PRELIMINARY SEWERAGE SYSTEM EVALUATION STUDY PLAN FOR SEWER SYSTEM EVALUATION AND REHABILITATION PROGRAM SEWERAGE AND WATER BOARD OF NEW ORLEANS

NOVEMBER 7, 1997

INTRODUCTION

This Preliminary Sewerage System Evaluation Study Plan (Plan) is presented herein. The objectives of this Plan are to identify:

- The particular geographic areas, known as service area basins, that remain to be studied in the East Bank Plan collection system, and the order in which they are to be studied;
- The justification for the order in which the geographic areas, or service area basins, are to be studied;
- The types of inflow and infiltration investigation techniques to be used for each geographic area (including but not limited to dye-testing, smoke-testing, televising, etc.), the justification for the selected investigation techniques, and if authorized by the private property owners and/or law to do such testing and investigation on private property;
- The resources to be committed to carrying out each study; and
- Information the Board will use to perform the Sewerage System Evaluation Studies.

BACKGROUND

The Sewerage and Water Board (Board) has subdivided its sewer system into ten service area basins for study purposes. The boundaries of the service area basins are shown on the base map in Exhibit 1. Sewer System Evaluation Studies (SSES) will be performed in each of the basins as part of the Sewer System Evaluation and Rehabilitation Program (SSERP). These studies will identify and prioritize defects in the sewer facilities, and will provide recommendations for rehabilitation of the facilities to be performed as part of the SSERP. The study for the Lakeview area basin (Basin A) was completed in 1996. The study for the Central Business District/French Quarter service area (Basin E) is currently underway and will be completed by March 31, 1998.

PRIORITIZATION METHODOLOGY

The process discussed in this Plan will be used to prioritize the remaining eight basins for study. Specifically, this section of the Plan will:

- Identify the decision methodology for prioritizing sewer service area basins for further investigation and rehabilitation
- Identify the criteria used and justify its inclusion in the decision methodology
- Present the resulting prioritized list of service area basins

The methodology utilized for basin prioritization requires an understanding of the wastewater collection system, developed through a preliminary evaluation and assessment of the system. Data collected during the temporary flow monitoring program was utilized, along with other factors which are described later in this report, to prioritize the service area basins.

The information required for analysis of each of the criteria was researched and developed through detailed data collection efforts, including substantial input from Board staff. Workshops were held between Board and Montgomery Watson staff to confirm the criteria utilized and to determine the relative importance (weights) of the various prioritization criteria.

The "Criterium Decision Plus" graphical decision support software was used to assist in the process of defining weights, computing scores, understanding the critical criteria driving the priorities, and performing sensitivity analysis. Information detailing each criterion, its relative weight and basin ratings is attached to this Plan.

The methodology utilized is designed to accommodate additional criteria and data when it becomes available (e.g., system hydraulic constraints). Sufficient information currently exists, however, so that the process can be used to select the next basin to be studied. Once the computerized hydraulic model of the Board sewer collection system has identified hydraulic constraints in the system, this data will be incorporated into the decision process, providing a revised listing of service area basin prioritization. This listing will be reflected in the Revised Sewerage System Evaluation Plan.

The Board has established an objective methodology to identify the remaining eight service area basins for study. A basic requirement of this process is that the criteria be quantifiable and that the data be available or able to be reasonably estimated. The following prioritization framework and criteria have been developed.

Prioritization Framework

A decision matrix framework was selected for prioritization of the service area basins. The application of this method first involves the adoption of criteria and the assignment

of a relative weight to each. This weight identifies the importance of each criterion in the selection process. Criteria with higher weights have a greater impact on the decision.

A numeric score or rating is then determined for each service area basin for each criterion. For example, for the criteria "work activities", a service area basin would be assigned a rating based on analysis of historical work activity data in the service area basin. A decision score is computed for each basin by multiplying the ratings by the weights for each criterion and summing across all criteria. The service area basins are then ranked based on their decision scores.

Whenever possible, the ratings should be numeric and objective. The ratings may require sophisticated computer database and GIS computations, but no subjectivity. The subjective element in this process is the selection of criteria and their relative weights. Graphical decision support software can be used in an interactive way to help in the process of defining weights, computing scores, understanding the factors that led to the selection of the top basins, and performing sensitivity analysis. A software program, "Criterium Decision Plus", was used for this purpose and applied in a workshop setting with BOARD staff. Once the criteria and weights were established, the computation of decision scores was performed.

