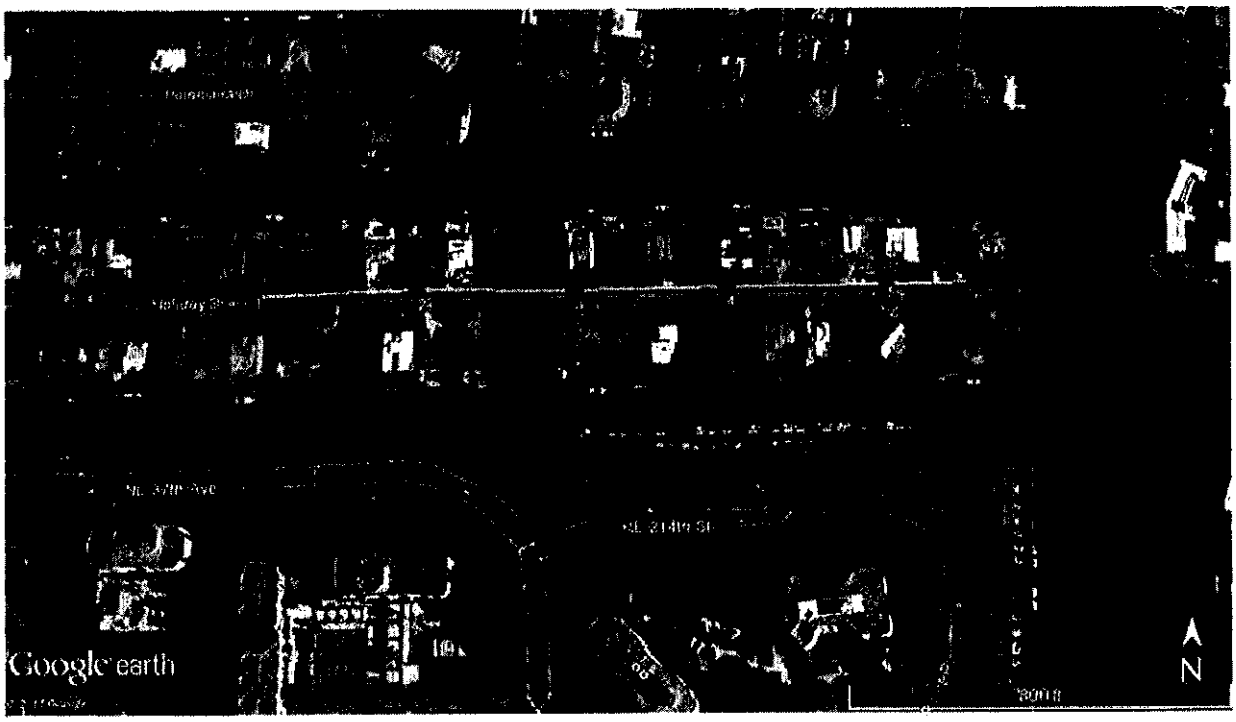


Figure 3.67 – Manholes GPSed - Lift Station 11 Service Area

Table 3.18 – Manhole Data - Lift Station 11 Service Area

Manhole ID	Invert	General Condition	Comments
1	Underwate	Average	Invert underwater has 1 pick hole and has metal pipe in wall
6	Good	Good	Good
5	Good	Good	Good
4	Good	Good	Good
3	Good	Good	Good
2	Good	Good	Good

Lift Station 12 – SW 4th Ave.

The Lift Station 12 service area contains 213 manholes that were found, GPSed and sealed. The midnight run indicated points where infiltration as noted (see map in Appendix A). A review of rainfall versus flows from July 1, 2014 to June 30, 2016 indicates that the slope of the line is increasing each year, indicating inflow volumes are increasing (see Figures 3.68 and 3.69). The year 2016-2017 was increasing but the slope was less – due to some early high flows at zero rain (Figure 3.70). When these are removed, the same high trend is noted. There were 79 openings found on the system, confirming the inflow. The overall trend indicates inflow is present (see Figure 3.71). The average pumps times increased from 2014 to 2017 (35 to 38%).

Figure 3.72 shows the manhole locations. With respect to the manhole construction types, all were precast. None had steps. All manhole covers and rings were cast iron. A number of the manhole covers have pick-holes (see Table 3.19). None had steps. Most of the manholes (167) were in good condition. There were 45 manholes in average condition and one in poor or very poor condition. Manhole #84 has leaks in the walls and should be addressed in Phase 2. The inverts of manholes #1, 2, 6, and 64 were submerged.

There were 79 sites that smoke testing indicated were open to the surface (see Figure 3.73). Of the 79, 18 were on private property or related to stormwater and not corrected in Phase 1 (noted on Table 3.20). The property owners should be advised of the issue and required to make appropriate corrections. This is a larger service area with average leakage. The worst area was the southeastern part of the service area. Most of the leaking pipes are shallow.

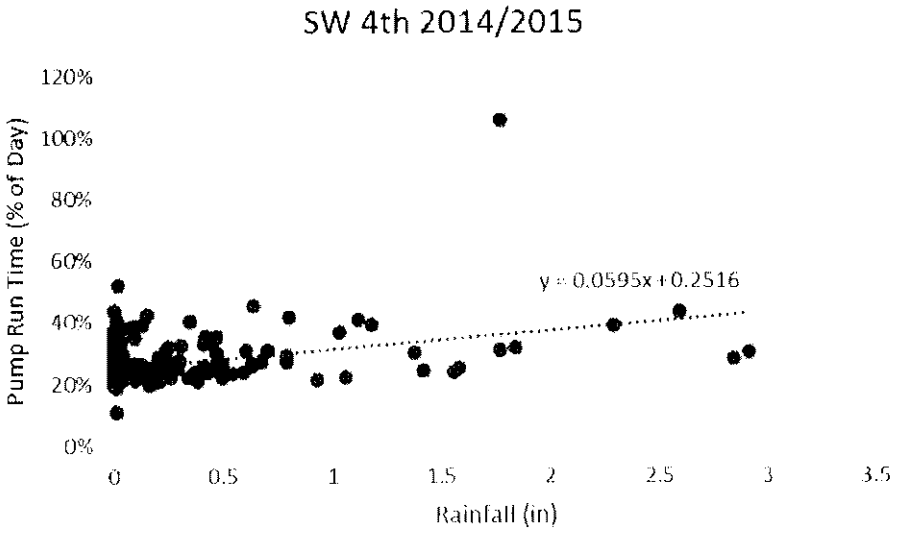


Figure 3.68 – Inflow for 2014-2015 – the increasing slope indicates flows increased with rainfall - Lift Station 12 Service Area

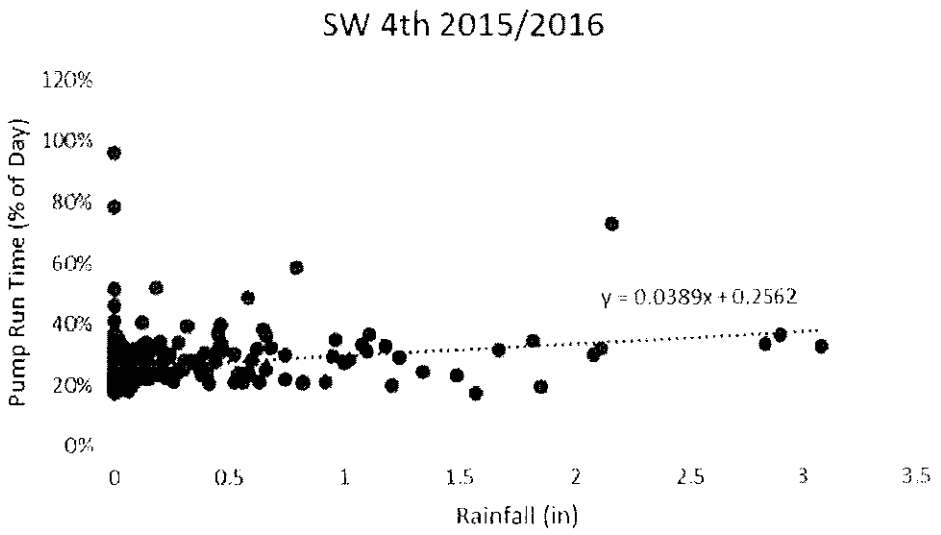


Figure 369 – Inflow for 2015-2016 – the increasing slope indicates flows increased with rainfall - Lift Station 12 Service Area

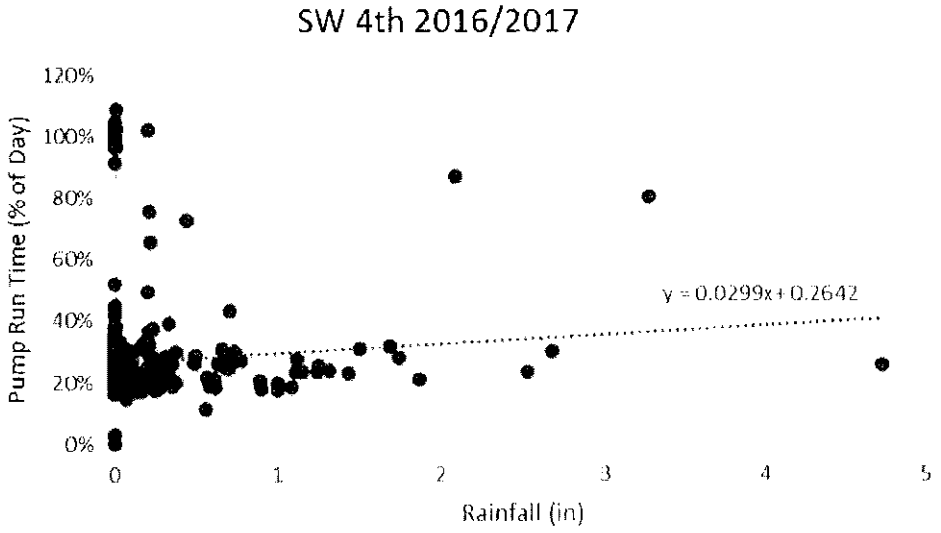


Figure 3.70 – Inflow for 2016-2017 – the regression slope is negative, but note some early high run times. The actual slope (solid line) slope indicates flows increased with rainfall - Lift Station 12 Service Area

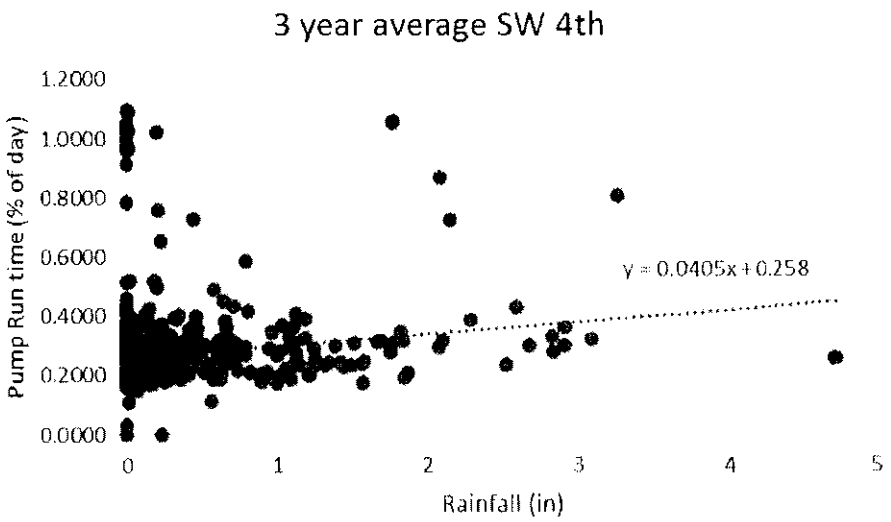


Figure 3.71 – Average graphic foe Inflow for 2014-2017 – the increasing slope indicates flows increased with rainfall - Lift Station 12 Service Area

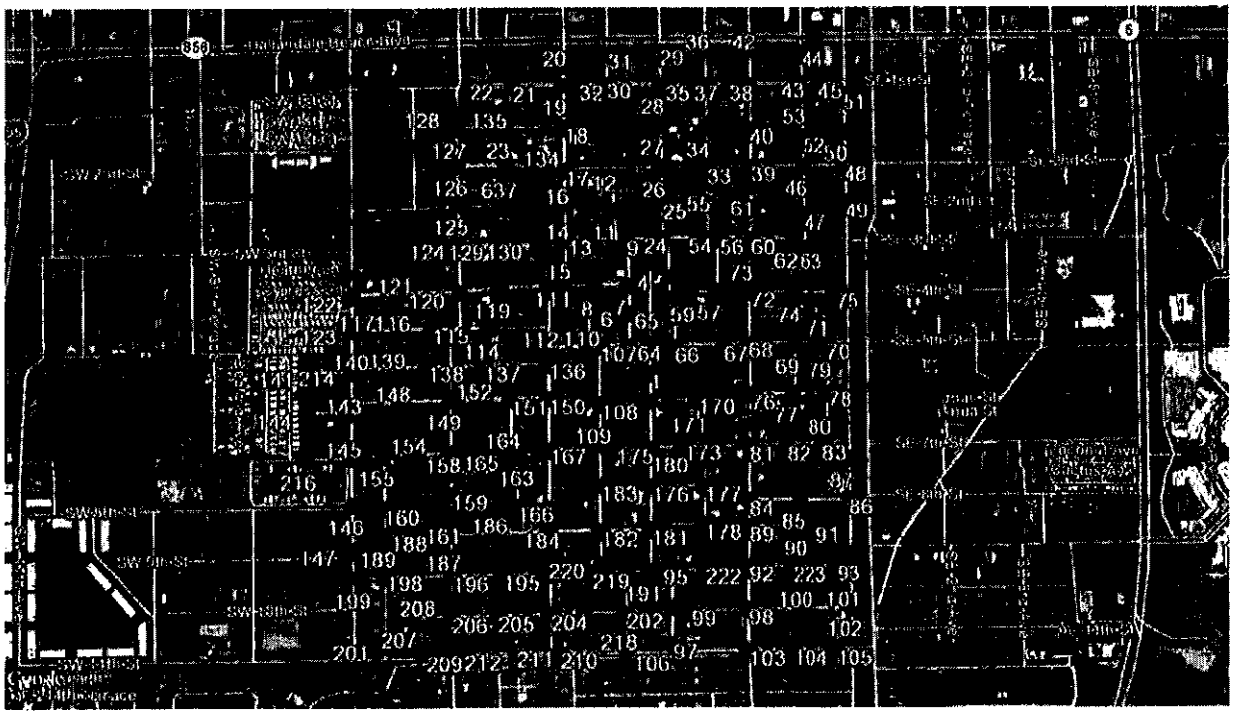


Figure 3.72 – Manholes GPSed - Lift Station 12 Service Area

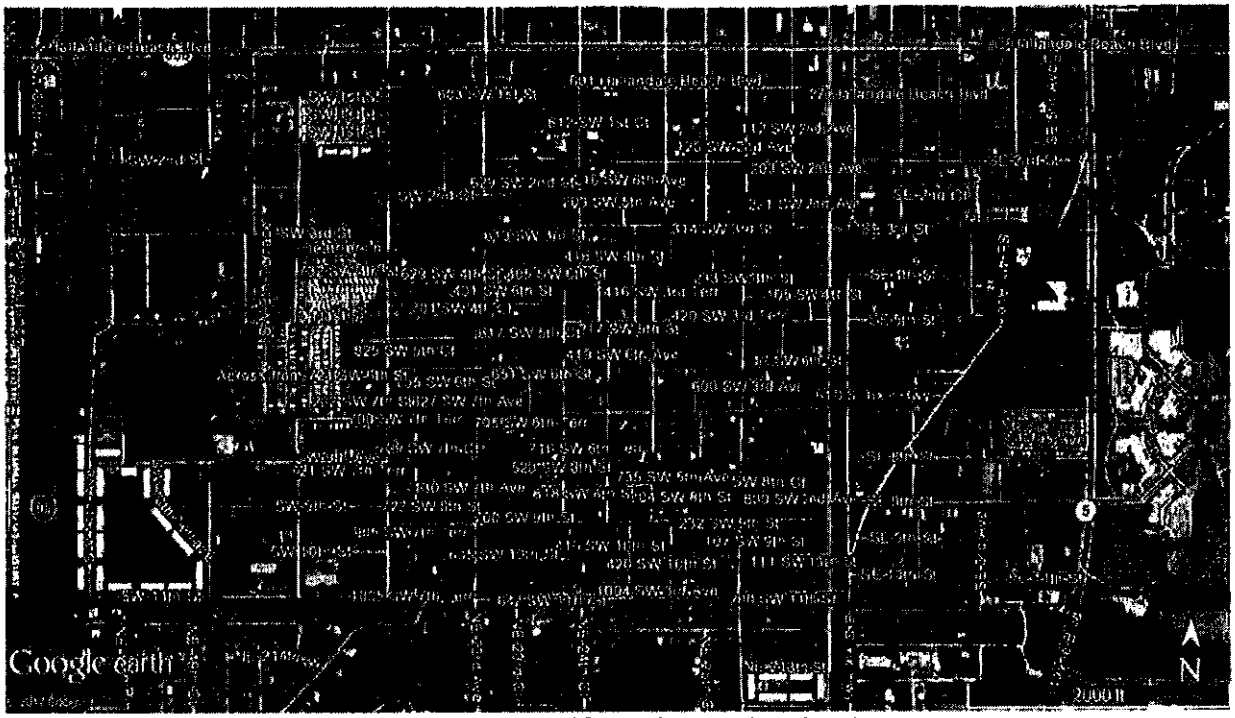


Figure 3.73 Location of Smoke test leaks - Lift Station 12 Service Area

Table 3.19 – Manhole Data - Lift Station 12 Service Area

Manhole ID	Invert	General Condition	Comments
201	Good	Average	Good two small pick holes
199	Good	Average	Good two small pick holes
209	Good	Average	Good two small pick holes
206	Good	Average	Good two small pick holes
207	Good	Good	Good two smallnpick holes
208	Good	Average	Good two small pick holes
196	Good	Average	Good two small pick holes
197	Good	Average	Good two small puck holes
198	Good	Average	Good two small pick holes
187	Good	Average	Good two small pick holes
186	Good	Average	Good has 2 pick hole
161	Good	Average	Good two small pick holes
162	Good	Average	Good two small pick holes
188	Good	Good	Good has 2 pick holes
221	Good	Good	Goodbhas 2 pick holes
189	Good	Good	Good has 2 pick holes
160	Good	Good	Good has 2 pick holes
159	Good	Good	Good has 2 pick holes
163	Good	Good	Good has 2 pick holes
158	Good	Good	Good has 2 pick holes
153	Good	Good	Good has 2 pick holes
154	Good	Good	Good has 2 pick holes
155	Good	Good	Good
156	Good	Average	Good two small pick holes
157	Good	Average	Good two small pick holes
216	Good	Average	Good two small pick holes
144	Good	Average	Good two small picks
141	Good	Average	Good two small pick holes
148	Good	Average	Good two small pick holes
149	Good	Average	Good two small pick hole
150	Good	Average	Good two large pick holes
151	Good	Average	Good two large pick holes
152	Good	Average	Good two large pick holes
164	Good	Average	Good two large pic holes
166	Good	Good	Good has 2 pick holes
165	Good	Good	Good has 2 pick holes
167	Good	Good	Good has 2 pick holes
169	Good	Good	Good
184	Good	Good	Good has 2 pick holes
194	Good	Good	Good has 2 pick holes
193	Good	Good	Good has 2 pick holes
186a	Good	Good	Good has 2 pick holes
205	Good	Good	Good has 2 pick holes
204	Good	Good	Good has 2 pick holes

Manhole ID	Invert	General Condition	Comments
136	Good	Good	Good has 2 pick holes
137	Good	Good	Good has 2 pick holes
138	Good	Good	Good
139	Good	Good	Good has 2 pick holes
140	Good	Average	Good two small pick holes
117	Good	Average	Good two large pic holes
115	Good	Average	Good two large pick holes
112	Good	Good	Good has 2 pick holes
121	Good	Good	Good has 2 pick holes
114	Good	Average	Good two large pick holes
120	Good	Good	Good has 2 pick holes
119	Good	Good	Good has 2 pick holes
118	Good	Good	Good has 2 pick holes
20	Good	Good	Good has 2 pick holes
19	Good	Good	Good has 2 pick holes
18	Good	Good	Good has 2 pick holes
17	Good	Good	Good has 2 pick holes
16	Good	Good	Good has 2 pick holes
14	Good	Good	Good has 2 pick holes
15	Good	Good	Good has 2 pick holes
130	Good	Good	Good has 2 pick holes
129	Good	Good	Good has 2 pick holes
124	Good	Good	Good has 2 pick holes
125	Good	Average	Good two small pick holes
126	Good	Average	Good two small pick holes
637	Good	Good	Good has 2 pick holes
134	Good	Average	Good two small pick holes
128	Good	Average	Good two small pick holes
127	Good	Average	Good two small pick holes
135	Good	Average	Good two small pick holes
23	Good	Good	Good has 2 pick holes
21	Good	Good	Good has 2 pick holes
22	Good	Good	Good has 2 pick holes
32	Good	Good	Good has 2 pick holes
30	Good	Good	Good has 2 pick holes
31	Good	Good	Good has 1 pick holes
28	Good	Good	Good has 2 pick holes
37	Good	Good	Good has 2 pick holes
34	Good	Good	Good has 2 pick holes
33	Good	Good	Good has 2 pick holes
39	Good	Good	Good has 2 pick holes
46	Good	Good	Good has 2 pick holes
52	Good	Good	Good
53	Good	Good	Good has 2 pick holes

Manhole ID	Invert	General Condition	Comments
47	Good	Good	Good has 2 pick holes
61	Good	Good	Good has 2 pick holes
55	Good	Good	Good has 2 pick holes
25	Good	Good	Good has 2 pick holes
35	Good	Good	Good has 2 pick holes
36	Good	Good	Good has 2 pick holes
26	Good	Good	Good has 2 pick holes
40	Good	Good	Good has 2 pick holes
38	Good	Good	Good has 2 pick holes
42	Good	Good	Good has 2 pick holes
44	Good	Good	Good has 2 pick holes
43	Good	Good	Good has 2 pick holes
45	Good	Good	Good has 2 pick holes
51	Good	Good	Good has 2 pick holes
50	Good	Good	Good has 2 pick holes
48	Good	Good	Good has 2 pick holes
13	Good	Good	Good has 2 pick holes
12	Good	Good	Good has 2 pick holes
11	Good	Good	Good has 2 pick holes
9	Good	Good	Good has 2 pick holes
6	Good	Good	Good has 2 pick holes
4	Good	Good	Good has 2 pick holes
24	Good	Good	Good has 2 pick holes
54	Good	Good	Good has 2 pick holes
59	Good	Good	Good has 2 pick holes
56	Good	Good	Good has 2 pick holes
60	Good	Good	Good has 2 pick holes
62	Good	Good	Good has 2 pick holes
63	Good	Good	Good has 2 pick holes
74	Good	Good	Good has 2 pick holes
75	Good	Good	Good has 2 pick holes
41	Good	Good	Good has 2 pick holes
73	Good	Good	Good has 2 pick holes
71	Good	Good	Good has 2 pick holes
70	Good	Good	Good has 2 pick holes
111	Good	Good	Good has 2 pick holes
8	Good	Good	Good has 2 pick holes
7	Good	Good	Good has 2 pick holes
109	Good	Good	Good has 2 pick holes
108	Good	Good	Good
110	Good	Good	Good has 1 pick hole
107	Good	Good	Good has 2 pick holes
105	Good	Good	Good has 2 pick holes
2	Underwater	Average	Invert underwater has 2 pick holes

Manhole ID	Invert	General Condition	Comments
65	Good	Good	Good has 2 pick holes
66	Good	Good	Good has 2 pick holes
67	Good	Good	Good has 2 pick holes
68	Good	Good	Good has 2 pick holes
77	Good	Good	Good has 2 pick holes
78	Good	Good	Good has 2 pick holes
79	Good	Good	Good has 2 pick holes
83	Good	Good	Good has 2 pick holes
80	Good	Good	Good has 2 pick holes
82	Good	Good	Good has 2 pick holes
168	Good	Good	Good has 2 pick holes
175	Good	Good	Good has 2 pick holes
172	Good	Good	Good has 2 pick holes
173	Good	Good	Good has 2 pick holes
174	Good	Good	Good has 2 pick holes
76	Good	Good	Good has 2 pick holes
81	Good	Good	Good has 2 pick holes
91	Good	Good	Good has 2 pick holes
90	Good	Good	Good has 2 pick holes
85	Good	Good	Good has 2 pick holes
84	Good	Poor	Manhole walls leaking has 2 pick holes
89	Good	Good	Good has 2 pick holes
92	Good	Good	Good has 2 pick holes
93	Good	Good	Good has 2 pick holes
223	Good	Good	Good has 2 pick holes
222	Good	Good	Good has 2 pick holes
94	Good	Good	Good has 2 pick holes
95	Good	Good	Good has 2 pick holes
195	Good	Good	Good has 2 pick holes
219	Good	Good	Good has 2 pick holes
192	Good	Good	Good has 2 pick holes
191	Good	Good	Good has 2 pick holes
181	Good	Good	Good has 2 pick holes
179	Good	Good	Good has 2 pick holes
215	Good	Good	Good has 2 pick holes
178	Good	Good	Good has 2 pick holes
177	Good	Good	Good has 2 pick holes
180	Good	Good	Good has 2 pick holes
171	Good	Good	Good has 2 pick holes
170	Good	Good	Good has 2 pick holes
87	Good	Good	Good has 2 pick holes
217	Good	Good	Good has 2 pick holes
1	Underwater	Good	Invert underwater has 2 pick holes
183	Good	Good	Good has 2 pick holes

Manhole ID	Invert	General Condition	Comments
182	Good	Good	Good has 2 pick holes
220	Good	Good	Good has 2 pick holes
202	Good	Good	Good has 2 pick holes
203	Good	Good	Good has 2 pick holes
96	Good	Good	Good has 2 pick holes
99	Good	Good	Good has 2 pick holes
98	Good	Good	Good has 2 pick holes
103	Good	Good	Good has 2 pick holes
106	Good	Good	Good has 2 pick holes
218	Good	Good	Good has 2 pick holes
210	Good	Good	Good has 2 pick holes
211	Good	Good	Good has 2 pick holes
212	Good	Good	Good has 2 pick holes
104	Good	Good	Good has 2 pick holes
116	Good	Good	Good has 2 pick holes
100	Good	Good	Good has 2 pick holes
146	Good	Good	Good 2 small pickholes
145	Good	Good	Good 2 small pickholes
143	Good	Good	Good 2 small pickholes
142	Good	Good	Good 2 small pickholes
214	Good	Average	Good 2 large pick holes
29	Good	Average	Good 2 large pick holes
49	Good	Good	Good has 2 pick holes
123	Good	Average	Good 2 large pick holes
101	Good	Good	Good has 2 pick holes
122	Good	Average	2 large pick holes crack in ring
102	Good	Good	Good has 2 pick holes
27	Good	Average	Good 2 large pick hole
176	Good	Good	Good
64	Underwater	Average	Invert underwater has 2 pick holes
88	Good	Good	Good has 2 pick holes
97	Good	Good	Good has 2 pick holes
147	Good	Average	2 small pick holes
86	Good	Average	Good 2 large pick holes
69	Good	Average	Good 2 large pick holes
72	Good	Average	Good 2 large pick holes
57	Good	Average	Good 2 large pick holes

Table 3.20 – Smoke test result information - Lift Station 12 Service Area

Street Address	Fixed	Latitude	Longitude	Comments
100 SE 11th St		25.97443	-80.14941	Broken 4 inch PvC c/o center of yard by sidewalk
1004 SW 3rd Ave	yes	25.97476	-80.15189	Open 4 inch PvC c/o left front of porch
1005 SW 7th Terr	yes	25.97451	-80.1575	Open 4 inch PvC c/o right of driveway
				Cracked 3 inch PvC c/o right side of house in fence can't install
105 SW 4th St		25.98066	-80.14979	LDL plug
107 SW 9th St	yes	25.97582	-80.14969	Open 4 inch PvC c/o left front
108 SW 10th St		25.9752	-80.14975	Open 4 inch PvC c/o left front
111 SW 10th St	yes	25.97507	-80.14997	Hole drill in cap of c/o right front in sidewalk light smoke
112 SW 2nd Ave	yes	25.98403	-80.1505	Open 4 inch PvC c/o left front
				Smoke from under sidewalk right side of house under 2nd
117 SW 1st Ave		25.98409	-80.1491	window
				Possible c/o inside water meter box left front of driveway by
120 SW 2nd Ave	yes	25.98387	-80.15042	sidewalk
130 SW 7th Ave	yes	25.97675	-80.15625	Cracked 6 inch PvC c/o across the street 1ft from road
17 SW 6th St	yes	25.97901	-80.1488	Cracked 3 inch PvC c/o right of driveway by sidewalk
				Open 4 inch PvC c/o back left of building in sidewalk can't install
200 SW 11th St		25.97442	-80.15042	LDL plug
201 SW 3rd St	yes	25.9819	-80.15058	Open 4 inch PvC c/o left property line
202 Dixie Hwy		25.9831	-80.14867	Broken 4 inch PvC c/o at 'T' behind building by sidewalk
202 SW 7th St	yes	25.97791	-80.15878	Open 4 inch PvC c/o left property line
203 SW 2nd Ave	yes	25.98309	-80.15022	Cracked 4 inch PvC c/o left property line light smoke
209 SW 5th Ave	yes	25.98266	-80.15302	Open 4 inch PvC c/o right front
209 SW 5th Ave	yes	25.98281	-80.15301	Open 4 inch PvC c/o 20ft left of left property line
210 SW 5th St	yes	25.97997	-80.15096	Light smoke coming from 3 inch PvC c/o left of driveway
210 SW 6th Ave	yes	25.98275	-80.15424	Open 4 inch PvC c/o right of driveway
217 SW 5th St	yes	25.97979	-80.15134	Smoke from under cement under window left of door
221 SW 2nd Ave	yes	25.98236	-80.15025	Cracked 4 inch PvC c/o left front
232 SW 9th St	yes	25.97582	-80.15161	Open 4 inch PvC c/o left of driveway
233 SW 4th St	yes	25.98082	-80.15145	Open 4 inch PvC c/o right front
25 SW 4th St	yes	25.98081	-80.14911	Open 3 inch PvC c/o in middle of driveway
27 Hallandale Beach Blvd	yes	25.98477	-80.14887	Open 4 inch PvC c/o back right property by sidewalk
304 SW 8th St	yes	25.97669	-80.15141	Open 4 inch PvC c/o right of driveway
31 SW 4th St	yes	25.98079	-80.14926	Open 4 inch PvC c/o left front by sidewalk
314 SW 3rd St	yes	25.98188	-80.15198	Open 4 inch PvC c/o left front by sidewalk
35 SW 4th St	yes	25.98081	-80.14934	Open 4 inch PvC c/o left property line
401 SW 6th St	yes	25.98062	-80.15426	Cracked 4 inch PvC c/o right side of house under 1st window
405 SW 6th St	yes	25.98063	-80.15436	Open 4 inch PvC c/o left front
				Open 4 inch PvC c/o behind address in handicap spot front of
409 Hallandale Beach Blvd	yes	25.98471	-80.15315	door 422

Street Address	Fixed	Latitude	Longitude	Comments
415 SW 8th St	yes	25.9764	-80.15298	Open 4 inch PvC c/o right front of parking spots in cement
416 SW 10th St	yes	25.97512	-80.15296	Open 4 inch PvC c/o right front
416 SW 3rd Terr	yes	25.98033	-80.15197	Open 4 inch PvC c/o center of front yard
416 SW 4th St		25.98102	-80.15306	Open hole smoking right of driveway
419 SW 6th Ave	yes	25.97918	-80.1543	Cracked 4 inch PvC c/o right of driveway by fence
420 SW 10th St		25.97494	-80.15322	Service line break across the street 50ft from road in open field
420 SW 3rd Terr	yes	25.98017	-80.15192	Cracked 4 inch PvC c/o center of front yard
500 SW 4th St	yes	25.981	-80.15339	Open 4 inch PvC c/o right front by sidewalk
520 SW 8th St	yes	25.97676	-80.15418	Open 4 inch PvC c/o back left of house by gate
600 SW 3rd Ave	yes	25.97862	-80.15141	Open 4 inch PvC c/o front door in grass
601 Hallandale Beach Blvd		25.98478	-80.1544	Grease trap smoking
603 SW 1st St		25.98449	-80.15474	Open 4 inch PvC c/o right front by sidewalk
604 SW 4th St	yes	25.98093	-80.15431	Open 4 inch PvC c/o right of driveway
610 S Dixie Hwy	yes	25.97864	-80.14851	Open 4 inch PvC c/o right of house by window
612 SW 1st Ct	yes	25.9839	-80.15486	Open 4 inch PvC c/o left property line
613 SW 3rd St		25.9814	-80.15489	Smoke from under sidewalk right side of house in fence
617 SW 5th Ct	yes	25.97941	-80.15495	Cracked 4 inch PvC c/o 20ft left of driveway
618 SW 8th St	yes	25.97651	-80.1549	Open 4 inch PvC c/o right front
627 SW 7th Ave	yes	25.97796	-80.15643	Open 4 inch PvC c/o right front
629 SW 2nd St	yes	25.983	-80.15523	Cracked 4 inch PvC c/o left front corner of house
629 SW 4th St	yes	25.98081	-80.15547	Cracked 4 inch PvC c/o right of driveway
635 SW 10th St	yes	25.97482	-80.15543	Open 4 inch PvC c/o center of front yard
642 SW 11th St	yes	25.97425	-80.1557	Open 4 inch PvC c/o right property line
651 SW 6th St	yes	25.97873	-80.15599	Open 4 inch PvC c/o left of driveway
700 SW 7th Terr		25.97759	-80.15774	Cracked 4 inch PvC c/o left side of house by road
700 SW 9th St		25.97594	-80.1563	Open 3 inch PvC c/o right front of house can't install LDL plug
701 SW 4th Ct	yes	25.97987	-80.15653	Cracked 4 inch PvC c/o left of front door
701 SW 7th Ave	yes	25.98064	-80.1565	Open 4 inch PvC c/o back right property line
705 SW 6th Terr	yes	25.97759	-80.15491	Open 4 inch PvC c/o right front by sidewalk
709 SW 4th St	yes	25.98058	-80.15684	Open 4 inch PvC c/o right of front door
712 SW 4th St	yes	25.98079	-80.15694	Open 4 inch PvC c/o center of yard
716 SW 6th Terr		25.97725	-80.15508	Cracked 3 inch PvC c/o right front
716 SW 6th Terr	yes	25.97712	-80.15504	Smoking 4 inch PvC c/o left front by sidewalk
721 SW 7th Terr	yes	25.97687	-80.15753	Cracked 4 inch PvC c/o right side of house under 1st window
722 SW 8th St	yes	25.97637	-80.15712	Open 4 inch PvC c/o left property line
	yes			
727 SW 3rd Ave	yes	25.97693	-80.1511	Open 4 inch PvC c/o left of driveway
729 SW 7th Ct		25.97701	-80.15719	Open 4 inch PvC c/o left of driveway
732 SW 4th St	yes	25.9808	-80.15782	Open 4 inch PvC c/o center of yard
735 SW 5th Ave		25.97678	-80.15307	Smoke under cement under A/C left back corner of house
755 SW 6th St	yes	25.97865	-80.1582	Open 4 inch PvC c/o center of front yard
800 SW 2nd Ave	yes	25.97635	-80.15016	Open 4 inch PvC c/o left of driveway
825 SW 5th Ct		25.97927	-80.15918	Storm water crossover
905 SW 7th Terr	yes	25.97528	-80.15755	Open 4 inch PvC c/o left property line
Across from 724 SW 6th St		25.97868	-80.15754	Smoking 6 inch PvC c/o across the street by sidewalk

Lift Station 13 – SW 8th St

The Lift Station 13 service area contains 82 manholes that were found, GPSed and sealed. The midnight run indicated points where infiltration as noted (see map in Appendix A). A review of rainfall versus flows from July 1, 2014 to June 30, 2017 indicates that the slope of the line is increasing each year, indicating inflow volumes are increasing (see Figure 3.74). The years 2015-2017 the increasing relationship exists, but the slope was less – due to some early high flows at zero rain each year (see Figures 3.75 and 3.76). These need further investigation. When these are removed, the same high trend is noted. There were 19 openings found on the system, confirming the inflow. The overall trend indicates inflow is present (see Figure 3.77). The average pumps times increased from 2014 to 2017 (10 to 18.9%).

Figure 3.78 shows the manhole locations. With respect to the manhole construction types, 27 were precast and 55 were brick. None had steps. All manhole covers and rings were cast iron. A number of the manhole covers have pick-holes (see Table 3.21). Most of the manholes (53) were in good condition. There were 28 manholes in average condition and none were in poor or very poor condition. Manholes 30 and 33 need some repairs. The inverts of manholes #1, 5-8, 10, 27-29, 34, 35, 46, 47, 62, 63 and 66. The excessive amount of flooding deserves more attention.

There were 19 sites that smoke testing indicated were open to the surface (see Figure 3.79). Table 3.22 outlines those sites. Of the 19, 4 were on private property and not corrected in Phase 1 (noted on Table 3.23). The property owners should be advised of the issue and required to make appropriate corrections.

This service area was relatively tight except adjacent to Sunset Lake Park 1 and 2 and Lakeside Estates Lake. Stormwater connections and leaky pipe are suggested.

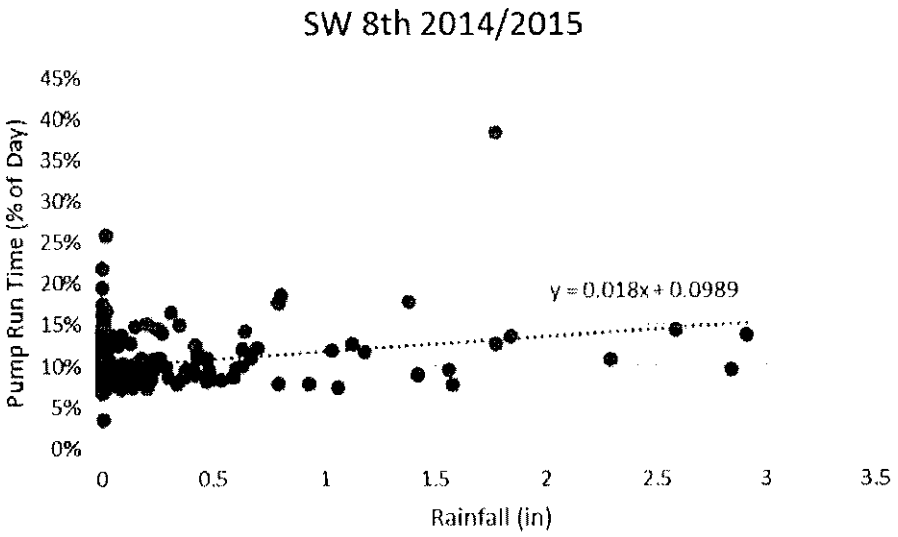


Figure 3.74 – Inflow for 2014-2015 – the increasing slope indicates flows increased with rainfall - Lift Station 13 Service Area

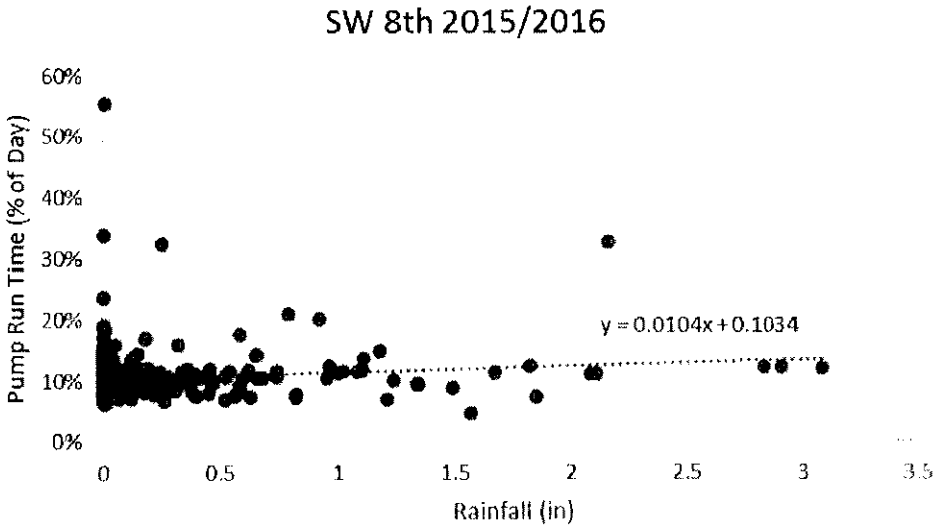


Figure 3.75 – Inflow for 2015-2016 – the increasing slope indicates flows increased with rainfall - Lift Station 13 Service Area

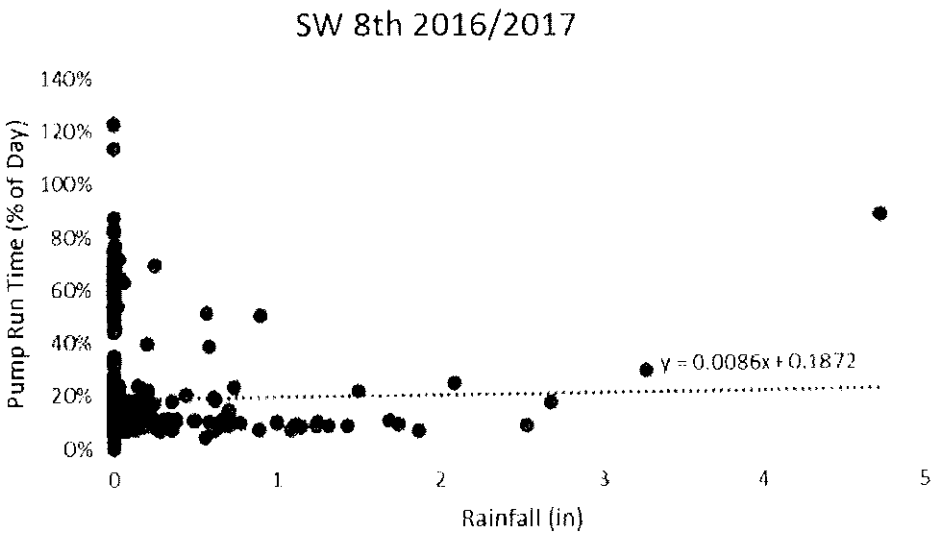


Figure 3.76 – Inflow for 2016-2017 – the regression slope is negative, but note some early high run times. The actual slope (solid line) slope indicates flows increased with rainfall - Lift Station 13 Service Area

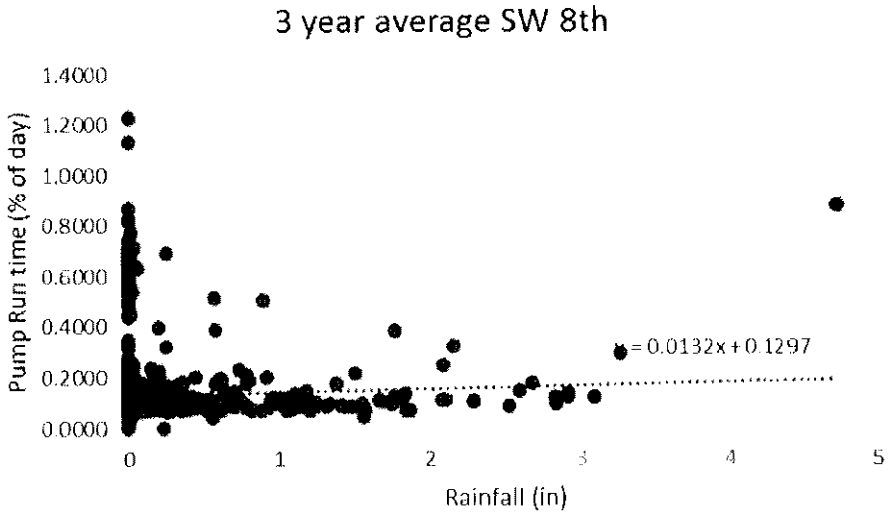


Figure 3.77 – Average graphic foe Inflow for 2014-2017 – the increasing slope indicates flows increased with rainfall - Lift Station 13 Service Area

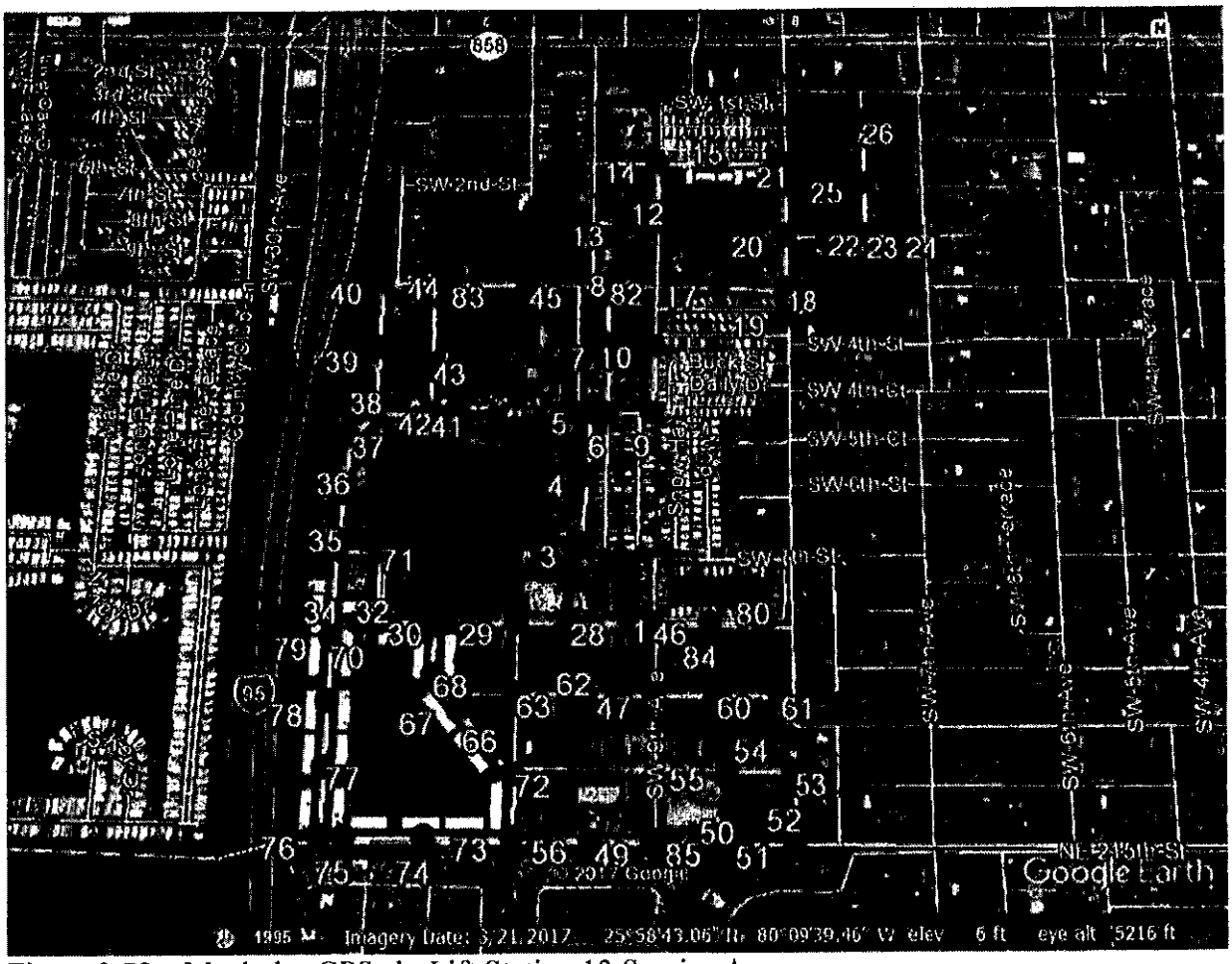


Figure 3.78 – Manholes GPSed - Lift Station 13 Service Area

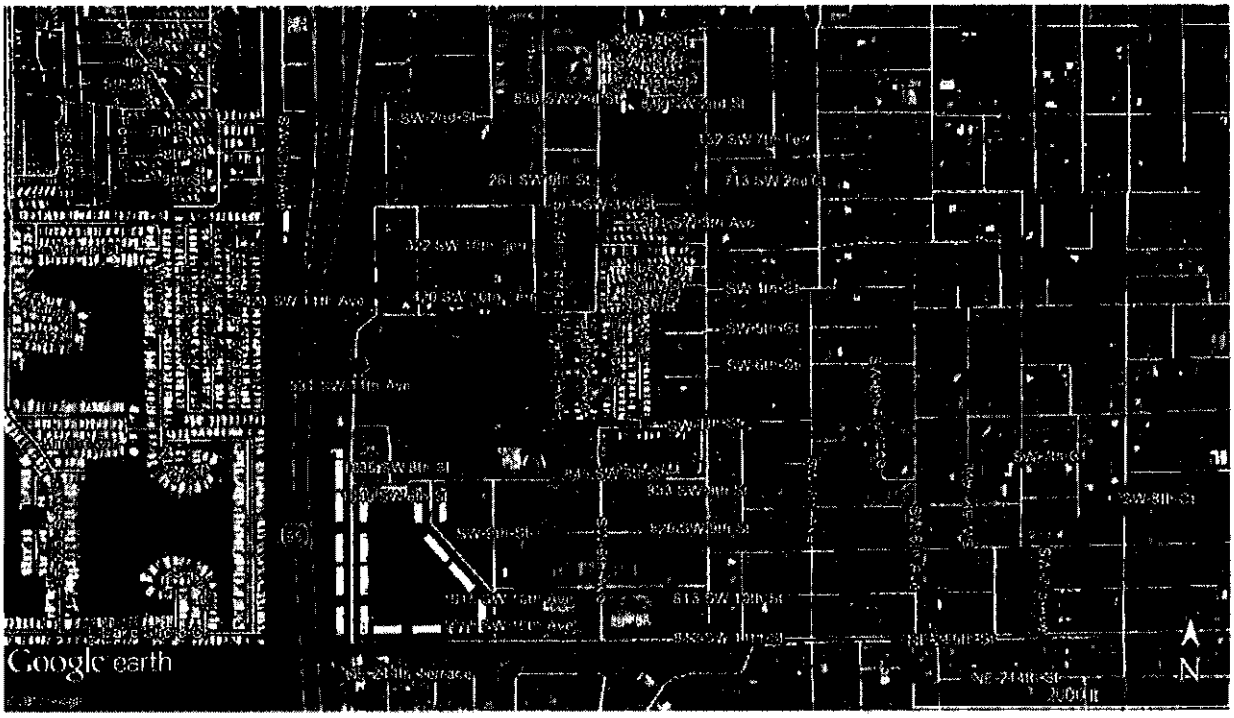


Figure 3.79 - Location of Smoke test leaks - Lift Station 12 Service Area

Table 3.21 – Manhole Data - Lift Station 12 Service Area

Manhole ID	Invert Condition	General Condition	Comments
1	Underwater	Average	Manhole underwater
4	Good	Average	Good
5	Underwater	Average	Ivert underwater has 2 pick holes
6	Underwater	Average	Good two large pick holes
7	Underwater	Average	Good two large pic holes
8	Underwater	Average	Good two large pick holes
9	Good	Average	Good two larg puck holes
10	Underwater	Average	Good two small pick holes
12	Good	Good	Good has 2 pick holes
13	Good	Good	Good has 2 pick holes
14	Good	Good	Good has 2 pick holes
15	Good	Good	Good has 2 pick holes
16	Good	Good	Good has 2 pick holes
17	Good	Average	Good two small pick holes
18	Good	Good	Good
19	Good	Average	Good 2 large pick holes
20	Good	Good	Good has 2 pick holes
21	Good	Good	Good
22	Good	Good	Good has 2 pick holes
23	Good	Good	Good
24	Good	Good	Good has 2 pick holes
25	Good	Good	Good has 2 pick holes
26	Good	Good	Good has 2 pick holes
27	Underwater	Average	Manhole backed up has 2 pick holes
28	Underwater	Average	Manhole backed up has 2 pick holes
29	Underwater	Average	Manhole backed up
30	Needs Repair	Average	Manhole backed up has 2 pick holes
31	Good	Good	Good has 2 pick holes
32	Good	Good	Good has 1 pick hole
33	Needs Repair	Average	Manhole backed up
34	Underwater	Good	Under water has 2 pick holes
35	Underwater	Good	Underwater has 2 pick holes
36	Good	Good	Good
37	Good	Good	Goodnhas 2 pick holes
38	Good	Good	Good has 2 pick holes
39	Good	Good	Good has 2 pick holes
40	Good	Good	Good has 2 pick holes
41	Good	Good	Good has 2 pick holes
42	Good	Good	Good has 2 pick holes
43	Good	Good	Good has 2 pick holes
44	Good	Good	Good has 2 pick holes
45	Good	Good	Good has 2 pick holes
46	Underwater	Average	Manhole underwater has 2 pick holes
47	Underwater	Average	Manhole backed up