The following paragraphs present the criteria selected for prioritizing the Board sewer service area basins. The weight assigned to each criterion is given as a number ranging from 1 to 10, with a weight of 10 having the most importance.

Criteria

The following criteria were selected for inclusion in the prioritization:

- Work Activities
- Rainfall Dependent Inflow and Infiltration (RDI/I)
- Criticality
- Water Use Records
- Groundwater Infiltration (GWI)
- Soil Condition

These criteria correspond to the goal of the prioritization, which is to prioritize the service area basins for Sewer System Evaluation Studies to be performed.

Work Activities (Weight = 10)

The number of historical work activities in the service area basin is a strong indicator of the condition of the collection system. Work activities that could be eliminated or significantly reduced by sewer rehabilitation were considered. The Board's Cass Works database was used to identify and quantify appropriate work activity categories. Work

activities from the last four years have been included, as this represents the time frame that the Cass Works database has been in existence (since July 1993). The categories utilized include:

- Bad odor (ODOR)
- Clean sewer line (SFLUSH)
- Sewer house connection backup (SHCBU)
- Sewer house connection overflow (SHCOF)
- Line sewer main (SLINE)
- Sewer main broken (SMAIN)
- Sewer main backup/choke (SMBU)
- SMH – brick repair or wipe (SMHBW)
- SMH – cover broken/missing (SMHC)
- SMH – overflowing (SMHOF)

To determine the number of work activities associated with each service area basin, a query of the Cass Works database was performed. The location of the work activities was determined through address-matching using ArcView GIS software. The address-matching procedure was successful for approximately 92% of the total number of work activities.

For quantifying work activities associated with a service area basin, the boundaries of the basins were first digitized onto the ArcView base map. GIS routines were executed to identify the work activities falling inside each basin boundary. Each work activity was then automatically tagged with the service area basin identification, allowing the number of work activities in each basin to be computed. Exhibit 2 presents the work activity analysis per service area basin by category.

RDI/I (Weight = 10)

Rainfall-dependent infiltration/inflow (RDI/I) is the major cause of wet weather related capacity deficiencies. Concurrent monitoring of flow and rainfall throughout the wastewater collection system during several rainfall events of different magnitudes is used to characterize RDI/I under existing conditions and to understand the system's wet weather response to rainfall.

Flow monitoring performed as part of the temporary flow monitoring program recorded dry and wet weather flows for 75 sub-basins of the Board sewer collection system during the months of March, April, and May, 1997. Rainfall amounts were recorded at 20 locations during the same period.

An R-factor is sometimes used in quantifying the amount of RDI/I entering a particular sub-basin of a wastewater system. The volume of flow caused by rainfall over and above that which would occur under normal dry weather flow conditions is expressed as a

percentage of the total volume of rainfall which fell over the sub-basin during the rainfall event. This percentage is referred to as the R-factor.

The 75 sub-basins monitored were classified into four distinct categories based on the results of the temporary flow monitoring program. Sub-basins with an R-factor category of 1 require the least amount of attention, and sub-basins with an R-factor category of 4 require the most attention. Exhibit 3 is a map of the 75 monitored sub-basins indicating the R-factor category for each.

To quantify the priorities of R-factor categories in each service area basin, the 75 monitored sub-basins were digitized onto the ArcView base map. The area in each monitored sub-basin was calculated and the monitored sub-basins falling inside each service area basin boundary were identified by applying GIS routines. Each monitored sub-basin was then tagged with the service area basin identification, allowing the R-factor category in each basin to be computed as a weighted average, as presented in Exhibit 4.

Criticality (Weight = 9)

Sewer systems have important line segments for which failure would result in a significant impact to public health, safety and service. Rehabilitation of these line segments would reduce the amount of failures, and therefore the impact to public health, safety and service.

Factors typically considered in evaluating the importance, or "criticality" of a pipeline include large diameter (12-inch diameters and larger), excessive depth, and location under high-traffic streets or major transportation routes.

All service area basins include many high-traffic streets and major transportation routes, with minimal differences between most basins. Because of the minimal differentiation of this factor among the majority of basins, the effect of this factor was assumed to be equal.

The majority of sewer lines have been installed at depths ranging from 8 to 14 feet, which is not considered excessive. The effect of this factor was also considered to be equal among service area basins.

The remaining factor utilized in determining pipeline criticality is size. The amount of gravity sewers 12 inches and larger varies considerably among service area basins. An assumption was made that the greater the length of pipe with diameters of 12 inches and larger, the greater the impacts that could be reduced by sewer rehabilitation.

For quantifying the amount of gravity lines 12 inches and larger, service area basin boundaries were drawn on the Board's Plan of the Sewer System (Plan). Pipe lengths were then scaled directly off of the Plan and totaled for each basin. Exhibit 5 presents the lengths for each service area basin by pipe diameter.

Water Use Records (Weight = 7)

The Board provides water and wastewater services to the City of New Orleans. Included in the City limits are areas of swamp and wetlands that are undeveloped. The areas of the City that were developed first tend to have a higher concentration of population, and resulting water and wastewater service usage.

Wastewater service use is estimated as a percentage of water use. It is therefore assumed that higher water consumption equates to higher wastewater service use and larger population. Because of issues of public health and safety, as well as customer service, service area basins with higher water consumption would be impacted more by lack of sewer rehabilitation (by occurrence of more unplanned repairs) than basins with lower water consumption.

A query of the water use database was performed to determine water use for a one-year period (January through December 1996) for each service area basin. Account records indicating account address and water use were obtained. The locations of the accounts were determined through address-matching using ArcView GIS software. The address-matching procedure was successful for 96% of the total number of water accounts.

For quantifying water consumption associated with a service area basin, GIS routines were executed to identify the water accounts falling inside each basin boundary, which had been digitized onto the ArcView base map. Each water account was then automatically tagged with the service area basin identification, allowing the total water consumption in each basin to be computed. Exhibit 6 presents the water use data by service area basin.

GWI (Weight = 5)

Groundwater infiltration (GWI) enters the sewerage system through cracks and joints in the pipes and manholes. High levels of GWI result in a reduction of available capacity for wet weather flows as well as additional annual pumping and treatment costs.

GWI flow rates can be expressed as a percentage of the average dry weather flow to enable comparison between different sub-basins. These estimates allow a relative characterization of the influence of GWI at a given site. Care must be taken in interpreting these values, as knowledge of site conditions, upstream contributions, and downstream hydraulic constrictions is needed to interpret the analysis results.

The flow data collected during the temporary flow monitoring program during the months of March, April, and May, 1997 were analyzed. Estimates of GWI as a percentage of the average daily dry weather flow were determined for each of the flow monitor sub-basins. A map of the monitored sub-basins with GWI percentages for each is presented in Exhibit 7.

The flow monitor sub-basins were digitized onto the ArcView base map in order to quantify the priorities of GWI flow rates in each service area basin. GIS routines were applied to calculate the area in each flow monitor sub-basin and to identify the monitored sub-basins falling inside each service area basin boundary. Each flow monitor sub-basin was then tagged with the service area basin identification, allowing the computation of the weighted average of the GWI flow rate in each basin, as presented in Exhibit 8.

It must be emphasized that these GWI estimates are *preliminary*. These estimates will be further refined with the calibration of the hydraulic model of the system, and with the analysis of additional data from the permanent flow monitoring program and flow monitoring efforts performed in association with future Sewer System Evaluation Studies. The decision model can be updated to incorporate the results of the analysis as these efforts have been completed.

Soil Condition (Weight = 4)

Soils in the New Orleans area are comprised of many combinations of clay, loam, silt, sand and muck (including high percentages of organics). Various factors, such as high groundwater levels, low strength, and presence of organic materials, result in soils which tend to shrink and swell, and settle. Some soils also tend to be corrosive. Each of these soil characteristics can adversely effect the integrity of subsurface structures. The more of these characteristics (shrink/swell, subsidence, corrosiveness) the soil possesses, the more potential it has for adversely effecting the collection system, thus the more it would benefit from rehabilitation.

The service area basin boundaries were overlaid onto the United States Department of Agriculture, Soil Conservation Service Areas map entitled "Soil Survey of Orleans Parish, Louisiana" (Exhibit 9). This map indicates the areas of the five major soil types found in New Orleans. The amount of each soil type in each service area basin was estimated.