Manhole ID	Invert Condition	General Condition	Comments
49	Good	Good	Good has 2 pick holes
50	Good	Good	Good has 2 pick holes
51	Good	Good	Good has 2 pick holes
52	Good	Average	Good two large pick holes
53	Good	Average	Good 2 large pick holes
54	Good	Good	Good 2 small pickholes
55	Good	Average	Good two pick holes
56	Good	Good	Good has 2 pick holes
57	Good	Good	Good has 2 pick holes
61	Good	Good	Good has 2 pick holes
62	Underwater	Average	Manhole backed up
63	Underwater	Average	Manhole backed up
65	Good	Average	Good 2 large pick holes
66	Underwater	Average	Invert underwater has 1 pick hole
67	Good	Good	Good has 1 pick hole
68	Good	Good	Good has 1 pick hole
69	Good	Good	Good has 1 pick hole
70	Good	Good	Good has 1 pick hole
71	Good	Good	Good has 2 pick holes
72	Good	Good	Good has 1 pick hole
73	Good	Good	Good has 1 pick hole
74	Good	Good	Good has 1 pick hole
75	Good	Good	Good
76	Good	Good	Good. Has 2 pick hole
77	Good	Good	Good has 1 pick hole
78	Good	Good	Good has 1 pick hole
79	Good	Good	Good has 1 pick hole
80	Good	Good	Good has one pick hole
82	Good	Good	Good has 2 pick holes
83	Good	Good	Good has 2 pick holes
84	Good	Good	Good has one pick hole
85	Good	Good	Good has 2 pick holes
005A	Good	Average	Good 2 large pick hole
3	Good	Average	Good
58	Good	Average	Good 2 large pick holes
59	Good	Average	Good 2 large pick holes
60	Good	Good	Good has 2 pick holes

Table 3.22 – Smoke test result information - Lift Station 12 Service Area

Street Address	Fixed	Latitude	Longitude	Comments
1040 SW 8th St	yes	25.97672147	-80.1641729	Open 4 inch PvC c/o right property line
1036 SW 8th St	yes	25.976765	-80.164105	Open 4 inch PvC c/o left front of house
1015 SW 10th Ave		25.97459199	-80.161865	Open 2 inch pipe behind building by A/C in fence
813 SW 10th St	yes	25.9748721	-80.1589174	Cracked 4 inch PvC c/o right front by sidewalk
812 SW 11th St	yes	25.97425667	-80.15889	Open 4 inch PvC c/o left of house by A/C unit
1013 SW 8th Ave	yes	25.97419333	-80.1581833	Open 4 inch PvC c/o center of yard by sidewalk
826 SW 9th St	yes	25.9759987	-80.1593899	Open 4 inch PvC c/o under right window
833 SW 8th St	yes	25.9766418	-80.1594643	Cracked 3 inch PvC c/o under right window
845 SW 8th St	yes	25.97672476	-80.1599152	Open 4 inch PvC c/o center of yard by sidewalk
531 SW 11th Ave	yes	25.97858	-80.1650383	Open 4 inch PvC c/o right property line
421 SW 11th Ave	yes	25.9798665	-80.1646452	Cracked 3 inch PvC c/o right property line
830 SW 2nd St		25.98317887	-80.1597262	Smoking 4 inch PvC c/o in parking spot 3
830 SW 2nd St	yes	25.98317711	-80.1597703	Smoking 4 inch PvC c/o under car in parking spot 5
261 SW 9th St	yes	25.98191895	-80.1603685	Cracked 4 inch PvC c/o right property line
420 SW 10th Terr		25.97994	-80.16403	Open 4 inch PvC c/o left front
322 SW 10th Terr	yes	25.98065252	-80.1641858	Open 4 inch PvC c/o left side of house by trash cans
713 SW 2nd Ct		25.9822247	-80.1569731	Open 4 inch PvC c/o right of left driveway
301 SW 8th Ave	yes	25.98148475	-80.1584334	Open 4 inch PvC c/o left front by sidewalk
132 SW 7th Terr	yes	25.98291155	-80.1573851	Open 4 inch PvC c/o left side of house under 1st window

Lift Station 14 – NW 10th Terr

The Lift Station 14 service area contains 83 manholes that were found, GPSed and sealed. The midnight run indicated points where infiltration as noted (see map in Appendix A). A review of rainfall versus flows from July 1, 2014 to June 30, 2017 indicates that the slope of the line is increasing each year, indicating inflow volumes are increasing (see Figures 3.80, 3.82 and 3.83). The year 2015-2016 did not show this trend, but there were some very large zero rainfall flows that impact the trend line. Overall flows for the service area were greater than the subsequent year, but much higher than the prior. There were 33 openings found on the system, confirming the inflow. The overall trend indicates inflow is present (see Figure 3.83). The average pumps times increased from 2014 to 2017 (44 to 72.5%).

Figure 3.84 shows the manhole locations. With respect to the manhole construction types, 81 were precast and 2 were brick. Four had steps, three in good condition. The steps in Manhole #34 need repairs. All manhole covers and rings were cast iron. A number of the manhole covers have pick-holes (see Table 3.24). There were 31 manholes were in good condition. There were 52 manholes in average condition and none were in poor or very poor condition. Manhole 23 needs the grease to be removed.

There were 33 sites that smoke testing indicated were open to the surface (see Figure 3.85). Table 3.25 outlines those sites. Of the 33, 13 were on private property and not corrected in Phase 1 (noted on Table 3.25). The property owners should be advised of the issue and required to make appropriate corrections.

The high school discharged a very large amount of clean water out the west side (past the athletic fields) for no apparent reason. This looks like a stormwater connection. Shallow piping around Chaves Lake showed infiltration. Some areas along Hallandale Beach Blvd also showed leakage.

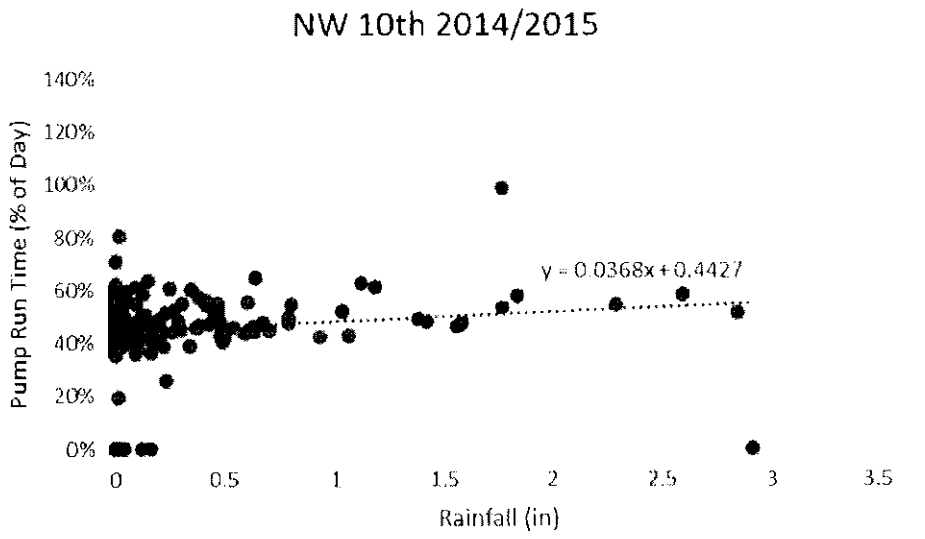


Figure 3.80 – Inflow for 2014-2015 – the increasing slope indicates flows increased with rainfall - Lift Station 14 Service Area

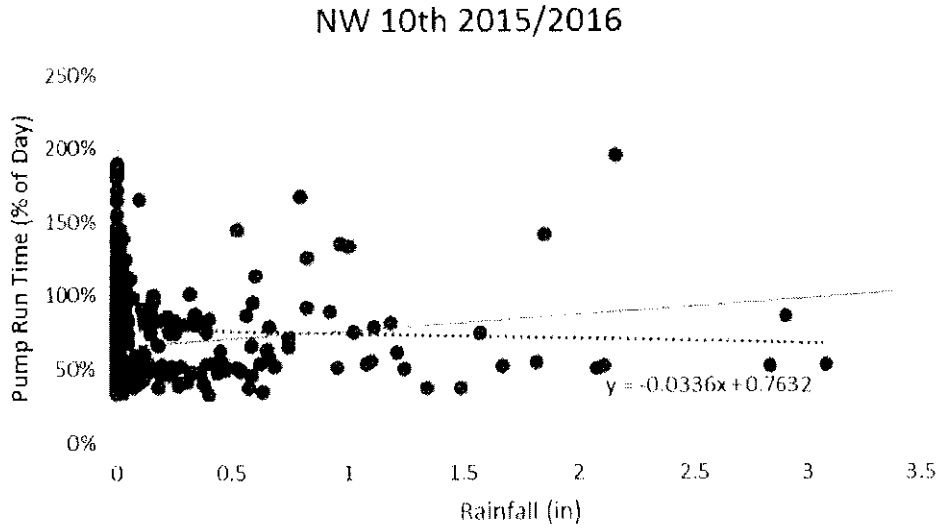


Figure 3.81 – Inflow for 2015-2016 – the increasing slope indicates flows increased with rainfall - Lift Station 14 Service Area

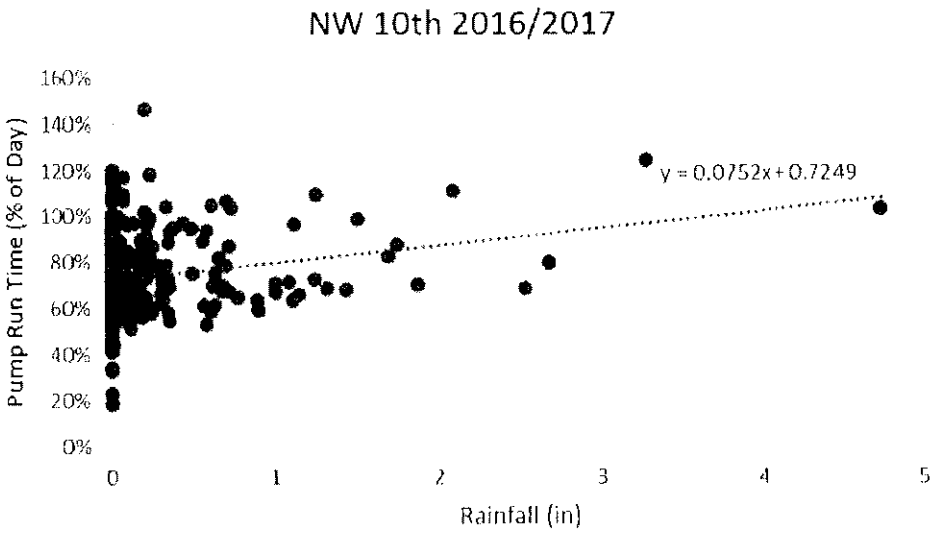


Figure 3.82 – Inflow for 2016-2017 – the regression slope is negative, but note some early high run times. The actual slope (solid line) slope indicates flows increased with rainfall - Lift Station 14 Service Area

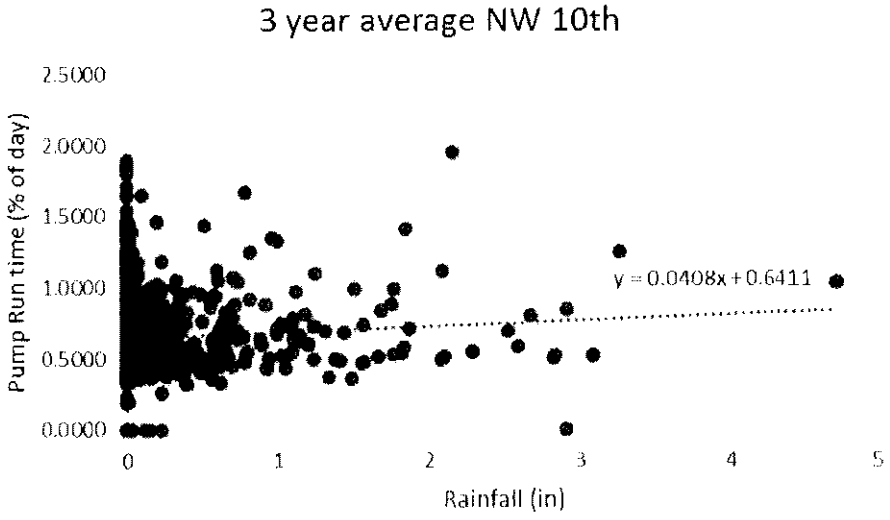


Figure 3.83 – Average graphic foe Inflow for 2014-2017 – the increasing slope indicates flows increased with rainfall - Lift Station 14 Service Area

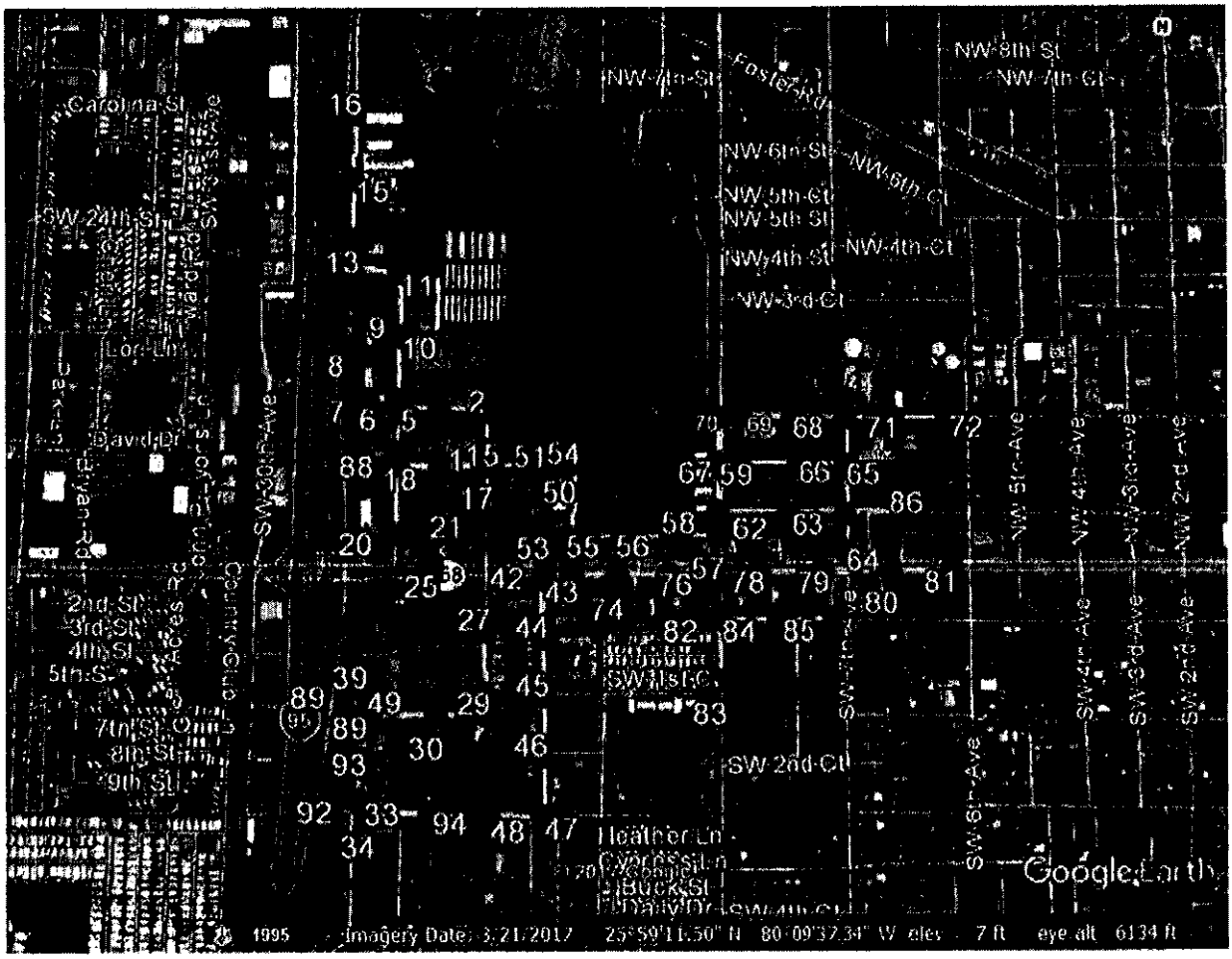


Figure 3.84 – Manholes GPSed - Lift Station 14 Service Area

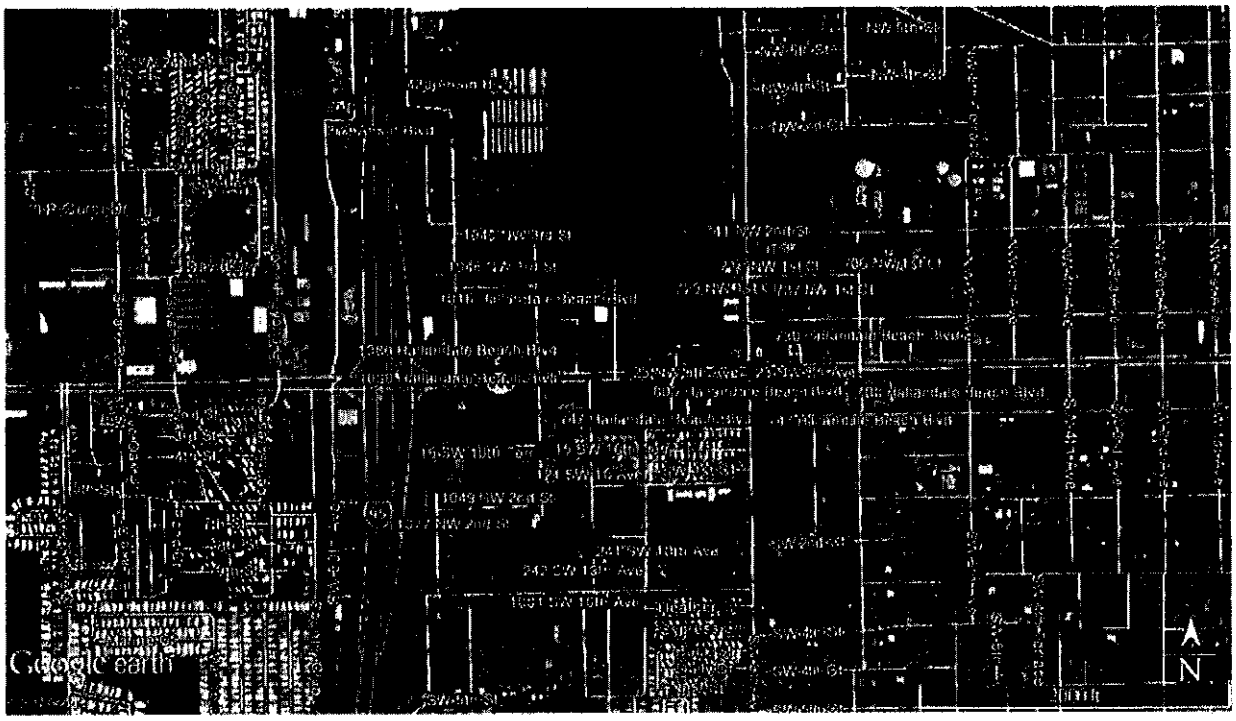


Figure 3.85 - Location of Smoke test leaks - Lift Station 14 Service Area

Table 3.23 – Manhole Data - Lift Station 14 Service Area

Manhole ID	Invert Condition	General Condition	Comments
85	Good	Good	Good has 2 pick holes
84	Good	Good	Good has 2 pick holes
34	Good	Average	Steps need repair has 2 pick holes
94	Good	Good	Good has 2 pick holes
37	Good	Good	Good has 2 pick holes
48	Good	Good	Good has 2 pick holes
47	Good	Good	Good has 2 pick holes
35	Good	Good	Good has 1 pick hole
32	Good	Good	Good has 2 pick holes
89A	Good	Good	Good has 2 pick holes
31	Good	Good	Good has 2 pick holes
30	Good	Good	Good has 2 pick holes
46	Good	Good	Good has 2 pick holes
45	Good	Good	Good has 2 pick holes
44	Good	Good	Good has 2 pick holes
92	Good	Good	Good has 1 pick hole
90	Good	Good	Good has 1 pick hole
93	Good	Good	Good has 1 pick hole
49	Good	Good	Good has 2 pick holes
29	Good	Good	Good has 2 pick holes
27	Good	Good	Good has 2 pick holes
28	Good	Good	Good has 2 pick holes
89	Good	Good	Good has 1 pick hole
39	Good	Good	Good has 1 pick hole
40	Good	Good	Good has 2 pick holes
86	Good	Average	Good 2 large pick holes
63	Good	Average	Good 2 large pick holes
64	Good	Average	Good 2 large pick holes
62	Good	Average	Good 2 large pick holes
65	Good	Average	Good 2 large pick holes
66	Good	Average	Good 2 large pick holes
67	Good	Average	Good 2 large pick holes
68	Good	Average	Good 2 large pick holes
69	Good	Average	Good 2 large pick holes
70	Good	Average	Good 2 large pick holes
71	Good	Average	Good 2 large pick holes
72	Good	Average	Good 2 large pick holes
16	Good	Average	Good 2 large pick holes
13	Good	Average	Good 2 large pick holes
14	Good	Average	Good 2 large pick holes
15	Good	Average	Good 2 large pick holes
8	Good	Average	Good 2 large pick holes
9	Good	Average	Good 2 large pick holes
7	Good	Average	Good 2 large pick holes

Manhole ID	Invert Condition	General Condition	Comments
87	Good	Average	Good 2 large pick holes
10	Good	Average	Good 2 large pick holes
6	Good	Average	Good 2 large pick holes
19	Good	Average	Good 2 large pick holes
88	Good	Average	Good 2 large pick holes
20	Good	Average	Good 2 large pick holes
18	Good	Average	Good 2 large pick holes
17	Good	Average	Good 2 large pick holes
1	Good	Average	Good 2 large pick holes
17A	Good	Average	Good 2 large pick holes
54	Good	Average	Good 2 large pick holes
51	Good	Average	Good 2 large pick holes
50	Good	Average	Good 2 large pick holes
21	Good	Average	Good 2 large pick holes
2	Good	Average	Good 1 large pick hole
5	Good	Average	Good 2 large pick holes
53	Good	Average	Good 2 large pick holes
55	Good	Average	Good 2 large pick holes
56	Good	Average	Good 2 large pick holes
83	Good	Good	Good has 1 pick hole
82	Good	Good	Good has 2 pick holes
60	Good	Good	Good has 2 pick holes
59	Good	Good	Good has 2 pick holes
58	Good	Good	Good has 2 pick holes
57	Good	Good	Good has 2 pick holes
25	Good	Average	Good 2 large pick holes
43	Good	Average	Good 2 large pick holes
73	Good	Average	Good 2 large pick holes
74	Good	Average	Good 2 large pick holes
75	Good	Average	Good 2 large pick holes
76	Good	Average	Good 2 large pick holes
78	Good	Average	Good 2 large pick holes
79	Good	Average	Good
80	Good	Average	Good 2 large pick holes
81	Good	Average	Good 2 large pick holes
52	Good	Average	Good 2 large pick holes
42	Good	Average	Good 2 large pick holes
23	Good	Average	2 large pick holes grease in invert
33	Good	Good	Good has 2 pick holes

Table 3.24 – Smoke test result information - Lift Station 13 Service Area

Street Address	Fixed	Latitude	Longitude	Comments
741 NW 2nd St	yes	25.9875658	-80.1582917	Cracked 6 inch PvC c/o left front in sidewalk
700 NW 1st Ct		25.9871868	-80.1562465	Open 4 inch PvC c/o right of house by fence
721 NW 1st Ct		25.9867598	-80.157375	Open 4 inch PvC c/o left side of building front of 1st door in fence
710 NW 1st Ct	yes	25.9871371	-80.156857	Open 4 inch PvC c/o right front
729 NW 1st Ct	yes	25.9868074	-80.1577338	Cracked 4 inch PvC c/o left front in fence
706 NW 1st Ct		25.9871738	-80.1567262	Open 4 in metal c/o right of building by door A
737 NW 1st Ct		25.9868163	-80.1580991	Smoke from corner of back left of house in fence
136 NW 8th Ave	yes	25.9872443	-80.1584268	Open 4 inch PvC c/o right front by sidewalk
730 Hallandale Beach Blvd	yes	25.9859665	-80.1580979	Open 4 inch PvC c/o back left of building behind dumpster
700 Hallandale Beach Blvd	yes	25.9850046	-80.156421	Open 4 inch PvC c/o right of driveway
800 Hallandale Beach Blvd	yes	25.9852331	-80.1584268	Open 4 inch PvC c/o back right of building by air pump
23 NW 8th Ave	yes	25.9852818	-80.1584704	Open 4 inch PvC c/o left front by wall
1016 Hallandale Beach Blvd		25.9863359	-80.1625256	Concrete box smoking back left of building
1080 Hallandale Beach Blvd		25.9853932	-80.1640727	Cracked 4 inch PvC c/o back left corner of building
1080 Hallandale Beach Blvd	yes	25.9854795	-80.1641161	Open 4 inch PvC c/o 20ft off back left corner of building
1080 Hallandale Beach Blvd		25.985677	-80.164697	Metal box back left of building
1080 Hallandale Beach Blvd	yes	25.9854337	-80.1640881	Metal box smoking back left of building
430 Ansin Blvd	yes	25.9901884	-80.1652998	Open 6 inch PvC c/o left of entrance under mteal cover
373 Ansin Blvd	yes	25.98940333	-80.1644383	Open 4 inch PvC c/o middle of building by parking lot
1048 NW 3rd St		25.9873302	-80.1632448	Cracked 4 inch metal c/o right of front door
1040 NW 3rd St		25.987437	-80.1629539	Open 4 inch metal c/o right of front door
16 SW 10th Terr		25.98381833	-80.162565	Open 3 inch PvC c/o right front
15 SW 10th Terr		25.9839064	-80.1623372	Smoke from open 3 inch pipe from under side of house
16 SW 10th Terr	yes	25.98385	-80.1624217	Broken service line right of house
1049 SW 2nd St	yes	25.9828868	-80.1632796	Cracked 4 inch PvC c/o right front
21 SW 10th Terr	yes	25.9832233	-80.1626651	Open 6 inch PvC c/o across the street sidewalk under metal cover
1077 NW 2nd St		25.9828751	-80.1641393	4 inch PvC c/o broke at 'T' under right front driveway
241 SW 10th Ave	yes	25.9822539	-80.1614958	Open 4 inch PvC c/o left front
242 SW 10th Ave	yes	25.9820905	-80.1615932	Open 4 inch PvC c/o front of left window in driveway
121 SW 10 Ave	yes	25.98375333	-80.1615067	Open 6 inch PvC c/o center of lot by sidewalk
1001 SW 10th Ave	yes	25.9815405	-80.1617519	Cracked 4 inch PvC c/o left side of house by parking spots
747 Hallandale Beach Blvd		25.9845525	-80.1582084	Smoking grease trap behind address
747 Hallandale Beach Blvd		25.9845901	-80.1582093	Grease trap smoking around cover behind address

Lift Station 15 – Sunset West

The Lift Station 15 service area contains 4 manholes listed as Area 1-29 to 32 on the City's map and are hence included in that service area. See Lift Station #1 service area for details on these manholes. No inflow was noted. The midnight run showed no excessive infiltration. A review of rainfall versus flows from July 1, 2014 to June 30, 2017 indicates that the slope of the line is increasing each year, indicating inflow volumes are increasing (see Figures 3.86-3.88). There were no openings found on the system. The overall trend indicates inflow is present (see Figure 3.89). The average pumps times increased from 2014 to 2017 (7.7 to 18%).

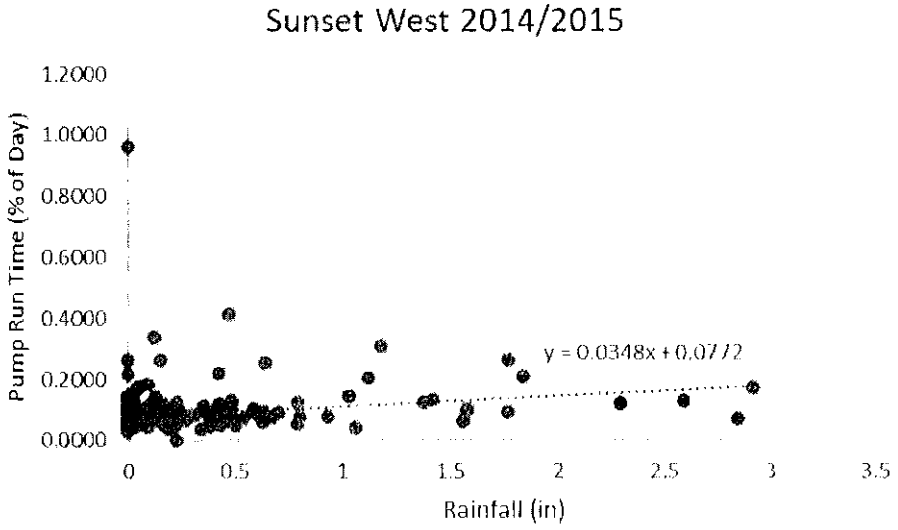


Figure 3.86 – Inflow for 2014-2015 – the increasing slope indicates flows increased with rainfall - Lift Station 15 Service Area

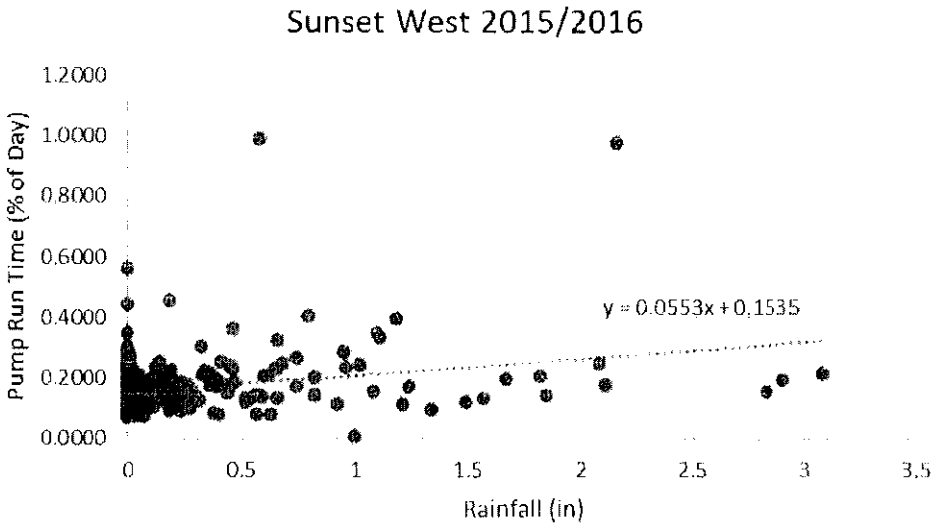


Figure 3.87 – Inflow for 2015-2016 – the increasing slope indicates flows increased with rainfall - Lift Station 15 Service Area

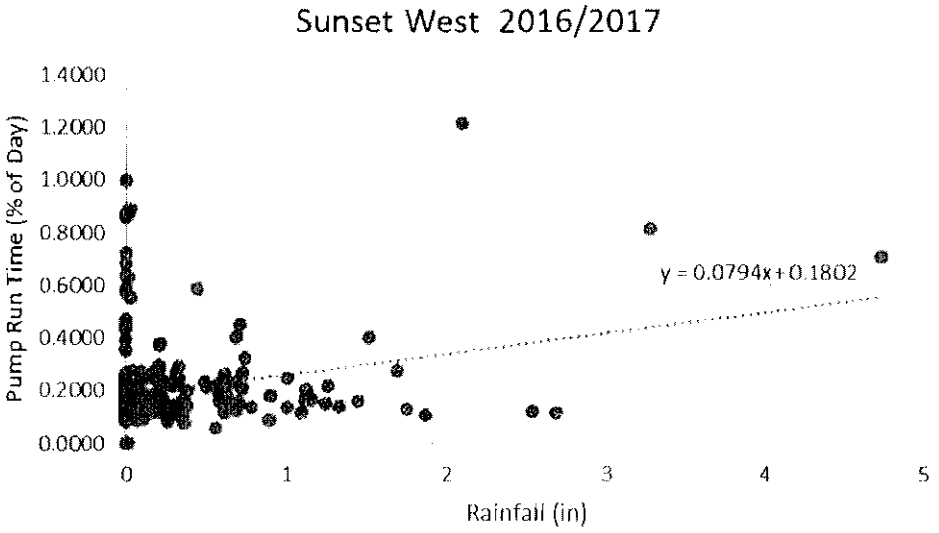


Figure 3.88 – Inflow for 2016-2017 – the regression slope is negative, but note some early high run times. The actual slope (solid line) slope indicates flows increased with rainfall- Lift Station 15 Service Area

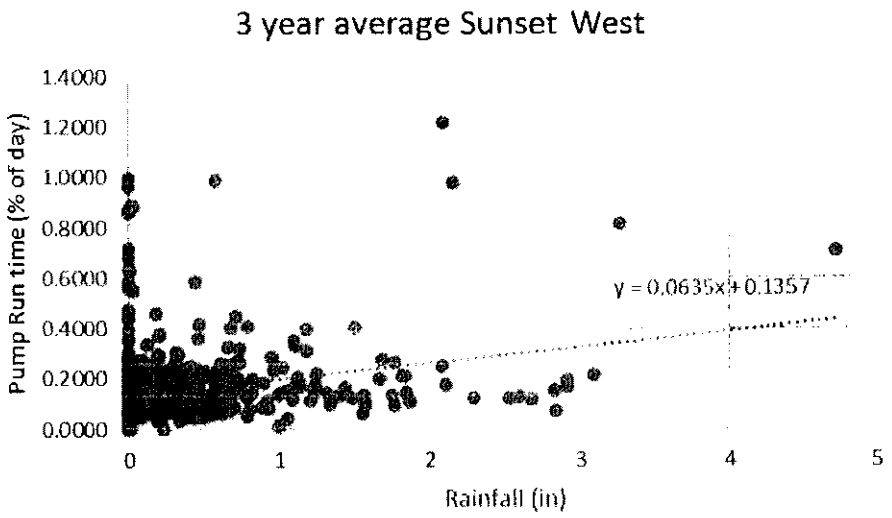


Figure 3.89 – Average graphic foe Inflow for 2014-2017 – the increasing slope indicates flows increased with rainfall - Lift Station 15 Service Area

Lift Station 18 – Three Islands

The Lift Station 18 service area contains 11 manholes that were found, GPSed and sealed. The midnight run indicated points where infiltration as noted (see map in Appendix A). A review of rainfall versus flows from July 1, 2014 to June 30, 2017 indicates that the slope of the line was increasing the first year (Figure 3.90), but is fairly flat thereafter (Note there is missing data and some very high flows that distort the trend. (see Figures 3.91 and 3.92 and solid trend line). This matches with finding no openings during smoke testing and being a small basin. The overall trend indicates little inflow is present (see Figure 3.93). The average pumps times doubled from 2014 to 2017.

Figure 3.94 shows the manhole locations. With respect to the manhole construction types, all but Manhole 3 are brick. None had steps. All manhole covers and rings were cast iron. A number of the manhole covers have pick-holes (see Table 3.26). Nine manholes were in average condition. Manholes #8 has water coming in the invert and Manhole#6 has water leaking in the walls. The guard shack sends a constant stream of clean water to the Manhole #13.

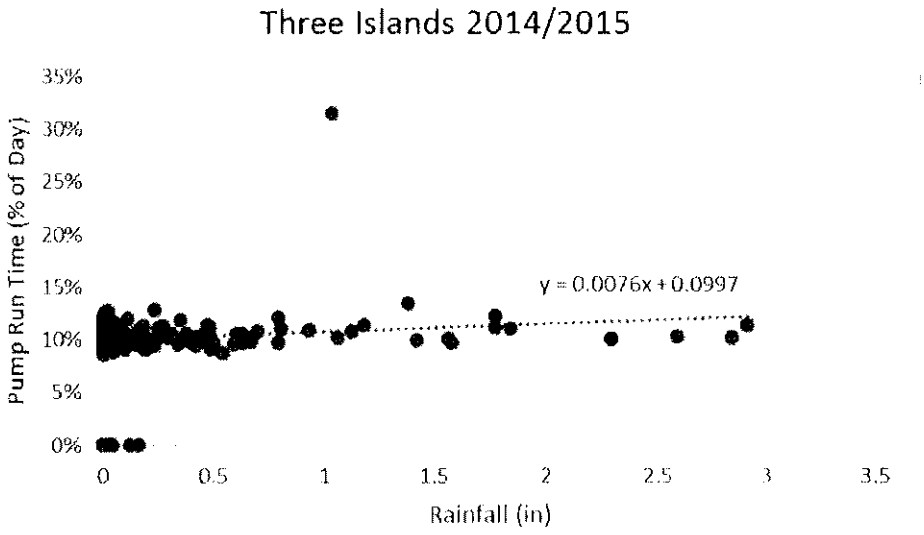


Figure 3.90 – Inflow for 2014-2015 – the increasing slope indicates flows increased with rainfall - Lift Station 18 Service Area

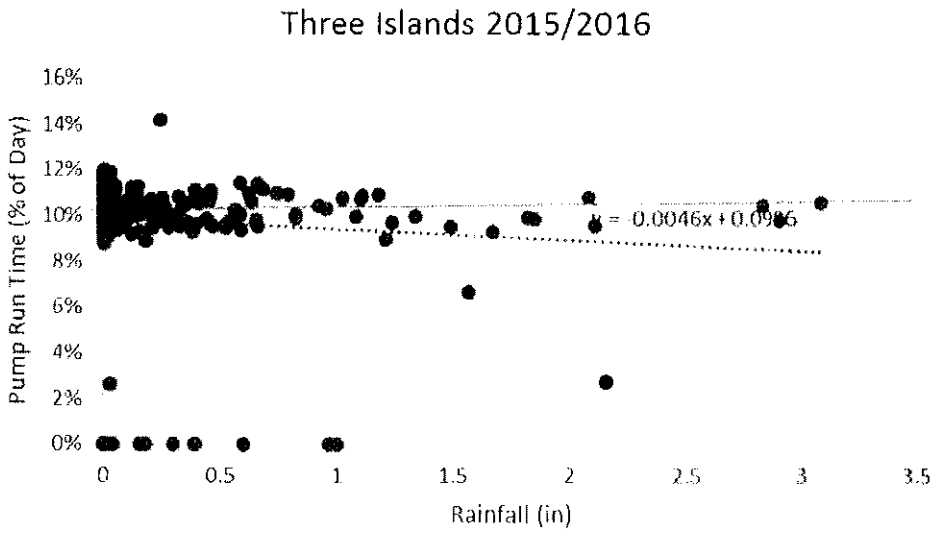


Figure 3.91 – Inflow for 2015-2016 – the increasing slope indicates flows increased with rainfall - Lift Station 18 Service Area

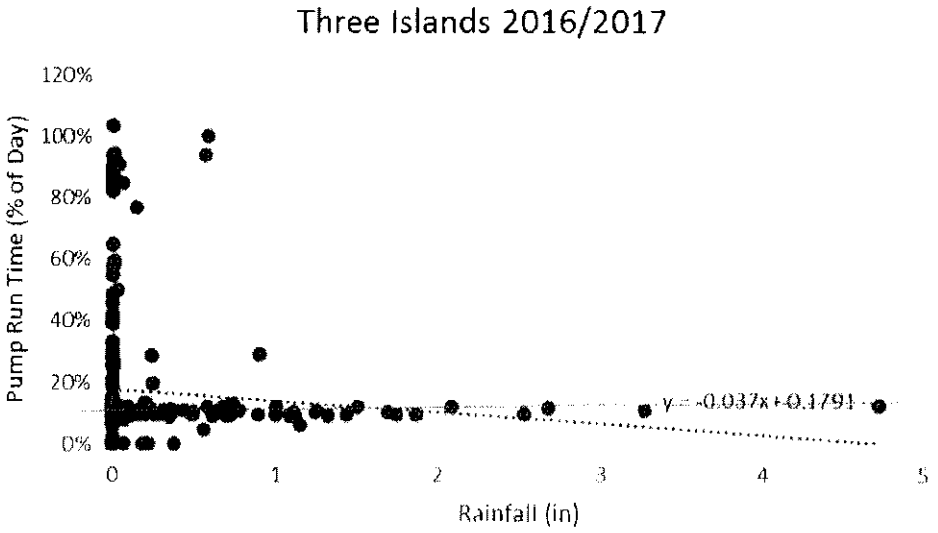


Figure 3.92 – Inflow for 2016-2017 – the regression slope is negative, but note some early high run times. The actual slope (solid line) slope indicates flows increased with rainfall- Lift Station 18 Service Area

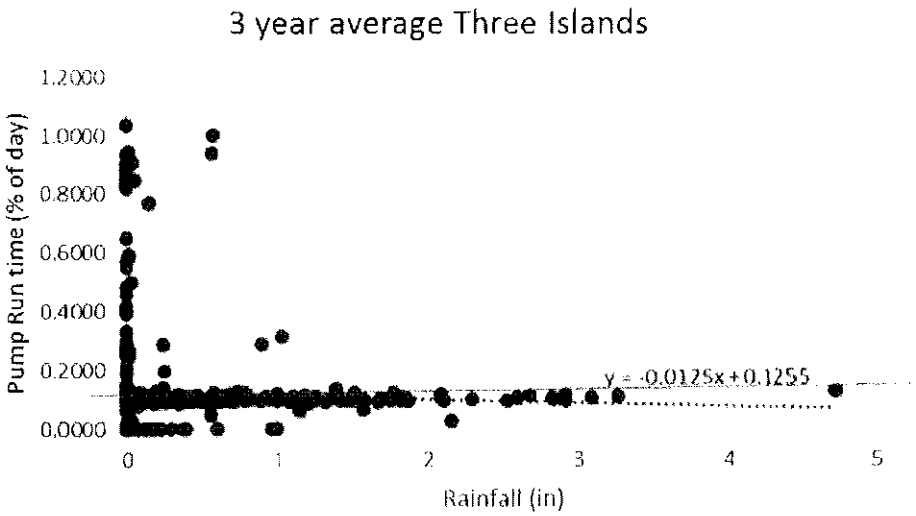


Figure 3.93 – Average graphic foe Inflow for 2014-2017 – the increasing slope indicates flows increased with rainfall - Lift Station 18 Service Area

Figure 3.94 – Manholes GPSed - Lift Station 18 Service Area

Table 3.25 – Manhole Data - Lift Station 18 Service Area

Manhole ID	Manhole Walls	Invert	General Condition	Comments
11	Good	Good	Average	Good
10	Good	Good	Average	Good 1 large pick hole
7	Good	Good	Average	Good 1 large pick hole
8	Good	Needs Repai	Poor	Slight water coming in through invert 1 large pick hole
3	Good	Good	Average	Good 1 large pick hole
1	Good	Good	Average	Good 1 large pick hole
1A	Good	Good	Average	Good 1 large pick hole
12	Good	Good	Average	Good 1 large pick hole
13	Good	Good	Average	4 inch c/o from guard shack has steady flow of clean water 1 large pick hole
5	Good	Good	Average	Good 1 large pick holes
6	Needs Repair	Good	Poor	Good 2 large pick holes leaking from walls

4. Phase 1 Findings and Recommendations

CONCLUSIONS

The City of Hallandale Beach is responsible for the planning, construction and maintenance of its lift stations and collection systems. City crews are responsible for insuring the reliable service of sewage lift stations and accompanying force mains and gravity lines throughout the City of Hallandale Beach. Maintenance and repair of the sewer force main piping and gravity collection system includes excavation and repair of manholes, gravity piping, service connections and force mains.

Wastewater from the City is transmitted through 1,097 manholes, nearly 50 miles of gravity mains and 20 miles of force main piping to the wastewater treatment plant. These pipelines range from 8 to 27 inches in diameter. Sanitary sewer lines serve a vital role in the health and safety of the public, but these collection systems are usually taken for granted because they are out of sight. These systems are designed to convey wastewater from its source to wastewater treatment plants. The City sends its wastewater to Hollywood for treatment. The City's service area comports with the City's corporate limits.

For the City of Hallandale over a third of their flows are infiltration and/or inflow. Since many of the pipes are vitrified clay, over 50 years old and submerged in water most of the year. Age, pipe type, roadway conditions and other factors affect the sewer system capacity by creating the potential for infiltration and inflow into the sewer system, compromising capacity and increasing the potential for overflows. Ongoing infiltration and inflow detection and elimination efforts are required to minimize excess water moving into the system since the total flows through the pipes directly translates to the size of the wastewater bill from the City of Hollywood.

The manholes and clean-outs are required for access and removal of material that may build up in the piping system. Manholes are used where there are changes in direction and/or size of the sewer pipe. They also serve as access sites for workers to perform maintenance or cleaning. Manholes are traditionally pre-cast concrete or brick. Brick was the method of choice until the 1960s. Most of the City's 1097 manholes are brick manholes. In addition, the manhole cover may not seal perfectly, becoming another source of infiltration during a rain event or even from normal irrigation runoff.

A Phase 1 Investigation of the City's sewer system was undertaken. The results are as follows:

- Inspection of 1097 sanitary sewer manholes was performed
- Installation of Elasti-seal in 1097 manholes was performed
- Defender inflow dishes have been installed in1097 manholes – note that a number needed special fits due to a series of riser rings of the configuration of the riser ring (see manholes reports)
- There was no apparent need to repair benches in poor condition or exhibiting substantial leakage

- There was no apparent need to repair manhole walls in poor condition or exhibiting substantial leakage although several liners were noted as leaking
- 800,000 ft of smoke testing was completed in November with 176 openings on the City's right-of-way
- 5% of services had issues noted during smoke testing.
- 176 LDL plugs and caps were installed in the public right-of-way
- Over 100 smoke sources outside the right-of-way were noted that need repairs
- Documentation of all problems in a report to City that identifies problem, location and recommended repair

The results of the final piece of the contract, the midnight run, indicated the following:

- Nearly 96,000 ft of sewer lines to be televised, which is 32% of the sewer system should be further investigated for infiltration form pipe breaks or service lines.
- Of the total, over 80% of the pipes to be televised are 8-inch gravity lines, many of which are dead ends.
- Issues like grease and inappropriate items in the sewer.
- Several manhole repairs
- About 20 places where the manholes are submerged
- A need to repair the top of Lift Station #3

An estimate for the Phase 2 work –cleaning, televising, lining and service line repairs was just under $3 million. The payback estimated is under 6 years (see Table 4.1).