Each soil type was assigned a point value corresponding with the number of the characteristics which adversely effect the condition of the pipe: shrinking/swelling, subsidence, and risk of corrosion, as presented in Exhibit 10. A weighted average of the point values assigned to each of the five soil classifications in each service area basin was then calculated. Additional point values were given to service area basins with other soil characteristics which are known to adversely effect the condition of the pipe, such as "running sand" in the Gentilly service area (Basin F). Highest ratings relate to worst soil conditions. Exhibit 11 summarizes the weighted average calculations for each service area basin.

Future Prioritization Requirements

As discussed in earlier, the prioritization process can be further refined as additional data for applicable criteria is obtained. It is anticipated that data related to system capacity will be incorporated once the computerized hydraulic model of the sewer system has been completed. This will allow for a re-evaluation of the remaining service area basins at that time, and will assure the utilization of funding where it will have the greatest benefit.

PRIORITIZATION RESULTS

The raw statistics were used to compute the service area basin ratings for each criterion and the decision score for each service area basin, as presented in Exhibit 12. The basins were sorted by decision score, and are listed below with the highest priority basins listed first:

- Gentilly (Basin F)
- Uptown (Basin C)
- Mid-City (Basin D)
- CBD/FQ (Basin E)
- Ninth Ward (Basin G)
- Lakeview (Basin A)
- Carrollton (Basin B)
- New Orleans East (Basin J)
- Algiers (Basin H)
- South Shore (Basin I)

As noted in an earlier section of this report, the study for the Lakeview area basin (Basin A) was completed in 1996, and the study for the Central Business District/French Quarter service area (Basin E) is currently underway. These two service area basins were included in the prioritization analysis in order to compare their rankings within this methodology.

FUTURE SEWERAGE SYSTEM EVALUATION STUDIES

Investigation Techniques

The types of inflow and infiltration investigation techniques to be utilized in each Sewerage System Evaluation Study for each service area basin will include manhole inspection, visual pipe inspection, smoke testing, flow monitoring, flow isolation, dyed water testing, and closed circuit television inspection (CCTV). These are industry standard techniques utilized in identifying sewer collection system defects and sources of excessive inflow and infiltration.

Smoke testing will be utilized to identify those sources with the highest potential for

contributing inflow to the system, such as cross connections with storm sewer pipelines, roof and yard drains which connect directly into the sewer system, and defective cleanouts. Smoke testing can also identify locations of other infiltration sources in pipelines and manholes. The success of identifying these types of sources with smoke testing is highly dependent on soil and groundwater conditions. Smoke testing as a means to identify collection system defects is limited in the New Orleans area because of the high groundwater level and clayey soils, both of which can affect smoke returns.

Smoke testing and dyed water testing and CCTV inspection will be utilized to confirm smoke testing results and to identify additional inflow and infiltration sources. Investigation by these methods help to identify defects which may not yield positive smoke returns due to soil and groundwater conditions.

Flow monitoring results will be utilized to prioritize areas for flow isolation. That is, areas with higher amounts of groundwater infiltration (GWI) as a percentage of average daily dry weather flow will be given higher priority for flow isolation. Flow isolation will be utilized to identify line segments with excessive groundwater infiltration, which in turn will be used to select line segments for CCTV inspection.

Physical inspection of manholes and visual pipe inspection of those pipes visible from the manholes will be performed to identify structural defects as well as inflow and infiltration sources.

No investigation of private property defects will be performed as part of the Sewerage System Evaluation Studies. It is anticipated, however, that smoke testing of the main sewer lines will identify a number of private property inflow and infiltration defects.

Resources

The Sewerage System Evaluation Studies will be performed for the Board by engineering consultants. These studies will be coordinated by Board staff. Field work included as part of the studies will be assisted by Board staff.

Information to be Used

The Sewerage System Evaluation Studies will utilize information available from the Board regarding collection system component location and layout. Specific information utilized for the study effort will primarily include the Sewer and Water Location Maps and the Cass Works database. Other maps and plans detailing the collection system location and layout may also be utilized.