Table 4.1 Payback for Infiltration portion

Year	Est. InI (MGD)	Annual InI Flows (est) 000 g	Est savings (50% reduction)
2014	45%	263,621.25	$ 840,952
2015	42%	224,584.50	$ 716,425
2016	38%	181,697.00	$ 579,613
2017	37%	168,812.50	$ 538,512

Payback @ 0.31% interest Under 6 yrs
Cost is $3,000,000 for the work

The next steps are the following. Note Task 7 is this report and the specs for Task 1 are included in the appendices. Note that the Phase 1 work cost the City $520,000. It will however save a minimum of $320,000 in pipe that does not need to be televised in Phase 2.

Task 7 – Sanitary Sewer Evaluation Survey Report with Rehabilitation Plan

a. Develop a report to document data collection and analysis tasks completed throughout the project including night flow isolation, manhole inspection, smoke testing, and video

inspection and review. Estimate flow rates associated with I/I sources, confirm preliminary repair recommendations, and present recommendations and a planning level repair cost estimate.

b. Prioritize the recommended rehabilitation work based on cost-effectiveness and other factors. Rehabilitation of a collection system main line, manhole or service line is typically termed "cost-effective" when the cost of rehabilitation to remove a given amount of extraneous flow is less than the cost of continuing to transport, treat, and dispose of that same amount of extraneous flow over a selected time period. The cost-effectiveness analysis involves the following steps –

   i. Estimate the cost of rehabilitation of each main line, manhole, or service line defect.
   ii. Calculate the approximate cost to transport, treat, and dispose of the extraneous flow associated with that defect.
   iii. Compare the costs developed in the previous two steps and determine the "payback period" of the repair (the number of years to recover the repair cost).

c. Other factors are considered in addition to cost-effectiveness. Factors such as structural condition, public nuisance, health hazards, system hydraulics, and operation and maintenance demand may become the determining factor as to whether a given repair is assigned a higher priority for rehabilitation.

d. Generate rehabilitation summary tables that identify each defect and provide the following associated information.

   i. Collection basin number.
   ii. Upstream and downstream manhole number.
   iii. Pipe length, diameter, depth and material.
   iv. Defect description, I/I quantification, recommended repair method, estimated repair cost, and estimated payback period.

e. Sort and organize the rehabilitation summary tables by drainage area, repair category, and payback period. Rehabilitation summary tables can be used to develop contractor task assignments to be awarded in the rehabilitation program under a subsequent phase of work.

f. Provide copies of draft report for review by City.

g. Meet with City to review draft report.

h. Provide two bound copies and one electronic copy (PDF format) of the final report.

Task 1 – Technical Specifications for Closed-Circuit Video Inspection

a. Prepare the technical specifications and bid form for cleaning and video inspection of gravity sewer mains and laterals. The bid form will be based on estimated quantities to be

developed based on discussion with the City. The objective is to use the bid process to arrive at a contract with a specialty contractor who can perform the necessary work using unit costs. This will allow City to issue inspection task orders at contracted unit cost prices.

b. Issue a draft copy of the contract documents to City for review.

c. Incorporate City review comments in revisions to the contract documents and provide copies of the contract documents for the City's use in soliciting competitive bids.

d. Attend a pre-bid conference with prospective contractors, if requested.

e. Provide assistance to the City during the bidding of the project. Reply to bidder's questions and prepare draft addenda, if required, to be furnished electronically to the City's Procurement Department.

Task 2 – Mainline Video Review

a. Analyze videotapes provided by a specialty sewer inspection contractor or by the City.

b. Record and document the nature and location of pipe conditions that may require intervention and/or correction, including offset or separated joints, protruding or damaged service connections, roots or solids accumulations, cracked or broken pipe, and any other defects that may permit groundwater infiltration or compromise structural or operational integrity. Develop infiltration estimates, repair recommendations, and estimated costs as warranted.

c. Identify "suspect" laterals to be inspected at a later time using specialized equipment.

Task 3 – Lateral Video Review

a. Analyze videotapes provided by a specialty sewer inspection contractor or by the City.

b. Record and document the nature and location of pipe conditions that may require intervention and/or correction, including offset or separated joints, protruding or damaged service connections, roots or solids accumulations, cracked or broken pipe, and any other defects that may permit groundwater infiltration or compromise structural or operational integrity. Develop infiltration estimates, repair recommendations, and estimated costs as warranted.

Task 8 – Technical Specifications for Rehabilitation Contract Documents

a. Organize the rehabilitation program based on repair technologies and quantities. Similar or related technologies will be grouped to facilitate the performance of the work by specialty contractors or by the City. It is expected that the below-listed "Groups" will be considered for detailed development in contract documents to be bid. All Groups will

include those ancillary items that are typically necessary such as bypass pumping and traffic control. Repair types selected for inclusion will be those (a) that City does not elect to perform with its own forces and (b) for which a sufficient need is known or anticipated to exist

- i. Group A – Excavated Point Repairs: Point repairs, cleanout installation, surface restoration, and television survey.
- ii. Group B – Manhole Rehabilitation: Manhole frame and cover replacement, manhole liner installation, and replacement of entire manholes.
- iii. Group C – Mainline Lining: Cured-in-place and fold-and-form pipe lining for gravity mains, and associated work such as cleaning and preparation, lateral reinstatement, and television survey.
- iv. Group D – Sectional and Lateral Lining: Cured-in-place lateral liner and mainline sectional liner installation, cleanout installation, and television survey for mains and laterals.

b. Prepare the technical specifications and bid form for groups selected from among the previously noted technologies, along with an engineer's estimate. The bid form and engineer's estimate will be based on estimated quantities to be developed based on discussion with the City – the actual amount of work awarded may be more or less depending on the needs identified through ongoing inspection and prioritization. The objective is to use the bid process to arrive at contracts with specialty contractors who can accomplish the selected repairs at unit costs. This will allow City to issue sewer rehabilitation task orders to selected specialty contractors at contracted unit cost prices.

c. Issue a draft copy of the contract documents to City for review.

d. Incorporate City review comments in revisions to the contract documents and provide copies of the contract documents for the City's use in soliciting competitive bids.

e. Prepare documents for and attend a pre-bid conference with prospective contractors.

f. Provide assistance to the City during the bidding of the project. Reply to bidder's questions and prepare draft addenda, if required, to be furnished electronically to the Procurement Department.

g. Prepare a recommendation to the City for award of bids. Provide data for use with the City Commission to award the bid. Attend the Commission meetings for award if requested to do to.

Task 9 – Office Engineering and Management

a. Coordinate office and field staffs. Act as liaison between the City and the inspection contractor.

b. Manage and organize inspection documentation generated by Consultant, contractor, and

City personnel.

c. Prepare and submit periodic status reports to the City. The reports shall provide a description of work performed, significant findings, issues requiring resolution, and contractor-provided scheduling information.

d. Prepare disbursement requests for FDEP on behalf of the City during the current and infiltration correction phase of the project.

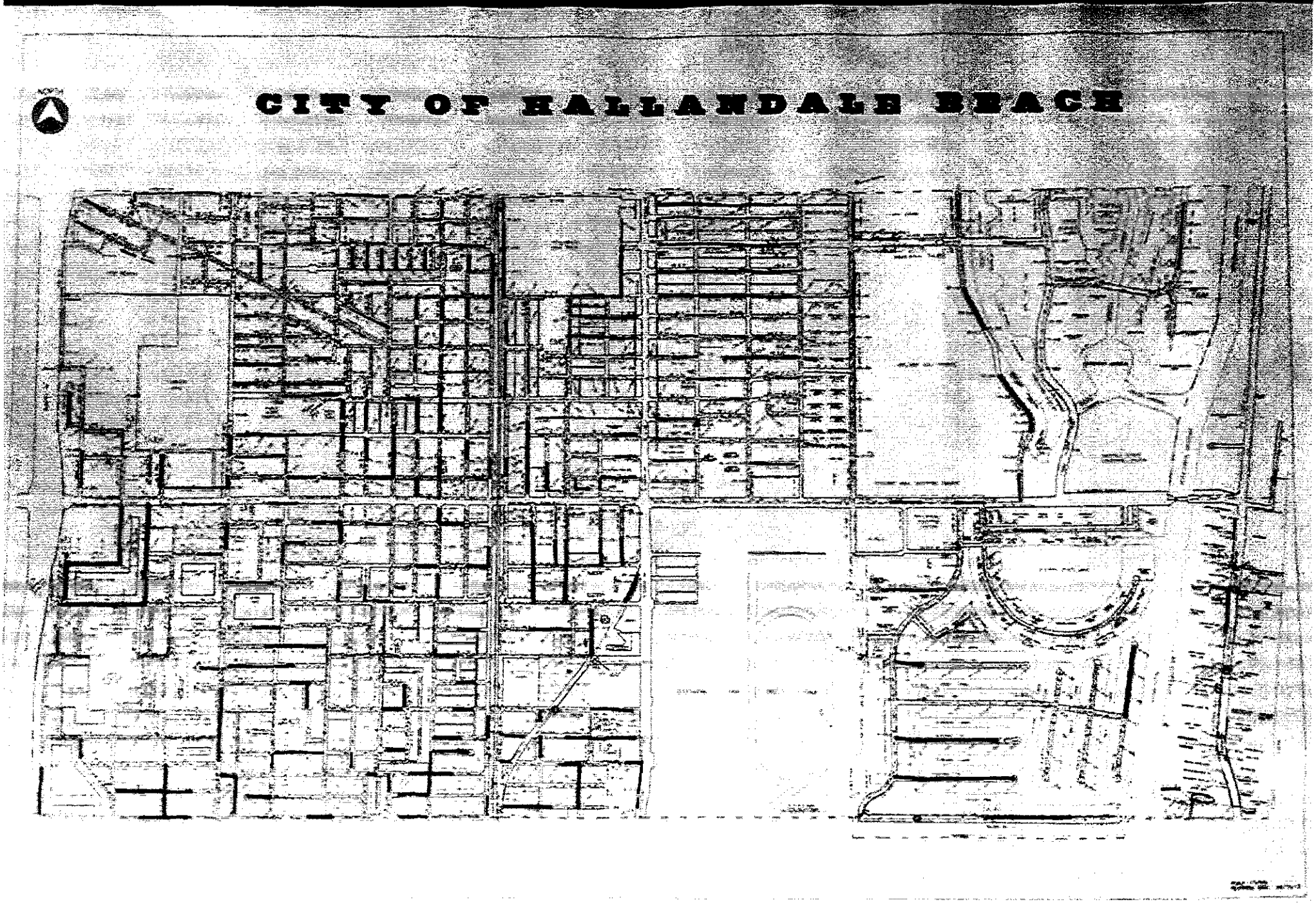
e. Review pay requests of the contractor(s) and recommend approval (or not) during the current and infiltration correction phase of the project.

f. Attend periodic meetings with City in association with the work performed under the previous tasks. It is anticipated that meetings will generally be held every one to two months to review the program status and work performed, discuss potential problem areas and issues requiring resolution, and establish schedules and action items for future work.

Specifications for all anticipated conditions are included in Appendix C. The bid sheet and cost estimates for Phase II are estimated at $2.5 million (see Appendix D). Priority areas, including cleaning all lines, plus televising and making repairs are highlighted in the GIS Map in Appendix A which will be used for bidding purposes.

Appendix A Map of Sewer Lines to be Investigated in Phase II (Separate file)

CITY OF HALLANDALE BEACH



Appendix B – Listing of Sewer Inspection Identifying Areas of I/I

APPENDIX B - SUmmary of Midnight Run Investigation

Manhole	Flow Bead (in)	Video to	Dead end?	flow dir from	flow dir out	LF	size (in)	Comments
9-212	2	9-213		N	W	250	8	
9-211	3	9-208		EW	W	150	8	
9-210	S	9-209	y	N	S	250	8	
9-198	4	9-199		N	S	250	8	
9-197	3,4,3 F fr S	9-200	y	S	W	240	8	3 way manhole - high flow from DE south, not much picked up N &E
9-201	4	9-202		S N E	W	260	8	
9-186	2	9-185	y	NA		360	8	DE
9-195	1	9-194		SWE	N	350	8	could be skipped, parallel line above main line
9-216	3F	9-217	y	NA	E	240	8	
9-215	5F	9-195		NSE	W	350	10	
9-237	2 SW	9-221	y	N	S	270	8	
9-219	5F	9-218	y	N	S	350	8	
9-182							8	laundry pumping about 1/2 full pipe
9-185	2	9-186	y	N	S	360	8	
9-191	2	9-192	y	S	N	220	8	
9-194	8	9-195		S	N	250	8	parallel line above main line
9-189	2F, 12 M	9-190		S	W	300	10	
9-103	4F	9-104	y	S	N	400	8	
9-098	2	9-099	y	S	N	250	8	
9-184	4F	9-185		S	N		8	
9-171	2	9-172	y	N	W	240	8	
9-169	8	9-170	y	N	S	240	8	
9-089	6	9-088		W	N	15-Dec	8	is there a LS outsie gate of WTP - flow comes form WTP
9-083	4	9-086		EW	W	400	8	
9-086	3	9-087	y	EW	N	370	8	
9-034	?	9-085	y	W	E	300	8	Cant see this but there is flow I MH 9-084
9-081	2	9-082	y	W	E	300	8	
9-080	3	9-081		W	N	330	8	
9-078	4	9-079	y	EW	W	300	8	
9-074	4	9-075		W	N	300	8	
9-069	4 to 8	9-072		EW	N	180	8	
9-069	4	9-070		W	N	330	8	
9-067	4	9-068		SE	W	330	8	
9-067	4f	9-064		EW	N	50	8	
9-065	8 s	9-066	Y	W	N	300	8	
9-110	4 dirt	9-112	y	N	W	270	8	
9-109	2, 6S	9-113	y	N	W	270	8	dish in hole
9-138	2	9-139	y	S	W	270	8	
9-140	3	9-141	y	S	W	270	8	
9-160	4s,6s,2s	9-163	y	NSE	W	270	8	
9-164	3	9-167		S	W	200	8	
9-164	3	9-165		N	W	300	8	
9-165	2	9-166	y	N	W	280	8	
9-191	2	9-192	y	S	N	200	8	
09-089	3	09-090			N	350	8	
9-161	6s	9-162		W	S	230	8	
9-116	4f	9-117		N	S	330	8	
9-224	2f	9-223		W	S	280	8	
9-107	3s	9-223		N	E	280	8	
9-126	3	9-127	y	W	S	300	8	
9-122	3	9-123		EW	S	330	8	
9-123	2	9-125	y	E	S	250	8	

9-120	2	9-121	y	N	W	300	8	
9-134	3	9-133a		N	W	0	8	nw 3rd ave - mh unnumbered
9-130	3	9-235		N	W	280	8	
9-135	2	9-136	y	N	S	180	8	
9-143	4	9-158		E	S	280	8	
9-158	3	9-159	y	E	W	270	8	
0-151	2	9-155	y	E	S	200	8	
9-146	3	9-144		W	S	300	8	
9-231	?	9-232	y	W	S	260	8	
9-050	3s	9-051	y	E	W	300	8	
9-148	3	9-149	y	N	E	310	8	
9-052	3s	9-053		E	S	320	8	
9-055	8f	9-299,230	y	E	S	650	8	in pembroke road.
9-057	5						8	laundromat? CHECK
9-047	2	9-048	y	W	S	270	8	
9-028	3	9-029	y	W	E	270	8	
9-018	4	9-025	y			1250	8	tv line under Pembroke road - has flow uncertain why
9-011	7	NA		S	E		8	flow enters from high school service line?
9-010	8	NA		S	E		8	huge flow coming from high school at 4 am
14-016	6f	NA		E	S		8	large, very dirtly flow from high school at 4 am
9-008	6s	9-009	y	W	E	300	8	
9-013	6	9-014		W	E	250	8	
14-007	4+	14-009	y	N	E	400	8	heavy paint smell & grease - industrial issue, line not accessible
14-088	2	14-019		N	E	70	8	
14-020	8	14-019		S	E	400	8	
14-017							8	mislabeled on map
6-047	6						8	large flow from east
6-128							8	large flow from east
6-029	6						8	large flow from east
6-026	4						8	large flow from east
6-016							8	large flow from east
6-010							8	large flow from east
6-002							8	large flow from east
6-046	6	6-047	y	E	W	280	8	
6-045	8	6-046		E	N	300	8	
6-015	6	6-016		E	N	310	8	
6-011	5	6-010		E	N	340	8	
6-012	4	6-013		W	N	320	8	
6-012	6	6-011	y	E	N	300	8	
6-005	5 clear	6-006		W	E	340	8	
6-007	4 clear	6-008		W	E	250	8	
6-119	4	6-120		W	E	320	8	
6-018							8	gold watch or bracelet
6-017	8	6-018		W	E	400	8	
6-043	6	6-044		W	E	250	8	
6-035	4	6-036		W	E	250	8	
6-036	6		Y	N			8	coming from north
6-056	4 clear	6-057		W	N	280	8	
6-057	4 clear	6-058	Y	W	E	280	8	
6-122	6	6-123		W	N	280	8	
6-123	4	6-124		W	E	280	8	
6-045							8	halfful coming off HBB
6-033	2	6-034	Y	S	N	50	8	
6-033	6	6-035		W	N	260	8	may be nothing given upstream flow

6-021							8	major grease issue
6-020	4	6-021		W	N	400	8	grease
6-014	8	6-017		W	N	400	8	
6-062	6s	6-063		W	E	360	8	liner
6-067	8	6-068		W	E	370	8	liner
6-068	8	6-069		W	E	320	8	liner
6-069	6	6-070		W	E	350	8	liner, big leak
6-071	4f	6-078		N	S	310	10	
6-072	8	6-073		N	E	360	10	liner
6-073	3	6-074		W	E	360	10	liner
6-074	8	6-075		W	E	360	10	liner
6-075	6	6-076	Y	W	E	360	10	liner
6-095	4	6-096		W	E	360	8	liner LEAK
6-096	?	6-097		W	E	360	8	blockage in line, liner
6-097	8	6-098		W	E	360	8	liner
6-091		6-092	Y	W	E	360	8	big leak at liner IN MH
9-144	3	9-145		N	S	250	8	
09-039	3	9-040		N	W	240	8	
9-040	3	9-041		N	S	200	8	
								guardshack has 4 in flow constantly, not
6-093a							8	on map
6-112	6	6-113		N	S	250	8	
6-113	8 n 3 e	6-114		N	S	250	8	major flow
6-110		6-109					8	cant find
6-109		6-108					8	cant find
6-125	6	6-126		E	N	330	8	
6-126							8	grease
6-107	8	6-108					8	old dish in botom
6-103							8	huge clean flow coming in
6-105							8	MH leak
6-101	10	6-107		N	S	350	10	
6-081	4+	6-082		W	S	400	10	
6-082	4	6-083		W	E	400	10	
6-083	4	6-084		W	E	400	10	
6-084	3SW	6-085		W	E	400	10	
6-085	2SW	6-086		W	E	250	10	
6-087	4	6-088		W	E	400	10	
6-088	6	6-089		W	E	400	10	
6-089	4	6-090		W	E	400	10	
6-090	2+	6-091		W	E	400	10	
6-068	8	6-069		W	E	400	10	
6-069	6	6-070	Y	W	E	350	8	
6-065	8F	6-066		W	S	370	8	
6-066	8S	6-067		W	E	370	8	
6-067	8	6-068		W	E	370	8	
6-071	2	6-072		W	S	370	8	
5-009	3	5-010		N	S	350	8	
18-013	3	8-012		W	E	300	10	leak in MH also
5-004	4clear	5-006		S	N	370	8	
5-006	6	5-012	Y	S	N	250	8	
5-006							8	check clear water
2-030		2-031		N	S	300	10	leak at liner
2-029	3 clear	2-030		N	S	300	10	
2-028	full, slow	2-029		N	S	120	10	
2-027		2-028		E	W	120	10	dish in manhole
7-084	6	7-085		E	W	210	8	
7-085	8	7-086	Y	E	N	280	8	
7-084	2	7-089		S	W	150	8	comes off HBB
7-087	2	7-088	Y	E	W	200	8	
7-083	3	7-087		S	W	150	8	

7-079	4 liner	7-080	Y	E	W	320	8	
7-069	4 liner	7-070	Y	E	W	280	8	
7-065	2	7-066	Y	W	N	Feb-01	8	
7-073	2	7-074		S	N	360	8	
7-060	4+	7-061		S	N	300	8	
7-061	4	7-062		S	N	300	8	
7-062	2	7-063	Y	S	N	300	8	
7-057	4	7-058		S	N	300	8	
7-053	2+	7-054		N	E	200	8	rat
7-054	2	7-055	Y	N	X	350	8	
7-034	6	7-035		S	N	300	8	
7-035	3	7-036	Y	S	N	300	8	
7-031	4 sl	7-032	Y	S	N	300	8	
7-024	4	7-025		N	E	340	8	
7-025	3	7-026		N	S	330	8	
7-026	3	7-027		N	S	330	8	
7-007	2+	7-008		E	S	300	8	
7-008	2	7-009		E	W	270	8	
7-011	8	7-012		E	S	300	8	
7-012	6+	7-013		E	W	300	8	
7-013	2	7-014	Y	E	W	300	8	
7-015	6	7-016		S	S	350	10	
7-016		7-020		N	W	950	10	not accessible clear water
4-003	6	4-004		N	S	300	10	
4-004	4	4-005		N	S	300	10	
4-005	3	4-006	Y	N	S	300	10	
4-009	5	4-001		S	N	200	10	
3-008							8	surcharged
3-007							8	surcharged
3-006							8	surcharged
LS 3							8	top leaks and needs to be raised
3-024	3	3-025		E	S	50	8	3:00 AM
3-037	4	3-036		N	S	300	8	
3-033							10	**full of adult diapers**
3-035	3	3-036		E	S?	200	10	mineral buildup
3-044							8	large, clear water flow
3-044	4	3-052		E	W?	80	12	
3-043			Y	E	S			clear water in park
3-039	2	3-040		W	S	80	8	
3-035	4	3-034		W	S	50	8	
03-049	6	03-050		N	S	70	10	
03-050	4	03-051		N	S	180	10	
3-050	6, 4						8	flow from condo t 3 am
10-005	2	10-008		N	N	330	8	
10-008	2	10-009		N	S	300	8	
10-009	1	10-010	Y	N	S	300	8	
10-003							8	heavy mineral deposits on walls of MH
11-001	4	11-002		E	LS	380	8	
11-002	4s	11-003		E	W	350	8	
11-003	1	11-004		E	W	350	8	
1-016							8	leak in MH trough
1-014							8	something wierd here, lots of clean water, mineral buildup (next to canal)
1-011	4	1-019		E	W	400	8	
1-019	3	1-020		E	S	400	8	
1-020	2	1-021		E	S	370	8	
1-021	2	1-022	Y	E		330	8	
1-009	4	1-023		E	LS	210	8	

APPENDIX B - SUmmary of Midnight Run Investigation

1-023	?	1-024		E	W	180	8	Septic - belly
1-024	3	1-025		E	W	300	8	
1-025	3	1-026		E	W	300	8	
1-026	1	1-027		E	W	300	8	
1-006	1	1-033		E	N	400	8	under canal
1-053	2 BU	1-054		W	E	200	8	leak between pipe and liner
1-050	3	1-049		N	S	30	8	
1-057	2	1-058		E	W	150	8	
1-049								CHK MH
1-054	1	1-055		W	E	340	8	
1-045	2.5	1-046		W	E	230	8	
2-036	2	2-037		E	W	380	8	
2-033	4	2-034		W	E	400	8	
2-022	5	2-024		N	W	400	8	seems like flow increased from above
3-030	12						8	seems like a lot of flow for 3 am
2-020	4	2-032		W	E	300	8	mineral buildup in MH 20
							8	
8-065	3	8-066		E	W	270	8	
8-066	4	8-067	Y	E	W	270	8	
8-055	surcharged						8	
8-072	2 dw	08-073		S	W	350	8	
8-001	surcharged						8	
8-104	surcharged						8	
8-083	2	08-081		EW	N	260	8	
8-100	1	8-099	Y	S	E	250	8	
8-085	1	8-086		W	E	330	8	
8-086	1+	8-087		W	E	310	8	
8-034	2	8-035		N	S	250	8	
8-033	2	8-034		N	S	400	8	
8-010	4	8-039		N	S	250	10	
8-039	3	8-041		N	S	250	10	
8-074	2	8-073	Y	S	N	210	8	
8-071	3	8-072		S	E	210	8	
8-078	full pipe	8-079	Y	E	W	310	8	pipe is clear water
8-068	4	8-078		E	N	270	8	
8-094	1	8-080		W	E	260	8	
8-061	1	8-062		N	E	140	8	
8-059	1	8-060		E	N	320	8	
8-056	1	8-057	Y	S	E	110	8	
8-018	2	8-019		W	N	270	8	
8-019	1	8-020		W	E	270	8	
8-011	1	8-012		N	S	220	8	
8-012	1	8-013		N	S	360	8	
8-003	2	8-004		N	S	300	8	
8-097	3	8-068		E	N	340	10	
8-081	2	8-082		S	N	220	10	
8-004	2	8-005		N	S	140	8	
8-007	1	8-008		N	E	350	8	
8-050	1	8-051		N	W	350	8	
8-048	2 dw	8-046		N	E	340	8	
8-041	2dw	8-042		N	S	340	8	
8-033	2+	8-027		N	E	400	8	
12-103	1	12-106	Y	W	N	400	8	
12-099	1	12-098	Y	W	N	400	8	
12-101	1	12-102	Y	S	W	250	8	
12-092	3,2,3 min	12-098		S	N	250	8	mineral dep
12-092	3	12-222		W	E	270	8	
12-096	1	12-094		N	N	250	8	
12-092	2	12-223		E	W	300	8	

12-090	1	12-091		E	W	100	8	
12-089	2	12-090	Y	E	W	250	8	
12-092	5	12-089		S	N	250	8	
12-084	1.5	12-085		E	N	350	8	
12-086	1	12-087	Y	N	W	250	8	
12-082	2	12-083	Y	E	W	250	8	
12-077	1	12-078		E	W	220	8	
12-067	2	12-069		E	W	300	8	
12-074	1	12-075	Y	E	W	270	8	
12-178	2	12-179		W	N	290	8	
12-172	3	12-173		E	W	200	8	
12-170	1	12-171		S	W	290	8	
12-048	1	12-050		N	W	250	8	
12-046	2	12-048		E	N	300	8	
12-041	1	12-053	Y	E	S	350	8	
12-041	1	12-042		N	S	200	8	
12-039	3	12-033		E	W	300	8	
12-030	1+	12-028		W	S	350	8	
12-061	2	12-060		N	W	360	8	
12-025							8	too little flow here - blockage
12-009	2	12-024				230	8	
12-010	1+	12-011				200	8	
12-002							8	MH leak
13-034	surcharged						8	
13-035	surcharged						8	
13-076	2	13-077		N	E	300	8	
13-077	1	13-078		N	S	300	8	
								no reason for this MH to be surcharged
13-072	surcharged						8	unless blocked
13-068	1	13-069		S	E	250	8	
13-081	surcharged						8	
13-063	surcharged						8	
13-062	surcharged						8	
13-027	surcharged						8	
13-083	1	13-045		E	W	360	8	
13-040	2	13-083		E	S	250	8	
13-038	3	13-039		N	S	330	8	
13-041	1	13-042	Y	E	W	130	8	
13-058	1	13-059	Y	W	E	350	8	
13-048	4	13-046		S	N	340	8	
13-049	2	13-056		W	N	300	8	
13-049	2	13-085		E	N	310	8	
13-048	2	13-055		E	N	300	8	
13-049	2	13-048		S	N	300	8	
12-147	1	12-146	Y	S	N	300	8	
12-198	1	12-199	Y	S	N	200	8	
12-200	1	12-201	Y	W	W	220	8	
12-141	1	12-214	Y	W	S	280	8	
12-139	2	12-140	Y	N	S	250	8	
12-113	2	12-114		W	S	400	8	
12-114	1	12-115		W	N	400	8	
12-145	1	12-146		S	N	300	8	
12-143	2	12-145		S	N	300	8	
12-120	1.5	12-121		W	E	370	8	
12-126	1	12-127		N	S	260	8	
12-127	1	12-135	Y	E	S	270	8	
12-019	1	12-021		W	S	320	8	
13-023	1+	13-024	Y	E	W	200	8	
13-022	2	13-023		E	W	220	8	
13-020	2	13-022		E	S	200	8	

APPENDIX B - SUmmary of Midnight Run Investigation

13-011	surcharged						8	no reason for this to surcharge - blocked grease?
12-198	2	12-200		S	E	240	8	
12-206	2	12-207	Y	S	E	320	8	
12-187	1	12-186	Y	S	E	220	8	
12-185	2	12-186		W	E	330	8	
12-184	3	12-185		W	E	350	8	
12-182	1	12-220	Y			170	8	
12-219	blocked						8	
12-210	1	12-211		W	E	330	8	
12-191	1	12-192		W	N	150	10	
12-014	1	12-016		N	S	300	8	
12-018	1	12-019		N	S	260	8	
14-079	4	14-080		E	N	370	8	
14-086	1	14-063		E	W	400	8	
14-068	2	14-069		W	S	300	8	
14-069	1	14-070	Y	W	E	300	8	
14-067	1	14-066	Y	W	E	370	8	
14-068	3	14-065		W	S	270	8	
14-059	3 dw	14-60		N	S	270	8	
14-058							8	flow too small from north - clean
14-057	5	14-058		N	W	130	8	
14-053	2	14-054		N	E	400	8	
14-074	9	14-075		E	W	300	12	
14-075	7	14-076		E	W	300	12	
14-076	6+	14-077		E	W	40	12	
14-082	1+	14-083	Y	S	N	350	8	
13-015	1	13-016	Y	E	W	300	8	
14-047	1	14-048	Y	N	S	200	8	
14-032	2.5	14-033		S	N	220	8	
14-031	3	14-032		S	W	240	8	
14-029	3	14-030		W	E	390	10	
14-028	5	14-029		W	N	110	10	
14-027	6	14-024		S	N	300	10	lots of mineral dep
14-047	1+	14-046		S	N	350	8	
14-046	2.5	14-045		S	N	320	8	
14-045	5	14-044		S	N	300	8	
14-044	5	14-043		S	N	350	10	mineral dep
13-006	surcharged							
13-005	surcharged							
13-009	surcharged							
13-010	surcharged							
14-028	5	14-029		S	N	350	10	
13-058	2	13-048		E	N	280	8	
12-113	2	12-114		W	E	400	8	
12-114	1+	12-115		W	E	400	8	
12-137	3	12-138		W	E	400	8	
12-138	2	12-139		W	E	230	8	
12-164	2+	12-151		S	E	300	8	
12-132	2	12-151		W	E	200	8	

Appendix C – Listing of Smoke Test Results, Noting the ones Fixed

		Street Address	Latitude	Longitude	Comments	Fixed ?
LS 1						
	1	701 Layne Blvd	25.9762175	-80.1323126	Open 6 inch PvC c/o left of driveway	Yes
	2	661 Layne Blvd	25.9763707	-80.1324207	Cracked 6 inch PvC c/o left of right driveway	Yes
	3	418 Poinciana Dr	25.9763477	-80.1290076	Cracked 4 inch PvC c/o left front	Yes
	4	425 Tamarind Dr	25.9801694	-80.1287359	Open 6 inch PvC c/o right of driveway	Yes
LS 2						
	1	136 Golden Isles Dr	25.9819526	-80.1245041	Light smoke coming from 6 inch PvC c/o in left driveway can't install LDL plug	
	2	130 Golden Isles Dr	25.9822392	-80.12421632	Open 4 inch PvC c/o left front in bushes	Yes
	3	301 Golden Isles Dr	25.9811845	-80 1263681	Open 3 inch metal c/o right side of parking lot	
	4	401 Golden Isles Dr	25.9814253	-80.12697754	Manhole smoking	
	5	1930 Hallandale Beach Blvd	25 9851754	-80.12809707	Open 4 inch metal c/o behind building in driveway	
	6	2100 Hallandale Beach Blvd	25.9851884	-80 12829108	Open 4 inch PvC c/o back right corner of building	Yes
	7	2100 Hallandale Beach Blvd	25.985251	-80.12817089	Open 4 inch PvC c/o right of building in road	Yes
	8	2100 Hallandale Beach Blvd	25.9854659	-80.12831415	Possible open 4 inch c/o under metal cover right side of building by drive-thru	Yes
LS 4						
	1	Across from 930 NE 27th Ave	25.9963618	-80.1218536	Box smoking in grass	
LS 5						
	1	719 Diplomat Pkwy	25.9940846	-80 1302839	Open 4 inch PvC c/o left front	Yes
LS 6						
	1	819 NE 8th St	25.9941483	-80.13977667	Open 4 inch PvC c/o in planters garden center of yard	Yes
	2	822 NE 8th St	25.993925	-80.13959833	Smoking 4 inch PvC c/o right of driveway	Yes
	3	808 NE 7th St	25.9930743	-80.139963	Cracked 4 inch PvC c/o left front	Yes
	4	1124 NE 5th St	25.9916268	-80.13678507	Broken 4 inch PvC c/o right of the c/o can't install LDL plug broke at 'T'	Yes
	5	813 NE 4th St	25.9905517	-80.13963667	Open 4 inch PvC c/o left at property line	Yes
	6	814 NE 4th St	25.9900933	-80.139875	Open 4 inch PvC c/o center of yard by sidewalk	
	7	813 NE 4th St	25.9902469	-80.1398236	Cracked 4 inch PvC c/o right front	Yes
	8	1016 NE 4th St	25.9901635	-80.1377568	Open 3 inch metal c/o front of front porch	
	9	221 NE 11th Ave	25.9890683	-80.13775167	Open 4 inch PvC c/o right of driveway	Yes
	10	818 NW 2nd Ct	25.9887008	-80.1394655	Open 4 inch metal c/o left side of house	Yes
	11	1425 Atlantic Shores Blvd	25.9953753	-80.1335184	Cracked 4 inch metal c/o front of parking spot 114	Yes
	12	1025 Hallandale Beach Blvd	25.9859289	-80.13688489	Open 4 inch PvC c/o in front of plaza sign in meter box	
	13	1107 NE 1st Ct	25.9872793	-80.1369497	Cracked 4 inch PvC c/o right of driveway	Yes
	14	728 NE 1st St	25.9864433	-80.140505	Open 4 inch PvC c/o left front by power poles in open lot	Yes
LS 7						
	1	106 Pembroke Rd	25.9961313	-80.1478251	Cracked 4 inch PvC c/o left front of bowling alley by yellow pole under metal cover	Yes
	2	106 Pembroke Rd	25.9962564	-80.1478433	Cracked 4 inch PvC c/o in left side of parking lot	Yes
	3	200 Pembroke Rd	25.9964716	-80.14704227	Open 4 inch PvC c/o front center by sidewalk	Yes
	4	212 NE 3rd St	25.9890926	-80.1463874	Cracked 6 inch PvC c/o right front of entrance by green electric box	Yes
	5	301 Sea Esta Ln	25.99275	-80.1454309	Open 2 inch metal c/o back right corner of house	
	6	318 NE 6th St	25.9920644	-80.1447685	Cracked 4 inch PvC c/o 10ft front of right side door	Yes
	7	325 Maple St	25.9911827	-80.1450006	Cracked 4 inch PvC c/o in center of empty lot left of address	yes
	8	224 NE 4th St	25.9898961	-80 1457451	Cracked 6 inch PvC c/o right of sidewalk by front door	Yes
	9	312 NE 3rd Ave	25.9890301	-80.1455124	Service line break right of left entrance by power line stake	
	10	410 NE 2nd St	25.9878329	-80.1435691	Open 4 inch PvC c/o back left corner of yard	Yes
	11	111 N Federal Hwy	25.9871791	-80.1430947	Grease trap smoking around cover behind building by dumpster	
	12	105 NE 2nd Terr	25.9866822	-80.1463448	Cracked 4 inch PvC c/o left front	Yes
	13	220 NE 1st Ave	25.9886037	-80.1477572	Possible c/o under cement cover front of suite 218	
	14	209 NE 1st Ave	25.9884722	-80.147977	Open 4 inch metal c/o front of stairs to front door	Yes
	15	500 NE 3rd St	25.9892627	-80.14355518	Open 6 inch PvC c/o behind house inside fence can't install LDL plug	
	16	311 Sea Esta Ln	25.992682	-80.14505932	Illegal connection	
	17	327 Sea Esta Ln	25.9926896	-80.14448356	Service line break back right of trailer	
	18	313 NE 5th St	25.9916793	-80.14515053	Open 3 inch PvC c/o back right of trailer	Yes
	19	345 NE 5th St	25.9914926	-80.14441901	Open 2 inch PvC pipe left at property line	
	20	312 NE 3rd St	25.988719	-80.14540479	Light smoke coming from 6 inch PvC c/o right front of building by trees can't installed LDL plug	
	21	329 NE 1st St	25.9865185	-80.14451305	Open 4 inch PvC c/o right property line	Yes
	22	314 NE 1st St	25.9861714	-80.14496869	Open 4 inch metal c/o 100ft up driveway on right side	

23	118 NE 2nd Terr	25.9875816	-80.14618393	Open 4 inch PvC c/o right of house	Yes
24	19 NE 1st Ave	25.9861488	-80.1479598	Open 4 inch metal c/o right front of building	
LS 8					
1	400 SE 9th Ct	25.9753918	-80.1440164	Cracked 2 inch metal c/o in grass front of door 7	
2	221 SE 9th Ct	25.9756062	-80.14513144	Storm water crossover in driveway	
3	407 SE 9th Ct	25.9755797	-80.1436918	Storm water crossover	
4	SE 9th Ct & SE 3rd Ave	25.9756219	-80.14464534	Storm water crossover	
5	109 Old Federal Hwy	25.9763658	-80.1473281	Cracked 3 inch metal c/o left side of building 10ft front of window	
6	815 SE 1st Ave	25.9767385	-80.14762759	Smoke coming from underneath dumpster	
7	815 SE 1st Ave	25.9764948	-80.1476488	Smoke from outlet socket in building	
8	214 SE 4th St	25.9809078	-80.14573069	Open 3 inch metal c/o right of house	
9	211 SE 1st Ave	25.9825288	-80.14763852	Cracked 3 inch PvC c/o front of building in mulch by propane tank	Yes
10	65 SE 3rd Ave	25.9842477	-80.1453079	Open 6 inch PvC c/o in backyard in fence can't access	
LS 9					
1	107 Pembroke Rd	25.9964313	-80.1502302	Open 4 inch PvC c/o right front in cement	
2	101 NW 10th St	25.9953261	-80.14977846	Open 4 inch PvC c/o in sidewalk left side of brown fence	Yes
3	100 NW 10th St	25.995663	-80.1499169	Possible open 4 inch PvC c/o in fence left front of house	
4	104 NW 9th St	25.9947274	-80.1499668	Smoke in building	
5	Foster Rd & NW 1st Ave	25.9912529	-80.1496682	Open 4 inch PvC c/o in lot off 1st Ave 20ft from storm drain in grass	Yes
6	Foster Rd & NW 1st Ave	25.991059	-80.1497093	Storm water crossover over drain by fire hydrant	
7	Foster Rd & NW 1st Ave	25.9910448	-80.14986481	Storm water crossover	
8	309 NW 1st Ave	25.9895326	-80.14959957	Open 4 inch PvC c/o right front	Yes
9	Foster Rd & Dixie Hwy	25.9913882	-80.1487116	Open 4 inch PvC c/o 100ft left of intersection in grass by sidewalk	Yes
10	309 NW 2nd Ave	25.9898145	-80.1506827	Open 4 inch PvC c/o right front in fence	Yes
11	309 NW 4th Ave	25.989556	-80.1527351	Open 4 inch PvC c/o left of front door	Yes
12	513 NW 3rd Ave	25.9914846	-80.1517599	Cracked 3 inch PvC c/o under right window	Yes
13	600 NW 6th St	25.9919772	-80.1526207	Smoke from under sidewalk back left of yard	
14	816 NW 4th Ave	25.9942272	-80 15246337	Open 4 inch PvC c/o right front by sidewalk	
15	594 NW 9th St	25.9947234	-80.1539554	4 inch PvC c/o broke at 'T' underground under 1st window left side of house	
16	501 NW 10th St	25.995447	-80.1537413	Cracked 4 inch PvC c/o left of driveway	Yes
17	412 NW 10th St	25.9955832	-80.1535754	Smoke from under driveway left side	Yes
18	904 NW 6th Terr	25.9954212	-80.1559129	Cracked 4 inch PvC c/o right front	Yes
19	902 NW 6th Terr	25.9952356	-80.1559462	Cracked 4 inch PvC c/o right of driveway	
20	728 NW 8th Ct	25.9948727	-80.15765043	Open 4 inch PvC c/o right front	
21	818 NW 7th Terr	25.994276	-80.1579849	Open 6 inch PvC c/o across the street in grass	
22	744 NW 7th St	25.9926863	-80.1582855	Cracked 4 inch PvC c/o left of driveway by tree	
23	843 NW 7th St	25.9929472	-80.1605755	Illegal connection in driveway - draining into c/o left front of driveway	
24	839 NW 7th St	25.9929146	-80.1605437	Open 4 inch PvC c/o under right window	Yes
25	846 NW 8th St	25.9938237	-80.1606527	Open 3 inch PvC c/o front center of building	
26	836 NW 10th St	25.9952373	-80.16044153	Open 4 inch PvC c/o left front in grass	Yes
27	845 NW 10th St	25.9953925	-80.160767	Cracked 4 inch PvC c/o front of right window	Yes
28	889 Foster Rd	25.9943228	-80.1603986	Smoke from under square cover right side of business	
29	896 NW 9th St	25.9944561	-80.1606057	Open 4 inch PvC c/o left front	Yes
30	942 NW 10th St	25.9956631	-80.16200935	Cracked 4 inch PvC c/o across the street by white wall	Yes
31	956 NW 10th St	25.9956124	-80.1618863	Cracked 4 inch PvC c/o across the street by white wall	Yes
32	908 NW 10th St	25.9953392	-80.1614459	Possible 4 inch PvC c/o in fence back right of house	
33	1025 NW 8th St	25.994712	-80.1640615	Open 4 inch PvC c/o left of driveway	
34	1045 NW 7th Ct	25.9941795	-80.1646294	Open service line in open lot to the right	
35	737 NW 6th St	25.9919211	-80.1580377	Open 4 inch PvC c/o across the street from address 5ft left of storm drain	Yes
36	744 NW 5th Ct	25.9913064	-80.158134	Possible c/o in fence right side of house under 3rd window	
37	756 NW 5th Ct	25.9911522	-80.1586516	Storm water crossover in grass by stop sign	
38	756 NW 5th St	25.9908954	-80.1584945	Open 2 inch pipe in open right lot 15ft off front right corner of house	
39	757 NW 5th St	25.990706	-80.1586105	Storm water crossover over in grass by sidewalk	
40	514 NW 6th Ave	25.9913071	-80.1546348	Cracked 4 inch PvC c/o right front	Yes
41	402 NW 5th Ave	25.9901102	-80.1531731	Cracked 3 inch service line right side of house	
42	300 NW 5th Terr	25.9892757	-80.15382107	Cracked 4 inch PvC c/o behind house by A/C	
43	533 NW 3rd Ct	25.9892373	-80.1545419	Open 4 inch PvC c/o back left corner of backyard	Yes
44	691 NW 3rd Ct	25.9894509	-80.1547703	Open hole smoking right front inside fence	
45	532 NW 3rd Ct	25.9897179	-80.1546187	Smoke from under cement slab left side of house by A/C	
46	124 NW 5th Ave	25.9871081	-80.1533143	Cracked 4 inch PvC c/o right side of house under 2nd window in fence	
47	219 NW 3rd Ave	25.9886417	-80.1516638	Open 4 inch PvC c/o front of meter room center of building	

48	203 NW 3rd Ave	25.9879566	-80.1514233	Smoke in building	
49	208 NW 2nd Ave	25.988258	-80.1503353	Cracked 3 inch PvC c/o in fence left side of house front of second window	
50	212 NW 2nd Ave	25.9884633	-80.15034333	Open 2 inch pipe right side of house by window	
51	212 NW 2nd Ave	25.9884817	-80.15027333	Possible service line break left side of house by sidewalk	
52	124 NW 2nd Ave	25.9873677	-80.1504209	Cracked 4 inch PvC c/o center left of parking spot 124B light smoke	Yes
53	208 NW 1st Ave	25.9881938	-80.149306	Possible c/o under cover cemented down front of meter room	Yes
54	30 NW 10th St	25.9956197	-80.14956443	Open 4 inch PvC c/o in driveway	Yes
55	3 NW 4th St	25.9900307	-80.1501957	Open 4 inch PvC c/o right front of building	Yes
56	302 NW 3rd Ave	25.9897301	-80.15152335	Open 6 inch PvC c/o left of driveway	
57	416 NW 3rd Ave	25.990741	-80.15139466	Open 4 inch PvC c/o behind building by concrete pad	
58	416 NW 3rd Ave	25.9907966	-80.15136793	Open hole smoking	Yes
59	420 NW 7th Ct	25.9932546	-80.15355712	Open 4 inch PvC c/o left at property line	Yes
60	302 NW 8th St	25.9937023	-80.15172344	Open 4 inch PvC c/o behind house by fence	
61	308 NW 7th Ct	25.9936504	-80.15217432	Open hole smoking	
62	404 NW 8th St	25.9937184	-80.15335727	Open 4 inch metal c/o left of house by window	
63	412 NW 10th St	25.9956248	-80.15366645	Light smoke coming from 4 inch c/o left front	Yes
64	629 NW 9th Ct	25.9948952	-80.15642321	Open 3 inch PvC c/o center of yard by sidewalk	Yes
65	621 Pembroke Rd	25.9961352	-80.15583168	Open 4 inch PvC c/o right of lot by sidewalk	
66	725 NW 7th Ave	25.9934021	-80.1569006	Open 4 inch PvC c/o center of building	
67	842 NW 8th St	25.9935549	-80.16056237	Open 4 inch PvC c/o back right of building	Yes
68	803 NW 9th St	25.9943911	-80.1592159	Open 4 inch PvC c/o in valve box	Yes
69	1020 Foster Rd	25.9952178	-80.16353002	Open 4 inch PvC c/o left front by sidewalk	Yes
70	1000 Foster Rd	25.9945281	-80.16216427	Open 4 inch PvC c/o left of house by window	Yes
71	1029 NW 8th St	25.9947684	-80.16439141	Smoke entered building	
72	Across from 713 NW 5th St	25.990905	-80.15722167	Across from address center of lot	
73	660 NW 4th Ct	25.9904917	-80.15661667	Light smoke coming from 3 inch PvC c/o center of building by window	Yes
74	505 NW 5th St	25.990831	-80.15375047	Open 4 inch PvC c/o center of yard by sidewalk	Yes
75	505 NW 5th St	25.990795	-80.15379667	Open 4 inch PvC c/o right of front door	Yes
76	648 NW 3rd Ct	25.9896093	-80.15813439	Open 4 inch PvC c/o right of front door	Yes
77	621 NW 6th Ct	25.9914317	-80.155645	Open 4 inch PvC c/o center of yard by sidewalk	Yes
78	100 NW 5th Ave	25.9864827	-80.15327797	Open 4 inch PvC c/o back left property line	
79	206 NW 4th Ave	25.98817	-80.15227167	Open 4 inch PvC c/o in parking lot left of front door	
80	107 NW 4th Ave	25.9863633	-80.15249	Open 4 inch PvC c/o left at property line	
81	107 NW 4th Ave	25.9863667	-80.15245167	Open 4 inch PvC c/o left at property line	
	718 Nw 9 Ct	25.9948773	-80.1576497		Yes
	737 Nw 6th St	25.9919148	-80.15803024		Yes

LS 12

1	603 SW 1st St	25.98449	-80.15474333	Open 4 inch PvC c/o right front by sidewalk	
2	601 Hallandale Beach Blvd	25.984775	-80.15439833	Grease trap smoking	
3	612 SW 1st Ct	25.9839028	-80.1548632	Open 4 inch PvC c/o left property line	yes
4	210 SW 6th Ave	25.982753	-80.1542406	Open 4 inch PvC c/o right of driveway	yes
5	409 Hallandale Beach Blvd	25.9847081	-80.1531456	Open 4 inch PvC c/o behind address in handicap spot front of door 422	yes
6	112 SW 2nd Ave	25.9840267	-80.1504968	Open 4 inch PvC c/o left front	yes
7	120 SW 2nd Ave	25.983865	-80.1504211	Possible c/o inside water meter box left front of driveway by sidewalk	yes
8	27 Hallandale Beach Blvd	25.98477	-80.148865	Open 4 inch PvC c/o back right property by sidewalk	yes
9	203 SW 2nd Ave	25.9830941	-80.1502218	Cracked 4 inch PvC c/o left property line light smoke	yes
10	117 SW 1st Ave	25.9840906	-80.1490971	Smoke from under sidewalk right side of house under 2nd window	
11	202 Dixie Hwy	25.9830983	-80.14866667	Broken 4 inch PvC c/o at 'T' behind building by sidewalk	
12	221 SW 2nd Ave	25.9823645	-80.1502515	Cracked 4 inch PvC c/o left front	yes
13	201 SW 3rd St	25.9819017	-80.15058167	Open 4 inch PvC c/o left property line	yes
14	233 SW 4th St	25.9808208	-80.1514516	Open 4 inch PvC c/o right front	yes
15	314 SW 3rd St	25.98188	-80.15197667	Open 4 inch PvC c/o left front by sidewalk	yes
16	209 SW 5th Ave	25.9826642	-80.1530189	Open 4 inch PvC c/o right front	yes
17	209 SW 5th Ave	25.9828075	-80.1530065	Open 4 inch PvC c/o 20ft left of left property line	yes
18	613 SW 3rd St	25.9814012	-80.1548879	Smoke from under sidewalk right side of house in fence	
19	629 SW 4th St	25.9808071	-80.1554671	Cracked 4 inch PvC c/o right of driveway	yes
20	701 SW 7th Ave	25.98064	-80.15650167	Open 4 inch PvC c/o back right property line	yes
21	604 SW 4th St	25.9809326	-80.1543141	Open 4 inch PvC c/o right of driveway	yes
22	709 SW 4th St	25.9805809	-80.15683825	Open 4 inch PvC c/o right of front door	yes
23	712 SW 4th St	25.980785	-80.15694167	Open 4 inch PvC c/o center of yard	yes