CONCLUSIONS

The Preliminary Sewerage System Evaluation Study Plan identifies the order in which the remaining service area basins will be studied, and the methodology for determining this order. Additionally, the Plan provides for the following:

- The service area basins can be grouped by decision score as follows:
  - Gentilly (Basin F) and Uptown (Basin C) service areas have the highest rankings, with decision scores of 0.76 and 0.70, respectively.
  - Mid-City (Basin D), CBD/French Quarter (Basin E), Ninth Ward (Basin G), and Lakeview (Basin A) service area basins are close in ranking, with decision scores ranging from 0.58 to 0.63.
  - Carrollton (Basin B) service area basin is in the mid-range of the basin scores, with a decision score of 0.38.
  - New Orleans East (Basin J), Algiers (Basin H), and South Shore (Basin I) service areas are close in ranking, with decision scores ranging from 0.16 to 0.24.

- Gentilly (Basin F) and Uptown (Basin C) will be the next service area basins to be studied based on the results of the prioritization analysis. Use of the computerized decision model can be used to further refine the basin prioritization as more information is known. The results of future data analysis, such as the identification of hydraulic constraints by use of the computerized hydraulic model, will be incorporated to update the basin ranking. This updated ranking will be reflected in the Revised Sewerage System Evaluation Plan.

- Investigation methods to be utilized in the Sewerage System Evaluation Studies will include manhole inspection, visual pipe inspection, smoke testing, flow monitoring, flow isolation, dyed water testing, and closed circuit television (CCTV) inspection.

- The Sewerage System Evaluation Studies will be performed for the Board by engineering consultants and will be coordinated by Board staff. The Sewerage System Evaluation Studies may utilize the Sewer and Water Location maps, the Cass Works database, and other plans and maps available from the Board in order to locate system components.

Sewer System Evaluation & Rehabilitatic Program

Basin Priorization

Map of Service Area Basins

SEWERAGE & WATER BOARD OF NEW ORLEANS

MONTGOMERY WATSON

Exhibit 1

Exhibit 2
Service Area Basin Prioritization
Work Activity Analysis*

Basin	ODOR	SFLUSH	SHCBU	SHCOF	SHNE	SMAIN	SMBUP	SMHBW	SMHC	SMHOF	Total	% of Total
Lakeview	205	65	847	271	10	105	1,608	38	48	97	3,294	9.4%
Carrollton	217	69	1,122	392	11	62	1,538	17	33	73	3,534	10.1%
Uptown	308	71	1,451	546	6	72	2,176	10	30	70	4,740	13.6%
Mid-City	341	76	1,207	471	13	72	2,086	12	37	112	4,427	12.7%
CDB	267	136	962	398	21	42	1,959	14	61	102	3,962	11.3%
Gentilly	258	100	1,115	468	15	55	2,347	28	43	106	4,535	13.0%
9th Ward	256	34	1,440	521	2	42	1,523	13	25	63	3,919	11.2%
Algiers	110	25	663	260	21	54	1,147	21	22	140	2,463	7.0%
S. Shore	72	35	363	224	0	14	705	5	16	274	1,708	4.9%
N.O. East	122	26	590	350	1	24	1,004	22	73	179	2,391	6.8%
Total	2,156	637	9,760	3,901	100	542	16,093	180	388	1,216	34,973	100.0%

*query run 8/28/97

Sewer System Evaluation & Rehabilita Program

Basin Prioritization

Map of R-Factor Catagories

SEWERAGE & WATER BOARD OF NEW ORLEANS

MONTGOMERY WATSO

Exhibit 3

Exhibit 4
R-Factor Category Analysis

Flow Monitor ID	Basin ID	Sub-basin Area (Acres)	R-factor Category	R-factor X Area
01	B	533	2	1,066
02	B	415	3	1,246
03A	B	109	2	218
03B	B	316	2	631
03C	B	239	2	479
03D	B	72	2	144
04	B	337	2	674
Total		2,022		4,459
Average			2.21	

05	C	530	3	1,590
06	C	481	2	962
07A	C	177	4	707
07B	C	161	2	323
08	C	416	2	832
09	C	590	2	1,179
10	C	269	3	806
11	C	337	3	1,010
12	C	330	2	660
Total		3,290		8,069
Average			2.45	