24	732 SW 4th St	25.9807983	-80.15781667	Open 4 inch PvC c/o center of yard	yes
25	701 SW 4th Ct	25.9798735	-80.1565297	Cracked 4 inch PvC c/o left of front door	yes
26	405 SW 6th St	25.9806317	-80.1543567	Open 4 inch PvC c/o left front	yes
27	401 SW 6th St	25.9806239	-80.1542647	Cracked 4 inch PvC c/o right side of house under 1st window	yes
28	419 SW 6th Ave	25.9791844	-80.1542951	Cracked 4 inch PvC c/o right of driveway by fence	yes
29	416 SW 4th St	25.9810229	-80.1530566	Open hole smoking right of driveway	
30	500 SW 4th St	25.980995	-80.15338833	Open 4 inch PvC c/o right front by sidewalk	yes
31	217 SW 5th St	25.9797948	-80.1513446	Smoke from under cement under window left of door	yes
32	420 SW 3rd Terr	25.9801703	-80.1519195	Cracked 4 inch PvC c/o center of front yard	yes
33	416 SW 3rd Terr	25.9803295	-80.151969	Open 4 inch PvC c/o center of front yard	yes
34	210 SW 5th St	25.97997	-80.15096333	Light smoke coming from 3 inch PvC c/o left of driveway	yes
35	35 SW 4th St	25.98081	-80.14934167	Open 4 inch PvC c/o left property line	yes
36	105 SW 4th St	25.9806598	-80.1497939	Cracked 3 inch PvC c/o right side of house in fence can't install LDL plug	
37	31 SW 4th St	25.9807933	-80.14926	Open 4 inch PvC c/o left front by sidewalk	yes
38	25 SW 4th St	25.980805	-80.14910667	Open 3 inch PvC c/o in middle of driveway	yes
39	617 SW 5th Ct	25.979413	-80.1549468	Cracked 4 inch PvC c/o 20ft left of driveway	yes
40	755 SW 6th St	25.9786523	-80.1581971	Open 4 inch PvC c/o center of front yard	yes
41	825 SW 5th Ct	25.9792667	-80.15917667	Storm water crossover	
42	651 SW 6th St	25.9787267	-80.15598693	Open 4 inch PvC c/o left of driveway	yes
43	Across from 724 SW 6th St	25.9786817	-80.15753667	Smoking 6 inch PvC c/o across the street by sidewalk	
44	705 SW 6th Terr	25.977585	-80.15491461	Open 4 inch PvC c/o right front by sidewalk	yes
45	716 SW 6th Terr	25.9772509	-80.1550834	Cracked 3 inch PvC c/o right front	
46	716 SW 6th Terr	25.9771193	-80.15503888	Smoking 4 inch PvC c/o left front by sidewalk	yes
47	700 SW 9th St	25.975935	-80.15629833	Open 3 inch PvC c/o right front of house can't install LDL plug	
48	618 SW 8th St	25.9765065	-80.15490402	Open 4 inch PvC c/o right front	yes
49	722 SW 8th St	25.9763708	-80.15711868	Open 4 inch PvC c/o left property line	yes
50	130 SW 7th Ave	25.9767541	-80.1562501	Cracked 6 inch PvC c/o across the street 1ft from road	yes
51	627 SW 7th Ave	25.9779573	-80.15642985	Open 4 inch PvC c/o right front	yes
52	729 SW 7th Ct	25.9770066	-80.157189	Open 4 inch PvC c/o left of driveway	
53	700 SW 7th Terr	25.9775874	-80.1577446	Cracked 4 inch PvC c/o left side of house by road	
54	721 SW 7th Terr	25.9768692	-80.1575289	Cracked 4 inch PvC c/o right side of house under 1st window	yes
55	202 SW 7th St	25.9779075	-80.15878266	Open 4 inch PvC c/o left property line	yes
56	905 SW 7th Terr	25.9752783	-80.15754667	Open 4 inch PvC c/o left property line	yes
57	1005 SW 7th Terr	25.9745083	-80.1575	Open 4 inch PvC c/o right of driveway	yes
58	635 SW 10th St	25.9748154	-80.15543428	Open 4 inch PvC c/o center of front yard	yes
59	642 SW 11th St	25.9742517	-80.15569833	Open 4 inch PvC c/o right property line	yes
60	520 SW 8th St	25.976759	-80.15418418	Open 4 inch PvC c/o back left of house by gate	yes
61	416 SW 10th St	25.9751239	-80.1529595	Open 4 inch PvC c/o right front	yes
62	420 SW 10th St	25.9749378	-80.1532208	Service line break across the street 50ft from road in open field	
63	232 SW 9th St	25.9758233	-80.15160703	Open 4 inch PvC c/o left of driveway	yes
64	1004 SW 3rd Ave	25.9747573	-80.1518868	Open 4 inch PvC c/o left front of porch	yes
65	111 SW 10th St	25.9750734	-80.1499708	Hole drill in cap of c/o right front in sidewalk light smoke	yes
66	100 SE 11th St	25.9744263	-80.14940987	Broken 4 inch PvC c/o center of yard by sidewalk	
67	108 SW 10th St	25.9751979	-80.1497521	Open 4 inch PvC c/o left front	
68	200 SW 11th St	25.974424	-80.15041877	Open 4 inch PvC c/o back left of building in sidewalk can't install LDL plug	
69	107 SW 9th St	25.9758203	-80.14968608	Open 4 inch PvC c/o left front	yes
70	800 SW 2nd Ave	25.9763521	-80.15015516	Open 4 inch PvC c/o left of driveway	yes
71	17 SW 6th St	25.9790107	-80.148804	Cracked 3 inch PvC c/o right of driveway by sidewalk	yes
72	610 S Dixie Hwy	25.9786409	-80.14850513	Open 4 inch PvC c/o right of house by window	yes
73	600 SW 3rd Ave	25.9786158	-80.1514094	Open 4 inch PvC c/o front door in grass	yes
74	304 SW 8th St	25.97669	-80.1514057	Open 4 inch PvC c/o right of driveway	yes
75	727 SW 3rd Ave	25.9769254	-80.15110471	Open 4 inch PvC c/o left of driveway	yes
76	415 SW 8th St	25.9763977	-80.1529801	Open 4 inch PvC c/o right front of parking spots in cement	yes
77	735 SW 5th Ave	25.9767842	-80.1530707	Smoke under cement under A/C left back corner of house	
78	629 SW 2nd St	25.9830022	-80.1552336	Cracked 4 inch PvC c/o left front corner of house	yes

LS 13

1	1040 SW 8th St	25.9767215	-80.16417287	Open 4 inch PvC c/o right property line	Yes
2	1036 SW 8th St	25.976765	-80.164105	Open 4 inch PvC c/o left front of house	Yes
3	1015 SW 10th Ave	25.974592	-80.161865	Open 2 inch pipe behind building by A/C in fence	
4	813 SW 10th St	25.9748721	-80.1589174	Cracked 4 inch PvC c/o right front by sidewalk	Yes
5	812 SW 11th St	25.9742567	-80.15889	Open 4 inch PvC c/o left of house by A/C unit	Yes
6	1013 SW 8th Ave	25.9741933	-80.15818333	Open 4 inch PvC c/o center of yard by sidewalk	Yes
7	826 SW 9th St	25.9759987	-80.1593899	Open 4 inch PvC c/o under right window	Yes

8	833 SW 8th St	25.9766418	-80.1594643	Cracked 3 inch PvC c/o under right window	Yes
9	845 SW 8th St	25.9767248	-80.1599152	Open 4 inch PvC c/o center of yard by sidewalk	Yes
10	531 SW 11th Ave	25.97858	-80.16503833	Open 4 inch PvC c/o right property line	Yes
11	421 SW 11th Ave	25.9798665	-80.1646452	Cracked 3 inch PvC c/o right property line	Yes
12	830 SW 2nd St	25.9831789	-80.15972622	Smoking 4 inch PvC c/o in parking spot 3	Yes
13	830 SW 2nd St	25.9831771	-80.15977033	Smoking 4 inch PvC c/o under car in parking spot 5	Yes
14	261 SW 9th St	25.9819189	-80.16036853	Cracked 4 inch PvC c/o right property line	Yes
15	420 SW 10th Terr	25.97994	-80.16403	Open 4 inch PvC c/o left front	
16	322 SW 10th Terr	25.9806525	-80.16418578	Open 4 inch PvC c/o left side of house by trash cans	Yes
17	713 SW 2nd Ct	25.9822247	-80.1569731	Open 4 inch PvC c/o right of left driveway	
18	301 SW 8th Ave	25.9814848	-80.15843338	Open 4 inch PvC c/o left front by sidewalk	Yes
19	132 SW 7th Terr	25.9829116	-80.15738512	Open 4 inch PvC c/o left side of house under 1st window	Yes

LS 14

1	741 NW 2nd St	25.9875658	-80.1582917	Cracked 6 inch PvC c/o left front in sidewalk	Yes
2	700 NW 1st Ct	25.9871868	-80.1562465	Open 4 inch PvC c/o right of house by fence	Yes
3	721 NW 1st Ct	25.9867598	-80.157375	Open 4 inch PvC c/o left side of building front of 1st door in fence	
4	710 NW 1st Ct	25.9871371	-80.156857	Open 4 inch PvC c/o right front	Yes
5	729 NW 1st Ct	25.9868074	-80.1577338	Cracked 4 inch PvC c/o left front in fence	Yes
6	706 NW 1st Ct	25.9871738	-80.1567262	Open 4 in metal c/o right of building by door A	
7	737 NW 1st Ct	25.9868163	-80.1580991	Smoke from corner of back left of house in fence	
8	136 NW 8th Ave	25.9872443	-80.1584268	Open 4 inch PvC c/o right front by sidewalk	Yes
9	730 Hallandale Beach Blvd	25.9859665	-80.1580979	Open 4 inch PvC c/o back left of building behind dumpster	Yes
10	700 Hallandale Beach Blvd	25.9850046	-80.156421	Open 4 inch PvC c/o right of driveway	Yes
11	800 Hallandale Beach Blvd	25.9852331	-80.1584268	Open 4 inch PvC c/o back right of building by air pump	Yes
12	23 NW 8th Ave	25.9852818	-80.1584704	Open 4 inch PvC c/o left front by wall	Yes
13	1016 Hallandale Beach Blvd	25.9863359	-80.1625256	Concrete box smoking back left of building	
14	1080 Hallandale Beach Blvd	25.9853932	-80.1640727	Cracked 4 inch PvC c/o back left corner of building	Yes
15	1080 Hallandale Beach Blvd	25.9854795	-80.1641161	Open 4 inch PvC c/o 20ft off back left corner of building	Yes
16	1080 Hallandale Beach Blvd	25.985677	-80.164697	Metal box back left of building	
17	1080 Hallandale Beach Blvd	25.9854337	-80.1640881	Metal box smoking back left of building	
18	430 Ansin Blvd	25.9901884	-80.1652998	Open 6 inch PvC c/o left of entrance under mteal cover	
19	373 Ansin Blvd	25.9894033	-80.16443833	Open 4 inch PvC c/o middle of building by parking lot	Yes
20	1048 NW 3rd St	25.9873302	-80.1632448	Cracked 4 inch metal c/o right of front door	
21	1040 NW 3rd St	25.987437	-80.1629539	Open 4 inch metal c/o right of front door	
22	16 SW 10th Terr	25.9838183	-80.162565	Open 3 inch PvC c/o right front	Yes
23	15 SW 10th Terr	25.9839064	-80.1623372	Smoke from open 3 inch pipe from under side of house	
24	16 SW 10th Terr	25.98385	-80.16242167	Broken service line right of house	Yes
25	1049 SW 2nd St	25.9828868	-80.1632796	Cracked 4 inch PvC c/o right front	Yes
26	21 SW 10th Terr	25.9832233	-80.1626651	Open 6 inch PvC c/o across the street sidewalk under metal cover	Yes
27	1077 NW 2nd St	25.9828751	-80.1641393	4 inch PvC c/o broke at 'T' under right front driveway	
28	241 SW 10th Ave	25.9822539	-80.1614958	Open 4 inch PvC c/o left front	Yes
29	242 SW 10th Ave	25.9820905	-80.1615932	Open 4 inch PvC c/o front of left window in driveway	Yes
30	121 SW 10 Ave	25.9837533	-80.16150687	Open 6 inch PvC c/o center of lot by sidewalk	Yes
31	1001 SW 10th Ave	25.9815405	-80.1617519	Cracked 4 inch PvC c/o left side of house by parking spots	Yes
32	747 Hallandale Beach Blvd	25.9845525	-80.1582084	Smoking grease trap behind address	
33	747 Hallandale Beach Blvd	25.9845901	-80.1582093	Grease trap smoking around cover behind address	

Appendix D – Addresses of properties that should be notified on inflow openings

LS 2	Street Address	Latitude	Longitude	Comments
1	136 Golden Isles Dr	25.9819526	-80.1245041	Light smoke coming from 6 inch PvC c/o in left driveway can't install LDL
3	301 Golden Isles Dr	25.9811845	-80.1263681	Open 3 inch metal c/o right side of parking lot
4	401 Golden Isles Dr	25.9814253	-80.12697754	Manhole smoking
5	1930 Hallandale Beach Blvd	25.9851754	-80.12809707	Open 4 inch metal c/o behind building in driveway
LS 4				
1	Across from 930 NE 27th Ave	25.9963618	-80.1218536	Box smoking in grass
LS 6				
6	814 NE 4th St	25.9900933	-80.139875	Open 4 inch PvC c/o center of yard by sidewalk
8	1016 NE 4th St	25.9901635	-80.1377568	Open 3 inch metal c/o front of front porch
12	1025 Hallandale Beach Blvd	25.9859289	-80.13688489	Open 4 inch PvC c/o in front of plaza sign in meter box
LS 7				
5	301 Sea Esta Ln	25.99275	-80.1454309	Open 2 inch metal c/o back right corner of house
9	312 NE 3rd Ave	25.9890301	-80.1455124	Service line break right of left entrance by power line stake
11	111 N Federal Hwy	25.9871791	-80.1430947	Grease trap smoking around cover behind building by dumpster
13	220 NE 1st Ave	25.9886037	-80.1477572	Possible c/o under cement cover front of suite 218
15	500 NE 3rd St	25.9892627	-80.14355518	Open 6 inch PvC c/o behind house inside fence can't install LDL plug
16	311 Sea Esta Ln	25.992682	-80.14505932	Illegal connection
17	327 Sea Esta Ln	25.9926896	-80.14448356	Service line break back right of trailer
19	345 NE 5th St	25.9914926	-80.14441901	Open 2 inch PvC pipe left at property line
20	312 NE 3rd St	25.988719	-80.14540479	Light smoke coming from 6 inch PvC c/o right front of building by trees
22	314 NE 1st St	25.9861714	-80.14496869	Open 4 inch metal c/o 100ft up driveway on right side
24	19 NE 1st Ave	25.9861488	-80.1479598	Open 4 inch metal c/o right front of building
LS 8				
1	400 SE 9th Ct	25.9753918	-80.1440164	Cracked 2 inch metal c/o in grass front of door 7
2	221 SE 9th Ct	25.9756062	-80.14513144	Storm water crossover in driveway
3	407 SE 9th Ct	25.9755797	-80.1436918	Storm water crossover
4	SE 9th Ct & SE 3rd Ave	25.9756219	-80.14464534	Storm water crossover
5	109 Old Federal Hwy	25.9763658	-80.1473281	Cracked 3 inch metal c/o left side of building 10ft front of window
6	815 SE 1st Ave	25.9767385	-80.14762759	Smoke coming from underneath dumpster
7	815 SE 1st Ave	25.9764948	-80.1476488	Smoke from outlet socket in building
8	214 SE 4th St	25.9809078	-80.14573069	Open 3 inch metal c/o right of house
10	65 SE 3rd Ave	25.9842477	-80.1453079	Open 6 inch PvC c/o in backyard in fence can't access
LS 9				
1	107 Pembroke Rd	25.9964313	-80.1502302	Open 4 inch PvC c/o right front in cement
3	100 NW 10th St	25.995663	-80.1499169	Possible open 4 inch PvC c/o in fence left front of house
4	104 NW 9th St	25.9947274	-80.1499668	Smoke in building
6	Foster Rd & NW 1st Ave	25.991059	-80.1497093	Storm water crossover over drain by fire hydrant
7	Foster Rd & NW 1st Ave	25.9910448	-80.14986481	Storm water crossover
13	600 NW 6th St	25.9919772	-80.1526207	Smoke from under sidewalk back left of yard
14	816 NW 4th Ave	25.9942272	-80.15246337	Open 4 inch PvC c/o right front by sidewalk
15	594 NW 9th St	25.9947234	-80.1539554	4 inch PvC c/o broke at 'T' underground under 1st window left side of
19	902 NW 6th Terr	25.9952356	-80.1559462	Cracked 4 inch PvC c/o right of driveway
20	728 NW 8th Ct	25.9948727	-80.15765043	Open 4 inch PvC c/o right front
21	818 NW 7th Terr	25.994276	-80.1579849	Open 6 inch PvC c/o across the street in grass
22	744 NW 7th St	25.9926863	-80.1582855	Cracked 4 inch PvC c/o left of driveway by tree
23	843 NW 7th St	25.9929472	-80.1605755	Illegal connection in driveway - draining into c/o left front of driveway
25	846 NW 8th St	25.9938237	-80.1606527	Open 3 inch PvC c/o front center of building

28	889 Foster Rd	25.9943228	-80.1603986	Smoke from under square cover right side of business
32	908 NW 10th St	25.9953392	-80.1614459	Possible 4 inch PvC c/o in fence back right of house
33	1025 NW 8th St	25.994712	-80.1640615	Open 4 inch PvC c/o left of driveway
34	1045 NW 7th Ct	25.9941795	-80.1646294	Open service line in open lot to the right
36	744 NW 5th Ct	25.9913064	-80.158134	Possible c/o in fence right side of house under 3rd window
37	756 NW 5th Ct	25.9911522	-80.1586516	Storm water crossover in grass by stop sign
38	756 NW 5th St	25.9908954	-80.1584945	Open 2 inch pipe in open right lot 15ft off front right corner of house
39	757 NW 5th St	25.990706	-80.1586105	Storm water crossover over in grass by sidewalk
41	402 NW 5th Ave	25.9901102	-80.1531731	Cracked 3 inch service line right side of house
42	300 NW 5th Terr	25.9892757	-80.15382107	Cracked 4 inch PvC c/o behind house by A/C
44	691 NW 3rd Ct	25.9894509	-80.1547703	Open hole smoking right front inside fence
45	532 NW 3rd Ct	25.9897179	-80.1546187	Smoke from under cement slab left side of house by A/C
46	124 NW 5th Ave	25.9871081	-80.1533143	Cracked 4 inch PvC c/o right side of house under 2nd window in fence
47	219 NW 3rd Ave	25.9886417	-80.1516638	Open 4 inch PvC c/o front of meter room center of building
48	203 NW 3rd Ave	25.9879566	-80.1514233	Smoke in building
49	208 NW 2nd Ave	25.988258	-80.1503353	Cracked 3 inch PvC c/o in fence left side of house front of second window
50	212 NW 2nd Ave	25.9884633	-80.15034333	Open 2 inch pipe right side of house by window
51	212 NW 2nd Ave	25.9884817	-80.15027333	Possible service line break left side of house by sidewalk
56	302 NW 3rd Ave	25.9897301	-80.15152335	Open 6 inch PvC c/o left of driveway
57	416 NW 3rd Ave	25.990741	-80.15139466	Open 4 inch PvC c/o behind building by concrete pad
60	302 NW 8th St	25.9937023	-80.15172344	Open 4 inch PvC c/o behind house by fence
61	308 NW 7th Ct	25.9936504	-80.15217432	Open hole smoking
62	404 NW 8th St	25.9937184	-80.15335727	Open 4 inch metal c/o left of house by window
65	621 Pembroke Rd	25.9961352	-80.15583168	Open 4 inch PvC c/o right of lot by sidewalk
66	725 NW 7th Ave	25.9934021	-80.1569006	Open 4 inch PvC c/o center of building
71	1029 NW 8th St	25.9947684	-80.16439141	Smoke entered building
72	Across from 713 NW 5th St	25.990905	-80.15722167	Across from address center of lot
78	100 NW 5th Ave	25.9864827	-80.15327797	Open 4 inch PvC c/o back left property line
79	206 NW 4th Ave	25.98817	-80.15227167	Open 4 inch PvC c/o in parking lot left of front door
80	107 NW 4th Ave	25.9863633	-80.15249	Open 4 inch PvC c/o left at property line
81	107 NW 4th Ave	25.9863667	-80.15245167	Open 4 inch PvC c/o left at property line

LS 12

1	603 SW 1st St	25.98449	-80.15474333	Open 4 inch PvC c/o right front by sidewalk
2	601 Hallandale Beach Blvd	25.984775	-80.15439833	Grease trap smoking
10	117 SW 1st Ave	25.9840906	-80.1490971	Smoke from under sidewalk right side of house under 2nd window
11	202 Dixie Hwy	25.9830983	-80.14866667	Broken 4 inch PvC c/o at 'T' behind building by sidewalk
18	613 SW 3rd St	25.9814012	-80.1548879	Smoke from under sidewalk right side of house in fence
29	416 SW 4th St	25.9810229	-80.1530566	Open hole smoking right of driveway
36	105 SW 4th St	25.9806598	-80.1497939	Cracked 3 inch PvC c/o right side of house in fence can't install LDL plug
41	825 SW 5th Ct	25.9792667	-80.15917667	Storm water crossover
43	Across from 724 SW 6th St	25.9786817	-80.15753667	Smoking 6 inch PvC c/o across the street by sidewalk
45	716 SW 6th Terr	25.9772509	-80.1550834	Cracked 3 inch PvC c/o right front
47	700 SW 9th St	25.975935	-80.15629833	Open 3 inch PvC c/o right front of house can't install LDL plug
52	729 SW 7th Ct	25.9770066	-80.157189	Open 4 inch PvC c/o left of driveway
53	700 SW 7th Terr	25.9775874	-80.1577446	Cracked 4 inch PvC c/o left side of house by road
62	420 SW 10th St	25.9749378	-80.1532208	Service line break across the street 50ft from road in open field
66	100 SE 11th St	25.9744263	-80.14940987	Broken 4 inch PvC c/o center of yard by sidewalk
67	108 SW 10th St	25.9751979	-80.1497521	Open 4 inch PvC c/o left front
68	200 SW 11th St	25.974424	-80.15041877	Open 4 inch PvC c/o back left of building in sidewalk can't install LDL plug
77	735 SW 5th Ave	25.9767842	-80.1530707	Smoke under cement under A/C left back corner of house

LS 13

3	1015 SW 10th Ave	25.974592	-80.161865	Open 2 inch pipe behind building by A/C in fence
15	420 SW 10th Terr	25.97994	-80.16403	Open 4 inch PvC c/o left front
17	713 SW 2nd Ct	25.9822247	-80.1569731	Open 4 inch PvC c/o right of left driveway
LS 14				
3	721 NW 1st Ct	25.9867598	-80.157375	Open 4 inch PvC c/o left side of building front of 1st door in fence
6	706 NW 1st Ct	25.9871738	-80.1567262	Open 4 in metal c/o right of building by door A
7	737 NW 1st Ct	25.9868163	-80.1580991	Smoke from corner of back left of house in fence
13	1016 Hallandale Beach Blvd	25.9863359	-80.1625256	Concrete box smoking back left of building
16	1080 Hallandale Beach Blvd	25.985677	-80.164697	Metal box back left of building
17	1080 Hallandale Beach Blvd	25.9854337	-80.1640881	Metal box smoking back left of building
18	430 Ansin Blvd	25.9901884	-80.1652998	Open 6 inch PvC c/o left of entrance under mteal cover
20	1048 NW 3rd St	25.9873302	-80.1632448	Cracked 4 inch metal c/o right of front door
21	1040 NW 3rd St	25.987437	-80.1629539	Open 4 inch metal c/o right of front door
23	15 SW 10th Terr	25.9839064	-80.1623372	Smoke from open 3 inch pipe from under side of house
27	1077 NW 2nd St	25.9828751	-80.1641393	4 inch PvC c/o broke at 'T' under right front driveway
32	747 Hallandale Beach Blvd	25.9845525	-80.1582084	Smoking grease trap behind address
33	747 Hallandale Beach Blvd	25.9845901	-80.1582093	Grease trap smoking around cover behind address

Manhole	Comments
10-003	heavy mineral deposits on walls of MH
1-006	under canal
	something wierd here, lots of clean water, mineral buildup
1-014	(next to canal)
1-016	leak in MH trough
1-023	Septic - belly
1-049	CHK MH
1-053	leak between pipe and liner
12-002	MH leak
12-025	too little flow here - blockage
12-092	mineral dep
13-011	no reason for this to surcharge - blocked grease?
13-072	no reason for this MH to be surcharged unless blocked
	heavy paint smell & grease - industrial issue, line not
14-007	accessible
14-016	large, very dirtly flow from high school at 4 am
14-017	mislabeled on map
14-027	lots of mineral dep
14-044	mineral dep
14-058	flow too small from north - clean
18-013	leak in MH also
2-020	mineral buildup in MH 20
2-022	seems like flow increased from above
2-027	dish in manhole
2-030	leak at liner
3-006	surcharged
3-007	surcharged
3-008	surcharged
3-024	3:00 AM
3-030	seems like a lot of flow for 3 am
3-033	**full of adult diapers**
3-035	mineral buildup
3-043	clear water in park
3-044	large, clear water flow
3-050	flow from condo t 3 am
5-006	check clear water
6-002	large flow from east
6-010	large flow from east
6-016	large flow from east
6-018	gold watch or bracelet
6-020	grease
6-021	major grease issue
6-026	large flow from east
6-029	large flow from east
6-033	may be nothing given upstream flow

6-036	coming from north
6-045	halfful coming off HBB
6-047	large flow from east
6-069	liner, big leak
6-091	big leak at liner IN MH
6-093a	guardshack has 4 in flow constantly, not on map
6-095	liner LEAK
6-096	blockage in line, liner
6-103	huge clean flow coming in
6-105	MH leak
6-107	old dish in botom
6-109	cant find
6-110	cant find
6-113	major flow
6-126	grease
6-128	large flow from east
7-016	not accessible clear water
7-084	comes off HBB
8-078	pipe is clear water
9-010	huge flow coming from high school at 4 am
9-011	flow enters from high school service line?
9-018	tv line under Pembroke road - has flow uncertain why
9-034	Cant see this but there is flow I MH 9-084
9-055	in pembroke road.
9-057	laundromat? CHECK
9-089	is there a LS outsie gate of WTP - flow comes form WTP
9-109	dish in hole
9-134	nw 3rd ave - mh unnumbered
9-182	laundry pumping about 1/2 full pipe
9-194	parallel lilne above main line
9-195	could be skipped, parallel lilne above main line
	3 way manhole - high flow from DE south, not much picked
9-197	up N &E
LS 3	top leaks and needs to be raised

Appendix F – Specifications for Phase I

SECTION 027800 - INFILTRATION AND INFLOW PROGRAM – SEALING SYSTEM FORM INFLOW OR REPAIRS OF SYSTEM

1 - Not used

2 – CONTRACTOR's Responsibility

2.1 CONTRACTOR agrees to do everything required by this Agreement and to comply with any and all other provisions in the documents and items incorporated by reference into this Agreement. CONTRACTOR also agrees to perform all clean-up and bear the expense of any off-site disposal, which is or may be necessitated by its Project work.

2.2 CONTRACTOR agrees that all work performed under this Agreement shall be done in a professional manner and that CONTRACTOR's efforts will produce a quality result.

2.3 CONTRACTOR represents to Town, with full knowledge that Town is relying upon these representations when entering into this Agreement with CONTRACTOR, that CONTRACTOR has the expertise, experience and work force sufficient to timely perform the services to be provided by CONTRACTOR pursuant to the terms of this Agreement.

2.4 CONTRACTOR represents to Town that CONTRACTOR is properly licensed by all applicable federal, state and local agencies to provide the services specified under this Agreement. If any of the CONTRACTOR's licenses are revoked, suspended or terminated for any reason by any governmental agency, CONTRACTOR shall notify the Town immediately.

2.5 CONTRACTOR agrees to conduct all work and services under this Agreement in accordance with all applicable federal, state and local laws and regulations. CONTRACTOR will identify all governmental authorities and agencies having jurisdiction to approve work involved in the Project and CONTRACTOR agrees to obtain all permits and approvals from any and all such governmental authorities which have jurisdiction. If permitted by the permitting agency, and if Town can realize a cost savings by such action, Town may authorize the CONTRACTOR to seek required permits on behalf of and in the name of Town as its CONTRACTOR; provided, however, that CONTRACTOR agrees to fully indemnify and hold harmless the Town in all respects as a result of the obtaining of any and all such permits and approvals. Without limiting the foregoing, Town agrees to reimburse CONTRACTOR, upon Town's receipt of adequate proof that CONTRACTOR has paid same, the amounts of all permit fees incurred by CONTRACTOR in connection with the applications, processing and securing of approvals or permits which are required to be obtained from all governmental authorities which have jurisdiction over any and all aspects of this work, except Town permits and fees which shall be waived and except for so much of any fees as to which the Town is required to remit to other governmental agencies.

2.6 ENGINEER, or other designated representative, will be the person through whom CONTRACTOR must communicate all information pertaining to the Project.

2.7 CONTRACTOR shall guarantee the entire Project work against poor workmanship and faulty materials for a period of one (1) year after final payment and shall immediately correct any defects which may appear during this period upon written notification by the Town's ENGINEER or designated representative. CONTRACTOR waives any and all rights to claim any statute of limitations defense as to any condition that may arise under this guarantee.

3 – Manhole Inspection

3.1 The CONTRACTOR shall furnish all items (labor, equipment, materials and supervision) necessary to open and inspect all manholes assigned within this contract. Inspection of the manholes shall include, but not be limited to:

- Opening of the manholes
- Inspecting them for leaks
- Inspecting them for hydrogen sulfide damage or damage incurred as a part of road paving or initial construction
- GPS location of the manhole
- Determining the condition of the manhole cover and its fit
- Photograph of the manhole

3.2 Once the CONTRACTOR has inspected the manhole, CONTRACTOR's personnel shall complete the inspection form attached hereto for each manhole. The inspection forms will be used for reporting to the owner.

3.3 CONTRACTOR will insure that the manhole cover is reinstalled so as to insure no damage will occur to traffic as a result of traffic running over manhole (I.e. manhole flipping)

4 – Sealing Manhole Chimneys

4.1 The work covered under this section includes, but is not limited to all labor, equipment, materials, supervision and any other efforts required to seal the manhole chimney as outlined herein. The intent of the chimney seal is to prevent inflow from the area beneath the rim of the manhole, but above the cone. See figure 4.1. The chimney includes the ring, cement extensions, lift rings, brick or cement used to raise the manhole ring.

4.2 The chimney seal shall be installed using ElastaSeal® internal manhole sealing system or equivalent as approved by the ENGINEER that specifies a primer material to stick to the concrete, and a flexible seal. The seal is to be of a Aramid fiber Reinforced flexible, but resistant material to account for surface loading changes that create most chimney damage. The sealing materials shall have the following parameters:

Primer coat:

- Specific gravity > 1.0
- >90 % solids as measured by ASTM D2369
- Elongation 650 +/- 50 as measured by ASTM D412
- Adhesive strength > 700 psi on steel or concrete as measured by Eclometer 109
- Tensile strength = 3200 +/- 50 psi as measured by ASTM D412
- Tear resistance =325 +/- 10 psi as measured by ASTM D624
- Nonflammable as measured by ASTM D-93 in a Pensky-Martens closed cup
- Temperature Range -65 to 200 F
- Minimal water absorption capacity (<0.5%)

Top Coat

- Specific gravity > 1.0
- >99 % solids as measured by ASTM D2369
- As applied, solids greater than 70%
- Ultimate Elongation equal to or greater than 850% +/- 50 as measured by ASTM D412
- Elongation as applied equal to or greater than 325% +/- 10 as measured by ASTM D412
- Adhesive strength > 700 psi on steel or concrete as measured by Eclometer 109
- Tensile strength = 2300 +/- 50 psi as measured by ASTM D412
- Tear resistance =345 +/- 10 psi as measured by ASTM D624
- Nonflammable as measured by ASTM D-93 in a Pensky-Martens closed cup
- Temperature Range -65 to 200 F
- Kevlar® fiber (Aramid Fiber Reinforcer)
- Minimal water absorption capacity (<0.5%)
- Shore A Hardness equal to 75 +/- 5 as measured by ASTM 2240

Neither material shall contain VOCs. The final sealing system shall remain flexible with time to account for surface loading variations.

Kevlar™ is a registered Trademark of E.I. DuPont Corporation

4.3 Seal coat shall be resistant to damage after 14 days of immersion in:

- Salt
- Gasoline
- Hydrogen sulfide
- Antifreeze
- Low pH

4.4 Installation

4.4.1 All loose mortar, concrete brick or other materials shall be removed by CONTRACTOR as they would interfere with seal performance and adhesion.

4.4.2 High pressure sandblast chimney and ring to create a dry, clean surface. Surface shall be clean from dust and moisture.

4.4.3 Mastic Primer coat shall be applied to clean chimney material and applied in accordance with manufacturer instructions. Coating shall cure for a minimum of 30 minutes or as specified by the manufacturer prior to application of lining

4.4.4 Lining material shall be applied on top of primer in accordance with manufacturer instructions.

4.4.5 The primer and lining shall have a finished, dry thickness greater than 120 mils.

4.4.6 The manhole shall be opened once to install primer and liner to minimize disruptions to traffic.

NOTE: Concrete must be at least 28 days old with a compressive strength of 3500 psi prior to application of sealant.

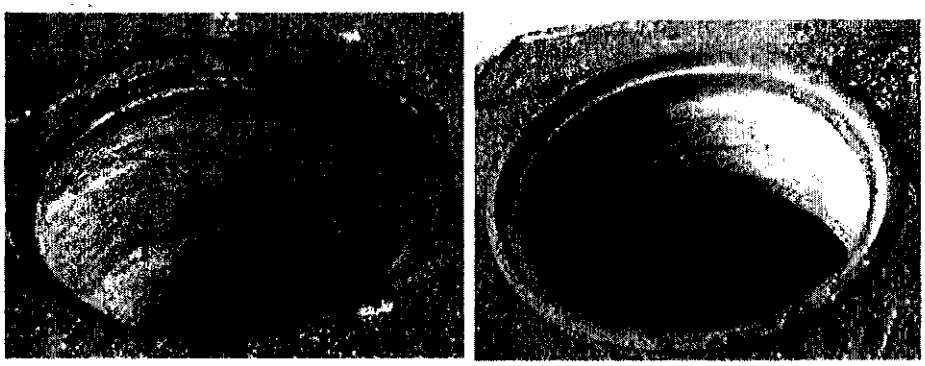
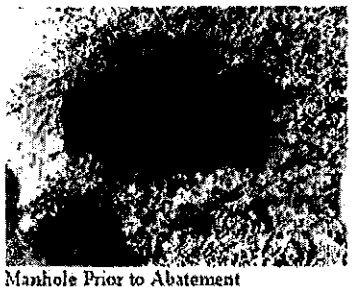
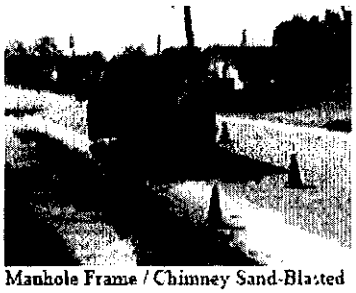


Figure 4.1 chimney seal installed.

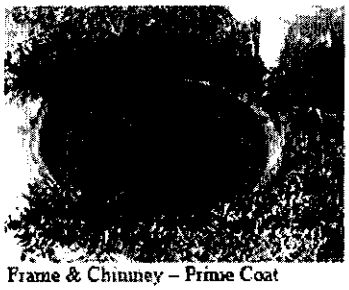


Manhole Prior to Abatement

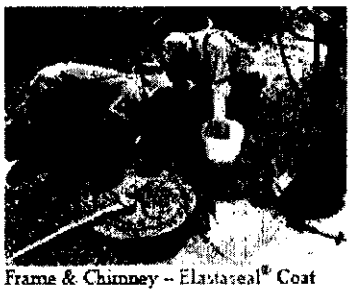


Manhole Frame / Chimney Sand-Blasted

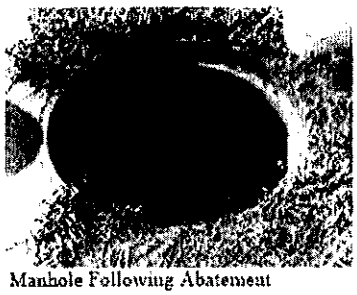
Manhole Interior Following Sand-blasting



Frame & Chimney – Prime Coat



Frame & Chimney – Elastaseal® Coat



Manhole Following Abatement

Figure 4.2 Installation procedure

5 - Repair of Benches And Manholes Wall

5.1 The work covered under this section includes, but is not limited to all labor, equipment, materials, supervision and any other efforts required to repair concrete and mortal damaged inside the manhole that is, or may in the future permit, leaks into the sewer system. .

5.2 The chimney seal shall be installed using Sewpercoat® or equivalent as approved by the ENGINEER that creates a concrete impregnating hard seal. The seal is to be of a resistant material to account for corrosion potential in the manhole. The sealing materials shall have the following parameters:

- Specific gravity > 1.0
- Compressive strength > 7000 psi after 24 hours as measured by ASTM C495
- Compressive strength > 9000 psi after 28 days as measured by ASTM C495
- Flexural strength > 1200 psi after 24 hours as measured by ASTM C293
- Flexural strength > 1400 psi after 28 days as measured by ASTM C293
- Splitting Tensile strength 800 psi after 24 hours as measured by ASTM C496
- Adhesive strength > 1600 psi after 28 days on concrete as measured by ASTM C882
- Shrinkage after 2 days <0.06 % cured at 90 percent humidity
- Nonflammable as measured by ASTM D-93 in a Pensky-Martens closed cup
- Temperature Range -65 to 200 F
- Minimal water absorption capacity (<0.5%)
- Material shall contain VOCs.

5.3 Installation

5.3.1 All loose mortar, concrete brick or other materials shall be removed by CONTRACTOR as they would interfere with seal performance and adhesion.

5.3.2 High pressure sandblast manhole as necessary to create a dry, clean surface with appropriate roughness for adhesion designated as CPS 4 by the International Concrete Repair Institute guideline 3732 – selecting and Specifying Concrete Surface Preparation for Sealers, Coatings and Polymer Overlays. If the cone also needs repair, the overhead areas shall be sandblasted to create a roughness for adhesion designated as CPS 3 by the International Concrete Repair Institute guideline 3732 – selecting and Specifying Concrete Surface Preparation for Sealers, Coatings and Polymer Overlays. Surface shall be clean from dust.

5.3.3 Prior to application of sealant, all surfaces shall be being soaked with water. Surface must be saturated, but not dripping wet, prior to application of liner (see manufacturer's recommendations)

5.3.4 Lining material shall be applied in accordance with manufacturer instruction and under the appropriate application pressure. Water used for mixing material shall be fresh, clean potable water only.

5.3.5 The lining material shall have a finished, dry thickness greater than ½ inch thick on all surfaces.

5.3.6 Curing shall be in accordance with ASTM C309 and the manufacturer's recommendations. Moist curing shall

NOTE: concrete must be at least 28 days old with a compressive strength of 3500 psi prior to application of sealant. Temperatures must be above 40 F during application

6 – Smoke Testing

Not used

7 – Installation of LDL Plug

7.1 The work covered under this section includes, but is not limited to all labor, equipment, materials, supervision and any other efforts required to install LDL® or equivalent plugs in the broken cleanouts within the utility's control during smoke testing.

7.2 The plug shall be LDL® or equivalent consisting of the following:

- Plug body shall be molded, one piece, synthetic urethane polymer material designed to align and seal cleanout.
- Inner seal of plug shall consist of a pvc material fabricated with an internal tapered, beveled seat with a thickness of .187 in and overall height of 1.25 in.
- Plug will not permit gases to escape past it
- Plug will not permit sewage to flow past it
- Plug will be removable by utility crews from the surface using embedded hardware molded into the plug body with a corrosion resistant material
- Retrieval hasp and hardware shall be made of corrosion resistant material and shall protrude at least one inch above the plug body and have a thickness of 0.187 in.
- Plug shall have embedded steel to permit surface detection by metal detector.

7.3 Installation

7.3.1 Remove cleanout cap (broken or otherwise)

7.3.2 CONTRACTOR shall wipe all cleanouts to remove soil and moisture from the interior of cleanout stack. All loose materials shall be removed by CONTRACTOR as they would interfere with plug.

7.3.3 CONTRACTOR will scuff the interior of stack with a file hone
7.3.4 Swab interior scuffed area with PVC cleaner.

7.3.5 Swab exterior of inner seal ring of plug with PVC cleaner

7.3.6 Apply PVC glue to interior walls of cleanout and exterior of inner seal ring of plug

7.3.7 With surface tools, slide inner seal ring into appropriate point in cleanout. Align with depth gauge installation tool. Twist to glue in place.

7.3.8 Cure for 60 sec

7.3.9 Install plug (see Figures 7.1 and 7.2)

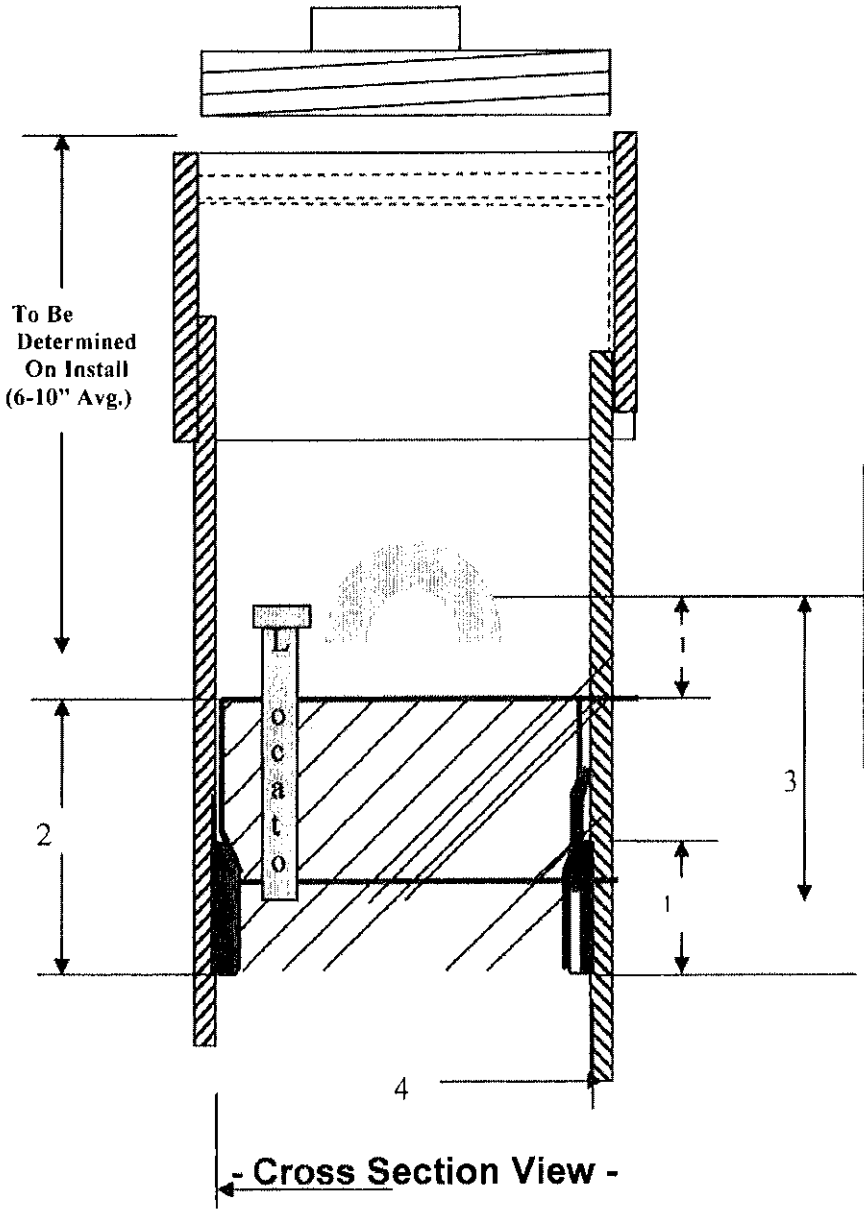
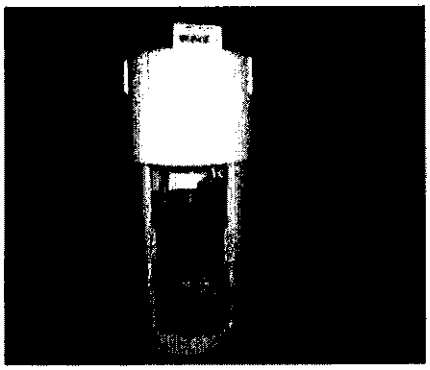


Figure 7.1 – LDL Plug installed in cleanout



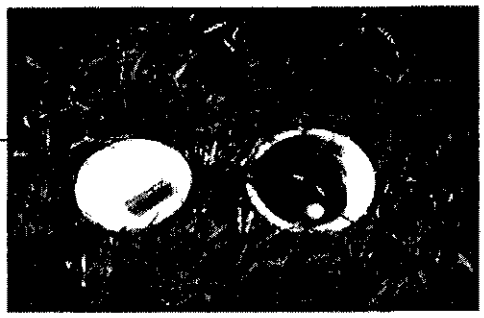


Figure 7.2 LDL Plug Design

NOTE: If the clean-out stack is in such a state of disrep er
installation of the LDL® Clean Out Plug a notation sh ıe
smoke testing report to provide the owner the opportuni

SECTION 02751 – CLEANING

SECTION 02751 - PREPARATORY CLEANING AND ROOT REMOVAL

1 -- GENERAL

1.1 Scope

This Section covers the preparatory cleaning of sewer lines and manholes as needed prior to the internal survey of the sewer lines by closed-circuit television. It also covers the preparatory cleaning and root removal of sewer lines and the cleaning of manholes prior to rehabilitation. The CONTRACTOR shall furnish all necessary material, labor, equipment and services required for cleaning the specific sewer lines.

1.2 General

1.2.1 Sewer Line Cleaning. The intent of sewer line cleaning is to remove foreign materials from the lines and restore the sewer to a minimum of 95% of the original carrying capacity or as required for proper seating of internal pipe joint sealing packers or performance of other specified work. It is recognized that there are some conditions such as broken pipe and major blockages that prevent cleaning from being accomplished or where additional damage would result if cleaning were attempted or continued. Should such conditions be encountered, the CONTRACTOR will not be required to clean those specific sewer sections. If, in the course of normal cleaning operations, damage does result from preexisting and unforeseen conditions such as broken pipe, the CONTRACTOR will not be held responsible.

1.2.2 Manhole Cleaning General. All concrete and masonry surfaces must be cleaned prior to repair. Grease, laitance, loose bricks, mortar, unsound concrete, and other materials must be completely removed. Water blasting (minimum 1,200 psi) utilizing proper nozzles shall be the primary method of cleaning; however, other methods such as wet or dry sandblasting, acid wash, concrete cleaners, degreasers or mechanical means may be required to properly clean the surface. Surfaces on which these methods are used shall be thoroughly rinsed, scrubbed, and neutralized to remove cleaning agents and their reactant products.

1.2.3 Cleaning and Preparation for Cementitious Liner Rehabilitation

1.2.3.1 The manhole or chamber surface shall be clean, structurally sound and free from oil, grease, loose mortar, paints, protective coatings, efflorescence, laitance and airing compounds. The conditions of the manhole or chamber may require the use of an environmentally safe degreasing compound; if so, the surface shall be thoroughly rinsed to eliminate any residue.

1.2.3.2 Place covers over invert to prevent extraneous material from entering the sewer lines.

1.2.3.3 All foreign material shall be removed from the manhole wall and bench using a high pressure water spray (minimum 4,000 psi). Loose and protruding brick, mortar, and concrete shall be removed using a mason's hammer, chisel and/or scraper. Fill any large voids with quick setting patching material.

1.2.3.4 If the 4,000 psi high water pressure water spray is not successful in removing all grease and contaminants, then a chemical wash shall be used to clean and degrease the interior of the manhole or chamber. The entire structure shall be thoroughly water- and/or sand-blasted to remove any loose or deteriorated material. The CONTRACTOR shall clean all accumulations of debris, such as dirt and grease, loose mortar, bricks and concrete, and dispose or properly. Care shall be taken to prevent any loose material from entering outlet sewer lines by inserting a 2-inch or smaller mesh protective screen into the manhole's outlet.

1.2.3.5 Any existing manhole steps shall be removed prior to sealing (waterproofing) the structure walls, and installing liners.

1.3 Hydraulic Cleaning Equipment

1.3.1 Hydraulically Propelled Equipment. The equipment used shall be of a movable dam type and be constructed in such a way that a portion of the dam may be collapsed at any time during the cleaning operation to protect against flooding of the sewer. The movable dam shall be equal in diameter to the pipe being cleaned and shall provide a flexible scraper around the outer periphery to insure removal of grease. If sewer cleaning balls or other equipment which cannot be collapsed is used, special precautions to prevent flooding of the sewers and public or private property shall be taken.