13	D	512	2	1,024
14B	D	192	3	577
14C	D	74	3	221
14D	D	65	1	65
15A	D	131	4	523
15B	D	101	4	405
16	D	392	4	1,570
17	D	273	2	545
18	D	384	2	768
19A	D	48	2	96
19B	D	307	2	613
20	D	390	4	1,558
Total		2,869		7,966
Average			2.78	

Exhibit 4
R-Factor Category Analysis

Flow Monitor ID	Basin ID	Sub-basin Area (Acres)	R-factor Category	R-factor X Area
21	E	692	1	692
22	E	135	4	542
23	E	152	4	609
24	E	215	2	431
25	E	283	2	567
26	E	298	2	596
27	E	75	1	75
28	E	430	2	859
29	E	493	1	493
Total		2,774		4,863
Average			1.75	

30A	G	450	4	1,802
30B	G	328	2	657
31	G	573	2	1,145
32	G	361	2	723
33	G	323	2	646
Total		2,036		4,973
Average			2.44	

36	A	133	3	398
37A	A	187	3	560
38	A	23	3	68
39	A	626	3	1,877
40	A	512	3	1,536
41	A	74	3	221
42	A	235	2	469
43	A	423	3	1,268
44A	A	277	4	1,106
44B	A	172	3	515
44C	A	49	3	148
46	A	494	1	494
47	A	312	2	624
Total		3,515		9,286
Average			2.64	

Exhibit 4
R-Factor Category Analysis

Flow Monitor ID	Basin ID	Sub-basin Area (Acres)	R-factor Category	R-factor X Area
48	F	67	4	267
49	F	1,194	2	2,388
50A	F	89	3	268
50C	F	397	3	1,191
50CA	F	131	4	523
50D	F	278	3	834
51	F	228	2	456
52	F	361	3	1,082
53	F	342	1	342
54A	F	108	3	323
55	F	236	2	471
56	F	211	3	634
Total		3,640		8,778
Average			2.41	

57	J	52	2	104
58	J	183	1	183
Total		235		287
Average			1.22	

59	H	135	1	135
60	H	59	2	118
Total		194		253
Average			1.30	

61	I	58	1	58
62	I	101	1	101
63A	I	111	2	222
64	I	59	1	59
Total		328.14		439
Average			1.34	

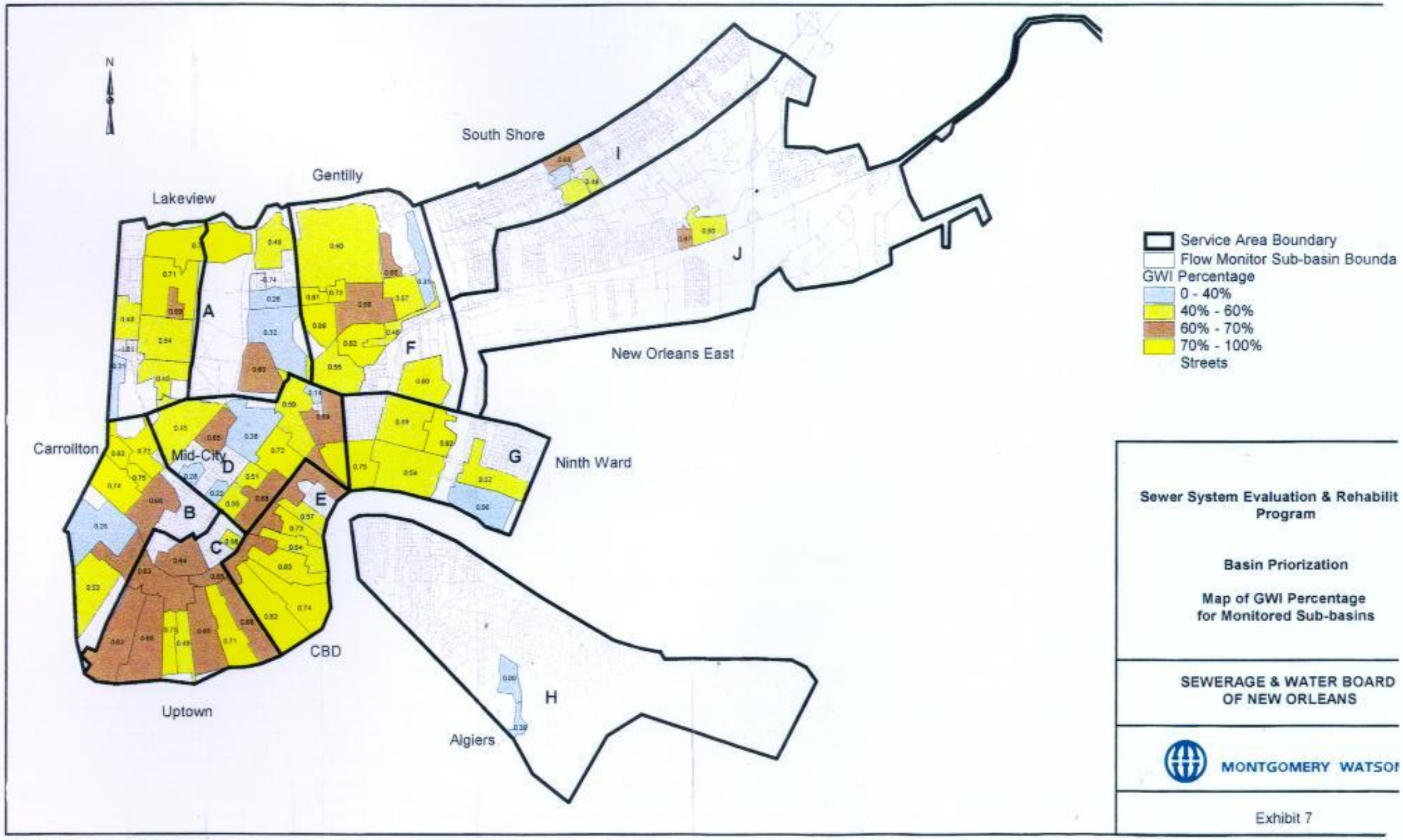
Exhibit 5
Summary of Collection System Pipes 12-inches and Larger
Pipe Lengths (linear feet)