1.3.1.1 High-Velocity Jet (Hydrocleaning) Equipment. All high-velocity sewer cleaning equipment shall be constructed for ease and safety of operation. The equipment shall have a selection of two or more high-velocity nozzles. The nozzles shall be capable of producing a scouring action from 15 to 45 degrees in all size lines designated to be cleaned. Equipment shall also include a high-velocity gun for washing and scouring manhole walls and floor. The gun shall be capable of producing flows from a fine spray to a solid stream. The equipment shall carry its own water tank, auxiliary engines, pumps, and hydraulically driven hose reel.

1.3.1.2 Mechanically Powered Equipment: Bucket machines shall be in pairs with sufficient power to perform the work in an efficient manner. Machines shall be belt operated or have an overload device. Machines with direct drive that could cause damage to the pipe will not be allowed. A power rodding machine shall be either a sectional or continuous rod type capable of holding a minimum of 750 feet of rod. The rod shall be specifically heat-treated steel. To insure safe operation, the machine shall be fully enclosed and have an automatic safety clutch or relief valve.

3 -- EXECUTION

3.1 General

3.1.1 The designated sewer sections shall be cleaned using hydraulically propelled, high-velocity jet, or mechanically powered equipment. The equipment shall dislodge, transport and remove all sludge, mud, sand, gravel, rocks, bricks, grease, roots, sticks, and all other debris from the interior of the sewer pipe and manholes. The equipment and methods selected shall be based on the conditions of lines and manholes at the time the work commences and shall be satisfactory to the ENGINEER. If cleaning of an entire section cannot be successfully performed from one manhole, the equipment shall be set up on the other manhole and cleaning again attempted. If, again, successful cleaning cannot be performed, or the equipment fails to traverse the entire manhole section, the cleaning effort shall be stopped and sufficient

inspection performed so that the ENGINEER can be notified of the reason for inability to continue. CITY And the ENGINEER, in consult with CONTRACTOR, will identify a solution.

3.1.2 Cleaning Precautions

3.1.2.1 During all cleaning and preparation operations all necessary precautions shall be taken to protect the sewer from damage. During these operations, precautions shall also be taken to insure that no damage is caused to public or private property adjacent to or served by the sewer or its branches.

3.1.2.2 Satisfactory precautions shall be taken in the use of cleaning equipment. When hydraulically propelled cleaning tools (which depend upon water pressure to provide their cleaning force) or tools which retard the flow in the sewer line are used, precautions shall be taken to insure that the water pressure created does not damage or cause flooding of public or private property being served by the sewer. When possible, the flow of sewage in the sewer shall be utilized to provide the necessary pressure for hydraulic cleaning devices. When additional water from fire hydrants is necessary to avoid delay in normal work procedures, the water shall be conserved and not used unnecessarily. No fire hydrant shall be obstructed in case of a fire in the area served by the hydrant.

3.3 Material Removal

3.3.1 All sludge, dirt, sand, rocks, grease, roots, and other solid or semisolid material resulting from the cleaning operation shall be removed at the downstream manhole of the section being cleaned. Passing material from manhole section to manhole section, which could cause line stoppages, accumulations of sand in wet wells, or damage pumping equipment, shall not be permitted.

3.3.2 Under no circumstances shall sludge or other debris removed during these operations be dumped or spilled into the streets, ditches, storm drains or other sanitary sewers. The CONTRACTOR shall remove from the site and properly dispose of all solids or semi-solids recovered during the cleaning operation. The CONTRACTOR shall obtain permits and make arrangements as required to properly dispose of solids.

3.3.3 The CONTRACTOR is advised that he shall not dispose of this material by legal or illegal dumping on private or public property, by sale to others, or any means other than those given above.

3.3.4 The CONTRACTOR shall keep his haul route and work area(s) neat and clean and reasonably free of odor, and shall bear all responsibility for the cleanup of any spill which occurs during the transport of cleaning/surface preparation by-products and the cleanup of any such material which is authorized by or pursuant to this Contract and in accord with applicable law and regulations. The CONTRACTOR shall immediately cleanup any such spill, or waste. If the CONTRACTOR fails to cleanup such spill, or waste immediately, the CITY shall have the right to cleanup or arrange for its cleanup and may charge to the CONTRACTOR all costs, including administrative costs and overhead, incurred by the CITY in connection with such cleanup. The CITY may also charge to the CONTRACTOR any costs incurred or penalties imposed on the CITY as a result of any spill, dump or discard. Under no circumstances is this material is to be discharged into the waterways or any place other than where authorized to do so by the

appropriate authority. The term "CONTRACTOR" as used in this section shall include the CONTRACTOR's SUBCONTRACTORs and other CONTRACTORs.

3.3.5 The general requirements for vehicles hauling such waste materials are as follows: Transport vehicles must be of type(s) approved for this application by the political jurisdictions involved. General requirements are that the vehicles have watertight bodies, that they be properly equipped and fitted with seals and covers to prohibit material spillage or drainage, and that they be cleaned as often as is necessary to prevent deposit of material on roadways. Vehicles must be loaded within legal weight limits and operated safely within all traffic and speed regulations.

3.3.6 The routes used by the CONTRACTOR for the conveyance of this material on a regular basis shall be subject to approval by the governing authority having jurisdiction over such routes.

3.4 DISPOSAL OF MATERIALS

All solids or semisolids resulting from the cleaning operations shall be removed from the site and disposed of by the CONTRACTOR in a legal and sanitary manner as approved by appropriate authorities, at the CONTRACTOR's cost. Copies of records of all disposal shall be furnished to the CITY, indicating disposal site, date, amount and a brief description of material disposed. All materials shall be removed from the site no less often than at the end of each workday. Under no circumstances will the CONTRACTOR be allowed to accumulate debris, etc., on the site of work beyond the stated time, except in totally enclosed containers and as acceptable to the ENGINEER.

3.5 ROOT REMOVAL

Roots shall be removed in the designated sections and manholes where root intrusion is indicated on the work order. Special attention should be exercised during the cleaning operation to assure almost complete removal of roots from the joints. Any roots which could prevent the traveling of the packer or could prevent the proper application of chemical sealants, or could prevent the proper seating and application of cured-in-place, fold-and-formed or sectional cured-in-place liners, shall be removed. Procedures may include the use of mechanical equipment such as rodding machines, bucket machines and winches using root cutters and porcupines, and equipment such as high-velocity jet cleaners. When specifically directed, chemical root treatment shall be used before the root removal operation, in accordance with Section 02762 - Chemical Root Treatment, and grouting will take place after root removal in accordance with Section 02763 - Chemical Grouting. CONTRACTOR shall capture and remove all roots from the line.

3.6 CHEMICAL ROOT TREATMENT

To aid in the removal of roots, manhole sections that have root intrusion shall be treated with an acceptable herbicide when specifically directed. The application of the herbicide to the roots shall be done in accordance with the manufacturer's recommendations and specifications in such a manner to preclude damage to surrounding vegetation. Any damaged vegetation so designated by the ENGINEER shall be replaced by the CONTRACTOR at no additional cost to the CITY. All safety precautions as recommended by the manufacturer shall be adhered to concerning handling and application of the herbicide.

3.7 ACCEPTANCE OF CLEANING OPERATION

3.7.1 Acceptance of sewer line cleaning shall be made upon the successful completion of the television survey and shall be to the satisfaction of the ENGINEER. If television survey shows the cleaning to be unsatisfactory, the CONTRACTOR shall be required to reclean and reinspect the sewer line until the cleaning is shown to be satisfactory. In areas where television survey is not performed, the ENGINEER may require the CONTRACTOR to pull a double squeegee (with each squeegee the same diameter as the sewer) through each manhole section as evidence of adequate cleaning. If internal sealing is to follow the television survey, particular attention should be given to the adequacy of the cleaning to insure that proper seating of the sealing packer can be achieved.

3.7.2 In addition, on all those lines which have sags or dips, to an extent that the television camera lens becomes submerged for three (3) or more feet during the television inspection, the CONTRACTOR shall pull double squeegee and/or sponges through the line in order to remove the water from those dips or sags, or draft the water by means of high-velocity jet cleaners. Water removal shall be performed until the television camera lens will no longer be submerged. This requirement may be waived by the ENGINEER if the water in which the camera lens is submerged, is clear enough to allow the identification of pipe defects, cracks, holes and location of service taps.

- END OF SECTION -

SECTION 02752 - TELEVISION SURVEY

PART 1 -- GENERAL

1.1 SCOPE

1.1.1 The work consists of furnishing all labor, materials, accessories, equipment, tools, transportation, services and technical competence for performing all operations required to execute the internal closed circuit television survey to inspect the entire barrel of sewers up to 30 inches in diameter in the areas denoted on the plans and record same to DVD. Drawing A identifies sections of the sewer system where excessive infiltration is occurring and denoted same on the attached drawings. CONTRACTOR will televise and provide to CITY and ENGINEER copies of all DVDs.

1.1.2 The survey shall show all defects, identify the locations, determine amount of infiltration entering the sewer system and suggest repairs for same. These repairs may be lining, point repairs or other mechanism. ENGINEER will render a decision of the appropriate repair.

1.2 GENERAL

1.2.1 After cleaning as specified in Section 02751- Preparatory Cleaning, and before and after rehabilitation operation/replacement work, the pipe sections shall be visually surveyed by means of closed-circuit television in the presence of the ENGINEER. The survey shall be performed one manhole-to-manhole section at a time and the flow in the section being surveyed shall be suitably controlled.

1.2.2 Pre- and post-construction survey video on CD-ROM or DVD shall be delivered to the ENGINEER on a one-line-per CD-ROM basis, accompanied with the corresponding work order, and pre- and post-TV log, for each sewer line surveyed. The video on CD-ROM shall be direct from a live video source into a video file, format MPEG1.

1.3. DIGITAL CCTV INSPECTION

1.3.1 The CONTRACTOR shall use a color pan and tilt camera or wide angle camera specifically designed and constructed for both sewer and manhole inspection. Each sewer to be televised shall be suitably isolated to control flow during the inspection. The CONTRACTOR shall provide a recording of the televised sewer inspection, locating each sewer service connection entering the sewer.

1.3.2 Lighting for the pan and tilt camera or wide angle camera shall provide a clear picture of the entire periphery of the existing sewer or manhole inspected.

1.3.3 The pan and tilt camera shall pause, pan, and visually inspect all service connections, pipe ends, and maintenance or structural defects. If utilizing a camera with fish eye capabilities, pausing and panning of each lateral is not necessary during the inspection if the image clearly depicts the inside of the lateral for post processing. If a blockage cannot be removed and hampers the televising of the sewer in one direction then the CONTRACTOR shall attempt to complete the section by televising from the other manhole to complete the section, this reversal should immediately follow the initial direction. The CONTRACTOR must report the obstructions to the

ENGINEER daily.

1.3.4 If the image quality is not adequate, the CONTRACTOR shall be required to repeat the survey at the CONTRACTOR's expense. The equipment utilized in 8"-12" sewers shall be specifically designed with multiple camera lenses to limit the requirement for repeated inspections in the event a camera lens becomes obscured during inspection unless prior approved in writing by ENGINEER.

1.3.5 The CONTRACTOR shall perform all pipe CCTV inspections in accordance with NASSCO's Pipeline Assessment Certification Program (PACP). CCTV inspections will be delivered entirely in electronic format. The entire survey shall be recorded in an approved electronic format submitted with electronic links between the data and the video. All television inspection reports shall be with-in +/- two (2) feet of the measured linear footage between manholes along the existing sewer centerline from the start of pipe to end of pipe. All ENGINEER and PACP required header information must be fully and accurately entered on all CCTV reports. Work not following these specifications may be rejected for payment and the CONTRACTOR may be required to re do the work.

1.3.6 The CONTRACTOR shall perform all manhole CCTV inspections in accordance with NASSCO's Manhole Assessment Certification Program (MACP). CCTV inspections will be delivered entirely in electronic format. The entire survey shall be recorded in an approved electronic format submitted with electronic links between the data and the video. All MACP Level 1 mandatory header information must be collected and fully and accurately entered on all CCTV reports including northing and easting to submeter accuracy. Work not following these specifications may be rejected for payment and the CONTRACTOR may be required to re do the work.

1.3.7 The CONTRACTOR shall provide a NASSCO certified operator on site at all times during the entire survey. If video is to be coded separately from the actual recording, both the onsite Operator and the individual performing the PACP coding shall be PACP certified. The CONTRACTOR shall provide proof of certification prior to commencement of work, prior to a change in personnel involved in data collection, and as requested by the ENGINEER

1.3.8 The importance of minimization of disturbances and requirements for traffic control is emphasized. The CONTRACTOR shall utilize equipment specifically designed to perform multiple simultaneous inspections via autonomy (allowing an operator to conduct multiple inspections at one time) from each access point unless specifically approved in writing by the ENGINEER.

1.3.9 The video camera shall include a title feature capable of showing on the tape the following information:

1. City and State
2. Date/Time
3. CONTRACTOR's Name
4. Line Size, Material, and Depth
5. Manhole Identification (both manholes)

6. On-going Footage Counter

1.4 SUBMITTALS

1.4.1 Submittals required seven (7) days prior to the Pre-construction Meeting upon request

1. Name of the project supervisor and resumes
2. Documentation of NASSCO PACP certification for all CCTV operators, database and software
3. Site Safety Plan. A complete site safety plan, specific for the project, must be submitted one week prior to the pre-construction meeting. Work will not begin until an approved site safety plan is in place
4. Sample inspection CCTV data and video or data from other approved inspection method

1.4.2 Submittals Required for the Pre-construction Meeting upon request

1. An initial schedule of work, (To be approved by the ENGINEER)
2. Management Organization: Provide an organization chart depicting the essential organizational elements and senior personnel of the proposed CONTRACTOR and the functions and interrelationships of the personnel proposed to provide technical support, project management and supervision for this project. Provide succinct resumes of the personnel proposed to provide technical support and project management for this project. The personnel designated in the management summary for essential positions shall not be changed except with the permission of ENGINEER. The ENGINEER will only approve such a change when, in its opinion, the substitute personnel have equal or greater qualifications and experience to those intended to be replaced

1.4.3 Submittals Required One Week Prior to Any Televising Work.

1. Site specific site safety plan addenda
2. Entry releases, if applicable
3. itemization and justification to ENGINEER or representatives of any inspections to be performed not utilizing autonomous equipment to perform simultaneous inspections

1.4.4 Weekly Submittals

1. Detailed updates to the work schedule will be provided to the ENGINEER no later than 3:00 p.m. on the Friday preceding the next week's cleaning and televising work
2. Electronic logs, and / or electronic worksheets submitted seven (7) days prior to work. All field paperwork must be submitted before the CONTRACTOR's invoice will be processed for payment
3. Corrections to punch list items as required by the ENGINEER to fulfill the requirements of this specification
4. itemization and justification for any inspections that could not be completed according to schedule in the CONTRACTOR's opinion due to inability to locate the access structure, the structure being in an inaccessible area (including paved over, buried, under water prohibited areas, etc.), inoperable due to

damage or locking mechanisms, requiring specialized tools such as excavators or action outside of the intended scope of work such as legal action

1.4.5. CCTV Reports, logs, electronic reports, and worksheets must include the following information and conform to the applicable guidelines:

1. CCTV media, NASSCO PACP and MACP Certified Databases, and electronic worksheets must accompany all inspection work.
2. All ENGINEER and NASSCO PACP mandatory header information must be fully and accurately entered on all PACP CCTV reports.
3. All MACP Level 1 Mandatory header information and detail must be fully and accurately entered on all MACP CCTV reports

2 -- PRODUCTS

All inspection information and data (including video) written to digital media (CD-ROM or DVD).

3 - USE OF AUTONOMOUS PLATFORM/TRANSPORT

3.1 Th contractor has the option to use autonomous platform systems (Redline). The provision of a platform capable of operating in 8-12" (200-300mm) wastewater pipelines without operator monitoring. The system must function such that an operator is capable of initiating multiple segment inspections by utilizing more than one platform for the purpose of increasing throughput without loss in data quality ("force multiplication"). To accomplish these objectives, the platform must possess sufficient onboard sensors, and artificial intelligence to traverse a pipe segment and return to the starting manhole autonomously. Other systems, such as power and tether, must be self-contained so that no special transport/vehicle or other fixed equipment is required that would prevent force multiplication. The tether must have a safety factor of 12x (break strength divided by robot weight) to facilitate safe robot self-retrieval and reduce the risk of becoming lost in a pipeline. The platform must also support one or more sensors that collect pipe information in a manner that is sufficiently dense and comprehensive to enable offline data analysis.

3.1.1. Autonomous Platform Detailed Minimum Capabilities - It is required that the platform be capable of force-multiplication, which requires conducting an inspection beneath a closed manhole without operator monitoring. The platform must be completely self-contained, including onboard computing, data storage, power, and tether. It must be pressurized and capable of operating in fully submerged conditions.

3.1.2. The platform shall be driven by dual, independently powered full-coverage tracks. It must steer itself such that it remains upright and centered in the pipeline.

3.1.3 Autonomous Platform Equipment Specifications

1. Platform Weight: 25lb (11kg) weight class
2. On-board Power: Rechargeable batteries
3. Drive: Electric motors with self-activated winch-assist
4. Steering: Independent track control with powered forward and reverse

5. Tether: On-board high-strength non-conductive, non-communicating tether for robot self-retrieval
6. Max Drawbar Pull: Laying onboard tether (versus pulling) requires minimal drawbar pull
7. Construction: Aluminum and synthetic body with rubber treads
8. Speed: 0-30 ft/min (0-9 m/min) for single robot per NASSCO requirements, equivalent to 120 ft/min (36 m/min) with four robots deployed

3.1.4 Distance Measurement - An onboard distance-reading device which uses tether length to accurately measure the location of the platform in the pipe shall be incorporated into the platform. This device shall be accurate to ±1% the length of the inspection and measure to a resolution of at least 4000 data points per foot (14,000 per meter). Distance data must be automatically logged with sensor data.

3.2 Transport - No special transport (i.e. vehicle) shall be required for transportation or use of the equipment. Platform and all support equipment must be of minimum weight and bulk such that they can be easily hand-carried for operator safety and usage in easement or off-road areas.

4 Spherical Video Data Collection

If using an autonomous platform vehicle, it must include spherical veidoe capability. purpose of Spherical Video data collection is to gather a complete view of the pipeline for off-line processing to identify features and defects. Data is obtained from dual 180° field-of-view (hemispherical) fisheye lenses, one each at the front and rear of the platform. When the data from these two lenses is combined, 360° is captured and a Spherical Video is created. The work shall include an autonomous inspection of the pipeline and the preparation of all CCTV video, digital, and written reports.

4.1 Spherical Video Camera System

4.1.1 A pair of digital cameras must capture Spherical video from dual fisheye lenses each with field-of-view of 180° or greater. This video must be stored onboard the robot in a format that allows for post-processing and "virtual" transport through the pipe in forward or reverse direction and with off-site pan-tilt-zoom capabilities.

4.1.2 "Sidescan" or other similar technology that utilizes a single lens will not be accepted as it does not offer a sufficient view of laterals entering at angles beyond the field-of-view of the single lens. Equipment that captures image data at a low frame-rate that prevents observation of flow, drippers, or other relevant movement in the pipe will also not be accepted.

4.2 Illumination The primary means of illumination should be via high-intensity LED lighting that maximizes output while being impact resistant and reducing the possibility for failure during operation relative to traditional means. The general illumination shall be such as to allow an even distribution of light around the pipeline perimeter without the loss of contrast, flare, or abnormal shadowing on the dry portion. The camera system must actively and automatically adjust light output to maximize image quality regardless of pipe size or material transitions.

4.3 Camera Data Post-Inspection Review - Imagery from any point in the pipeline must be made available for operator review via a wireless interface immediately following an inspection.

4.4 Operator Certification

4.4.1 CCTV experience and/or PACP coding certification is not required for data collection. Any operator shall be able to collect data utilizing this equipment with maximum one day on-site training.

4.4.2 Data review with certified coding must be conducted by the equipment manufacturer or authorized party utilizing a NASSCO PACP certified individual using NASSCO certified software.

4.4.3 Information Delivery & Viewer - Collected data shall be processed so that the information obtained is presented in a useful format. The information shall be packaged and delivered together along with access to a viewing application. This application must support multiple methods of viewing the data along with export capabilities.

4.4.4 Information Data Delivery - All information data shall be delivered in digital format on an appropriately sized medium (DVD, Hard Drive, etc.) to minimize the number of separate delivered components. All data should be accessible from a single Viewing Application.

4.4.5 iewing Application - The viewing application shall be available via online download and automatically check for updates.

4.4.6 The application shall provide a list of all pipeline segments included in the project identified by manhole number or segment ID. Selecting a segment should present detailed header information as well as a distance-based chart of the observations associated with that segment. Within each selected segment, the user should be able to conduct activities such as Playback and Export.

4.4.6.1 Spherical Video Playback

4.4.6.1.1 The viewing application shall include the ability to load the Spherical Video of a selected segment. Controls associated with the video should allow the user to navigate *Forward* and *Reverse* as well as *Pan*, *Tilt*, and *Zoom* at desired levels. The user shall also have the option to select a distance or an observation on the distance-based chart and the Spherical video should jump to that location at the ideal Pan-Tilt-Zoom level.

4.4.6.2 Distributable Data

4.4.6.2.1 Information shall be made available, either via export functionality or included with the deliverable, in the form of a NASSCO PACP database or Microsoft Excel spreadsheet for import into common 3rd party applications. In addition, it shall include the capability to generate segment summary reports in PDF format that can be easily printed or distributed electronically via third party software.

4.5 Legacy Video

4.5.1 Spherical Video data must be able to be recorded in MPEG-2 format, if requested, inclusive of all Pan-Tilt-Zoom operations, payout, and observations as per conventional CCTV for viewing on television equipment or import into legacy systems.

5 -- EXECUTION

5.1 PRECONSTRUCTION SURVEY

5.1.1 Procedure

5.1.1.1 Prior to any repair work, the entire sewer line (from manhole to manhole) shall be televised. The camera shall be placed at the center of the manhole and videotaping shall commence prior to entering the pipe. The CONTRACTOR shall show the inside of the manhole walls and the pipe connection to the wall at both the upstream and downstream manhole.

5.1.1.2 The camera shall be moved through the line in either direction at a moderate rate, stopping when necessary to permit proper documentation of the sewer's condition. In no case shall the television camera be pulled at a speed greater than 30 feet per minute. Manual winches, power winches, TV cable, powered rewinds and tractors or other devices that do not obstruct the camera view or interfere with proper documentation of the sewer conditions shall be used to move the camera through the sewer line. If the camera is being pulled through the sewer line by a hydraulic cleaning unit hose the cleaning nozzle shall be located a minimum of eight (8) feet away from the camera to allow a clear, unobstructed view. Jet nozzle shall be used in front of camera while televising through a dip to draft out water. If, during the survey operation, the television camera will not pass through the entire manhole section, the CONTRACTOR shall set up his equipment so that the survey can be performed from the opposite manhole.

5.1.1.3 Whenever non-remote powered and controlled winches are used to pull the television camera through the line, telephones or other suitable means of communication shall be set up between the two manholes of the section being surveyed to insure good communications between members of the crew.

5.1.1.4 Measurement for location of defects shall be above ground by means of a meter device. Marking on the cable, or the like, which would require interpolation for depth of manhole, will not be allowed. Measurement meters shall be accurate to tenths of a foot over the length of the section being surveyed. Accuracy of the distance meter shall be checked by use of a walking meter, roll-a-tape, electronic distance meter or other suitable device. Manhole numbers and linear footage shall be shown on screen during taping.

5.1.1.5 Movement of the television camera shall be temporarily halted for a minimum of ten seconds at each visible point source of infiltration and/or inflow until the leakage rate from that source is quantified. The camera shall be stopped at all service connections and the service lateral shall be inspected with the pan and tilt camera. The camera shall also be stopped at active service connections where flow is discharging. If the discharge persists, the property involved shall be checked to determine whether or not the discharge is sewage. If no flows are being discharged from the building, it shall be considered that the observed flow is infiltration/inflow.

5.1.2 Field Documentation

5.1.2.1 Television Inspection Forms (Survey Logs). Printed and electronically stored location records shall be kept by the CONTRACTOR and will clearly show the location in relation to an adjacent manhole of each infiltration point observed during survey. Upstream footage at face of manhole (0) and downstream footage at face of manhole (e.g., 250) shall be shown on the log. The television inspection forms to be utilized by the CONTRACTOR shall be those mandated by NASSCO's (National Association of Sewer Survey Companies) PACP (Pipe Line Assessment and Certification Program). Both the Header and Details information of the form shall be entered as indicated in the PACP standards. The survey logs shall include, but not be limited to the following information:

1. Correct pipe segment/manhole numbers
2. Correct address of manhole location
3. Pipe size, length and material
4. Manhole depth (up and downstream)
5. Lift station service area number
6. CD number and index
7. Footage locations, descriptions and estimated leak rates for visible point sources of infiltration inflow
8. Footage locations and descriptions of structural defects such as obstructions, any remaining root intrusion, offset joints, cracked pipe, fractured pipe, holes, collapses, sags, protruding service connections and/or blockages in the pipe.

The terminology to be used shall follow NASSCO's PACP standards. All information will be recorded and a copy of such electronic records and a hard copy will be supplied to the ENGINEER.

5.1.2.2 Photographs. Digital photographs of the television picture of problems shall be taken by the CONTRACTOR upon request of the ENGINEER.

5.1.3 Video Recordings. The purpose of video (CD-ROM or DVD) recording shall be to supply a visual and audio record of problem areas of the lines that may be replayed. CD-ROM recording playback shall be at the same speed that it was recorded. Slow motion or stop motion playback features shall be supplied by the CONTRACTOR. Once recorded, the CD-ROM becomes property of the CITY. The CONTRACTOR shall have all CD-ROM and necessary playback equipment readily accessible for review by the ENGINEER during the Project.

The observation terminology utilized during audio narration shall be consistent with NASSCO's PACP standards. The television inspection shall be video recorded on high quality CD-W. The CD shall be clearly labeled with the lift station number and individual manhole numbers clearly listed. The CDs are to be furnished to the ENGINEER with a printed hard copy (Survey Logs) and electronic data inspection report.

Video CDs displaying poor video quality will be deemed unacceptable and no payments will be made until lines are re-televised and a new CD is submitted. Poor video quality refers to, but is not limited to, the following: grease or debris on the lens, camera under water, picture too dark, excessive camera speed through the line, lines improperly cleaned, poor/no audio, etc.

5.1.4 Audio. All CD-ROM shall have audio record. As a preamble, at the beginning of the CD-ROM, the CONTRACTOR shall state the following: (CONTRACTOR's Name) is performing a pre/post TV survey for Job No. 10-01 - Hallandale Beach. State the date, time, operator's name, area, upstream manhole number to downstream manhole number, pipe size and material, upstream manhole depth, and TV survey will be from up- to downstream, or down- to upstream. The CONTRACTOR shall verbally state station and position of all laterals and defects. At the end of each line, state: End of line, upstream manhole number to downstream manhole number, and total linear footage.

5.2 POST CONSTRUCTION SURVEY

5.2.1 Procedure

1. The same procedures shall be used as indicated in Section 3.1 PRECONSTRUCTION SURVEY.

2. In addition, the CONTRACTOR shall stop camera at all point repairs, sectional repairs, and reinstated laterals, and inspect entire repaired pipe section.

3. The CONTRACTOR shall invert white foreground to black as needed in the line section with light background.

5.2.2 Documentation

1. The same documentation shall be provided as indicated in Section 3.1 PRECONSTRUCTION SURVEY.

- END OF SECTION –

SECTION 02765 - CURED-IN-PLACE PIPE LINING

1 -- GENERAL

1.1 Scope

1.1.1 It is the intent of this specification to provide for the reconstruction of pipelines and conduits by the installation of a resin-impregnated flexible tube which is formed to the original conduit by use of a hydrostatic head. The resin is cured using hot water under hydrostatic pressure within the tube. The Cured-In-Place Pipe (CIPP) will be continuous and tight fitting.

1.1.2 The work specified in this Section includes all labor, materials, accessories, equipment and tools necessary to install and test cured-in-place pipe lining in main lines and in service laterals.

1.2 General

1.2.1 The finished pipe in place shall be fabricated from materials which when cured will be chemically resistant to withstand internal exposure to domestic sewage.

1.2.2 This specification references ASTM F1216 (Rehabilitation of pipelines by the inversion and curing of a resin-impregnated tube), ASTM F1743 (Rehabilitation of pipelines by pulled-in-place installation of a cured-in-place thermosetting resin pipe), and ASTM D790 (Test methods for flexural properties of unreinforced plastics) which are made a part hereof by such reference and shall be the latest edition and revision thereof. In case of conflicting requirements between this specification and these referenced documents, this specification will govern.

1.3 Submittals

The CONTRACTOR shall submit shop drawings and other information to the ENGINEER for review in accordance with Section 01300, "Submittals". Included shall be design calculations for the work.

1.4 Product And Installer Acceptability

1.4.1 Since sewer products are intended to have a 50 year design life, and in order to minimize the CITY'S risk, only proven products with substantial successful long term track records will be approved.

1.4.2 Products seeking approval must meet all of the following criteria to be deemed commercially acceptable:

1.4.2.1 For a product to be considered commercially proven, a minimum of 1,000,000 linear feet or 10,000 manhole-to-manhole line sections of successful wastewater collection system installations in the U.S. must be documented to the satisfaction of the CITY to assure commercial viability. In addition, at least 500,000 linear feet of the product shall have been in successful service within the State of Florida for a minimum of five years.

1.5 For an Installer to be considered as commercially proven, the installer must satisfy all insurance, financial, and bonding requirements of the CITY, and must have had at least 5 (five) years active experience in the commercial installation of the product. In addition, the installer must have successfully installed at least 500,000 feet of the product in wastewater collection systems. Acceptable documentation of these minimum installations must be submitted to the ENGINEER.

1.6 Sewer rehabilitation products submitted for approval must provide third party test results supporting the long term performance and structural strength of the product and such data shall be satisfactory to the ENGINEER. Test samples shall be prepared so as to simulate installation methods and trauma of the product. No product will be approved without independent third party testing verification.

1.7 Documentation for products and installers must be satisfactory to the ENGINEER and must be submitted prior to contract award.

1.8 The bidder must have this expertise of 10,000 manhole connections and 500,000 feet of the product in wastewater collection systems.

2 -- Products

2.1 Materials For Main Lines

2.1.1 The sewn tube shall consist of one or more layers of absorbent non-woven felt fabric and meet the requirements of ASTM F1216 or ASTM F1743, Section 5. The tube shall be constructed to withstand installation pressures, have sufficient strength to bridge missing pipe, and stretch to fit irregular pipe sections.

2.1.2 The wetout tube shall have a uniform thickness that when compressed at installation pressures will meet or exceed the Design thickness.

2.1.3 The tube shall be sewn to a size that when installed will tightly fit the internal circumference and length of the original pipe. Allowance should be made for circumferential stretching during inversion. Overlapped layers of felt in longitudinal seams that cause lumps in the final product shall not be utilized.

2.1.4 The outside layer of the tube (before wetout) shall be coated with an impermeable, flexible membrane that will contain the resin and facilitate monitoring of resin saturation during the resin impregnation (wetout) procedure.

2.1.5 The tube shall be homogeneous across the entire wall thickness containing no intermediate or encapsulated elastomeric layers. No material shall be included in the tube that may cause delamination in the cured CIPP. No dry or unsaturated layers shall be evident.

2.1.6 The wall color of the interior pipe surface of CIPP after installation shall be a light reflective color so that a clear detailed examination with closed circuit television inspection equipment may be made.

2.1.7 Seams in the tube shall be stronger than the unseamed felt.

2.1.8 The outside of the tube shall be marked for distance at regular intervals along its entire length, not to exceed 5 ft. Such markings shall include the Manufacturers name or identifying symbol. The tubes must be manufactured in the USA.

2.1.9 The resin system shall be a corrosion resistant polyester, vinyl ester, or epoxy and catalyst system that when properly cured within the tube composite meets the requirements of ASTM F1216 and ASTM F1743, the physical properties herein, and those which are to be utilized in the Design of the CIPP for this project. The resin shall produce CIPP which will comply with the structural and chemical resistance requirements of this specification.

2.2 STRUCTURAL REQUIREMENTS

2.2.1 The CIPP shall be designed as per ASTM F1216, Appendix X1. The CIPP design shall assume no bonding to the original pipe wall.

2.2.2 The CONTRACTOR must have performed long-term testing for flexural creep of the CIPP pipe material installed by his company. Such testing results are to be used to determine the Long-term, time dependent flexural modulus to be utilized in the product design. This is a performance test of the materials (tube and resin) and general workmanship of the installation and curing. A percentage of the instantaneous flexural modulus value (as measured by ASTM D-790 testing) will be used in design calculations for external buckling. The percentage, or the long-term creep retention value utilized, will be verified by this testing. Values in excess of 50% will not be applied unless substantiated by qualified third party test data. The materials utilized for the contracted project shall be of a quality equal to or better than the materials used in the long-term test with respect to the initial flexural modulus used in design.

2.2.3 The layers of the cured CIPP shall be uniformly bonded. It shall not be possible to separate any two layers with a probe or point of a knife blade so that the layers separate cleanly or the probe or knife blade moves freely between the layers. If separation of the layers occur during testing of field samples, new samples will be cut from the work. Any reoccurrence may cause rejection of the work.

2.2.4 The cured pipe material (CIPP) shall conform to the structural properties, as listed below.

Property	Test Method	Cured Composite per ASTM F1216
Modulus of Elasticity	ASTM D-790 (short term)	250,000 psi
Flexural Stress	ASTM D-790	4,500 psi

2.2.5 The required structural CIPP wall thickness shall be based at a minimum, on the physical properties described above and in accordance with the design equations in the appendix of ASTM F 1216, and the following design parameters:

Design Safety Factor	2.0
Retention Factor for Long-Term Flexural Modulus to be used in Design *(as determined by Long-Term tests described in paragraph 2.02.B)*	50 %
Ovality*	5 %
Groundwater Depth = Pipe Depth (above invert)*	ft.
Soil Depth (above crown)*	ft.
Soil Modulus	700 psi
Soil Density	120 pcf
Live Load	Two H20 passing trucks
Design Condition	Fully deteriorated
**Denotes information which can be provided here or in inspection video tapes or project construction plans. Multiple line segments may require a table of values.*	

2.2.6 Any layers of the tube that are not saturated with resin prior to insertion into the existing pipe shall not be included in the structural CIPP wall thickness computation.

2.2.7 The lining manufacturer shall submit to the ENGINEER for review complete design calculations for the liner, signed and sealed by a Professional ENGINEER registered in the State of Florida and certified by the manufacturer as to the compliance of his materials to the values used in the calculations. A safety factor of 2 shall be applied in the design calculation. The host pipe shall be considered fully deteriorated. The liner shall be designed to withstand a live load equivalent to two H-20 passing trucks plus all pertinent dead loads, hydrostatic pressure and grout pressure (if any). For design purposes, the water table shall be considered at grade elevation. The liner shall be designed in accordance with ASTM F 1216. The buckling analysis shall account for the combination of dead load, live load, hydrostatic pressure and grout pressure (if any). The liner side support shall be considered as if provided by soil pressure against the liner. The existing pipe shall not be considered as providing any structural support. Modulus of soil reaction shall be 700, corresponding to a moderate degree of compaction of bedding and a fine-grained soil as shown in AWWA Manual M45, Fiberglass Pipe Design.

2.2.8 Because of the nature of the calculations and constants utilized, the minimum liner thicknesses shall be 5 percent greater than the amount specified.

2.2.9 As part of the design calculation submittal, the liner manufacturer shall submit a tabulation of time versus temperature. This tabulation shall show the lengths of time that exposed portions of the liner will endure without self-initiated cure or other deterioration beginning. This tabulation shall be at five degree Fahrenheit increments ranging from 70 degrees F to 100 degrees F. The manufacturer shall also submit his analysis of the progressive effects of such "pre-cure" on the insertion and cured properties of the liner. This information shall be submitted in a timely fashion prior to the preconstruction conference so that the ENGINEER may set procedures for dealing with such an instance caused by construction delays. The minimum liner thicknesses are for materials with characteristics as shown.

2.2.10 Liner shall be neither accepted nor installed until design calculations are acceptable to the ENGINEER. Liner shall be as manufactured by Insituform Technologies, Inc., 702 Spirit 40 Avenue, Chesterfield, MO 63005, Phone No. 800-325-1159, or approved equal.

2.3 Testing Requirements

2.3.1 Chemical Resistance - The CIPP shall meet the chemical resistance requirements of ASTM F1216, Appendix X2. CIPP samples for testing shall be of tube and resin system similar to that proposed for actual construction. It is required that CIPP samples with and without plastic coating meet these chemical testing requirements.

2.3.2 Hydraulic Capacity - Overall, the hydraulic profile shall be maintained as large as possible. The CIPP shall have a minimum of the full flow capacity of the original pipe before rehabilitation. Calculated capacities may be derived using a commonly accepted roughness coefficient for the existing pipe material taking into consideration its age and condition.

2.3.3 CIPP Field Samples - When requested by the CITY, the CONTRACTOR shall submit test results from field installations in the USA of the same resin system and tube materials as proposed for the actual installation. These test results must verify that the CIPP physical properties specified in Section 2.2.4 have been achieved in previous field applications.

2.3.4 CIPP samples shall be prepared and physical properties tested in accordance with ASTM F1216 or ASTM F1743, Section 8, using either method proposed. The flexural properties must meet or exceed the values listed in Table 1 of the applicable ASTM.

2.3.5 Wall thickness of samples shall be determined as described in paragraph 8.1.6 of ASTM F1743. The minimum wall thickness at any point shall not be less than 87.5% of the design thickness as calculated in Section 2.2.5, of this document.

2.3.6 Visual inspection of the CIPP shall be in accordance with ASTM F1743, Section 8.6.

2.4 Materials for Service Laterals

2.4.1 Intent: It is the intent of this portion of this specification to provide for the reconstruction of lateral sanitary sewer pipelines with the installation of resin impregnated, flexible felt tubes. They shall be installed into the existing service using a pull rope or a push rod. Curing shall be accomplished with hot water or other methods approved by the ENGINEER, the curing method shall be suitable for the selected resin, such that the resin produces a hard, impermeable pipe wall. The cured-in-place pipe (CIPP) should extend throughout the service lateral in a jointless, continuous, tight-fitting, watertight pipe-within-a-pipe.

2.4.2 Structural Requirements: The structural performance of the finished pipe must be adequate to accommodate all anticipated loads throughout its design life. No CIPP reconstruction technology will be allowed that requires bonding to the existing pipe for any part of its structural strength. Since the pipe strength is related to the uniformity and density of the pipe wall, only resin vacuum impregnation will be allowed. Resin impregnation without vacuum entraps air and creates voids which weaken the pipe wall. If reinforcing materials (fiberglass, etc.) are used, the reinforcing material must be fully encapsulated within the resin to assure that

the reinforcement is not exposed, either to the inside of the pipe or at the interface of the CIPP and the existing pipe.

2.4.3 Structural Design Methods: Design methods are to be derived from traditionally accepted pipe formulae for various loading parameters and modes of failure. All equations will be modified to include ovality as a design parameter. The design method shall be submitted to the ENGINEER for review. Design calculations shall be signed and sealed by a Professional ENGINEER registered in the State of Florida.

2.4.4 Continuous Structure: The lateral CIPP must bridge breaks and missing sections of the existing pipe, substantially reducing or eliminating infiltration or exfiltration. The new jointless pipe-within-a-pipe must fit tightly against the old pipe wall and consolidate all disconnected sections into a single continuous conduit.

2.4.5 Useful Life: The lateral CIPP must have a minimum design life of fifty (50) years. The minimum design life may be documented by submitting life estimates by national and/or international authorities or specifying agencies. Otherwise, long-term testing and long-term in-service results (minimum ten (10) years) may be used, with the results extrapolated to fifty (50) years.

2.4.6 Materials: All constituent materials will be suitable for service in the environment intended. The final product will not deteriorate, corrode or lose structural strength that will reduce the projected product life.

2.4.7 Physical Strength: The design for the lateral CIPP wall thickness will be based on the following strengths as shown herein, unless otherwise submitted and approved by the ENGINEER:

Test Parameter	**Magnitude**	**Test Standard**
Flexural Stress	4,500 PSI	Modified ASTM D790
Flexural Modulus of Elasticity	250,000-500,000 PSI	Modified ASTM D790

2.4.8 Service lateral liner shall be neither accepted nor installed until design calculations are acceptable to the ENGINEER. Liner shall be as manufactured by Insituform of North America, Inc., or approved equal.

3 -- EXECUTION

3.1 Cleaning/Surface Preparation

It shall be the responsibility of the CONTRACTOR to clean the pipeline with a high-pressure water jet and to remove all internal debris out of the pipeline in accordance with Section 02751, "Cleaning and Root Removal".

3.2 Sewer Repairs

3.2.1 Any protruding pieces of concrete, dropped joints or broken pipe shall be subjected to point repairs, so that the pipe is left in a clean smooth condition in all respects ready for lining.

3.2.2 If conditions such as broken pipe and major blockages are found that will prevent proper cleaning, or where additional damage would result if cleaning is attempted or continued, the CONTRACTOR, with the concurrence of the ENGINEER, shall perform the necessary point repair(s), and then complete the cleaning.

3.3 Flow Control

Flow control shall be exercised as required to ensure that no flowing sewage comes into contact with sections of the sewer under repair. See Section 02750, "Wastewater Flow Control" for additional information.

3.4 Liner Installation For Main Lines

3.4.1 The prepared pipe shall be reviewed and be acceptable to the ENGINEER for cleanliness and smoothness before the CONTRACTOR begins to line the pipe.

3.4.2 The CONTRACTOR shall present to the ENGINEER, for review, a description of his methods for avoiding liner stoppage due to conflict and friction with such points as the manhole entrance and the bend into the pipe entrance. He shall also present plans for dealing with a liner stopped by snagging within the pipe. This information shall be rendered to the ENGINEER in a timely fashion prior to the preconstruction conference.

3.4.3 The CONTRACTOR shall have on hand at all times, for use by his personnel and the ENGINEER, a digital thermometer or other means of accurately and quickly checking the temperature of exposed portions of the liner.

3.4.4 The CONTRACTOR shall immediately notify the ENGINEER of any construction delays taking place during the insertion operation. Such delays shall possibly require sampling and testing by an independent laboratory of portions of the cured liner at the ENGINEER's discretion. The cost of such test shall be born by the CONTRACTOR and no extra compensation will be allowed. Any failure of sample tests or a lack of immediate notification of delay shall be automatic cause for rejection of that part of the work at the ENGINEER's discretion.

3.4.5 The CONTRACTOR shall designate a location where the tube will be vacuum impregnated prior to installation. The CONTRACTOR shall allow the CITY to inspect the materials and the "wet-out" procedure.

3.4.6 A scaffold or elevated platform shall be erected at the upstream or downstream access point. The tube shall be inverted using an "inversion elbow" at the bottom of the manhole or an "inversion ring" above ground. The tube shall be inverted (turned inside-out) with water pressure.

3.4.7 After the inversion is complete, the CONTRACTOR shall supply a suitable heat source and water recirculation equipment. The equipment shall be capable of uniformly raising the water temperature to a level required to effectively cure the resin.

3.4.8 The heat source shall be fitted with suitable monitors to gauge the temperature of the incoming and outgoing water supply. Another such gage shall be placed between the tube and the host pipe in the downstream manhole at or near the bottom to determine the temperatures during cure. Water temperature in the pipe during the cure period shall be as recommended by the resin manufacturer.

3.4.9 Initial cure shall be deemed complete when the exposed portions of the tube appear to be hard and sound and the temperature sensor indicates that the temperature is of a magnitude to realize an exotherm. The cure period shall be of a duration recommended by the resin manufacturer and may require continuous recirculation of the water to maintain the temperature.

3.4.10 IPP installation shall be in accordance with ASTM F1216, Section 7, or ASTM F1743, Section 6, with the following modifications:

3.4.10.1 Resin Impregnation: The quantity of resin used for tube impregnation shall be sufficient to fill the volume of air voids in the tube with additional allowances for polymerization shrinkage and the loss of resin through cracks and irregularities in the original pipe wall. A vacuum impregnation process shall be used. To insure thorough resin saturation throughout the length of the felt tube, the point of vacuum shall be no further than 25 feet from the point of initial resin introduction. After vacuum in the tube is established, a vacuum point shall be no further than 75 feet from the leading edge of the resin. The leading edge of the resin slug shall be as near to perpendicular as possible. A roller system shall be used to uniformly distribute the resin throughout the tube. If the Installer uses an alternate method of resin impregnation, the method must produce the same results. Any alternate resin impregnation method must be proven.

3.4.10.2 Tube Insertion: The wetout tube shall be positioned in the pipeline using either inversion or a pull-in method. If pulled into place, a power winch should be utilized and care should be exercised not to damage the tube as a result of pull-in friction. The tube should be pulled-in or inverted through an existing manhole or approved access point and fully extend to the next designated manhole or termination point.

3.4.10.1Temperature gauges shall be placed inside the tube at the invert level of each end to monitor the temperatures during the cure cycle.

3.4.10.4 Curing shall be accomplished by utilizing hot water under hydrostatic pressure in accordance with the manufacturer's recommended cure schedule.

3.4.10.5 Cooldown: The CONTRACTOR shall cool the hardened pipe to a temperature below 100 F before relieving the hydrostatic head. Cooldown may be accomplished by the introduction of cool water into the inversion standpipe to replace water being pumped out of the manhole.

3.4.10.6 Finish: The new pipe shall be cut off in the manhole at a suitable location. The finished product shall be continuous over the length of pipe reconstructed and be free from dry spots, delamination and lifts. Should the liner not make a tight seal at the inside manhole wall, a seal shall be made by use of extra polyester fiber felt and epoxy resin. Pipe entries and exists shall be smooth, free of irregularities, and watertight. No visible leaks shall be present and the CONTRACTOR shall be responsible for grouting to remove leaks or fill voids between the host pipe and the liner. During the warranty period, any defects which will affect the integrity or

strength of the product shall be repaired at the CONTRACTOR's expense, in a manner mutually agreed upon by the ENGINEER and the CONTRACTOR.

3.4.11 After the pipe has been cured in place, the CONTRACTOR shall reconnect the existing service connections. This shall be done from the interior of the pipeline without excavation using a robotic cutter. Where holes are cut through the liner, they shall be neat and smooth in order to prevent blockage at the service connections. Cut-in service connections shall be opened to a minimum of 95 percent of the flow capacity of the building sewer. Cuts shall be wire-brushed to remove jagged edges. All coupons shall be recovered at the downstream manhole and removed. The CONTRACTOR shall stop all visible leaks, including at service connections as required. All reinstated service lateral connections (between the liner and the existing pipe) shall be grouted. The reinstatement of the service connections shall be a separate pay item. The CONTRACTOR should not reactivate any line sections until accepted by the ENGINEER.

3.5 Reinstatement of Branch Connections

It is the intent of these specifications that branch connections to buildings be reopened without excavation, utilizing a remote controlled cutting device, monitored by a video TV camera. The CONTRACTOR shall certify he has a minimum of 2 complete working cutters plus spare key components on the site before each inversion. Unless otherwise directed by the owner or his authorized representative, all laterals will be reinstated. No additional payment will be made for excavations for the purpose of reopening connections and the CONTRACTOR will be responsible for all costs and liability associated with such excavation and restoration work.

3.6 Liner Installation For Service Laterals

3.6.1 Site Disruption: The lateral CIPP usually requires an access point to be established at the reconstruction termination point remote from the mainline pipe. The authorization for the access point and required location and excavation shall be obtained and performed by the CITY of the system. The CITY may install a clean-out, if required. The clean-out will be constructed of a polyvinyl chloride fitting or its equivalent with a riser pipe of equal diameter to the service pipe. The riser will be extended to the existing grade elevation and capped.

3.6.2 Internal Mainline Connection: The lateral CIPP shall be installed to effect a bond with the mainline invert-and-cure pipe to substantially reduce or eliminate the infiltration into the mainline pipe. The mainline pipe opening shall be prepared to accept the lateral CIPP. The lateral CIPP will protrude into the mainline pipe and form a seal with the inside surface of the mainline invert-and-cure pipe surface. The bonding area of the lateral CIPP and the mainline invert-and-cure pipe shall be maximized to obtain the best possible bond. The protrusion shall not inhibit the closed circuit television post video inspection of the mainline or service lateral pipes.

3.6.3 Flow Requirements: The lateral CIPP will provide at least 100 percent of the flow capacity of the host pipe before reconstruction. In lieu of actual measurements, calculated capacities may be derived using commonly accepted equations and values of the Manning flow coefficients (designated "n" coefficients). The original pipe material and condition at the time of reconstruction will determine the Manning coefficient used in the host pipe. A Manning coefficient of 0.009 for a jointless, relatively smooth-wall cured-in-place pipe will be used for the lateral CIPP flow calculation.

3.6.4 Inspection: The materials and processes must be reasonably available for pre-installation, installation and post-installation inspections. Areas which require inspection include, but are not limited to, the following:

3.6.5 Product materials should exhibit sufficient transparency to visually verify the quality of resin impregnation.

3.6.6 Temperature sensing devices, such as thermocouples, shall be located between the existing pipe and the lateral CIPP to ensure the quality of the cure of the wall laminate.

3.7 Time of Construction:

Construction schedules will be submitted and approved by the ENGINEER. At no time will any service lateral remain inoperative for more than an eight (8)-hour period. Any service that will be out of service for more than eight (8) hours will be temporarily by-passed into a mainline sanitary sewer. This will be done at the CONTRACTOR's expense.