Basin/Pipe Size	Lakeview	Carrollton	Uptown	Mid-City	CBD/FQ	Gentilly	9th Ward	Algiers	S. Shore	N.O. East	Total
12"	25,792	6,000	9,292	12,833	9,708	36,834	20,292	26,167	24,208	19,583	190,709
14"	0	0	0		0	0		1,333	0	0	1,333
15"	24,500	5,500	12,417	11,583	11,167	14,833	14,542	30,917	12,292	14,750	152,501
16"	0	1,417	0	0	0	1,667	0	333	0	667	4,084
18"	17,958	7,000	9,917	3,542	10,542	14,333	7,833	21,000	9,167	17,125	118,417
20"	0	3,917	667	0	0	0	0	750	0	0	5,334
21"	6,250	4,167	25,917	8,250	14,833	5,125	8,125	2,833	1,333	3,000	79,833
24"	7,833	2,167	9,750	9,500	6,625	8,083	7,917	1,167	0	0	53,042
2'1"x3' 1-1/2"	0	0	0	0	0	0	1,417	0	0	0	1,417
27"	4,583	4,583	8,792	4,458	7,833	8,083	4,625	0	0	0	42,957
2' 3-1/2"x3' 5-1/2"	0	0	0	0	0	0	1,417	0	0	0	1,417
30"	1,500	3,083		7,208	3,500	4,417	1,333	1,667	0	0	22,708
33"	0	3,167	0	1,667	0	0	0	0	0	0	4,834
2' 9"x4' 1-1/2"	0	0	0	0	0	0	25,250	0	0	0	25,250
36"	833	1,583	1,250	4,500	0	2,000	0	0	0	0	10,166
39"(3' 3")	0	417	1,417	0	0	0	0	0	0	0	1,834
42"(3' 6")	0	583	1,250	0	0	0	0	0	0	0	1,833
45"(3' 9")	0	0	15,420	1,500	0	0	0	0	0	0	3,042
48"	0	1,833	750	0	0	7,538	0	0	0	0	10,166
51"(4' 3")	0	0	1,417	0	0	0	0	0	0	0	1,417
54"	0	0	857	0	0	2,833	0	0	0	0	3,708
57"(4' 9")	0	0	667	0	750	0	0	0	0	0	2,417
60"	0	0	0	0	583	0	0	0	0	0	583
63"(5' 3")	0	0	0	0	167	0	0	0	0	0	167
65"(5' 5")	0	0	0	0	500	0	0	0	0	0	500
66"	0	0	0	0	2,375	0	0	0	0	0	2,375
69"(5' 9")	0	0	0	0	750	0	0	0	0	0	750
72"	0	0	0	0	2,333	0	0	0	0	0	2,333
5'x6' 3"	0	0	0	0	500	0	0	0	0	0	500
5' 3"x6' 3"	0	0	0	0	3,167	0	0	0	0	0	3,167
84"(7')	0	0	0	0	500	0	0	0	0	0	500
Total, Force Mains	53,750	0	6,667	27,250	0	42,162	64,170	79,000	0	0	272,999
Total, Gravity Lines	89,249	45,417	85,920	63,541	78,333	105,791	92,751	86,167	47,000	55,125	749,294
TOTAL	142,999	45,417	92,587	90,791	78,333	147,953	156,921	165,167	47,000	55,125	1,022,293