3.8 Acceptance

The finished liner shall be continuous over the entire length of the installation. The liner shall be free from visual defects, damage, deflection, holes, delamination, uncured resin, and the like. There shall be no visible infiltration through the liner or from behind the liner at manholes and service connections. Cut-ins and attachments at service connections shall be neat and smooth.

3.9 Cleanup

After the liner installation has been completed and accepted, the CONTRACTOR shall cleanup the entire project area and return the ground cover to the original or better condition. All excess material and debris not incorporated into the permanent installation shall be disposed of by the CONTRACTOR.

3.10 Television Survey

Television survey, including Preconstruction Survey, Post Construction Survey, and Warranty Survey, as indicated in Section 02752 "Television Survey", is required for all cured-in-place lining, including main lines and service laterals.

3.11 Public Notification

3.11.1 The CONTRACTOR shall make every effort to maintain service usage throughout the duration of the project. In the event that a service will be out of service, the maximum amount of time of no service shall be 8 hours for any property served by the sewer. A public notification program shall be implemented, and shall as a minimum, require the CONTRACTOR to be responsible for contacting each home or business connected to the sanitary sewer and informing them of the work to be conducted, and when the sewer will be off-line. The CONTRACTOR shall also provide the following:

3.11.1.1 Written notice to be delivered to each home or business the day prior to the beginning of work being conducted on the section, and a local telephone number of the CONTRACTOR they can call to discuss the project or any problems which could arise.

3.11.1.2 Personal contact with any home or business which cannot be reconnected within the time stated in the written notice.

3.11 Warranty

The liner shall be certified by the manufacturer for specified material properties for a particular job. The manufacturer warrants the liner to be free from defects in raw materials for one year from the date of acceptance. During the warranty period, any defects which affect the integrity or strength of the pipe shall be repaired at the CONTRACTOR's expense in a manner mutually agreed by the CITY and the CONTRACTOR.

- END OF SECTION -

SECTION 02770 – CIP STRUCTURAL LATERAL CONNECTION LINING

1 -- GENERAL

1.1 Scope

The work specified in this section consists of providing for the reconstruction of a particular mainline section and the adjacent lateral sewer pipe without excavation while providing a structural one piece leak free connection at the interface of the mainline and lateral pipelines.

1.2 General

The reconstruction will be accomplished using a non-woven fabric tube of particular length and a thermoset resin with physical and chemical properties appropriate for the application. The lateral tube within a translucent inversion bladder is vacuum impregnated with the resin then placed inside a protective carrying device. The mainline liner that is physically attached to the lateral tube is affixed around a rigid launching device. The launching device and protective carrying device are winched into the existing sewer. When the launching device is properly positioned at the lateral connection, the mainline liner is inflated and the resin saturated tube is inverted up through the lateral pipe, using air or water pressure, by the action of the inversion bladder. Once the tube/resin composite is cured, the inversion bladder and launching/carrying devices are removed. The cured-in-place mainline/lateral connection repair system shall be "T-Liner" as manufactured by LMK Enterprises, Inc., or approved equal.

1.3 Submittals

The CONTRACTOR shall submit shop drawings, samples of materials, and other information to the CITY for review in accordance with Section 01300, "Submittals". Included shall be design calculations for the work.

1.4 Qualifications

1.4.1 The Qualifications of the CONTRACTOR shall be submitted with the bid. The CONTRACTOR is defined as the entity that holds the contracting license ("the state or county licensed company") to perform contracting work under these bid documents, the CONTRACTOR Qualifications must be submitted in this name. Individual qualifications will not be considered in the product experience. These Qualifications shall include detailed descriptions of the following:

1.4.1.1 Name, business address and telephone number of the CONTRACTOR.

1.4.1.2 Name(s) of all supervisory personnel to be directly involved with this project.

1.4.2 The CONTRACTOR shall sign and date the information provided and certify, that to the extent of his knowledge, the information is true and accurate, and that the supervisory personnel submitted will be directly involved with and used on this project. Substitutions of personnel will not be allowed without written authorization of the CITY.

1.4.3 Specialty technicians shall be certified by the proposed product manufacturer and/or its authorized representative. Certifications shall be submitted to the CITY.

1.4.4 The CONTRACTOR shall provide the references of previous project lists going back five years including his customer's names, city contact name, phone number, city project number, city project name. The list must include the number of laterals rehabilitated as well as the number and type of connection seals installed. If there have been any changes in the materials it shall be brought to the attention of the CITY and is to be noted on the submitted projects used for references showing the date and type of the changes.

1.4.5 To be acceptable, the company bidding must have a minimum of 2,500 full circle structural connection installations of the specific product bid, which must be documented, in Florida.

1.4.6 To be acceptable, the installer (the company bidding) must have had a minimum of five years active experience in the commercial installation of the product bid.

2 -- PRODUCTS

2.1 General

The finished liner shall be fabricated from material as specified in this section which when cured will be resistant to the corrosive effects of the raw sewage and hydrogen sulfide.

2.2 Liner Sizing

The liner shall be fabricated to a size that when installed will neatly fit the internal circumference of the conduit to be repaired as specified by the CITY.

2.3 Liner Material

2.3.1 The liner shall be one piece and will consist of a lateral portion and the mainline portion with one or more layers of flexible needled felt or an equivalent non-woven material. The liner will be continuous in length and the wall thickness shall be uniform. No overlapping sections shall be allowed in the circumference or the length of the lateral liner. The tube will be capable of conforming to offset joints, bells, and disfigured pipe sections. The mainline liner will be flat with one end overlapping the second end and sized accordingly to create a circular lining equal to the diameter of the mainline pipe. The resin will be polyester or vinyl ester or epoxy, with proper catalysts as designed for the specific application. The cured-in-place pipe shall provide a smooth bore interior. Both the lateral pipe and the main connection shall have a design report documenting the design criteria, fully deteriorated pipe section for the lateral and partially deteriorated for the main (if the main has already been lined), relative to the hydrostatic pressures, depth of soil cover, and type of soil. The mainline sectional liner shall be a full-circle 16-inch long CIPP liner integrally manufactured to the lateral liner providing a seamless connection between the mainline pipe liner and the lateral liner. Installation will be accomplished remotely using air or water for inversion and curing. The cured pipe repair system shall be watertight and shall conform to the existing pipe and eliminate any leakage or connection to the outside of the host pipe/service.

2.3.2 The liner shall meet or exceed ASTM F2561-06.

2.3.3 The composite of the materials above will, upon installation inside the host pipe, exceed the minimum test standards specified by the American Society for Testing Methods.

Physical Characteristics	**Test Procedure**	**Minimum Value**
Flexural Strength	ASTM D790	4,500 psi
Flexural Modulus	ASTM D790	250,000 psi
Long Term Modulus	Reduction for Creep	50%
Design Considerations	**Criteria**	
Tube Design	ASTM F 1216 or F2561	Appendix X1
Hydrostatic Buckling	ASTM F 1216 or F2561	Appendix X1

The CIPP design for the lateral tube and mainline structural connection shall assume no bonding to the original host pipe.

2.4 Liner Design

2.4.1 The minimum required structural CIPP wall thickness shall be based on the physical properties described above and in accordance with the design equations in the appendix of ASTM F 1216, and the following design parameters:

Design Safety Factor	2.0
Retention Factor for Long-Term Flexural Modulus to be used in Design	50 %
Ovality*	2 %
Groundwater Depth = Pipe Depth (above invert)*	ft.
Soil Depth (above crown)*	ft.
Soil Modulus	700 psi
Soil Density	120 pcf
Live Load	One H20 passing truck
Design Condition (lateral pipe)	Fully deteriorated
Design Condition (main pipe) Lined Main Pipe	Partially deteriorated
Design Condition (main pipe) Unlined Main Pipe	Fully deteriorated
**Denotes information which can be provided here or in inspection video tapes or project construction plans. Multiple line segments may require a table of values.*	

Note: There are two conditions that require design calculation in accordance with ASTM F1216. 1) Lateral piping. 2) The connection in the main, lined or unlined main.

2.4.2 The lining manufacturer shall submit to the CITY for review complete design calculations for the liner, both main connection and lateral pipe designs, signed and sealed by a Professional ENGINEER registered in the State of Florida and certified by the manufacturer as to the compliance of his materials to the values used in the calculations. A safety factor of 2 shall be applied in the design calculation. The lateral host pipe shall be considered fully deteriorated, the previously lined main pipe shall be considered partially deteriorated. The liner shall be designed to withstand a live load equivalent to one H-20 passing truck plus all pertinent dead

loads, hydrostatic pressure and grout pressure (if any). For design purposes, the water table shall be considered at grade elevation. The liner shall be designed in accordance with ASTM F 1216. The buckling analysis shall account for the combination of dead load, live load, hydrostatic pressure and grout pressure (if any). The liner side support shall be considered as if provided by soil pressure against the liner. The existing lateral pipe shall not be considered as providing any structural support. If the main pipe has been lined a partially deteriorated condition is to be used for the design of the main. Hydrostatic loads must be considered in three existing pipe conditions 1) mainline design, for previously lined mains and 2) unlined mains as well as 3) the lateral pipe design for unlined pipe. Modulus of soil reaction shall be 700, corresponding to a moderate degree of compaction of bedding and a fine-grained soil as shown in AWWA Manual M45, Fiberglass Pipe Design.

2.4.3 Liner shall be neither accepted nor installed until design calculations are acceptable to the CITY for the three existing pipe conditions.

3 -- EXECUTION

3.1 Cleaning Sewer Lines

Prior to any lining of a pipe, it shall be the responsibility of the CONTRACTOR to remove internal deposits from the pipeline in accordance with Section 02751 - Preparatory Cleaning and Root Removal. Both mainline and lateral line shall be cleaned.

3.2 Television Survey

3.2.1 Television survey shall be performed in accordance with Section 02752 - Television Survey, including Preconstruction and Post Construction Surveys. Both main line and lateral line shall be televised under separate pay items utilizing a pan and tilt camera for both mains and laterals.

3.2.2 The interior of the pipeline shall be carefully surveyed to determine the locations and extent of any structural failures. The location of any conditions which may prevent proper installation of lining materials into the pipelines shall be noted so that these conditions can be corrected. A video and suitable log in PACP format shall be kept and a copy turned over to the CITY.

3.3 Flow Bypassing

The CONTRACTOR, when required, shall provide for the transfer of flow, through or around section or sections of pipe that are to be repaired. The proposed bypassing system shall be acceptable in advance by the CITY. The acceptance of the bypassing system in advance by the CITY shall in no way relieve the CONTRACTOR of his responsibility and/or public liability. The flow bypassing shall be done in accordance with Section 02750 - Wastewater Flow Control.

3.4 Line Obstructions

It shall be the responsibility of the CONTRACTOR to clear the line of obstruction. If survey reveals an obstruction that cannot be removed by conventional cleaning equipment, the CONTRACTOR shall make a point repair excavation in accordance with Section 02757 - Point

Repair of Sanitary Sewers to uncover and remove or repair the obstruction. Such excavation shall be approved in writing by the CITY prior to the commencement of the work.

3.5 Liner Installation

3.5.1 The tube is inspected for tears and frayed sections. The tube, in good condition, will be vacuum impregnated with the thermostat resin. The resin will be introduced into the tube creating a slug of resin at the beginning of the tube. A calibration roller will assist the resin slug to move throughout the tube. All air in the tube shall be removed by vacuum allowing the resin to thoroughly impregnate the tube. All resin shall be contained to ensure no public property or persons are exposed to the liquid resin. The mainline liner will be saturated upon a wet-out platform. The resin impregnated sample (wick), shall be retained by the installer to provide verification of the curing process taking place in the host pipe.

3.5.2 The saturated tube along with the inversion bladder will be inserted into the carrying device. The mainline liner is affixed on the launching device. Both the launching and carrying device is pulled into the pipe using a cable winch. The pull is complete when the open port of the launching device is aligned with the interface of the service connection and mainline pipe. The resin saturated lateral tube is completely protected during the pull. No resin shall be lost by contact with manhole walls or the pipe during the pull. The resin saturated mainline liner is supported upon the rigid launcher that is elevated above the pipe invert by means of rotating skid system. The mainline liner should not be contaminated or diluted by exposure to dirt, debris, or water during the pull.

3.5.3 The installer shall document the placement of the liner by internal video inspection with the camera being inserted from the lateral pipe down to the mainline pipe.

3.5.4 The mainline liner is expanded against the mainline pipe and lateral tube is inverted out of the launcher/carrying device by controlled air or water pressure. The installer shall be capable of viewing the lateral liner contacting the lateral pipe from the beginning to the end of the repair. The mainline liner and the lateral tube are held tightly in place against the wall of the host pipe by controlled pressure until the cure is complete.

3.5.5 When the curing process is complete, the pressure will be released. The inversion bladder and launching device shall be removed from the host pipe with the winch. No barriers, coatings, or any material other than the cured tube/resin composite, specifically designed for desirable physical and chemical resistance properties, should ever be left in the host pipe. Any materials used in the installation other than the cured tube/resin composite are to be removed from the pipe by the installer.

3.6 Acceptance And Testing

3.6.1 The finished liner shall be continuous over the entire length of the installation. The liner shall be free from visual defects, damage, deflection, holes, delamination, uncured resin, and the like. There shall be no visible infiltration through the liner or from behind the liner.

3.6.2 Verification of a non-leaking lateral liner and service connection shall require an air test in accordance with the following specifications. Testing shall be performed at the CITY'S discretion but at a frequency not to exceed one test for every ten liners installed. The cost for the test shall be included in the liner installation cost, and no separate payment shall be made.

3.6.2.1 A camera shall be inserted into the lateral pipe via a clean-out upstream of the upper most portion of the cured in-place lateral liner. The camera is then moved through the lateral pipe until it becomes positioned at the lateral/main connection. The camera is utilized to assist in positioning and placing a pair of plugs in the mainline on either side of the lateral opening. A test device with a minimum of a ten-inch clear separation shall be centered on the lateral opening and spanning the brim of the lined connection.

3.6.3 Next, an air test plug shall be introduced into the lateral pipe. The test plug will be placed inside of the cured in-place lateral liner at its upper most portion. The test plug shall be inflated and sealed against the cured in-place lateral liner at the upstream end of the liner.

3.6.4 The testing device within the mainline are then inflated and sealed across the service connection.

3.6.5 Air-pressure not less than 4 PSI shall be introduced through the test plug. The void area between the three plugs shall be pressurized at 4 PSI, held for 2 minutes and during this time the pressure shall not drop below 3.0 PSI.

3.6.6 If an installed cured in-place lateral liner fails the specified air test, the following corrective measures shall be taken.

3.6.7 The cured in-place lateral liner shall be re-inspected by use of a closed circuit television camera in attempt to identify the defect.

3.6.8 Any repairs made shall consist of materials that are structural and meet or exceed the same criteria as the cured in-place lateral liner is required to meet in a domestic sewer collection system. Such materials shall have a minimum life expectancy of 50 years in accordance with ASTM F-1216 (most recent standard) Appendix X1 Design Considerations and Appendix X2 Chemical-Resistance Test.

3.6.9 Once the defect has been corrected, the renewed lateral pipe shall be re-tested in accordance with the air test procedure as described above.

3.6.10 Any corrective measures shall be performed at the CONTRACTOR's expense.

3.7 If any of the air tests fail, the CITY at its option may require the CONTRACTOR to test an additional lateral at no additional charge to the CITY. If a second air test shall fail, the CITY at its option may require the CONTRACTOR to test additional or all of the installed cured in-place lateral linings at no additional charge to the CITY.

3.7 Cleanup

After the liner installation has been completed and accepted, the CONTRACTOR shall clean up the entire project area and return the ground cover to grade. All excess material and debris not incorporated into the permanent installation shall be disposed of by the CONTRACTOR.

3.8 Warranty

The liner shall be certified by the manufacturer for specified material properties for a particular job. The manufacturer warrants the liner to be free from defects in raw materials for one year

from the date of acceptance. During the warranty period, any defects which affect the integrity or strength of the pipe shall be repaired at the CONTRACTOR's expense in a manner mutually agreed by the CITY and the CONTRACTOR.

END OF SECTION

SECTION 02771 –STRUCTURAL LATERAL CONNECTION LINING

Section 02770

CURED-IN-PLACE PIPE LINING – Laterals & Cleanouts

1.0 INTENT

This specification covers material requirements, installation practices, and test methods for the reconstruction of a sewer service lateral pipe and the main connection without excavation. The pipe renovation shall be accomplished by the inversion and inflation of a resin impregnated, single-piece lateral and main connection liner. When cured, the liner extends over a predetermined length of the service lateral and the full circumference of the main pipe at the connection (CIPP) outfitted with gasket seals. The Materials and Installation practices shall, at a minimum, adhere to the requirements of ASTM F2561-11 "Standard Practice for Rehabilitation of a Sewer Service Lateral and its Connection to the Main Using a One-Piece Main and Lateral Cured-in Place Liner"

This specification also covers the installation of a CIPP cleanout riser liner. The cleanout

riser liner shall be accomplished by the inversion of a resin impregnated, single-piece

cured-in-place pipe (CIPP) lateral and riser liner.

This specification takes precedence over any other similar lateral specification that may be found in other sections of the bid documents.

2.0 GENERAL

The lateral reconstruction shall be accomplished using a resin absorbent textile tube of particular length and a thermo-set resin with physical and chemical properties appropriate for the application. The launching device and launching hose is winched through the mainline and positioned at the appropriate service lateral connection. The mainline bladder is inflated seating the hydrophilic seals and presses the connection liner against the main pipe at the connection while the lateral tube inverts up into the lateral pipe by the action of the inversion bladder. The resin-saturated liner is cured, the hydrophilic gaskets are in place then the inversion bladder and launching device are removed.

The cleanout riser lining shall be accomplished by the inversion of a resin impregnated, single-piece cured-in-place pipe (CIPP) lateral and riser liner outfitted with engineered, molded hydrophilic gasket seals that are designed specifically for sealing the CIPP termination ends through a T-shaped cleanout connection. When cured, the liner renews the cleanout riser pipe and the connection to the lateral piping.

3.0 PRODUCT AND INSTALLER ACCEPTABILITY

A. All sewer products are intended to have a minimum 50 year design life, in order to minimize the owner's long term risk of failure, only proven products and installers with substantial successful long term track records will be considered.

B. Products and installers must document the following minimum criteria to be deemed commercially acceptable:

Product	Unit	Florida Minimum Requirement	U.S. Minimum Requirement
Lateral Liner	LF	100,000	500,000
Main / Lateral Connections	EA	5,000	50,000
Stack Single or Double Wye	EA	50	50
Lateral Transitions	EA	100	500

3.1 For materials and product to be considered commercially proven, the above referenced minimum units of successful wastewater collection system installations must be documented to the satisfaction of the owner to assure commercial viability of the proposed liner system. If changes in the product (installation, resin, materials, configuration, assembly, seals) did occur the date and scope of changes must be part of the product history documentation for the owner to review and tabulated to show the quantity of each specific product type or version. Any modifications to the finished product bid must show the date and reason the change was made.

3.2 All sewer rehabilitation products submitted for approval must provide third party test results supporting the long term performance and structural strength of the product and such data shall be satisfactory to the owner. Tests are to include the

main, laterals, and main/lateral connection materials and hydrophilic gasket seals. Test samples shall be prepared so as to simulate installation methods and trauma of the product. No product will be approved without independent third party testing verification for all components proposed.

3.3 The Contractor (the firm bidding) must meet the minimum requirements above. This is a company requirement; personal history is valuable, however will not be considered in evaluating the company's ability to meet the minimum requirements of this specification. The Contractor must have installed the same product (in the same constructed configuration) proposed for a minimum of five years.

4.0 MATERIAL

4.1 *Liner Assembly*- The liner assembly shall be continuous in length and consist of one or more layers of absorbent needle punched felt, circular knit or circular braid that meet the requirements of ASTM F1216 and ASTM D5813 Sections 6 and 8. No intermediate or encapsulated elastomeric layers shall be in the textile that may cause de-lamination in the CIPP. The textile tube and sheet shall be constructed to withstand installation pressures, have sufficient strength to bridge missing pipe segments, and flexibility to fit irregular pipe sections. The resin saturated textile tube and sheet shall meet ASTM F 1216, 7.2 as applicable, and the tube shall have 5% to 10% excess resin distribution (full resin contact with the host pipe) that when compressed and cured will meet or exceed the design thickness.

4.2 *Mainline Liner Tube*- The main liner tube shall be formed from a flat sheet of resin absorbent material suitable for CIPP. The forming of the tube is accomplished by one end of the textile sheet overlapping the second end and sized accordingly to create a circular lining equal to the inner diameter of the lined main pipe. The interior of the textile sheet shall be laminated with an impermeable, translucent flexible membrane. The textile sheet before insertion shall be permanently marked on the membrane as a "Lateral Identification" correlating to the address of the building the lateral pipe provides service.

4.3 *Lateral Liner Tube*- The exterior of the lateral liner tube shall be laminated with an impermeable, translucent flexible membrane. Longitudinal seams in the tube shall be stitched and thermally sealed. The lateral tube will be continuous in length. The lateral tube will be capable of conforming to offset joints, bends, bells, disfigured pipe sections and pipe diameter transitions.

4.4 *Mainline Connection*- The main tube and lateral tube shall form a one-piece assembly by stitching the lateral tube to the mainsheet aperture. The connecting end of the lateral tube shall be shaped to match the aperture and curvature of the main tube. The lateral tube and main tube shall be sealed by use of a flexible UV cured adhesive/sealant. The main/lateral tube assembly shall take the shape of a "TEE" or "WYE" with corresponding dimensions such as a curved circle or a curved elliptical opening in the pipefitting. Submittals for the liner assembly must

include the manufacturer's assembly methods and test protocol for the main/lateral liner assembly to be certified as airtight prior to resin saturation. Each liner assembly must include this test data and be certified by the manufacturer to be airtight prior to resin saturation.

4.5 *Gasket Seals*- The mainline connection shall include a seamless molded flange shaped gasket attached to the main liner tube. The gasket must be a minimum of 2.5mm and must retain this minimum thickness under installation pressures. The lateral tube shall include a compression O-ring gasket attached six-inches from the terminating end of the lateral tube. The gasket seals required must be a manufactured molded neoprene seal. Paste or caulk type of sealants are inconsistent in their placement and application and are not acceptable. All seals must be visible after the installation to verify their proper placement.

4.6 *Mainline End Seal Test Data*- The hydrophilic gasket seals shall include test data that supports substantial expansion properties so to form a watertight compression end seal at the terminating ends of the CIP-lateral liner. The test protocol shall simulate subterranean conditions and hydraulic loading at surface. Gasket seal submittals must include tests data simulating hydration/ dehydration conditions for a period of 10,000-hours and the test results must successfully demonstrate and document long-term performance without deterioration, loss of material, flexibility, and expansion of the gasket during repeated cycles of hydration and dehydration.

4.7 *Bladder Assembly*- The liner assembly shall be surrounded by a second impermeable, inflatable, invertible, flexible translucent membrane bladder that will form a liner/bladder assembly. The translucent bladder shall facilitate vacuum impregnation while monitoring the resin saturation process.

4.8 *Cleanout Riser Liner*- The liner shall be constructed of a resin absorbent textile tube and a thermo-set resin with physical and chemical properties appropriate for the application.

5.0 RESIN SYSTEM

5.1 The resin/liner system shall conform to ASTM D5813 Section 8.2.2.

5.2 The resin shall be a corrosion resistant polyester, vinylester, epoxy or silicate resin and catalyst system that when properly cured within the composite liner assembly, meets the requirements of ASTM F1216, the physical properties herein, and those which are to be utilized in the design of the CIPP, for this project.

5.3 The resin shall produce a CIPP, which will comply with the structural and chemical resistance requirements of ASTM F1216.

Table 1 CIPP INITIAL STRUCTURAL PROPERTIES

Property	ASTM Test	Minimum Value PSI	(MPa)
Flexural Strength	D 790	4,500	(31)
Flexural Modulus	D 790	250,000	(1,724)

6.0 DESIGN CONSIDERATIONS

6.1 The CIPP shall be designed per ASTM F1216, Appendix X1.

6.2 The CIPP design for the lateral tube and main sheet shall assume no bonding to the original pipe.

6.3 The resin saturated lateral tube and the main sheet must place the resin in full contact with the host pipe. The cured liner must have any coating on the interior of the lateral piping.

6.4 The liner must be smooth and have an average roughness coefficient "n" factor of 0.013 or lower.

7.0 REFERENCES

7.1 ASTM F-2561 - Standard Practice for Rehabilitation of a Sewer Service Lateral and Its Connection to the Main Using a One-Piece Main and Lateral Cured-In-Place Liner.

7.2 ASTM F1216 - Standard Practice for Rehabilitation of Existing Pipelines and Conduits by the Inversion and Curing of a Resin-Impregnated Tube.

7.3 ASTM D-790 Standard Test Methods for Flexural Properties of Unreinforced and Reinforced Plastics and Electrical Insulating Materials.

7.4 ASTM D-792 Standard Test Methods for Density and Specific Gravity of Plastics by displacement.

7.5 ASTM D-2990 Standard Test Methods for Tensile, Compressive, and Flexural Creep and Creep-Rupture of Plastics

7.6 ASTM D5813 Standard Specification for Cured-in Place Thermosetting Resin Sewer Pipe.

ASTM F2561-11 references several complementing standards; one of which is ASTM F1216. The ASTM F1216 standard is referenced for purposes of tube design considerations for a CIPP. ASTM F1216 is not a lateral pipe lining standard and is not applicable to the sealing of lateral connections to mainline pipe and a branch pipe using CIPP. ASTM F2561 is the industry standard for

renewing lateral pipes and main/lateral connections with CIPP and pre-molded compression gaskets.

8.0 INSTALLATION RECOMMENDATIONS

8.1 *Access Safety* – Prior to entering access areas such as manholes, an excavation pit, performing inspection or cleaning operations, an evaluation of the atmosphere to determine the presence of toxic or flammable vapors or lack of oxygen shall be undertaken in accordance with local, state, or federal safety regulations.

8.2 *Cleaning and Inspection* – As per NASSCO Standards.

8.3 *Cleaning Accessing the Lateral Pipe* – A cleanout is required to be located on the exterior of the building. The cleanout fitting shall be TEE shaped so to allow upstream and downstream access to the lateral pipe. The cleanout shall be located within two (2) feet of where the finished liner is to terminate.

8.4 *Plugging* – The upstream side of the cleanout shall be plugged during insertion and curing of the liner assembly ensuring no flows enter the pipe and no air, steam or odors will enter the building. When required, the main pipe flows will be by-passed. The pumping system shall be sized for peak flow conditions. The upstream manhole shall be monitored at all times and an emergency deflating system will be incorporated so that the plugs may be removed at any time without requiring confined space entry.

8.5 *Inspection of Pipelines* – The interior of the pipeline shall be carefully inspected to determine the location of any condition that shall prevent proper installation, such as roots, severe offsets, and collapsed or crushed pipe sections. Experienced personnel trained in locating breaks, obstacles, and service connections by closed circuit television shall perform inspection of pipelines.

8.6 *Line Obstructions* – The existing lateral pipe shall be clear of obstructions that prevent the proper insertion and expansion of the lining system. Changes in pipe size shall be accommodated, if the lateral tube is sized according to the pipe diameter and condition. Obstructions may include dropped or offset joints of no more than 20% of inside pipe diameter.

8.7 *Resin Impregnation* – The liner assembly is encapsulated within the translucent bladder (liner/bladder assembly), the entire liner including the flat sheet shall be saturated with the resin system (wet-out) under controlled vacuum conditions. The volume of resin used shall be sufficient to fill all voids in the textile lining material at nominal thickness and diameter. The volume shall be adjusted by adding 5% to 10% excess resin for the change in resin volume due to polymerization and to allow for any migration of resin into the cracks and joints in the original pipe. No dry or unsaturated area in the mainline sheet or lateral tube shall be acceptable upon visual inspection.

8.8 7.8 *Liner Insertion* – The lateral tube and inversion bladder shall be inserted into the launching hose. The main bladder and flat textile sheet (main liner tube) shall

be wrapped around a "T" launching device, formed into a tube and secured by use of rubber bands. A seamless molded flange shaped gasket shall be attached to the main liner tube by use of stainless steel snaps. The flanged gasket shall be inserted into the lateral pipe at the main/lateral juncture so that the brim of the flanged gasket is firmly seated against the mainline pipe liner. An O-ring end seal shall be positioned 6-inches from the terminating end of the lateral liner tube. The launching device is inserted into the pipe and pulled to the point of repair. The pull is complete when the lateral tube is exactly aligned with the lateral pipe connection. The lateral tube is completely protected during the pull. The mainline liner is supported on a rigid "T" launcher that is elevated above the pipe invert through the use of a rotating skid system. The liner assembly shall not be contaminated or diluted by exposure to dirt or debris during the pull.

8.9 *Bladder* – The main bladder shall be inflated causing the main sheet to unwrap and expand; pressing the main tube firmly into contact with the main pipe and embedding the flange shaped gasket between the main tube and the main pipe at the lateral opening. The lateral tube is inverted through the main tube aperture by the action of the lateral bladder extending into the lateral pipe to a termination point that shall be no less than 2-feet from the exterior cleanout. The bladder assembly shall extend beyond each end of the liner, so the liner remains open-ended and no cutting shall be required.

8.9.1 *Cleanout Riser Liner* - The tube shall be resin impregnated under a controlled vacuum within the translucent bladder. The liner/bladder assembly is then inserted into a mobile air-inversion device. The mobile air-inversion device shall include a camera port for inspecting the resin saturated tube inflated in the pipe before the resin is cured, and for visually verifying the liner has been fully deployed and the ends are open.

9.0 CIPP LATERAL PROCESSING

9.1 *Curing* – After the liner has been fully deployed into the lateral pipe, pressure is maintained pressing the liner firmly against the inner pipe wall until the liner is cured at ambient temperatures or by a suitable heat source. The heating equipment shall be capable of delivering a mixture of steam and air throughout the liner bladder assembly to a uniform raise the temperature above the temperature required to cure the resin. The curing of the CIPP shall take into account the existing pipe material, the resin system, and ground conditions (temperature, moisture level, and thermal conductivity of the soil). The heat source temperatures shall be monitored and logged during the cure and cool down cycles. The manufacturer's recommended cure schedule shall be submitted and followed.

9.2 *CIPP Processing* – Curing shall be done without pressure interruption with air or a mixture of air and steam for the proper duration of time per the resin

manufacturer's recommendations. The curing process is complete when the temperature of the CIPP reaches 100 degrees Fahrenheit or less.

10.0 FINISH

The finished CIPP – CIPP Shall be a homogenous CIPP liner assembly located within a lateral service pipe for a specific length, and extending into the main pipe to renew 18-inches of the main pipe at the main/lateral service connection. The CIPP shall be smooth with minimal wrinkling and shall increase flow rate. The CIPP shall be free of dry spots, lifts, and delamination. The CIPP shall include a textile taper at each end providing a smooth transition to the host mainline liner for accommodating video equipment and maintaining proper flow in the mainline. After the work is completed, the installer will provide the owner with video footage documenting the repair and the visual markings on the CIPP liner assembly identifying the building address. The finished product shall provide a verifiable non-leaking connection between the mainline liner and the CIP-Lateral liner.

11.0 RECOMMENDED INSPECTION AND TESTING PRACTICES

11.1 *Sampling* – As designated in the purchase agreement, the preparation of a CIPP sample is required. The sample shall be prepared by securing a flat plate mold using the textile tube material and resin system as used for the rehabilitated pipe.

11.2 *Pressure* – The pressure applied on the plate sample will be equal to the highest pressure exerted on the lateral tube during the inversion process.

11.3 *Length* – The minimum length of the sample must be able to produce at least five specimens for testing in accordance with ASTM D-790-03.

11.4 *Conditioning* – Condition the test specimens at 73.4 ± 3.6° F (23 ± 2°C) and 50 ± 5% relative humidity for not less than 40 hour prior to test in accordance with Practice ASTM D 618, for those tests where conditioning is required.

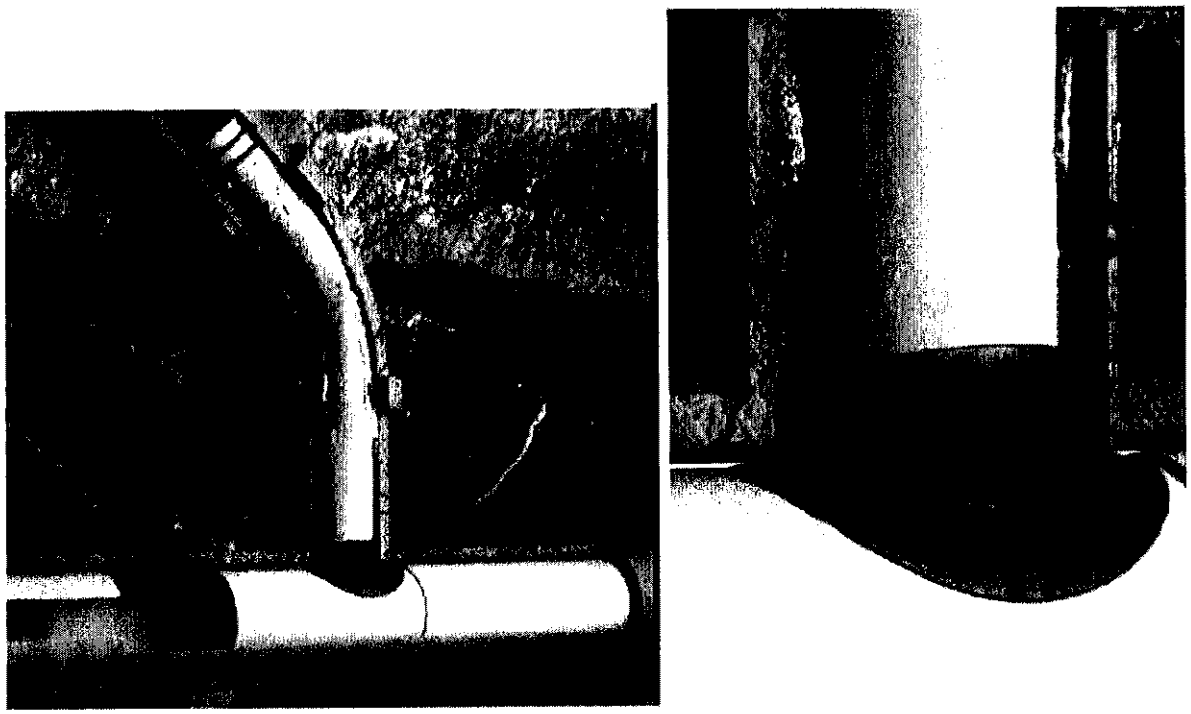
11.5 *Short-Term Flexural (Bending) Properties* – The initial tangent flexural modulus of elasticity and flexural stress shall be measured for gravity and pressure pipe applications in accordance with Test Method D 790 and shall meet the minimum requirements of Table 1.

11.6 *Gravity Pipe Leakage Testing* – If required by the owner in the contract documents or purchase order, gravity pipes should be tested using an air test method where a test plug is placed adjacent to the upstream and downstream ends of the main sheet CIPP and at the upper most end of the lateral tube. This test should take place no less than 72-hours after returning the lateral pipe back into service. This test is limited to pipe lengths with no service connections. The test pressure shall be 4-PSI for a test time of three-minutes; the pressure shall not drop below 3.5 PSI.

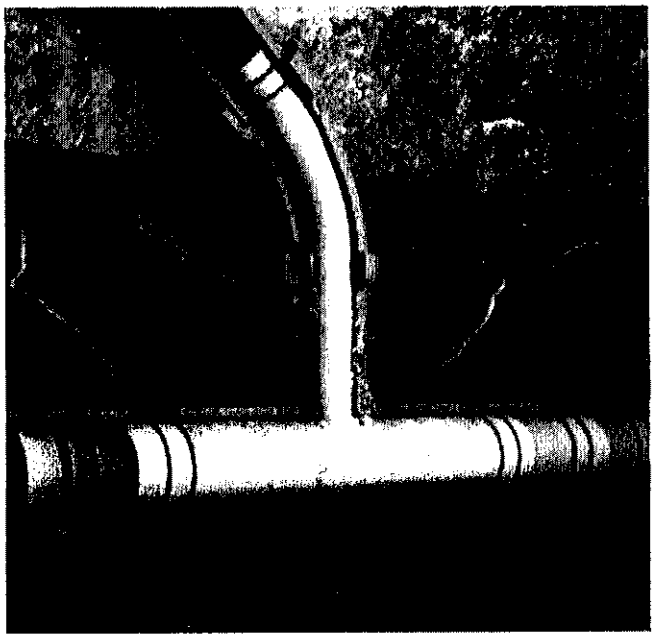
12.0 WARRANTY

All CIPP liners shall be certified by the manufacturer for specified material properties for the particular repair. The manufacturer warrants the liner to be free from defects in raw materials for ten years from the date of acceptance. The contractor guarantees the work to be free from defects caused by faulty workmanship for a period of five years from the date of acceptance. During the warranty period, any defects which affect the integrity, strength or water tightness of the installed pipe shall be repaired at the contractor's expense.

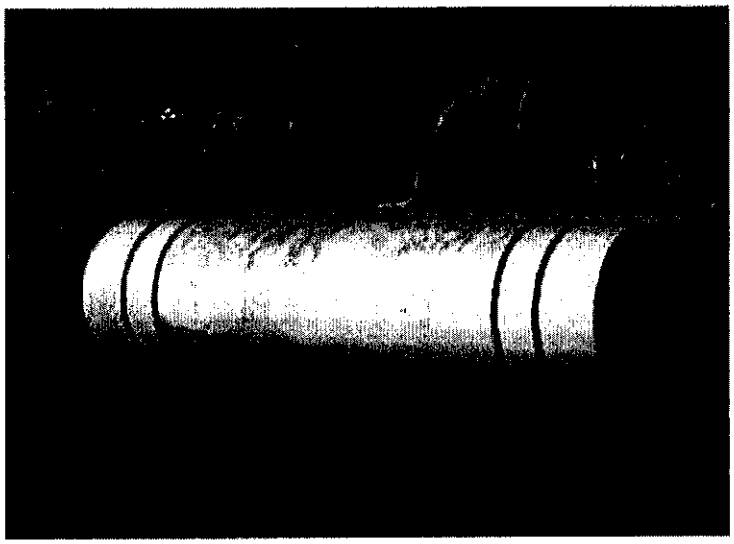
– END OF SECTION –



Watertight seal for lateral



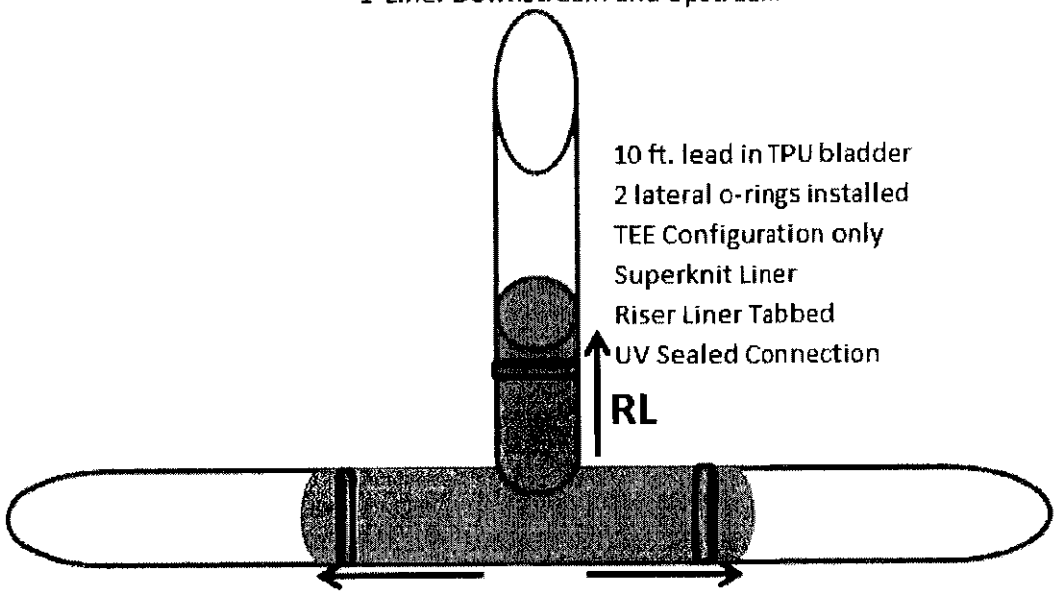
Main to tee connection



Spot repair

Base Configuration: 2' Riser Liner

1' Liner Downstream and Upstream



Downstream

2 ft. additional TPU bladder
2 lateral o-Rings installed
Superknit Liner

Upstream

2 ft. additional TPU bladder
2 lateral o-Rings installed
Superknit Liner

Riser Liner

SECTION 027800 - INFILTRATION AND INFLOW PROGRAM – SEALING SYSTEM FROM INFLOW OR REPAIRS OF SYSTEM

1 - Not used

2 – CONTRACTOR's Responsibility

2.1 CONTRACTOR agrees to do everything required by this Agreement and to comply with any and all other provisions in the documents and items incorporated by reference into this Agreement. CONTRACTOR also agrees to perform all clean-up and bear the expense of any off-site disposal, which is or may be necessitated by its Project work.

2.2 CONTRACTOR agrees that all work performed under this Agreement shall be done in a professional manner and that CONTRACTOR's efforts will produce a quality result.

2.3 CONTRACTOR represents to City, with full knowledge that City is relying upon these representations when entering into this Agreement with CONTRACTOR, that CONTRACTOR has the expertise, experience and work force sufficient to timely perform the services to be provided by CONTRACTOR pursuant to the terms of this Agreement.

2.4 CONTRACTOR represents to City that CONTRACTOR is properly licensed by all applicable federal, state and local agencies to provide the services specified under this Agreement. If any of the CONTRACTOR's licenses are revoked, suspended or terminated for any reason by any governmental agency, CONTRACTOR shall notify the City immediately.

2.5 CONTRACTOR agrees to conduct all work and services under this Agreement in accordance with all applicable federal, state and local laws and regulations. CONTRACTOR will identify all governmental authorities and agencies having jurisdiction to approve work involved in the Project and CONTRACTOR agrees to obtain all permits and approvals from any and all such governmental authorities which have jurisdiction. If permitted by the permitting agency, and if City can realize a cost savings by such action, City may authorize the CONTRACTOR to seek required permits on behalf of and in the name of City as its CONTRACTOR; provided, however, that CONTRACTOR agrees to fully indemnify and hold harmless the City in all respects as a result of the obtaining of any and all such permits and approvals. Without limiting the foregoing, City agrees to reimburse CONTRACTOR, upon City's receipt of adequate proof that CONTRACTOR has paid same, the amounts of all permit fees incurred by CONTRACTOR in connection with the applications, processing and securing of approvals or permits which are required to be obtained from all governmental authorities which have jurisdiction over any and all aspects of this work, except City permits and fees which shall be waived and except for so much of any fees as to which the City is required to remit to other governmental agencies.

2.6 ENGINEER, or other designated representative, will be the person through whom CONTRACTOR must communicate all information pertaining to the Project.

2.7 CONTRACTOR shall guarantee the entire Project work against poor workmanship and faulty materials for a period of one (1) year after final payment and shall immediately correct any defects which may appear during this period upon written notification by the City's ENGINEER or designated representative. CONTRACTOR waives any and all rights to claim any statute of limitations defense as to any condition that may arise under this guarantee.

3 – not used

4 – not used

5 - Repair Of Benches And Manholes Wall

5.1 The work covered under this section includes, but is not limited to all labor, equipment, materials, supervision and any other efforts required to repair concrete and mortal damaged inside the manhole that is, or may in the future permit, leaks into the sewer system. .

5.2 The chimney seal shall be installed using Sewpercoat® or equivalent as approved by the ENGINEER that creates a concrete impregnating hard seal. The seal is to be of a resistant material to account for corrosion potential in the manhole. The sealing materials shall have the following parameters:

- Specific gravity > 1.0
- Compressive strength > 7000 psi after 24 hours as measured by ASTM C495
- Compressive strength > 9000 psi after 28 days as measured by ASTM C495
- Flexural strength > 1200 psi after 24 hours as measured by ASTM C293
- Flexural strength > 1400 psi after 28 days as measured by ASTM C293
- Splitting Tensile strength 800 psi after 24 hours as measured by ASTM C496
- Adhesive strength > 1600 psi after 28 days on concrete as measured by ASTM C882
- Shrinkage after 2 days <0.06 % cured at 90 percent humidity
- Nonflammable as measured by ASTM D-93 in a Pensky-Martens closed cup
- Temperature Range -65 to 200 F
- Minimal water absorption capacity (<0.5%)
- Material shall contain VOCs.

5.3 Installation

5.3.1 All loose mortar, concrete brick or other materials shall be removed by CONTRACTOR as they would interfere with seal performance and adhesion.

5.3.2 High pressure sandblast manhole as necessary to create a dry, clean surface with appropriate roughness for adhesion designated as CPS 4 by the International Concrete Repair Institute guideline 3732 – selecting and Specifying Concrete Surface Preparation for Sealers, Coatings and Polymer Overlays. If the cone also needs repair, the overhead areas shall be sandblasted to create a roughness for adhesion designated as CPS 3 by the International Concrete Repair Institute guideline 3732 – selecting and Specifying Concrete Surface Preparation for Sealers, Coatings and Polymer Overlays. Surface shall be clean from dust.

5.3.3 Prior to application of sealant, all surfaces shall be being soaked with water. Surface must be saturated, but not dripping wet, prior to application of liner (see manufacturer's recommendations)

5.3.4 Lining material shall be applied in accordance with manufacturer instruction and under the appropriate application pressure. Water used for mixing material shall be fresh, clean potable water only.

5.3.5 The lining material shall have a finished, dry thickness greater than ½ inch thick on all surfaces.

5.3.6 Curing shall be in accordance with ASTM C309 and the manufacturer's recommendations. Moist curing shall

NOTE: concrete must be at least 28 days old with a compressive strength of 3500 psi prior to application of sealant. Temperatures must be above 40 F during application

DRAWING #1

Map of Sewer Line Segments to be Televised

Appendix H – Specifications for Phase III

TECHNICAL SPECIFICATIONS

Hallandale Beach
PROGRESS. INNOVATION. OPPORTUNITY.

INFILTRATION AND INFLOW REMOVAL PHASE 3

City of Hallandale Beach Bid No. 18-00x

CONTRACT DOCUMENTS

Prepared by:

Fred Bloetscher, PhD. P.E.
Public Utility Management and Planning Services, Inc.
P.O. Box 221890
Hollywood, Florida 33022

January 2018

Document 00002

PROJECT DATA

Project Title:	City of Hallandale Beach Infiltration and Inflow Removal Phase 3
Project Number:	City Bid No. 18-00x
Project Address:	Throughout the City of Hallandale Beach
Project Owner:	City of Hallandale Beach, Florida 100 West Hallandale Beach Boulevard Hallandale Beach, Florida 33004
Owner's Representative:	James Sylvain Deputy Utilities Director City of Hallandale Beach 400 S Federal Highway Hallandale Beach, Florida 33009 Phone: 954-457-1669 Fax: 954- 457-1624
Project Consultant	Fred Bloetscher, PhD. P.E. Public Utility Management and Planning Services, Inc. P.O. Box 221890 Hollywood, Florida 33022 Phone: 239-250-2423 Fax: 954-581-5076

END OF PROJECT DATA

Document 00004

LIST OF DRAWINGS

SHEET NO.	TITLE
1	Map of Point Repairs

END OF LIST OF DRAWINGS

BID SHEET

SECTION 027900 - INFILTRATION AND INFLOW PROGRAM – POINT REPAIRS OF SYSTEM – PIPE INSTALLATION

1 - Technical Specifications - Excavation And Pipe Laying

1.1 Terminology

Figure I-1 shows a trench cross-section which identifies the meaning and limits of terminology used in this specification for the terms foundation, bedding, haunching, initial backfill, pipe embedment and pipe zone and is not intended to specify the shape of the trench. Figure I-1.

2. Responsibility for Materials

2.1 - Pipe Storage and Handling

2.1.1 The interior of all pipe, fittings and other accessories shall be kept free from dirt and foreign matter at all time. Satisfactory protection from damage shall be provided.

2.1.2 All pipe, fittings and accessories shall be loaded and unloaded in such manner as to avoid shock or damage. Under no circumstances shall such material be dropped. Pipe shall not be skidded or rolled against pipe already on the ground.

3. Clearing and Grubbing

3.1 Clearing and Disposition of Materials

3.1 Where clearing and grubbing are necessary, the CONTRACTOR shall clear and grub the entire width of the right-of-way or easement except as may be noted in the Contract Documents or designated by the CITY.

3.2 Any standing timber of merchantable (saleable) quality shall be cut in merchantable lengths and neatly stacked along the right-of-way for removal to a mill. Any credit for this timber shall accrue to the CONTRACTOR.

3.3 Disposition of Brush, Limbs, Stumps, Roots and Unmerchantable Timber: All items other than merchantable timber shall be disposed of by the CONTRACTOR. Placing of this material on the adjacent property will not be permitted except by permission of the adjacent property owner in writing. This written permission shall be given to the ENGINEER by the CONTRACTOR prior to disposing of material in these areas.

4. Excavation

4.1 Excavation - General

4.1.1 The excavation for all work included in this project is included in the cost per unit of work installed, unless otherwise stated herein, and the unit price for work includes all excavation and grading in whatever nature of material may be encountered. No additional allowance to the unit price bid by the CONTRACTOR for the project or any part thereof will be allowed on any claim for extra compensation because of excavation and/or grading being of a nature different from that contemplated by CONTRACTOR. The CONTRACTOR is charged with the responsibility of

actually investigating and examining the site of the project before preparing his Bid and satisfying himself in this respect.

4.2 Pavement Cutting

4.2.1 Prior to trenching, pavement shall be cut or scored to straight edges, six inches (6") outside each edge of the proposed trench to avoid unnecessary damage to the remainder of the pavement. Edges of the existing pavement shall be recut and trimmed to square, straight edges after the pipe system has been installed and prior to placement of the new base and pavement.

4.3 Excavation and Preparation of Trench

4.3.1 The trench shall be dug so that the pipe can be laid to the alignment and depth required. The trench shall be braced and drained in such a manner that the work may be performed in a safe and efficient manner.

4.3.2 The trench width shall be ample to permit the pipe to be laid and jointed properly. The minimum width of the trench shall be at least three feet, six inches (3'-6") or eight inches (8") greater than the largest outside diameter of the pipe or bell, whichever is greater.

4.4 Trench Bottom

4.4.1 The soil surface at the trench bottom shall be free of any protrusions which may cause point loading on any portion of the pipe or bell, and shall provide a firm, stable and uniform support for the pipe.

4.4.2 Over-Excavation: During the course of construction, should the CONTRACTOR inadvertently over-excavate the trench more than six inches (6") (150 mm) below the bottom of the pipe, but less than twelve inches (12") (300 mm) below the bottom of the pipe, the CONTRACTOR shall fill that area of over-excavation with acceptable USCS Class I, II or III (see Exhibit I, Part (4) Section 4 for definitions) embedment material and compact to a density approximately equal to the native soil. The CONTRACTOR shall fill any area of over-excavation more than twelve inches (12") (300 mm) below the bottom of the pipe with USCS Class I material in the same manner as required for foundation bedding, but shall do so at his expense.

4.4.3 Ledge rock, hard pan, cobbles, boulders or stones larger than one and one-half inches (1«") (40 mm) shall be removed from the trench bottom to permit a minimum bedding thickness of six inches (6") (150 mm) under pipe.

4.4.4 Foundation Bedding: Class I bedding, to a depth specified by the ENGINEER, shall be required as a foundation in wet, yielding or mucky locations. Foundation bedding shall be constructed by removal of the wet, yielding or mucky material and replaced with sufficient Class I material to correct the instability. Foundation bedding, if necessary, will be paid for per ton of material used except cases where the instability is caused by negligence of the CONTRACTOR.

4.4.5 In stable trenches, trench bottom may be either native undisturbed soils of USCS Class II, III, or IV, or thoroughly compacted USCS Class I, II, or III material from three inches (3") to six inches (6") depth to provide a stable, continuous support for the pipe system. In USCS Class V soil areas, foundation bedding is required. All foundation bedding shall be USCS Class I material. In no case shall pipe be bedded on solid rock.

5. Pipe Handling

5.1 Placing Pipe Material into Trench

5.1.1 Proper implements, tools and facilities satisfactory to the ENGINEER shall be provided and used for the safe and convenient prosecution of the work. All pipes, fittings, valves and hydrants shall be carefully lowered into the trench piece-by-piece by means of a derrick, ropes or other suitable tools or equipment, in such a manner as to prevent damage to materials and protective coatings and linings. Under no circumstances shall pipe or other pipe materials or appurtenances be dropped or dumped into the trench.

5.1.2 Before each length of pipe is lowered into the trench, it shall be thoroughly inspected for structural soundness and cleanliness. Each length of pipe shall be lowered separately.

5.1.3 No length of pipe which is known to be defective shall be laid or placed in the trench. Defective pipe or fittings shall be conspicuously tagged, removed and replaced with satisfactory pipe or fittings without additional charge.

6. Laying and Joining Pipe and Fittings

6.1 General Procedure

6.1.1 Before being set in place, each component of piping shall be inspected for damage and cleaned. Damaged components shall be rejected. Pipe bells shall be laid on the upstream end. Sewer laying shall commence at the lowest elevation and shall terminate only at manholes on a gravity system, or service branches or clean outs on sewer services. Trenches shall be dewatered, as necessary. Potable water lines shall not be laid under water. Whenever pipe laying is interrupted, including lunch time, the end of the pipe shall be temporarily plugged to prevent the entrance of water, mud, animals or other foreign matter, and the pipe shall be secured to prevent its being dislodged.

6.2 Location and Alignment

6.2.1 Pipe and fittings shall be embedded in the trench with the bell end dug by hand and the invert conforming to the required elevations, slopes and alignment, and with the pipe bottom uniformly and continuously supported by a firm bedding and foundation.

6.2.2 Curved Alignment: In special cases where curved alignment is required on pressure lines, the deflection of alignment at a joint shall not exceed the appropriate permissible deflection as specified in the following table. These values indicate the maximum permissible deflection for eighteen foot (18') lengths as noted. Gravity systems shall contain deflections. Any deflection greater than the allowable deflection shall be made with appropriate fittings.

TABLE I.1 Pipe Deflection Allowances - Polyvinyl Chloride (PVC) Pipe Maximum Permissible Deflection, Inches Size of Pipe,

Inches Push-On-Joints,	Inches
4	23
6	16
8	12
10	9
12	8

TABLE I.2 Pipe Defection Allowances - Ductile Iron (DI)

Pipe Maximum Size of 18 ft. Length	Joint Deflection	Deflection in Inches Pipe	In Degrees
	4	5	19
	6	5	19
	8	5	19
	10	5	19
	12	5	19
	14	4	15
	16	4	15
	18	3	11
	20	3	11
	24	3	11
	30	3	11
	36	3	11
	42	3	12*
	48	3	12*
	54	3	12*

*20-foot Length

6.3 Joining Pipe and Fittings

6.3.1 All joints shall be assembled in accordance with recommendations of the pipe manufacturer.

6.3.2 All joints shall be thoroughly cleaned prior to assembly and suitable lubricants shall be used. Lubricant for push on joints shall be soap solution, per AWWA C600, 96.3, and shall be supplied by the pipe manufacturer. No other lubricant shall be used. As each length of pipe is joined, the spigot end shall be centered in the bell, the pipe forced fully home and brought to correct line and grade. Pipe shall be secured in accordance with the embedment procedures outlined herein.

6.3.3 If unusual joining resistance is encountered or if the insertion mark does not reach the flush position, disassemble the joint, inspect for damage, reclean the joint components and repeat the assembly steps. Note that bells of pipe fittings may permit less insertion depth than pipe bells. (Note: The bar and block method is recommended as a workman is able to feel the amount of force being used and whether the joint goes together smoothly.)

6.4 The Backhoe Method of Assembly

6.4.1 A backhoe may be used to assemble pipe of intermediate and larger sizes. The plain end of the pipe should be carefully guided by hand into the bell of the previously assembled pipe. The bucket of the backhoe may then be used to push the pipe until fully seated via a pipe sling only! Direct contact between the backhoe bucket and pipe shall not be permitted.

6.5 Field Cut Pipe

6.5.1 For shorter than standard pipe lengths, field cuts may be made with either hand or mechanical saws or plastic pipe cutters. Ends shall be saw cut square and perpendicular to the pipe axis, not burned. When pipe is cut in the field, the cut end shall be conditioned so that it can be used to make up the next joint. The outside of the cut end should be beveled about one-quarter inch (1/4") at an angle of about thirty degrees (30). This shall be quite easily done with a coarse file or a portable grinder. The CONTRACTOR shall remove any sharp, rough edges which otherwise might injure the gasket.

6.6 Voids Beneath Bell for Elastomeric Seal Joints

6.6.1 The void beneath the bell on push joint pipe, to allow for connection to succeeding pipe, shall be no larger than necessary to accomplish proper joint assembly. When the joint has been made, the void under the bell and pipe shall be filled with proper bedding or haunching material and compacted to provide adequate support to the pipe throughout its entire length.

6.7 Joining Mechanical-Joint Pipe

6.7.1 Variations in Dimensions: The outside diameter of the spigot end of pipe varies with the type, size and class of pipe. There is only one rubber gasket size for each diameter of pipe. When connecting existing lines to mechanical-joint or rubber gasket pipe the proper gaskets and fittings shall be used.

6.7.2 Cleaning and Assembling Joint: The last eight inches (8") outside of the spigot and inside of the bell of mechanical-joint pipe shall be thoroughly cleaned to remove oil, grit, tar (other than standard coating), and other foreign matter from the joint. The gland shall then be slipped on the spigot end of the pipe with the extension of the gland toward the socket or bell end. The rubber gasket shall be placed on the spigot end with thick edge toward the gland.

6.7.3 Bolting of Joint: The entire section of the pipe shall be pushed forward to seat the spigot end in the bell. The gasket shall then be pressed into place within the bell, being careful to have the gasket evenly located around the entire joint. The gland shall be moved along the pipe into position for bolting, all of the bolts inserted, and the nuts screwed up tightly with the fingers. All nuts shall be tightened with a suitable (preferably torque-limiting) wrench. The torque for various sizes of bolts shall be as shown in Table I.3. Nuts spaced one hundred eighty degrees (180º) apart shall be tightened alternately in order to produce an equal pressure on all parts of the gland.

Table I.3

Bolt Size (in)	Torque(inches)(ft.-lbs)
5/8	40 – 60
3/4	60 – 90
1	70 – 100

1 1/4 90 - 120

7. Haunching

7.1 Haunching of pipe from the invert to the spring-line shall be by hand placement of USCS Class I, II, or III material to ensure that the material is worked under the haunch. Where bedding was constructed of USCS Class I material, the same shall be used for haunching. All material shall be properly compacted.

8. Initial Backfill

8.1 Initial backfill shall extend from the springline to one foot (1') above the top of the pipe. Placement of initial backfill may be either by hand or mechanical means. Material for initial backfill may be USCS Class I, II, or III only.

8.2 CONTRACTOR shall keep the initial backfill free from rocks and clods which could damage the pipe while the filling operation is being undertaken. The purpose of extending the initial backfill to levels over the top of the pipe shall be to protect the pipe from impact damage resulting from any large objects in the final backfill. Machine compaction of initial backfill directly over the pipe is not desirable unless adequate cover has been provided to protect the pipe. Adequate cover will depend on the type of compaction equipment and shall be as specified by the ENGINEER.

9. Final Backfill

9.1 Backfill Material

9.1.1 All backfill material shall be USCS Class I, II, III or acceptable dry, native Class IV materials, and shall be free from cinders, ashes, refuse, vegetable or organic material, boulders, rocks, or stones, or other deleterious material which in the opinion of the ENGINEER is unsuitable.

9.1.2 Use of Excavated Material as Backfill: When the type of backfill material is not specified on the drawing, the excavated material may be used provided it consists of loam, clay, sand, or gravel which, in the opinion of the ENGINEER, is satisfactory for backfill.

9.2 Backfill Placement

9.2.1 Backfilling from the embedment zone to surface grade may be by hand or mechanical placement. In areas subject to traffic, compaction of backfill in eight inch (8") lifts shall be used to achieve ninety eight percent (98%) of Modified proctor density. Whenever trenches are in or across driveways, paved areas or streets, the CONTRACTOR shall be responsible for any settlement which occurs within one (1) year of preliminary acceptance. In areas of open terrain, backfill shall be made in twelve inch (12") lifts and heaped sufficiently to be level after natural compaction.

9.3 Compaction

9.3.1 Backfill shall be compacted in accordance with Table I.4 as a percentage of the maximum density at optimum moisture content as determined by the Standard Proctor Test, ASTM D698.

Table I.4

Area	Percent Maximum Dry Density ASTM D698	ASTM D1557 (Mod.)
Around and 1' above top of pipe	100	
Remaining Trench	100	
Pavement subgrade and shoulders	98	
(Last 3' of Fill) Base material and pavement	98	
Adjacent to structures	95	
(Areas not paved) Under structures	95	
Sub-base	98	

9.3.2 Test for density of compaction may be made at the option of the ENGINEER, and deficiencies shall be corrected by the CONTRACTOR without additional cost to the CITY.

9.3.3 Minimum frequency of testing for in-place density shall be as follows:

Pipe bedding (for other	One per 200 feet of trench than undisturbed soils) or per excavation.
Pipe Haunching	One per lift per 100 feet of trench.
	Initial backfill under
Initial backfill under pavement	One per lift
per 100 feet or open terrain.	One per 100 ft of per excavation.
Trench backfill under	One per lift per lane.
Pavement.	
Trench backfill under	One per lift per 200 feet of open terrain.
Pavement	trench or per excavation.
Limerock base.	One per lift per lane.
Embedment	One per lift per 200 feet.
Under structure.	One per excavation.

10. Installation of Tracer Tape

All pressure mains shall have a 3" wide identification warning tape installed in the ditch, over the main, twelve inches (12") below finished grade. Metallic tracer tape shall also be placed at the end of any stub outs for future connections, including, but not limited to, water branches and tees, and sanitary sewer services where the cleanouts are likely to become buried or destroyed.

11. Dewatering

All piping shall be laid in a dry trench excavation, unless otherwise approved by ENGINEER. Dewatering system shall be utilized in accordance with good standard practice and must be efficient enough to lower the ground water level in advance of the excavation and maintain it continuously to keep the trench bottom and sides firm and dry. If a sewer system is under construction, it shall not[used as a conduit to remove ground water from the pipe trench. The CONTRACTOR shall have on the job, or available for immediate use at all times, dewatering equipment adequate to handle the job for which it is intended. If well points are used sufficient header pipe and well points shall be provided to maintain a dry and workable trench, in advance of any pipe laying.

11.2 Water pumped or drained from the work shall be handled in accordance with current South Florida Water Management District and any underlying local governmental rules, regulations, and procedures, and at a minimum in a suitable manner without damage to adjacent property, to work under construction or to street pavement, parks or private property. Water shall not be discharged onto streets without adequate protection of the surface at the point of discharge. No water shall be discharged into a wastewater system. No water containing settleable solids shall be discharged into storm sewers.

11.3 Any and all damage caused by dewatering shall be promptly repaired by the CONTRACTOR at his expense. All permits required for dewatering operations shall be obtained by the CONTRACTOR and a copy filed with the CITY and ENGINEER.

SECTION 027902 - TECHNICAL SPECIFICATIONS - SEWER SYSTEM MATERIALS 1. Pipe Materials

1.1 Ductile Iron Pipe (all sizes for all sewer applications

1.1.1 Ductile iron pipe shall be of the size and class called for on the drawings. In the absence of a specified class on the drawings, all ductile iron pipe shall be Class 50, as specified by AWWA Specification C150, latest revision. All force mains and lines under traffic surfaces or pavement shall be Class 51 as specified by AWWA Specification C151, latest revision.

1.1.2 All Ductile iron pipe used on the sanitary sewer system shall be lined with polyethylene in accordance with ASTM D1248. A 40 mils (0.040 inch) nominal, [35 mils (0.035 inch) minimum] lining of polyethylene shall be furnished. The lining shall be a blend of high-density and low-density polyethylene powders complying with ASTM D1248 compounded with an inert filler and carbon black to provide resistance to ultraviolet rays during storage above ground. Prior to preheating, seventy-five percent (75%) or more of the high temperature oxide film must be removed through proper preparation of pipe interior surface. Fittings shall be sandblasted. Pipe and fittings shall be uniformly preheated to a temperature adequate to provide uniform fusing of the polyethylene powders and proper bonding to the pipe and fittings. The lining at the ends shall be hermetically sealed and every pipe and fitting shall be subjected to and pass a 400 volt wet sponge, or equivalent, spark test. A sample cut from a production pipe shall pass the four (4) hour boil adhesion test as described in ASTM C541. Pipe and fittings shall be U.S. Pipe's POLYLINED pipe and fittings or equal. Pipe and fittings shall have an outside asphaltic coating as specified in AWWA Standard C151. Each piece of pipe shall bear a marking denoting the class to which it belongs.

1.1.3 Joints for ductile iron force main pipe shall be mechanical or push-on type designed in accordance with AWWA C111. Gasket lubricant for push-on joints shall be as specified by the pipe manufacturer and labeled with the trade name and the pipe manufacturer's name. Other types of lubricant are prohibited.

1.1.4 Where restrained joints are shown on the plans, mechanical joint pipe and fittings shall be used. Unless otherwise noted, the pipe, joints, gaskets, and accessories shall be in accordance with standards, as previously specified for ductile iron pipe in this section. Restrained joints shall be as specified in paragraph 3.2.2 of SECTION 027901. A working pressure of 350 psi for sizes twelve inches (12") through twenty-four (24") and 250 psi for larger sizes shall be required, and shall conform to AWWA C110 or C153. Linings in all fittings shall be double that required under Section 1.1.2 of Exhibit I, Part (3).

1.1.5 The distances shown in Table I3.1 shall apply to lengths of pipe in inches required to be restrained on each side of the fittings. Tees, crosses, and dead ends shall be considered equivalent to ninety degree (90°) bends. Tees shall be installed with a thrust block poured opposite of the branch line in addition to the restrained joints. Dead ends shall be installed with a terminus thrust block as shown in Exhibit I, Detail 11 of 26.

TABLE I 3.1

Pipe	90ø Bend	45ø Bend	22-1/2 Bend	11¬1/4 Bend
8"	74	31	15	7
10"	87	36	17	9
12"	100	41	20	10
16"	123	51	24	12
20"	143	59	29	14
24"	162	67	32	16
30"	184	76	37	18
36"	207	86	41	20

1.1.6 Procedure for sealing cut ends and repairing field-damaged areas of polyethylene lined pipe and fittings: a) Remove burrs caused by field cutting of ends or handling damage and smooth out edge of polyethylene lining if made rough by field cutting or handling damage. b) Remove oil or lubricant used during field cutting operations. c) Areas of loose lining associated with field cutting operation must be removed and exposed metal cleaned by sanding or scraping. For larger areas, remove loose lining and dirt, then roughen bare pipe surface by scratching or gouging with a small chisel to provide an anchor pattern for the epoxy. It is recommended that the polyethylene lining be stripped back by chiseling, cutting, or scraping about one inch (1") to two inches (2") into well-adhered lined area before patching. This ensures that all areas of undercutting (rusting) have been removed. Be sure to roughen an overlap of one inch (1") to two inches (2") of polyethylene lining in area to be epoxy coated. This roughening should be done with a rough grade emery paper (40 grit), rasp, or small chisel. Avoid honing, buffing, or wire brushing since these tend to make surface to be repaired too smooth for good adhesion. d) With area to be sealed or repaired absolutely clean and suitably roughened, apply a thick coat of a two part coal tar epoxy such as Madewell 1104 or approved equal. The heavy coat of epoxy must be worked into the scratched surface by brushing. Mixing and application procedure for the epoxy must follow the epoxy manufacturer's detailed instructions. e) It is important that the entire freshly cut, exposed metal surface of the cut pipe be coated. To ensure proper sealing, overlap at least one inch (1") of the roughened polyethylene lining with this two part epoxy system.

1.2 Polyvinyl Chloride (PVC) Pipe (Gravity Lines Only)

1.2.1 Polyvinyl chloride pipe (PVC) shall conform to AWWA Specification C900, latest revision, Class 100, SDR 21 and shall bear the seal of the National Sanitation Foundation (NSF) for potable water pipe. All pipe shall be marked with the manufacturer's name, nominal size, type of plastic and pressure rating. Pipe O.D. shall be equivalent to cast iron pipe of the same nominal size. PVC pipe buried beneath roadways, parking lots or parking lot entrances shall meet AWWA specification C900, Class 200 SDR 14. All PVC Gravity Sewer Pipe shall be green in color.

1.2.2 Pipe joints shall include elastomeric gaskets and shall be integral bell-type coupling, in accordance with ASTM F477 and D2122, latest revision respectively. Lubricant and gaskets are to be supplied with the pipe by the manufacturer of the pipe. Other types of lubricants are prohibited.

1.3 Polyvinyl Chloride (PVC) Pipe (Force Mains and Effluent Lines)

1.3.1 Polyvinyl chloride pipe (PVC) shall conform to AWWA Specification C900, latest revision, Class 100, SDR 21 and shall bear the seal of the National Sanitation Foundation (NSF) for potable water pipe. All pipe shall be marked with the manufacturer's name, nominal size, type of plastic and pressure rating. Pipe O.D. shall be equivalent to cast iron pipe of the same nominal size. PVC pipe buried beneath roadways, parking lots or parking lot entrances shall meet AWWA specification C900, Class 200 SDR 14. Effluent force mains shall be lavender in color and marked "Effluent" or "Reuse" in acceptable, indelible markings one hundred and twenty degrees (120ø) apart, running continuously the full length of each section of pipe.

1.3.2 Pipe joints shall include elastomeric gaskets and shall be integral bell-type coupling, in accordance with ASTM F477 and D2122, latest revision respectively. Lubricant and gaskets are to be supplied with the pipe by the manufacturer of the pipe. Other types of lubricants are prohibited.

1.3.3 Restrained joints shall be acc0mplished using Uni-flange series 1300 or series 1350. Restraining clamps shall be epoxy coated steel or ductile iron. Bolts shall be 304 stainless steel or heat treated ductile iron in conformance with the latest edition of ASTM A536.

2. Manholes

2.1 General Requirements

2.1.1 All manholes shall be constructed of precast concrete components, utilizing Type 2 concrete, with a minimum wall thickness of eight inches (8"). All manholes shall be constructed upon a foundation consisting of no less than twelve inches (12") of crushed stone. Manhole bases shall be either extended base precast concrete with a minimum dimension across the extended base of seventy-two inches (72") (for 4-foot diameter manholes), reinforced concrete with a minimum twenty-eight (28) day compressive strength of 3,000 psi and shall be monolithically poured with the first riser section.

2.1.2 The excavation shall be kept free of water throughout construction and shall NOT be backfilled until inspected.

2.2 Precast Concrete Manholes

2.2.1 All precast concrete manhole components shall meet the requirements of ASTM C478 latest edition with 8" minimum thickness walls.

2.2.2 Components shall be assembled using Ram-Nek, Kent-Seal or other acceptable rubber or bituminous sealing compound which shall be accurately placed to assure a water-tight seal. The first construction joint shall be not less than two feet (2') above the base slab. Joints shall be tongue and groove suitable for flexible gasket. The gasket shall be applied to a clean joint after priming and in accordance with the manufacturer's recommendations. Excess material shall be smoothed flat with a roller. Voids remaining in the joint shall be caulked with anhydrous cement grout on the inside and outside to make a smooth water-tight joint seal.

2.2.3 The exterior and interior of the manhole shall be protected with two (2) coats of a two-component coal-tar epoxy. The first coat shall be thinned. The second coat shall be a minimum of eight (8) dry mils. The joint into the manhole shall be sealed with Ram-Nek, Kent-Seal or other acceptable product.

2.2.4 Components of the manhole shall be free of fractures, cracks, and undue roughness. Concrete shall be free of defects which indicate improper mixing or placing and surface defects such as honeycomb or spalling. Cracks or broken ends due to improper handling will not be acceptable. No lift holes will be allowed except in rise and corbal sections. These holes shall not penetrate the wall and shall be filled with non-shrink grout after installation.

2.3 Manhole Pipe Connections

2.3.1 Precast Manholes: Flexible, "boot-type" rubber gaskets in pipe entrances with stainless steel bands shall be precast into the manhole as specified by the manufacturer. However, mortar or concrete shall be required both inside and outside the manhole at the pipe connection to guarantee a water-tight seal and to match pipe and precast manhole inverts where necessary.

2.3.2 Doghouse Manholes: Doghouse manholes over existing sanitary sewer pipes are permitted, and in a number of instances, preferred. The concrete base shall be a minimum of eight inches (8") thick, with proper reinforcing rods to prevent cracking. This shall be poured upon a twelve inch (12") base of gravel. Precast manhole rings may be set in the concrete over the existing pipe. Concrete should then be used to form both the bench and to seal the pipe entrances, both inside and especially outside. Once dry, the top of the pipe in the manhole shall be removed.

2.3.3 Connection to Existing Sewers: Where required or shown on the plans, connection to existing sewer shall be made in a manner which will maintain existing flow on a continuous basis. Where flow cannot be maintained, interruption of service shall be minimized such that no by-pass of sanitary sewage to any natural waterway or storm drain occurs nor shall such interruption create a public health hazard by sewage back-up or overflows. Connections to existing sewers shall be made at manholes. New lines connecting to existing manholes shall be core bored and sealed with flexible boots and snap-in stainless steel inserts or "Link-Seal". Connection of sewer pipe shall be a non-shrinking mortar. Existing manholes to which connections are made shall be rehabilitated to the degree necessary to correct any apparent signs of infiltration. Upon completion of the connection to existing sewers, existing lines no longer needed shall be sealed or plugged at the invert to reflect new flow patterns.

2.4 Standard Manholes

2.4.1 The standard manhole shall be four feet (4') or more in depth measured from the base of the cover frame to the top of the concrete footing and shall be of the concentric cone type, as shown in the Standard Details. If the manhole is four feet (4') or less in depth, it shall be classified as a "Shallow Manhole" as specified in paragraph 2.5 below.

2.5 Shallow Manholes

2.5.1 The shallow manhole shall be four feet (4') or less in depth measured from the base of the cover frame to the top of the concrete footing and shall be of flat top construction, as shown in the Broward County Standard Details.

2.6 Manhole Inverts

2.6.1 Manhole inverts shall be formed from concrete having a minimum twenty-eight (28) day compressive strength of 2500 psi. Inverts for "straight-through" manholes may be formed by

laying the pipe straight through the manhole, pouring the concrete invert, and then cutting out the top half of the pipe, provided that 0.1 foot drop is maintained across the manhole.

2.6.2 Curved inverts shall be constructed of concrete, and shall form a smooth, even, half pipe section as shown. Precast inverts may be used, however, no large "bowls" shall be permitted in the center of the manhole. To alleviate this problem, the invert shall be grouted to form smooth, uniform inverts. 0.1 foot drop shall be maintained across the manhole.

3. Manhole Frames and Covers

3.1 Standard Frames and Covers

3.1.1 Manhole castings shall consist of cast iron frames and solid covers with non-penetrating pick holes and O-ring gaskets. Covers shall be set neatly in the frame, with edges machined for even bearing, and top flush with the edge of the frame, with frames set to proper grade. The O-ring shall be in a dovetail groove with a loose O-ring that is not under tension or compression. Frame and cover shall be traffic bearing type, and shall have the words "City of Hallandale Beach Sanitary Sewer" plainly visible. Manholes frames and covers shall be made of cast iron of superior quality and of even texture. The iron shall possess a tensile strength of not less than 18,000 psi. The combined weight of frame and cover shall be approximately 325 pounds. When used in a paved street, the ring and cover shall be set in suitable mortar flush with finished street grade so as to provide drainage away from the manhole and 2-1/2" above finished grade in glassed areas. Manhole frames shall be adjusted to finished grade through the use of precast concrete riser rings, or where approved by the ENGINEER, red clay bricks. At no time will more than one (1) course of brick be utilized in making the adjustment. If adjustment exceeds this limit, then concrete riser rings shall be utilized in conjunction with the brick. Each concrete ring shall be set in a bed of mortar to insure a proper bond and seal between successive concrete rings.

4. Sewer Service Connections

4.1 Materials, Construction

4.1.1 All sewer service connections shall be of SDR 35 PVC as specified in Section 1.2 of SECTION 027901 with elastomeric gaskets on pipe and fittings.

4.1.2 Service lines shall be connected to the sewer mains by means of a PVC wye fitting. The service branch of the wye fitting will be elevated depending on the depth of the sewer and the elevation of the property to be served. Forty-five degree (45ø) bends or other fittings shall be used to connect the service line at the wye branch. Service lines shall be installed at such grades as will adequately serve the properties, minimum 1% slope.

4.1.3 Service lines shall extend from the sewer to the property line and be plugged. Plugs shall be plastic with sealer. Service lines shall be six inches (6") for single residential properties and six inches (6") pipe and larger for commercial, industrial, and multiple residential services. Tracer tape and markers shall be installed at the end of each service or opposite wyes and locations recorded. Service lines will have a minimum of three feet (3') and a maximum of five feet (5') of cover at the property line. Service will be provided to each lot. All laterals shall have a vertical clean out installed at the property line. Clean outs shall extend 24 inches (24") above grade and should be capped. After final connection of the lateral to a structure the clean out shall be cut off at grade and capped.

5. Valves and Fittings on Pressure Lines All plug, gate, check and air release valves shall be American made, cast and assembled.

5.1 Gate Valves - 4" through 16"

5.1.1 Valves shall conform to the latest revision of AWWA Standard C509 covering resilient seated gate valves.

5.1.2 The valves shall be cast iron body with non-rising stem (NRS) opening by turning stem counterclockwise and provided with two inches (2") square operating nut with the word "Open" and an "Arrow" cast in the metal to indicate direction to open. Valve nuts shall be no more than 30" underground.

5.1.3 The wedge shall be of cast iron completely encapsulated with urethane rubber. The urethane sealing rubber shall be permanently bonded to the cast iron wedge to meet ASTM tests for rubber metal bond ASTM D429.

5.1.4 Stems for NRS assemblies shall be cast bronze with integral collars in full compliance with AWWA. OS&Y stems shall be on bronze bar stock. The NRS stem stuffing box shall be the O-ring seal type with two (2) rings located above thrust collar; the two (2) rings shall be replaceable with valve fully open and subjected to full rated working pressure. The design and machining of valves shall be such as to permit the replacement of O-ring(s) without undue leakage while the valves are wide open and in service.

51.5 All valves shall have a safe working pressure of 200 psi.

5.1.6 There shall be two (2) low torque thrust bearings located above and below the stem collar. The stem nut shall be independent of the wedge and shall be made of solid bronze. There shall be a smooth unobstructed waterway free of all pockets, cavities and depressions in the seat area.

5.1.7 The body and bonnet shall be coated with fusion bonded epoxy both interior and exterior. Each valve shall have maker's name, pressure rating, and year in which manufactured cast on the body. Prior to shipment from factory, each valve shall be tested by hydrostatic pressure equal to twice the specified working pressure. Valves with prior year manufacture dates shall not be used.

5.1.8 Gate valves shall be American Darling, Clow, U.S. Pipe or Kennedy.

5.2 Air Release Valves

5.2.1 Air release valves shall be of the single housing style that combines the operation features of both an air/vacuum and air release valve.

5.2.2 The air/vacuum valve shall automatically exhaust large quantities of air during the filling of the pipeline and automatically allows air to re-enter the pipeline when the internal pressure of the pipeline approaches a negative value due to column separation, draining of the pipeline or other event. The air release port shall automatically release small pockets of air from the pipeline while the pipeline is in operation and under pressure.

5.2.3 The air release valve shall have a maximum working pressure between 150 and 225 psi, unless otherwise indicated on the drawings, and shall have been tested at the pressure not less than 300 psi.

5.2.4 The materials of construction shall be: Body, cover, and baffle of cast iron; float and all other trim shall be of stainless steel with the exception of Buna-N seat: No plastic parts shall be accepted.

5.2.5 Air release valves shall be Empire Specialty Company Model 935 DS (Short Body), Valmatic Model 48S or equal.

5.2.6 Two-inch (2") NPT inlet and one half inch (1/2) outlet shall be provided unless otherwise noted on the drawings.

5.3 Plug Valves

5.3.1 Plug valves shall be used in all lift stations and on all sanitary sewer force mains.

5.3.2 Plug valves shall be manually actuated straight way valves of the non-lubricated, eccentric type with resilient faced plugs and joint ends to match the pipe. Port areas shall be at least eighty percent (80%) of the full pipe area.

5.3.3 Bodies shall be semi-steel with raised seats. The face of the seats shall be of nickel or rust-resistant alloy. Upper and lower plug stem bushings shall be of stainless steel and permanently lubricated. Valves shall be of the bolted bonnet design. Packing on valves shall be adjustable and valves designed for repacking without removing bonnet from the valve. Exposed nuts, bolts, springs, and washers shall be zinc plated. Valves shall be suitable for controlling sewage.

5.3.4 All valves in lift stations shall be provided with hand wheel operating nuts, turning counterclockwise to open. Valves on force mains not in lift stations shall be provided with two inch (2") inch square bronze operating nuts, with "Open" and an "Arrow" cast thereon and shall be no more than 30" underground.

5.3.5 All valves shall have a safe working pressure of 200 psi.

5.3.6 Valve exterior shall be painted with red oxide phenolic primer paint.

5.4 Check Valves

5.4.1 All check valve bodies shall be cast iron per ASTM A126 Class B, having integral (not Wafer) flanges.

5.4.2 The seat shall be centrifugally cast bronze with an O-ring seal and be locked in place with stainless steel lock screws and be field replaceable, without the use of special tools.

5.4.3 The shaft shall be single and continuous stainless steel, extending both sides of the body with a lever and weight, using an air cushion cylinder, side mounted.

5.4.4 The air cushion cylinder shall be constructed of corrosion-resistant material and the piston shall be totally enclosed within the cylinder and not open at one end. The air cushion

cylinder assembly shall be externally attached to either or both sides of the valve body and will permit adjustability to cushion the closure of the valve. Cushioning shall be by air trapped in the cushion cylinder which shall be fitted with a one-way adjustable control check valve to cushion disc contact to the seat at the shut-off point. The bottom cylinder head shall be swivel mounted and not rigid to follow the change of force angles as the lever raises or lowers to open or close the check valve. Valve shall prevent backflow on normal pump shut-off or power failure, at zero velocity, and be water tight.

5.4.5 The disc shall be cast iron utilizing a double clevice hinge connected to a Ductile iron disc arm. The disc arm assembly shall be suspended from a stainless steel shaft which passes through a seal retainer on both sides of the valve body.

5.4.6 Valve exterior shall be painted with Red Oxide Phenolic Primer Paint. Materials shall be certified to the following ASTM specifications:

Body, cover, disc	
Cast Iron	ASTM A126,
Class B Disc arm	
Ductile Iron	ASTM A536
Seat	
Aluminum bronze	ASTM B148
or Stainless steel	ASTM A276
Disc seat	Buna-N or metal
Cushion cylinder	Corrosion-resistant
Commercial	material

5.5 Sewer Valve Boxes

5.5.1 Construction of Boxes: Valve boxes shall be cast iron from the valve to finished grade, of the Roadway Extension type of proper length and base size with suitable detachable cover and shall be coated inside and out with epoxy paint. Valve boxes shall be Dewey Brothers VBX-TE 100 (6 5/16" cover) or approved equal. Valve boxes shall be made of close-grained, gray cast iron in three (3) pieces, as follows: a) The lower of base pieces, which shall be beveled at the bottom to fit around the stuffing-box gland, but must not rest on the valve bonnet or gear disc after installation. b) The upper barrel, which shall be flanged on the lower end and of such size as to telescope over the lower base piece; the upper end being constructed in the form of a socket to receive the valve box cover. c) The valve box cover, which shall have cast on the upper surface in raised letters, the word "sewer".

5.5.2 Valve Box Adjustment: All valve boxes shall be set plumb over the valve with the valve nut centered therein. The CONTRACTOR shall adjust valve boxes to final grade at the time designated by the ENGINEER. The CONTRACTOR shall build a reinforced concrete collar 18" x 18" x 6" around the valve box head in pavement, flush to the grade of the top of the box. In unpaved areas, a similar concrete collar shall be poured with the top flush with the surrounding ground level. No extra payment shall be made for this item.

6. Tracer Tape

6.1 Three inch (3") wide metallized warning tape, color green, marked "Caution - Sewer Line Below" shall be installed in the ditch over the pipe and shall be twelve inches (12") below

finished grade. Metallized tape shall be Terra Tape D as manufactured by Reef Industries, Inc., Houston, Texas, or approved equal.

7. Effluent

7.1 Three inch (3") wide metallized warning tape, color orange, marked "Caution - Non-Potable Water Line Below" shall be installed in the ditch over the pipe and twelve inches (12") to below finished grade. Metallized tape shall be Terra Tape D as manufactured by Reef Industries, Inc., Houston, Texas, or approved equal.

SECTION 027903 - TECHNICAL SPECIFICATIONS - GENERAL MATERIAL SPECIFICATIONS FOR INSTALLATION OF PIPELINES

1. Concrete and Cement

1.1 Cement

1.1.1 Portland Cement shall be of a standard brand and shall conform to the requirements of ASTM C150-latest edition, except as hereinafter stated. One bag of cement shall be considered as weighing ninety four (94) pounds. Type I shall be used unless higher cement is specified, in which event Type III shall be used. For Type I, the maximum amount of tricalcium silicate shall be sixty (60) percent. Cement may be shipped either in paper or cloth sacks and the package shall have the brand and name of manufacturer plainly marked on the outside. All cement shall be stored in weather-proof buildings in such a manner as will prevent absorption of moisture by the lower layers. Shipment shall be segregated by lot for identification. Type I cement which has been in storage more than ninety (90) days shall be re-tested before use. Where carload shipments are used, a certificate from an approved testing laboratory shall be submitted prior to use of such cement on the job.

1.2 Fine Aggregate

1.2.1 Composition: Fine aggregate shall consist of natural sand and shall be graded from coarse to fine within the following limits shown on Table I 4.1. Sand failing to meet the minimum requirement for material passing the Number 50 and/or Number 100 Sieve may be used, provided other satisfactory inorganic fine materials are added. If two sands are used, each must be mixed after separate weighing in proportions as set by CITY or ENGINEER.

TABLE I 4.1

U.S. Standard Square Opening Sieve	Percent of Total by Weight Passing	
No. 4	97	100
No. 8	80	100
No. 30	25	75
No. 50	10	30
No. 100	2	10
No. 200 (By Washing)	0	4

1.2.2 Stockpiling: Fine aggregate shall be stored on a well drained site which has been cleared, grubbed and cleaned. Stockpiles shall be built up so as to prevent segregation of large and small particles.

1.2.3 Unsuitable Materials in Fine Aggregate: Not more than one percent (1%) by weight of clay lumps or soft, disintegrated or coated grains shall be present in the fine aggregate. It shall also be free from foreign material such as dirt, wood, paper, burlap, or other unsuitable material. When tested in accordance with AASHTO T-21-27, it shall show a color not darker than standard. When tested for mortar strength in accordance with AASHTO T-71-38, the fine aggregate shall have a tensile strength at three (3) days (Type III), or at seven (7) days, (Type I); not less than 95 percent of that developed by mortar having the same water-cement ratio and

consistency, made of the same cement and graded Ottawa Sand having a fineness modulus of 2.40, plus or minus 0.05.

1.3 Coarse Aggregate

1.3.1 Composition: Coarse aggregate shall consist of crushed stone. It shall be washed to remove clay, loam and dust. At his discretion, the ENGINEER may waive the washing requirement for stone having a loss of not more than thirty per cent (30%) when tested in accordance with the provisions of AASHTO T-96-38.

1.3.2 Unsuitable Material in Coarse Aggregate: The coarse aggregate shall not contain more than the following percentages of deleterious material: Soft Fibrous, Disintegrated Particles (Weight) 3.0% Clay Lump (Weight) .2% Finer Than No. 200 Sieve (Weight) .5% Flat or Elongated Particles (Count) 10.0% When subjected to AASHTO Test T-96-38, the aggregate shall have a loss not greater than sixty-five percent (65%). Aggregate shall be free from loam, wood, leaves, or other foreign material.

1.3.3 Gradation: For unreinforced foundations, for paving or for other unreinforced mass concrete, the gradation of coarse aggregate shall be as shown in Table I4.2. For reinforced footings, reinforced walls over 6" in thickness, ordinary floor slabs and similar structures, the gradation shall be as shown on Table I4.3. For handrails, reinforced walls, thin reinforced floor slabs electrical conduit encasement, and similar construction, the gradation shall be as shown on Table I4.4.

TABLE I4.2

Passing Square Opening Sieve	Percent By Weight
2« Inch	- 100
2 Inch	95 - 100
1 Inch	35 - 70
« 1 Inch	10 - 30
No. 4	0 - 5

TABLE I4.3

Passing Square Opening Sieve	Percent By Weight
1« Inch	- 100
1 Inch	90 - 100
« Inch	25 - 60
No. 4	0 - 10
No. 8	0 - 5

TABLE I4.4

Passing Square Opening Sieve	Percent By Weight
1 Inch	- 100
3/4 Inch	90 - 100
3/8 Inch	20 - 55
No. 4	0 - 10
No. 8	0 - 5

1.3.4 Stockpiles: Stockpiles shall be constructed in layers not exceeding three feet (3') in height, and material shall be deposited in such manner as to prevent segregation of coarse and fine materials. Each type of aggregate shall be placed in a separate stockpile. Stockpile sites shall be cleared, grubbed and drained before using.

1.4 Water

1.4.1 Water shall be clean and free from salt, oil or organic substances. Laboratory tests shall be made to determine suitability of any water for use in concrete unless same is secured from a public water supply.

1.5 Concrete Classification

1.5.1 Concrete shall contain cement, coarse aggregate, and fine aggregate meeting the Specifications contained in previous paragraphs of this Part. Unless otherwise specified or shown in the plans, the design strength of the several elements included in the plans shall be: a) Four thousand (4,000) pounds minimum compressive strength per square inch at twenty-eight (28) days for all piers, reinforced walls, floors, slabs, and other special sections where specifically shown on the plans or Standard Details. b) Two thousand five hundred (2,500) pounds minimum compressive strength per square inch at twenty-eight (28) days for all blocking, reinforced footings, for retaining walls not subject to hydrostatic pressure.

1.6 Concrete Proportioning

1.6.1 Concrete aggregate shall be proportioned by weight. When the sources of supply shall have been determined by the CONTRACTOR and approved by the ENGINEER, the mix shall be set by an approved testing laboratory. Mix shall be designed for a "slump" suitable for the character of structure in which the concrete is to be incorporated. All concrete shall be as specified above in paragraph 1.5.1.

1.6.2 After a suitable designed mix has been approved by the ENGINEER, it shall not be changed so long as materials of the same characteristics are used in the mix. Within the limits of the various cement factors shown above, the mix shall be varied until the homogenous workable mixture, suitable for the class of structure intended, has been obtained.

1.7. Concrete Mixing

1.7.1 Concrete mixing shall be by means of a modern batch mixer quipped with an accurately operating water measuring device and an automatic time locking device.

1.7.2 Where a central batching plant is not operated, each mixer must have available an approved portable weighing device for use in proportioning. Each batch shall be mixed for one and one-half (1«) minutes after charging has been completed, and during such mixing period, that drum shall operate with a peripheral speed of not less than one-hundred and fifty-three (153), nor more than two-hundred and twenty-five (225) feet per minute. The number of revolutions per minute shall be between fourteen (14) and twenty (20). Retempering concrete or use of concrete in which initial set has taken place will not be allowed. Transit mixed concrete from an approved batching plant and suitable truck mixer may be approved by the ENGINEER.

1.8 Forms

1.8.1 Forms for concrete work may be of dressed lumber, plywood, metal or a combination thereof as may be approved by the ENGINEER. Where dressed lumber is used, the boards shall be surfaced both sides with tongue and groove edges, and for forms exceeding four feet (4') in height, the thickness of individual boards shall not be less than one and one-quarter (1¬) inches dressed. Forms shall be constructed mortar tight and with sufficient supports, walls and bracing to hold the concrete in line and shape without bulging.

1.8.2 Forms shall be held together by form ties so arranged as to permit the ends of the bolts to be removed to a depth of at least one and one-half (1«) inches beneath the surface of the concrete. The cavity, so formed, shall be filled as soon as possible with cement mortar proportioned so as to blend in with color and bond to the remaining portion of the wall. On thin walls not subject to hydrostatic pressure, wiring of forms will be permitted.

1.8.3 Forms for walls, basins, flumes or other exposed structures having straight outlines, shall be erected and set so as to be true in alignment and braced sufficiently to remain in that condition throughout pouring of concrete. Corners and edges shall finish true and plumb, and curved surfaces and edges shall finish true to radius. Concrete of the highest grade and form, only, will be acceptable.

1.8.4 Where forms are to be reused, they shall be cleaned thoroughly after dismantling, coated with form release agent and stored to prevent warping and twisting.

1.9 Reinforcing Steel

1.9.1 All steel for reinforcement bars shall be billet steel, open hearth of intermediate grade, having a tensile strength of not less than seventy thousand (60,000) pounds per square inch. For bars under three-fourths inch (3/4") in diameter, the bend test requirements shall be that the bar shall be bent cold one hundred and eighty (180) degrees around a pin having a diameter three (3) times that of the bar under test, without evidence of breaking. For bars three-fourth inch (3/4") in diameter and over, the bend test requirements shall be that the bar shall be bent cold ninety degrees (90º) around a pin having a diameter three (3) times the diameter of the bar under test without evidence of cracking.

1.9.2 Bars shall conform in every respect to ASTM Specification A615 latest revision, for billet steel reinforcements, intermediate grade.

1.9.3 Deformed bars must be used. Bars deformed by cold twisting or bars from rerolled stock will not be acceptable, except by special permission of the ENGINEER. The CONTRACTOR's Bid shall be based on reinforcement steel as specified, not on steel from rerolled stock.

1.9.4 Reinforcement steel bars must be kept in racks off the ground and classified by numbers until used. Bars must be wire brushed clean of mill scales, dirt, etc., before being placed in the forms. Where the epoxy coating is damaged, steel shall be rejected.

1.9.5 Bars for girders may be made up in unit frames. All bars shall be of sufficient length to extend through the full length of slabs and girders, and all joints shall be made over supports and by lapping for a length of at least forty (40) diameters. No welding of bars will be permitted.

1.9.6 The brand of manufacturer shall be legibly rolled on all bars, and when loaded for mill shipment, all bars shall be properly separated and tagged with manufacturer's test identification number.

1.9.7 All steel bars shall be epoxy coated unless otherwise noted.

2. Special Provision for Spiral Welded or Smooth Wall Pipe Encasements

2.1 Casing pipe shall be smooth walled or spiral welded new prime steel conforming to the requirements of ASTM A-139. Size and wall thickness of smooth wall or spiral welded encasement pipe for boring and jacking, unless otherwise specified, is shown on Table I.5.

TABLE I.5

Pipe Sizes (O.D.)	Wall Thickness
12 3/4"	.188
16"	.250
18"	.250
20"	.250
24"	.250
30"	.312
36"	.375
48"	.432

3. Embedment Materials

3.1 Classification

3.1.1 Embedment materials listed here include a number of processed materials plus the soil types defined according to the Unified Soil Classification System (USCS) in ASTM D2487. These materials are grouped into five (5) broad categories according to their suitability for this application.

3.1.2 Class I: Angular, one-quarter inch (¬") to one and one-half inch (1«") (6 to 40 mm) graded stone, including a number of fill materials that have regional significance such as coral, slag, cinders, crushed shells and crushed stone. (Note: The size range and resulting high void ratio of Class I material makes it suitable for use to dewater trenches during pipe installation. This permeable characteristic dictates that its use be limited to locations where pipe support will not be lost by migration of fine graned natural material from the trench walls and bottom or migration of other embedment materials into the Class I material. When such migration is possible, the material's minimum size range should be reduced to finer than one-quarter inch (1/4") (6 mm) and the gradation properly designed to limit the size of the voids. An alternative to modifying the gradation is to use a geotextile fabric as a barrier to migration to fines.)

3.1.3 Class II: Coarse sands and gravels with maximum particle size of one and one-half inches (1«") (40 mm), including variously graded sands and gravels containing small percentages of fines, generally granular and non-cohesive, either wet or dry. Soil Types GW, GP, SW and SP are included in this class. (Note: Sands and gravels which are clean or borderline between clean and with fines should be included. Coarse-grained soils with less than twelve percent (12%), but more than five percent (5%) fines are neglected in ASTM D2487 and the USCS, but should be included. The gradation of Class II material influences its density and pipe support strength when loosely placed. The gradation of Class II material may be critical to

the pipe support and stability of the foundation and embedment, if the material is imported and is not native to the trench excavation. A gradation other than well graded, such as uniformly graded or gap graded, may permit loss of support by migration into void spaces of a finer grained natural material from the trench wall and bottom. An alternative to modifying the gradation is to use a geotextile fabric as a barrier to migration of fines.)

3.1.4 Class III: Fine sand and clayey (clay filled) gravels, including fine sands, sand-clay mixtures and gravel-clay mixtures. Soil Types GM, GC, SM and SC are included in this class.

3.1.5 Class IV: Silt, silty clays and clays, including inorganic clays and silts of medium to high plasticity and liquid limits. Soil Types MH, ML, CH and CL are included in this class. (Note: Caution shall be used in the design and selection of the degree and method of compaction for Class IV soils because of the difficulty in properly controlling the moisture content under field conditions. Some Class IV soils with medium to high plasticity and with liquid limits greater than fifty percent (50%) (CH, MH, CH-MH) exhibit reduced strength when wet and should only be used for bedding, haunching and initial backfill in arid locations where the pipe embedment will not be saturated by groundwater, rainfall or exfiltration from the pipe. Class IV soils with low to medium plasticity and with liquid limits lower than fifty percent (50%) (CL, ML, CL-ML) also require careful consideration in design and installation to control moisture content, but need not be restricted in use to arid locations.)

3.1.6 Class V: This class includes the organic soils OL, OH and PT as well as soils containing frozen earth, debris, rocks larger than one and one-half inches (1«") (40 mm) in diameter and other foreign materials. These materials shall not be used for bedding, haunching or initial backfill.

4. Roadway Materials

4.1 Limerock for Roadway Base

4.1.1 The limerock base course material shall conform to the Florida Department of Transportation Standard Specifications for Road and Bridge Construction (latest edition), Section 911, Miami Oolitic Formation.

4.2 Prime Coat

4.2.1 The material used for prime coat shall be cut-back asphalt, meeting the requirements of Section 300 of the Florida Department of Transportation Standard Specifications for Road and Bridge Construction, latest edition, and all supplements thereto. The cover material for the prime coat shall be either sand (either bare or hot-asphalt coated) or screenings at the CONTRACTOR's option. The sand shall be nonplastic and free from any appreciable amount of silt, clay balls and root articles and from any noticeable sticks, trash, vegetation or other organic matter. Screenings shall be Miami Oolitic rock screenings meeting the specifications above.

4.3 Tack Coat

4.3.1 The tack coat shall be Emulsified Asphalt, meeting the requirements of Section 300 of the Florida Department of Transportation Standard Specifications for Road and Bridge Construction, latest edition, and all supplements thereto.

4.4 Asphaltic Concrete Type S-I or Type II

4.4.1 Except when otherwise directed by the Transportation Services Division hot bituminous mixtures shall conform with Sections 330, 331, or 332 for Type S-1 or Type II Asphaltic Concrete Surface Course of the Florida Department of Transportation Standard Specifications for Road and Bridge Construction, latest edition. The CONTRACTOR shall furnish sufficient proof that the named source of material supply to be used meets Florida Department of Transportation Road Specifications. The ENGINEER may require additional tests from time to time and the CONTRACTOR shall furnish all material necessary for said tests.

SECTION 027904 - TECHNICAL SPECIFICATIONS - EROSION AND SEDIMENTATION CONTROL

1. Erosion Control The method to be used in trench excavation, and the equipment to be used for the purpose of erosion control is optional to the CONTRACTOR, unless otherwise noted in the plans or by local regulations. Consequently, an erosion control plan shall be prepared based upon the method to be used. It is the responsibility of the CONTRACTOR to prepare the erosion control plan, submit it to the ENGINEER for review and comment, submit it for approval to the State and/or local authorities, prior to commencement of any land disturbing activities, and to provide the ENGINEER with a copy of the approved plan.

2. Types of Controls

2.1 Location

2.1.1 The type of sedimentation and erosion control (SEC) devices to be employed on the project will depend on location and adjoining features of the land at that location. Unless noted on the plans, CONTRACTOR shall construct SEC devices as directed by ENGINEER or deemed necessary by CONTRACTOR.

2.2 Riprap Channel Construction Specifications

2.2.1 Clear the foundation of all trees, stumps, and roots.

2.2.2 Excavate the bottom and sides of the channel thirty inches (30") below grade at all points to allow for the placement of riprap as shown in the typical cross-section in the Standard Details.

2.2.3 Install extra strength filter fabric on the bottom and sides of the channel foundation, placing the upstream fabric over the downstream fabric with at least a one foot (1.0') overlap on all joints. The fabric is to be securely held in place with metal pins.

2.2.4 Place riprap evenly to the lines and grades shown on the drawings and staked in the field. Riprap to be placed immediately following the installation of the filter fabric.

2.2.5 Riprap to meet specification for D.O.T. Class 2 Riprap.

2.2.6 Vegetate all disturbed areas following specifications shown in the vegetative plan.

2.3 Road Stabilization Construction Specifications

2.3.1 Clear road bed and parking areas of all vegetation, roots and other objectionable material.

2.3.2 Provide surface drainage.

2.3.3 Spread six inch (6") course of lime rock evenly over the full width of road and parking area and smooth to avoid depressions.

2.3.4 All disturbed areas adjoining roads and parking (as soon as grading is complete) shall be seeded or resodded in accordance with existing conditions prior to construction.

2.4 Temporary Sediment Trap Construction Specifications

2.4.1 Clear, grub and strip the area under the embankment of all vegetation and root mat.

2.4.2 Clear retention area to elevation as approved by ENGINEER.

2.4.3 Use fill material free of roots, woody vegetation and organic matter. Place fill in lifts not to exceed nine inches (9") and machine compact.

2.4.4 Construct dam and stone spillway to dimensions, slopes and elevations shown.

2.4.5 Ensure that the spillway crest is level and at least eighteen inches (18") below the top of the dam at all points.

2.4.6 Stone used for spillway section - Class "B" erosion control stone.

2.4.7 Stone used on inside spillway face to control drainage - #67 washed stone.

2.4.8 Extend stone outlet section to vegetated road ditch on zero grade with top elevation of stone level with bottom of drain.

2.4.9 Ensure that the top of the dam at all points is six inches (6") above natural surrounding ground.

2.4.10 Stabilize the embankment and all disturbed area above the sediment pools as shown in the vegetation plan.

2.5 Sediment Fence Construction Specifications

2.5.1 Construct sediment fence on low side of topsoil stockpile to prevent sediment from being washed into the drainage system. Fence to extend around approximately seventy percent (70%) of the perimeter of the stockpile.

2.5.2 Locate posts downslope of fabric to help support fencing.

2.5.3 Bury toe of fence approximately eight inches (8") deep to prevent undercutting.

2.5.4 When joints are necessary, securely fasten the fabric at a support post with overlap to the next post.

2.5.5 Filter fabric shall be of nylon, polyester, propylene or ethylene yarn with extra strength - 50 lb./linear inch (minimum) - and with a flow rate of at least 0.3 gal/ft./minute. Fabric should contain ultraviolet ray inhibitors and stabilizers.

2.5.6 Post to be four inches (4") diameter pine with a minimum length of four feet (4').

3. Siltation and Bank Erosion

The CONTRACTOR shall take adequate precautions to minimize siltation and bank erosion in crossing canals or ditches, in discharging well point systems, or during other construction activities. CONTRACTOR shall not place unusable materials within the limits of the Right-of-

Way unless so directed by the City Public Works Department. Work in Right-of-Way CONTRACTORs performing work within the public Right-of-Way shall be responsible to protect, during construction, all existing vegetation and facilities not authorized to be removed. CONTRACTOR shall be responsible for acquiring all state and local right-of-way permits. CONTRACTOR shall be responsible to restore all vegetation or facilities damaged during construction. Tree Cutting the indiscriminate cutting of trees or disfiguring of any feature of scenic value shall not be permitted. This includes methods such as the use of herbicides. The necessary trimming or cutting of trees by CONTRACTOR in the interest of public safety or continuity of facility service shall not be considered indiscriminate where such facilities cannot bypass the obstruction without violating the minimum clearance requirements.

4. Sidewalk/Driveway Replacement Materials

Sidewalk/driveway repairs shall be done using materials matching those disturbed during construction. Rock, asphalt, concrete, etc. shall be as specified in Exhibit I, Part (4) of the contract documents.

4.1.1 Grassing, mulching, and watering operations when required are to begin within three (3) weeks after completion of construction or as otherwise directed and shall be continually watered until growth is initiated or until sufficient local shower activity will ensure growth. All requirements regarding grassing, mulching and watering shall be in accordance with the Florida Department of Transportation Standard Specifications for Road and Bridge Construction, latest revision or as otherwise stipulated. Any yards or parts or right-of-way in front of private property that contain a grass mat shall be resodded with similar type sod.

4.1.2 Concrete sidewalks/bikeways shall be a minimum of four inches (4") thick, except that alley intersections and driveways shall be six inches (6") thick. All concrete sidewalk/bikeway work shall be in conformance with Section 522 (Concrete Sidewalks), of the Florida Department of Transportation Standard Specifications for Road and Bridge Construction, latest edition.

4.1.3 Asphalt sidewalks/bikeways or access paths where authorized shall be constructed to specifications established by the Transportation Services Division, but shall be no less than six inches (6") of compacted limerock base over a stabilized subgrade, primed and surfaced with a minimum of one inch (1") of Type II asphaltic concrete.

4.2 Public Safety (during construction, alteration or repair)

4.2.1 In areas of high vehicular traffic, the CONTRACTOR shall provide a safe walkway around the work area.

4.2.2 Barricades or other barriers shall be used to prevent any possibility of injury to the public caused by the CONTRACTOR's work.

4.2.3 Walk areas around the work areas shall be kept clean of sand, stones, and any other material that could cause a pedestrian accident.

4.2.4 Work areas left overnight shall be barricaded. The CITY may require the CONTRACTOR to install flashing warning lights in warranted areas.

5. Pavement Cutting and Replacement

5.1 Road Pavement Cutting - Open Cuts

5.1.1 Unless otherwise noted on the drawings, and/or in accordance with the right-of-way permit, open cutting of existing pavement will generally not be allowed, but may be considered under one or more of the following conditions: a) Subsurface obstructions including rock; b) Extreme high water table; c) Limited space for jack and bore pits; d) Condition of roadway surface - including imminent resurfacing and rebuilding, provided inspection and approval beforehand is made by the affected Transportation Services Division; e) Extreme economic hardship is proven with adequate supportive data.

5.1.2 Where an open cut has been permitted, replacement of backfill, base and wearing surface shall be in accordance with the Standard Details (for both paved and unpaved roads) and/or special stipulations of the right-of-way permit.

5.1.3 Limerock from a Florida Department of Transportation approved pit shall be on the job site during open cutting. When the specified compacted limerock base is greater than six inches (6"), the base shall be constructed in two (2) or more lifts.

5.2 Temporary Restoration

5.2.1 If the restoration is incomplete at the end of the day, the trench shall be backfilled and made flush with existing pavement edges. Temporary asphaltic patches are permitted when restoration of the road is incomplete at the end of the day, but only with the approval of the Transportation Services Division. If approval is given for a temporary patch, the cut shall be properly back-filled, with compaction meeting the density requirements specified, primed, then the cold or hot mix asphaltic patch applied. At such time when the conditions are corrected, the temporary cold or hot mix asphaltic patch used shall then be removed and the final asphaltic overlay shall be evenly applied, as required. The temporary patch may be utilized for a period from the commencement of the open cut, not to exceed ninety (90) days for each cut.

5.2.2 Upon backfill and completion of the base, if the hot mix asphalt is not immediately placed and when authorized, a temporary cold or hot mix asphaltic patch with a smooth all-weather surface may be utilized.

5.2.3 Before a lane is open to traffic, an asphaltic patch must be provided where applicable.

5.3 Conditions of Open Cuts (if permitted)

5.3.1 On dead-end streets, collector streets, and high traffic streets, trenching and pipe laying shall be performed in such a manner that at least one-way traffic is maintained at all times.

5.3.2 All trench lines across existing pavements, driveways, sidewalks, curbs, etc., shall be saw cut in straight parallel lines.

5.3.3 CONTRACTOR shall exercise care to minimize amount of pavement, sidewalk, driveways, and curbing to be removed. The final decision as to the amount of removal allowed shall rest with the ENGINEER.

5.3.4 Pavement shall not be left unrepaired overnight. If CONTRACTOR wishes to repave all damaged areas at one time, and such request is approved by ENGINEER, a cold patch mix shall be utilized immediately until final pavement restoration.

6. Paving

6.1 Limitation of Operations

6.1.1 Asphaltic Concrete shall be placed in accordance with FDOT SPEC Section 330.

6.1.2 Asphalt plant and placement operations shall not commence during periods of adverse weather. The mix shall be spread only on prepared, firm, and dry surfaces. Temperature shall be above forty degrees (40ø) F and winds shall not be of velocity to cause blowing sand, dust, etc., to deposit upon the application surface.

6.1.3 Temperature - Temperature of the mixture at time of spreading shall be between 275 and 350 degrees Fahrenheit. All other mixture temperatures will be rejected.

6.1.4 Rain and Surface Conditions - Any mixture caught in transit by a sudden rain may be laid, but at the CONTRACTOR's risk. Should such mixture prove unsatisfactory, it shall be removed and replaced with satisfactory mixture at the CONTRACTOR's expense. In no case shall the mixture be laid while rain is falling or when there is water on the surface to be covered.

6.2 Preparation of Surfaces

6.2.1 Prior to the laying of the mixture the edges of the area to be patched shall be saw-cut in smooth, straight lines.

6.2.2 The surface of the base or pavement to be covered shall be cleaned of all loose and/or organic material. Any irregular areas shall be properly beveled or smoothed out.

6.2.3 All structures which will be in contact with the asphalt mixture shall be painted with a uniform tack coat of asphalt cement to provide a closely bonded, watertight joint. Tack coat shall be emulsified asphalt, meeting the requirements of Section 300 of the FDOT Standard Specifications for Road & Bridge Construction, latest edition and all supplements thereto.

6.2.4 A tack coat shall be required on the following surfaces: a) Between successive surface courses; b) Between successive leveling courses; c) Between the leveling and surface courses; and d) On old pavements to be patched or leveled. A tack coat on freshly primed surfaces or surface treatment will be required only when so directed by the ENGINEER.

6.3 Placing Asphalt

6.3.1 Asphalt patches shall be filled by hand or by mechanical means. In either case, rolling shall immediately follow. When using mechanical spreaders for overlays or strip patches, the following paragraphs (6.3.1.1 through 6.3.1.6) shall be adhered to.

6.3.1.1 All asphaltic concrete mixtures (including leveling courses), other than those adjacent to curb and gutter or other true edges, shall be laid with the use of string lines to assure an accurate, uniform alignment of the pavement edge.

6.3.1.2 Depth of each layer shall be checked at frequent intervals, not to exceed twenty five feet (25'). Any deviation from the required thickness, in excess of the allowable tolerance, shall be immediately corrected.

6.3.1.3 No layer shall be greater than two inches (2") when compacted. Where a surface course is constructed to a thickness greater than two inches (2"), it shall be constructed in approximately equal layers, each not exceeding two inches (2").

6.3.1.4 Laying Width: Where necessitated by traffic conditions, mixture shall be laid in strips in such manner as to provide for the passage of traffic. Where the road is closed to traffic, mixture may be laid to the full width, by machines traveling in parallel.

6.3.1.5 Spreading Finishing: Upon arrival, mixture shall be dumped not the approved mechanical spreader and immediately spread and struck-off to the full width required and to such loose depth for each course that, when the work is completed, the required weight of mixture per square yard, or the specified thickness, will be secured. An excess amount of mixture shall be carried ahead of the screed at all times. Hand raking shall be done behind the spreader as necessary.

6.3.1.6 Correcting Defects: Before any rolling is started, the surface shall be checked, any irregularities adjusted, and all drippings, fat sandy accumulations from the screed, and fat spots from any source shall be removed and replaced with satisfactory material. No skin patching shall be done. When a depression is to be corrected while the mixture is hot, the surface shall be well scarified before the addition of fresh mixture.

6.4 Compaction

6.4.1 Compaction on small patches shall be accomplished through the use of five-ton rollers, first rolling the edges of the patch, then following with the center of the patch to prevent upheaval or separation at the joints. Do not overroll.

6.4.2 When compacting overlays or longitudinal patches, the following equipment and sequences shall be used for each spreader in operation. CONTRACTOR shall furnish a separate set of rollers with their operators. Rolling shall be done in the following sequence, with the equipment as noted, unless otherwise permitted by the ENGINEER.

6.4.2.1 Seal rolling, using tandem steel rollers weighing six and one half (6.5) to seventeen (17) tons, following as close behind the spreaders as is possible without pick-up, undue displacement or blistering of the material. On hot days, and where the asphalt material is too hot to roll without damage, some delay may be necessary.

6.4.2.2 Rolling with self-propelled pneumatic-tire rollers, following as close behind the seal rolling as the mix will permit. Roller shall cover every portion of the surface with at least five (5) passes.

6.4.2.3 Final rolling with the six and one half (6.5) to seventeen (17) ton tandem steel roller, to be done after the seal rolling and pneumatic-tire rolling have been completed, but before the pavement temperature has dropped below 140°F.

6.4.2.4 CONTRACTOR shall take note not to overroll pavement.

6.4.3 Compaction of Crossovers: When a separate paving machine is being used to pave pipe crossovers, compaction of the rossovers may be done by one eight (8) to ten (10) ton tandem

steel roller. If crossover, intersections with acceleration and deceleration lanes are placed with the main run of paving, a traffic roller shall also be used in the compaction of these areas.

6.4.4 Rolling Procedures

6.4.4.1 Rolling shall be longitudinal. Where the lane being placed is adjacent to a previously placed lane, center joint shall be pinched or rolled, prior to the rolling of the rest of the lane.

6.4.4.2 After the rolling or pinching of the center joint, rolling shall continue across the mat by overlapping each previous roller path by at least one-half the width of the roller wheel. The motion of the roller shall be slow enough to avoid displacement of the mixture, and any displacement shall be corrected at once by the use of rakes, and the addition of fresh mixture, if required. Final rolling shall be continued until all roller marks are eliminated.

6.4.5 Compaction of Areas Inaccessible to Rollers: Areas which are inaccessible to a roller (such as areas adjacent to curbs, headers, gutters, bridges, manholes, etc.) shall be compacted by the use of hand tamps or other approved satisfactory means.

6.5 Protection of Finished Surface

6.5.1 Sections of newly compacted asphaltic concrete which are to be covered by additional courses shall be kept clean until the successive course is laid.

6.5.2 Upon completion of the finished pavement, no dumping of any material directly on the pavement will be permitted. When shoulders are constructed after completion of the final surface, blade graders operating adjacent to the pavement during construction shall have a two inch (2") by eight inch (8") (or larger) board (or other attachment providing essentially the same results) attached to their blades in such a manner that it extends below the blade edge, in order to protect the pavement surface from damage by the grader blade. Vehicular traffic shall not be permitted on any pavement which has not set sufficiently to prevent rutting or other distortion.

6.6 Density Density Required for Asphaltic Concrete Pavement: After final compaction, the density shall be at least ninety five (95%) of the laboratory compacted density of the paving mixture.

6.7 Defects

6.7.1 Rollers shall not be allowed to deposit gasoline, oil or grease onto the pavement, and any areas damaged by such deposits shall be removed and replaced as directed by ENGINEER.

6.7.2 All drippings, fat or lean areas, and defective construction of any description shall be removed and replaced.

6.7.3 While rolling is in progress, surface shall be tested continuously and all discrepancies corrected to comply with the surface requirements.

6.7.4 Depressions which develop before completion of the rolling shall be remedied by loosening the mixture and adding new mixture to bring depressions to a true surface. Should depression remain after final compaction has been obtained, full depth of the mixture shall be

removed and replaced with sufficient new mixture to form a true and even surface. All high spots, high joints and honeycomb shall be corrected as directed by the ENGINEER.

6.7.5 Any mixture remaining unbonded after rolling shall be removed and replaced. Any mixture which becomes loose or broken, mixed or coated with dirt or in any way defective, prior to laying the wearing course shall be removed and replaced with fresh mixture which shall be immediately compacted to conform with the surrounding area.

6.7.6 Areas of defective surface may be repaired by the use of indirect heat. No method of repair involving open-flame heaters shall be used.

6.7.7 Any repairs required in this section shall be made at CONTRACTOR's expense.

7. Drainage Culvert Replacement

7.1 Replacement

7.1.1 All side drains, side ditches, swales, and storm sewers shall be referenced, by the CONTRACTOR, as to grade and location prior to construction, maintained during construction, and repaired as necessary after construction.

7.1.2 Where drainage structures are disturbed and must be replaced, the minimum size replacement shall be twelve inches (12").

7.1.3 All drainage culverts installed shall have mitered ends in conformance with the Standard Details of these Contract Documents.

7.1.4 CONTRACTOR shall place the culvert to the specified elevations and regrade or reshape the swale and road shoulders that have been disturbed or damaged during construction.

7.2 Sodding Swales

7.2.1 In all flow areas, sod shall be placed to the proper grade and cross-section to ensure the design flow of water in the ditch. In excavating for the placement of sod, a minimum three inch (3") undercut is to be provided.

8. Grassing

8.1 Specifications

8.1.1 All exposed ground surfaces that have been disturbed during construction shall be seeded in accordance with the following paragraphs.

8.1.1.1 Preparation of the soil: The soil shall be loosened and mixed to a depth of four inches (4"). Suitable equipment meeting the approval of the ENGINEER shall be used. This operation shall be accomplished by cutting on one foot (1') centers parallel to the contour of the slope.

8.1.1.2 Soil Improvements: Lime shall be applied at the rate of one to one and one half (1 to 1-1/2) tons per acre. 10-10-10 commercial fertilizer shall be applied at the rate of 800 pounds per acre and well worked into the top inch of topsoil.

8.1.1,3 Seed Mixture and Sowing the Seed - All seed must have been tested within six (6) months of planting. A seed bag tag shall be submitted with final payment requests from each type or mixture of seed used. Seed mixtures shall be chosen to insure the development of the planting during the season or planting, and to insure future growth and permanence.

8.1.1.4 Mulching and Asphalt-tie Down: All seeded areas will be mulched with one and one half (1-1/2) tons per acre of small grain straw spread uniformly, approximately one quarter (1/4) of the ground should be visible to avoid smothering seedlings. Asphalt emulsion shall be used to anchor the straw applied at 150 gallons per ton of straw, where necessary. (Alternate methods may be used, if approved by the ENGINEER.)

8.1.1.5 Maintenance: Care shall be taken to prevent run-off destruction to seeded area, and shall continue until turf is established.

8.1.1.6 Grassing, mulching, and watering operations when required are to begin within three (3) weeks after completion of construction or as otherwise directed, and shall be continually watered until growth is initiated or until sufficient local shower activity will ensure growth. All requirements regarding grassing, mulching and watering shall be in accordance with the Florida Department of Transportation Standard Specifications for Road and Bridge Construction, latest revision or as otherwise stipulated. Any yards or parts of right-of-way in front of private property that contain a grass mat shall be resodded with similar type sod.

8.1.2 Guarantee: The CONTRACTOR shall guarantee a live and vigorous stand of permanent grass at the time of acceptance of the work consisting of 80% coverage minimum for seeded grass with no bare spots greater than five (5) square feet.

9. Removal and Replacement of Existing Lawns and Shrubbery

9.1 Removal of Vegetation

9.1.1 Removal and/or replacement of existing lawns and shrubbery shall be accomplished in so far as practicable in accordance with the desires of the property owner, and in all cases shall be acceptable to the ENGINEER. Where possible, sod lawn areas shall be removed in one foot (1') square or rolled sections, carefully preserved, and replaced on a prepared topsoil base after all other construction operations are completed. Sod shall be rolled and watered as necessary to establish growth. In areas where the turf is not adequately thick to be removed as sod, the entire area that is damaged shall be replaced with a six inch (6") layer of topsoil, fertilized, raked and seeded with the same grass as is predominant in the existing lawn. The finished surface must be smooth and uniform throughout.

9.1.2 Shrubbery shall be expertly removed and shall be carefully preserved for replanting. Adequate earth ball shall be removed to guard against damage to the root system. Shrubs shall be replanted only after all other construction operations are complete. The excavation made for replanting shall be six inches (6") larger in every dimension than the ball removed with the shrub. This additional space shall be filled with a mixture of one half topsoil and one half peat moss. Care shall be taken to set the top of the ball flush with the surrounding ground surface. Any shrubbery damaged due to negligence of the CONTRACTOR shall be replaced at his expense.

10. Setting Valves and Fittings

10.1 General

10.1.1 Valves, fittings, plugs and caps shall be set and jointed to pipe in the manner heretofore specified for cleaning, laying and jointing pipe.

10.1.2 Valves in water mains shall be located as shown on the drawings.

10.1.3 A valve box or masonry pit shall be provided for every valve. The valve box shall be centered and plumb over the wrench nut of the valve. It shall not transmit shock or stress to the valve. Valve box shall be two piece telescope type.

10.1.4 All dead ends on new mains shall be terminated with a temporary blow-off or permanent fire hydrant.

11. Settlement of Trenches

11.1 Whenever water lines are in or cross driveways, paved areas or streets, the CONTRACTOR shall be responsible for any trench settlement which occurs within one year from the time of preliminary acceptance.

12. Restoration of Surfaces and/or Structures

12.1 The CONTRACTOR shall restore and/or replace paving, curbing, sidewalks, gutters, shrubbery, fences, sod or other disturbed surfaces or structures to a condition equal to that which existed before the work began to the satisfaction of the ENGINEER. The CONTRACTOR shall furnish all labor, materials and incidentals.

13. Local Ordinances

13.1 Not withstanding anything to the contrary in these Contract Documents, all work within the Right-of-Way shall be in conformance with local Ordinances, as amended.

SECTION 027905 - TECHNICAL SPECIFICATIONS - GENERAL

1. Separation from Other Pipe Systems

1.1 Parallel Water and Sewer, Storm or Effluent Lines

1.1.1 Separation of Water and Other Lines: Sanitary sewer, storm drains, effluent lines or force mains shall be separated from water mains by a minimum clear vertical distance of eighteen inches (18") and a horizontal distance of ten feet (10'- 0").When this standard cannot be maintained, the non-potable line shall be concrete encased for a distance of ten feet (10') each way from the water line and any other conduit, with a minimum vertical clearance of twelve inches (12") being provided at all times.

1.2 Crossing Water and Sewer Lines

1.2.1 Water mains crossing over a non-potable line shall be (bottom of water main to top of non-potable line) separated by at least eighteen inches (18") unless local conditions or barriers prevent an eighteen inch (18") vertical separation. All crossings with vertical clearance less than eighteen inches (18") shall be made using pipe thickness Class 200 AWWA C900 PVC pipe for a distance of ten feet (10') each side of the crossing. The gravity sewer pipe in these locations shall be backfilled with USCS Class I bedding stone to a height of 6 inches above the crown of the pipe.

1.2.2 When water mains cross under a sewer, both mains shall be constructed of C900 Class 200 PVC pipe with joints equivalent to water main standards for a distance of ten feet (10') on each side of the point of crossing with no intermediate joints. Additionally, a section of water main pipe shall be centered at the point of crossing.

2. Flushing and Disinfection of Water Mains

2.1 Flushing Mains

2.1.1 All water lines shall be filled with potable water, pigged or swabbed, and flushed, under the supervision of CITY's personnel, via a full bore flush. A section of pipe shall be inserted in the gap specified in the jumper shown in the Standard Details to connect to the new construction to the existing facilities for the purpose of accomplishing the full bore flush. After completion of the flush, the connection shall be removed. The facilities shall be capped and returned to the jumper connection shown in the Standard Details until final connection is permitted by CITY at the completion of construction and after finalization of all test procedures and bacterial clearance for new water facilities. \

2.2 Pressure Testing of Water Mains

2.2.1 Visual Examination Under Pressure: All exposed pipes, fittings, valves, hydrants, and joints will be carefully examined during the pressure test. All joints showing visible leaks shall be made tight. The pressure test shall be repeated until satisfactory to CITY.

2.2.2 All leaks evident at the surface shall be uncovered and repaired regardless of the total leakage as indicated by the test. All pipes, valves, and fittings and other materials found defective under the test shall be removed and replaced at the CONTRACTOR's expense. Tests shall be repeated until leakage has been reduced below the allowable amount.

2.2.3 Expelling Air Before Test: Before applying the specified test pressure, all air shall be expelled from the pipe. If hydrants or blow-offs are not available at the high places, taps shall be made to provide for air release valves.

2.2.4 The CONTRACTOR shall perform a pressure test of completed pressure mains. The CITY shall be notified of the test at least forty eight (48) hours in advance and will observe the test. The test shall be conducted for a period of two (2) hours at 150 psi pressure. Test procedure and allowable leakage shall be as specified for the appropriate pipe system in either AWWA C600, Section 13, or Uni-Bell Plastic Pipe Association Handbook of PVC Pipe, Chapter VI, Inspection and Testing - Pressure Pipe.

2.2.5 Simultaneously with the leak test, a hydrostatic test shall be performed. Test pressures shall not vary more than 5 PSI, for the duration of the test in accordance with AWWA C-600, Section 4.1, Paragraph 4.

2.3 Disinfection of Water Mains

2.3.1 After installation, leakage/pressure tests and all repairs on the water line have been completed, and the water lines flushed clean, water containing not less than fifty parts per million (50 ppm) chlorine (preferably 75 - 100 ppm) shall be placed in the line and allowed to stand at least forty eight (48) hours. After forty eight (48) hours, if the chlorine solution contains at least twenty five parts per million (25 ppm) of chlorine, the line may be flushed and samples taken at various points.

2.3.2 Chlorinating agent may be a chlorine gas-water mixture, calcium hypochlorite or chlorinated lime of known chlorine content, in water, and shall be fed through a suitable solution feed device located at or near the point from which the main is to be filled. Flow of both water and chlorine solution shall be at a slow rate and in such proportion that the required chlorine content is evenly distributed in the main. Air pockets shall be eliminated and system pressure applied. Following chlorination, all water shall be flushed from the lines until replacement water has a chlorine content not more than 0.1 ppm in excess of the residual in the water from the supplying main.

2.4 Bacteriological Testing

2.4.1 Water samples for bacteriological examination shall be taken by the CITY after receiving adequate notice (at minimum, forty eight (48) hours) from the CONTRACTOR. The lines shall not be placed in service until a negative bacteriological report is received.

3. Testing of Gravity Sanitary Sewer Lines

3.1 Watertight Construction

3.1.1 It is imperative that all sewers and force mains, manholes, and service connections be built watertight and that the CONTRACTOR adhere rigidly to the specifications for material and workmanship. Since of the water and sewage in the lines will be treated at the treatment plant, special care and attention must be given to securing watertight construction. After completion, the sewers or sections thereof will be tested and gauged. If infiltration or exfiltration is above the limits specified under 3.4 the sewer construction work will be rejected.

3.2 Cleaning

3.2.1 Care shall be exercised during construction of the manhole to see that materials do not enter the sewer line. The invert and shelf of the manhole shall be kept clean of all mortar, broken brick, sand, or any other materials falling into the manhole. Such material shall be immediately removed. This condition shall be maintained until final acceptance of the work. Prior to testing of gravity sanitary sewer lines, the lines shall be thoroughly cleaned, using appropriate tools.

3.3 Gravity Sewers - Visual Inspections On completion of each block or section of sewer, or at such other times as the ENGINEER may direct, the block or section of sewer is to be cleaned, tested and inspected. Each section of the sewer is to show, on examination from either end, a full circle of light between manholes. Each manhole, or other appurtenance to the system, shall be of the specified size and form, be watertight, neatly and substantially constructed, with the rim set permanently to design position and grade. All repairs shown necessary by the inspection are to be made; broken or cracked pipe replaced, all deposits removed and the sewers left true to line and grade, entirely clean and ready for use.

3.4 Infiltration Limits

3.4.1 The CONTRACTOR shall provide the equipment necessary to check the lines for infiltration or exfiltration as directed by the engineer, before they are put in service. Infiltration in excess of fifty (50) gallons per day inch-mile of sewer will result in having the CONTRACTOR go over the lines, ascertain where the leakage exists, and repair the lines to the extent necessary to bring the infiltration down within acceptable limits. No test shall exceed one manhole to manhole section. Observable inflow is not permitted.

3.5 Exfiltration Limits

3.5.1 The length of sewer subject to an exfiltration test shall be the distance between two (2) adjacent manholes. The inlets of the upstream and downstream manholes shall be closed with watertight plugs and the test section filled with water until the elevation of the water in the upstream manhole is two (2) feet above the crown of the pipe in the line being tested, or two (2) feet above the existing groundwater in the trench, whichever is higher. A standpipe may be used instead of the upstream manhole for providing the pressure head when approved by the ENGINEER. Exfiltration shall be measured by determining the amount of water required to maintain the initial water elevation for one (1) hour period from the start of the test. The maximum allowable leakage, including manholes, shall be 50 gallon per inch for diameter per mile of pipe per day.

3.6 Pipe Deflection Testing

3.6.1 Deflection testing shall be performed for all semi-rigid and flexible pipe eight inches (8") or larger in size. Deflection shall not exceed five percent (5%) of nominal diameter (95% of the ASTM base inside diameter). Testing shall be conducted in the presence of ENGINEER and shall utilize a mandrel go/no-go gauge complete with proving ring. Mandrel shall be approved by CITY for this test. Arm mandrels shall have a minimum of nine (9) arms.

3.7 Air Testing

3.7.1 Air testing shall be required if, in the opinion of the ENGINEER, conditions are such that infiltration measurements may be inconclusive. The test shall be conducted in the presence of ENGINEER and shall conform to the following requirements: a) Test pressure shall be 3.5 psi increased by the groundwater pressure above the top of the sewer. b) Pressure loss from 3.5 to 3.0 psi shall not exceed 0.5 psi during the required testing time. c) Testing time in minutes shall be calculated as 0.625 x nominal pipe size (inches).

3.7.2 Force Main Pressure Testing All force mains shall be designed by the ENGINEER and subject to pressure testing at the following standards:

System Operating Pressure	Test pressure	Duration
50 PSI or less	100 PSI	2 hours Greater than
50 PSI	150 PSI or 2	2 hours times the operating pressure, whichever is greater.

Allowable leakage on force mains shall be computed utilizing the standards for water loss in conformance with AWWA C600, the latest revision thereof.

3.7.3 Concurrently with the leakage test a hydrostatic test shall be performed using the 5 PSI, as specified in AWWA C-600, see 4.1 Paragraph

4. Gravity Sewer - Television Inspection Complete television inspection shall be required at the CONTRACTOR's expense prior to the project's preliminary acceptance inspection and at the one (1) year warranty inspection to ensure that the gravity sewer system is watertight and has no defects. Each section of line is to be videotaped in color on a standard high quality VHS tape and turned over to the local office of the CITY for review. The tape shall display data on pipe size, pipe type, invert depth, date, time, footage from manhole and location of main. All repairs shown necessary by this inspection are to be made; any broken or cracked pipe replaced and all deposits removed, leaving the sewers clean and ready for service. All joints or laterals shown to be leaking shall be excavated and repaired or sealed with an approved grout as supplied by Cues, Inc. Any time a line is \ repaired or sealed, a reinspection is required to ensure that the sewer is free of any leaks or defects. Any defective work or necessary correction shown during television inspections during construction must be corrected by the CONTRACTOR, at his expense, before the lines will be accepted by the City and placed into service.

All corrective measures required and identified during warranty inspections must be accomplished by the CONTRACTOR, at his expense, before final release of the Performance Bond provided for the construction. Disposal of Sewage It shall be the CONTRACTOR's responsibility to so arrange and coordinate his work, activities, and forces to adequately handle and dispose of all sewage encountered in this work to the entire satisfaction of the ENGINEER. The connection of new sewer force mains to existing force mains or new or existing sewer lines to manholes shall not be started until the sewage can be received in the system. Wherever it is necessary to handle or divert sewage during construction, CONTRACTOR shall submit a plan for such disposal to the ENGINEER for approval. The equipment used must be adequate and in good condition to insure the handling of sewage and alleviate any possible health hazard. Protection of Water System The CONTRACTOR will be required to take every precaution to guard against any or all damages to existing structures, pipe lines, and equipment of the water distribution system, from any cause whatsoever in the prosecution of the work. All work shall be planned and executed in such a manner by the CONTRACTOR as to absolutely insure the regular and continuous operation of the waterworks system insofar as same may be affected

by the CONTRACTOR's operations; and the sequence of operations of the CONTRACTOR in providing for and executing the work shall be at all times subject to the approval of the ENGINEER, insofar as the operation of the above-mentioned system may be affected. Such approval of the ENGINEER shall in no way relieve the CONTRACTOR of his responsibility for providing all and adequate means of guaranteeing the continuous, uninterrupted operation of the waterworks system. Any damage to existing structures, or pipe lines, shall be the direct responsibility of the CONTRACTOR and such damage shall be restored, replaced, or repaired by CONTRACTOR at no expense to CITY.

6. Alignment and Grade

All gravity sanitary sewer pipe shall be laid and maintained at the required lines and grades, with manholes and fittings at the required locations, and manhole rings and covers properly centered on the manholes. The lines and grades of the sanitary sewer lines may be determined by use of portable lasers or by stakes parallel to the line of the sanitary sewer and be set at such elevations that proper bater boards or grade boards can be set. The CONTRACTOR shall be responsible for the finished sanitary sewer being laid to exact and proper line and grade.

7. Ditch/Canal Crossings

7.1 Permits

7.1.1 CITY or ENGINEER will obtain the necessary construction permits for ditch or canal crossings from appropriate authorities. CONTRACTOR shall not begin work on any ditch or canal crossing until a copy of the approved permit is received from ENGINEER. The work shall be subject to any additional requirements of the governing authority.

7.2 Crossings

7.2.1 Aerial Crossing Pipes spanning elevated pier crossings shall be flanged ductile iron Class 53 pipe conforming to AWWA C115, C150 & C151. Pipe spanning on piers spaced further apart than normal pipe length of 18 or 20 ft. shall be multiple length pipe with interior flanged joints with a rubber gasket pipe such as Clow "Long-span Pipe," Flanged US Pipe, Flanged American Pipe or approved equal. The pipe wall thickness and flanged joints shall be designed to safely span the elevated piers under working pressure without exceeding the allowable stresses and conform to AWWA C150. Limit pipe deflection at center of span with pipe full of water to 1/720 of span length. Submit aerial pipe and flange computations for review. Submittal must be signed and sealed by a Florida registered Professional Engineer. Flanges shall conform to AWWA C150 and C115. Bolts and nuts shall be 304 stainless steel, ductile iron (ASTM-A536) or equal. Gaskets shall be full faced or recessed "O-Ring" type to prevent leaks in pipe under stress in the aerial crossing. Outside surface of all pipe, flanges or spool pieces shall be shop coated with zinc primer, High Build Epoxy protective coat and a field applied finish coat of polyurethane high gloss. All exposed water lines shall be painted blue. All exposed sewer force mains shall be painted green. All exposed treated effluent lines shall be painted purple.

7.3 Restoration

7.3.1 Ditch banks and bottoms shall be restored to the original condition or as required by the Permitting agency whichever is more stringent. 8. Connections to Existing Water Mains

8.1 Connections

8.1.1 Where connections are required to be made between new water mains and existing water mains the connections shall be made in a thorough and workmanlike manner using proper materials, fittings and labor practices to suit the actual conditions. In case a connection is made to an existing fitting in the line, the CONTRACTOR will schedule his work so that digging and locating this existing fitting can be completed prior to starting trench work on the line.

8.2 Interruptions of Service

8.2.1 Cut-ins into lines shall be done at a time approved in writing by the CITY. Whenever it is required to turn off valves which may interrupt the water supply of residents or businesses, the CONTRACTOR shall notify all concerned parties or agencies with personal contact, door hangers or written notice at least twenty-four (24) hours in advance to such cut-off, after having obtained the approval of the CITY and ENGINEER. The CONTRACTOR shall maintain water service to existing connections during construction, under any and all conditions and at no additional cost to the CITY. All pipe and fittings for cut-ins shall be thoroughly cleaned and swabbed with a concentrated solution of calcium hypochlorite.

9. Public Safety (during construction, alteration or repair)

9.1 In areas of high vehicular traffic, the CONTRACTOR shall provide a safe walkway around the work area.

9.2 Barricades or other barriers shall be used to prevent any possibility of injury to the public caused by the CONTRACTOR's work.

9.3 Walk areas around the work areas shall be kept clean of sand, stones, and any other material that could cause a pedestrian accident.

9.4 Work areas left overnight shall be barricaded. The CONTRACTOR shall install flashing warning lights in areas required by the ENGINEER.

9.5 Unless an approved detour is provided at any open cut crossings, a minimum of one-way traffic will be maintained during the daylight hours and two-way traffic at night. All traffic detours will be restricted to limits of the Right-of-Way with necessary flagmen and/or marking devices. These detours shall be approved by the ENGINEER. Detour of traffic outside of the Right-of-Way will be considered with the approval of local governmental agencies and private concerns involved.

9.6 Crossing and Intersections CONTRACTOR shall not isolate residences and places of business. Access shall be provided to all residences and places of business whenever construction interferes with existing means of access. Access shall be maintained at all times. If pavement is disturbed, a cold mix must be applied at the end of the day.

9.7 Detours

9.7.1 CONTRACTOR shall construct and maintain detour facilities wherever it becomes necessary to divert traffic from any existing roadway or bridge, or wherever construction

operations block the flow of traffic. The location of all detours will require prior approval of the CITY.

9.7.2 Furnishing of Devices and Barriers All traffic control devices (including signs), warning devices and barriers shall be furnished by the CONTRACTOR. Costs of such devices shall be incidental to construction and included in unit prices bid. Maintenance of Devices and Barriers Traffic control devices, warning devices, and barriers shall be kept in the correct position, properly directed, clearly visible and clean, at all times. Damaged, defaced or dirty devices or barriers shall immediately be repaired, replaced or cleaned as necessary.

9.8 Flagmen CONTRACTOR shall provide competent flagmen to direct traffic where one-way operation in a single lane is in effect, and in other situations as may be required. Radios may be required if flagmen cannot maintain contact with each other.

9.9 During construction, all necessary signs, flagmen, and other safety devices shall be utilized.

9.10 All work shall be performed with the requirements set forth by the Occupational Safety Health Administration.

10. Corrosive Soils

10.1 In corrosive soils (i.e., dump areas, swamps, marshes, alkaline soils, cinder beds, etc.), pipe will be protected by encasing in a polyethylene tube (eight (8) millimeters thick) or sheet material, to be installed in accordance with ANSI/AWWA c105/A21.5-88.

11. Use of Chemicals. All chemicals used during project construction or furnished for project operation, whether herbicide, pesticide, disinfectant, polymer, reactant or of other classification must show approval of either EPA or USDA. Use of all such chemicals and disposal of residues shall be in strict conformance with manufacturer's instructions or government regulations as applicable.

SECTION 0280000 - SUPPLEMENTAL CONDITIONS

1. Layout Of Work

Adequate vertical and horizontal control shall be provided to facilitate the proper layout of the work. The CONTRACTOR shall preserve all reference points and bench marks furnished. In the event control points are disturbed, either willfully or through carelessness, the CONTRACTOR shall cause the control points to be replaced at no cost to the owner. The CONTRACTOR shall carefully compare all lines and levels given on the plans with existing lines and levels and shall call any discrepancy to the attention of the ENGINEER, in writing, for a proper determination before proceeding with the work. The CONTRACTOR shall be responsible for the accuracy of the work and shall correct any discrepancy at no cost to the CITY. The CONTRACTOR shall utilize the services of a Professional Land Surveyor, licensed in the State of Florida, pursuant to the requirements set forth in Florida Statutes, Chapter 472 to provide adequate stakeout of the detailed work.

2 Contractors Office

The CONTRACTOR shall provide and maintain, on site and as approved by the CITY, an office or mobile office with telephone facilities where he or a representative of his organization may be reached at any time while work is in progress. CONTRACTOR will post and maintain in said office all permits, approved plans, specifications and Contract Documents. CONTRACTOR shall provide a 10 foot by 10 foot area with desk, chair and telephone extension for the exclusive use of the ENGINEER or his representative.

3. Care Of Existing Landscaping

The CONTRACTOR shall be fully responsible for maintaining, in good condition, all cultivated grass, trees and shrubs. Where maintained grass, trees or shrubs must be removed or destroyed as a result of the construction, the CONTRACTOR shall replace or restore to the original condition all destroyed or damaged grass or landscaping after completion of the pipe installation. Tree limbs which interfere with equipment operation and are approved for pruning shall be neatly trimmed and the tree cut coated with tree paint.

4. Testing

The CONTRACTOR shall pay for all testing. Generally tests will be compaction and density tests, limerock quality tests, concrete quality tests (cylinder breaks). On asphalt concrete and pipe, the manufacturer's or supplier's certificate that the product meets the specification requirement will be acceptable subject to the verification of the ENGINEER. All test results are subject to the ENGINEER's approval. No CONTRACTOR owned or operated testing laboratory will be considered "independent".

5 Record Drawings

During the entire construction process the CONTRACTOR shall maintain records of all deviations from the contract drawings and specifications and shall then prepare "record drawings" showing accurately and correctly all work as it was actually constructed in red pencil. Stationing and offset dimensions of all valves, fittings, air release valves, sample points or other appurtenances shall be accurately located by a [4mLicensed Land Surveyor[0m and shall be accurately and legibly shown on these "record drawings". Final disbursal of project monies shall

not occur until or unless said "record drawings" are submitted to the satisfaction of the CITY. The CITY shall supply one (1) set of blueprints for this sole purpose to the CONTRACTOR who shall safeguard same until presented back to the CITY as red-lined "record drawings" for approval.

6. Sequence Of Operation

The CONTRACTOR shall not open up work to conflict with work already in progress. The ENGINEER may; however; require the CONTRACTOR to finish a section on which work is in progress prior to starting another section.

7. Drainage

The CONTRACTOR shall conduct his work at all times such that adequate drainage is provided and shall not interfere with or block existing drainage facilities such as gutters, ditches, storm drains or other drainage appurtenances.

8. Hydrants

Existing fire hydrants adjacent to the project shall be kept accessible for fire apparatus at all times and no material or equipment shall be placed within 25 feet of any hydrant.

9. Traffic Maintenance

The CONTRACTOR shall protect his work throughout its length by the erection of suitable barricades where required. He shall further protect the work by installing and maintaining flashing lights or flares along or across thoroughfares. Whenever public walkways are temporarily disturbed the CONTRACTOR shall provide a suitable bypass walkway. The CONTRACTOR shall comply with all applicable laws and ordinances relating to the driving or walking public. Prior to start of construction, the CONTRACTOR shall submit five (5) copies of a Traffic Maintenance Plan for approval including but not limited to:

a. Placement of signs
b. Timing of phases
c. Transition lengths
d. Hours of traffic interference
e. Contact person (24 hour availability)

The CONTRACTOR shall supply all traffic control device The CONTRACTOR shall conduct his work, operate his equipment and place his material in such a manner as to insure the least amount of traffic interference or obstruction as possible. The CONTRACTOR may be allowed to restrict traffic for short periods of time provided the he first contacts the local County Transportation Department and/or Florida DOT for their restrictions and also provided that adequate traffic control devices are placed in accordance with applicable Local and/or State Ordinances. After approval from the local County Transportation Department and/or FDOT and prior to any proposed road closing the CONTRACTOR shall notify Police, Fire, EMS and applicable Utility companies at least 48 hours prior to the actual road closing. The CONTRACTOR shall schedule his operation such that all streets, roadways and/or driveways are usable and open to traffic at the end of each day and all open cuts through paved areas shall be repaved (at least with cold patch) within 48 hours. It shall be the CONTRACTORs

responsibility to notify property owners adjacent to the work in a timely and reasonable manner when traffic on their driveway will be restricted.

10. Traffic Control Standards

All design, application, installation, maintenance and removal of all traffic control devices and all warning devices and barriers which are necessary to protect the public and workmen from hazards within the project limits shall be as specified in the State of Florida, Manual of Traffic and Highway Construction, Maintenance and Utility Operations. The standards established in the afore mentioned Manual constitute the minimum requirements for normal conditions. Additional traffic control devices, warning devices, barriers, or other safety devices shall be required where unusual, complex or particularly hazardous conditions exist.

11. WATER MANAGEMENT/EROSION CONTROL

The CONTRACTOR shall exercise extreme care to minimize contamination of rainfall run-off from the site. All necessary provisions and care shall be taken to insure compliance with the Water Quality Standards of the State of Florida, more particularly the South Florida Water Management District. The CONTRACTOR shall make himself familiar with Chapter 62-3, Florida Administrative Code. Compliance for protection of State Waters and/or jurisdictional areas require the use of hay bales, temporary swales, settling ponds, silt screens and other appropriate methods as necessary to prevent soils and sediment from entering such areas. Prior to commencement of work the CONTRACTOR shall submit a plan of action and a list of materials he plans to use for sedimentation /erosion control to the owner for approval.

12 Permits

The CONTRACTOR shall obtain all necessary building permits prior to commencement of work. The CONTRACTOR shall become totally familiar with the requirements of all permits prior to start of work.

13. Color Audio-Visual Preconstruction Record

The CONTRACTOR shall have a audio-visual tape recording taken of all sections of the route of construction deemed necessary by the ENGINEER to serve as a permanent record of preconstruction conditions. The record tape shall be submitted to the CITY for approval prior to commencement of construction. The construction record tape shall have been made no more than 30 calendar days prior to construction start date. The construction record tape shall be taken by a responsible commercial firm known to be skilled and regularly engaged in the business of pre-construction color audio- video tape documentation. Audio-video tapes shall be new unused tapes as manufactured by Maxell or equal. The tapes shall be high grade, one half inch, high energy, extended still frame tapes capable of being played on a standard VHS, color video cassette recorder. The finished tape shall show bright, sharp, clear pictures with accurate colors and shall be free from distortion, tearing, rolls or other forms of imperfection. The audio portion shall reproduce the commentary with proper volume and shall be clear and free from distortion and interruptions. The audio portion of the tape shall begin with a complete description of the beginning point of the construction scene, ie, job name, street, direction of travel, direction of view. The video portion shall continuously show the time (hour, minute and second) and date. \All taping shall be done during daylight hours with sufficient sunlight to properly illuminate the surrounding area. Taping shall not be done during inclement weather conditions. Taping on heavily traveled streets or roads may require the use of police escort at

the option of the ENGINEER. If police escort is required all costs shall be borne by the CONTRACTOR.

14.0 CHANGE ORDERS

Notwithstanding anything in the Contract Documents to the contrary, Change Orders may be approved by the CITY Manager or his designee provided that the change (or the sum of the changes): (i) amounts to ten percent (10%) or less of the original Contract Amount approved by the CITY Commission; and(ii) does not exceed Twenty Five Thousand Dollars ($25,000.00).

Appendix I

EXAMPLE BID SHEET

Item	Original Quantity	Unit	Unit Cost	Original Total cost
Mobilization	1	LS		
Clean 8 inch piping identified on Appendix A map	83,000	LF		
Clean 10 or 12 inch piping identified on Appendix A map	14,000	LF		
Clean 15 or 18 inch piping identified on Appendix A map	0	LF		
Televise 8 inch Piping identified on Appendix A map	83,000	LF		
Televise 10 or 12 inch Piping identified on Appendix A map	14,000	LF		
Televise 15 or 18 inch Piping identified on Appendix A map	0	LF		
Televise service line - up to 30 ft from connection	9,000	LF		
8 inch pipe lining	41,500	LF		
10 or 12 inch pipe lining	7,000	LF		
15 inch pipe lining	0	LF		
18 inch pipe lining	0	LF		
Line non-metallic service laterals 4 or 6 in	4,500	LF		
Line metallic service laterals 4 or 6 in	4,500	LF		
Install full circle lateral connection to 8-12 in pipe with 4or 6 in lateral, plus 30 ft of liner pipe	300	ea		
Reconnect laterals repaired	300	ea		
Repairs to ManholeS	10	EA		
Traffic Control (time and material)	1	LS		
Repair and raise Top LS 3	1	LS		
Contingency	1	LS	$25,000.00	$25,000.00
TOTAL BID AMT				$25,000.00
		TOTAL BID AMT		