Exhibit 6
Basin Prioritization
Water Use Data Analysis

Basin	Water Use (100 gals/yr)	% of Total
Lakeview	16,418,580	7.7%
Carrollton	18,194,850	8.5%
Uptown	27,002,399	12.6%
Mid-City	25,372,636	11.8%
CDB	41,343,126	19.3%
Gentilly	16,147,246	7.5%
9th Ward	16,135,982	7.5%
Algiers	18,724,395	8.7%
S. Shore	15,962,455	7.5%
N.O. East	18,883,614	8.8%
Total	214,185,283	100.0%

Notes:
Analysis based on 96% of data provided by the S&WB in block face (per 100 block) format. Data includes monthly water use totals for the period January through December 1996.



Sewer System Evaluation & Rehabilit Program

Basin Priorization

Map of GWI Percentage for Monitored Sub-basins

SEWERAGE & WATER BOARD OF NEW ORLEANS

MONTGOMERY WATSOI

Exhibit 7

Exhibit 8
GWI Analysis

Flow Monitor ID	Basin ID	Sub-basin Area (Acres)	GWI (%)	GWI % X Area
01	B	533	0.25	131
02	B	415	0.53	219
03A	B	109	0.83	91
03B	B	316	0.74	234
03C	B	239	0.72	173
03D	B	72	0.75	54
04	B	337	0.68	228
Total		2,022		1,131
Average			0.56	

05	C	530	0.63	335
06	C	481	0.65	312
07A	C	177	0.48	84
07B	C	161	0.75	122
08	C	416	0.65	271
09	C	590	0.63	369
10	C	269	0.64	171
11	C	337	0.71	238
12	C	330	0.68	225
Total		3,290		2,127
Average			0.65	

13	D	512	0.45	231
14B	D	192	0.65	125
14C	D	74	0.28	21
14D	D	65	0.22	14
15A	D	131	0.55	72
15B	D	101	0.51	52
16	D	392	0.38	149
17	D	273	0.72	197
18	D	384	0.59	226
19A	D	48	0.14	7
19B	D	307	0.69	212
20	D	390	0.75	292
Total		2,869		1,597
Average			0.56	

Exhibit 8
GWI Analysis

Flow Monitor ID	Basin ID	Sub-basin Area (Acres)	GWI (%)	GWI % X Area
21	E	692	0.68	472
22	E	135	0.57	77
23	E	152	0.73	111
24	E	215	0.54	117
25	E	283	0.65	185
26	E	298	0.83	248
27	E	416	0.58	243
28	E	430	0.74	320
29	E	493	0.82	402
Total		3,115		2,174
Average			0.70	
30A	G	450	0.49	221
30B	G	328	0.92	302
31	G	573	0.59	336
32	G	361	0.06	20
33	G	323	0.52	169
Total		2,036		1,048
Average			0.51	
36	A	133	0.21	27
37A	A	187	0.43	81
38	A	23	-1.81	-41
39	A	626	0.74	461
40	A	512	0.71	363
41	A	74	0.69	51
42	A	235	0.45	107
43	A	423	0.54	230
44A	A	277	0.49	136
44B	A	172	0.26	45
44C	A	49	-0.74	-36
46	A	494	0.32	156
47	A	312	0.63	197
Total		3,515		1,776
Average			0.51	

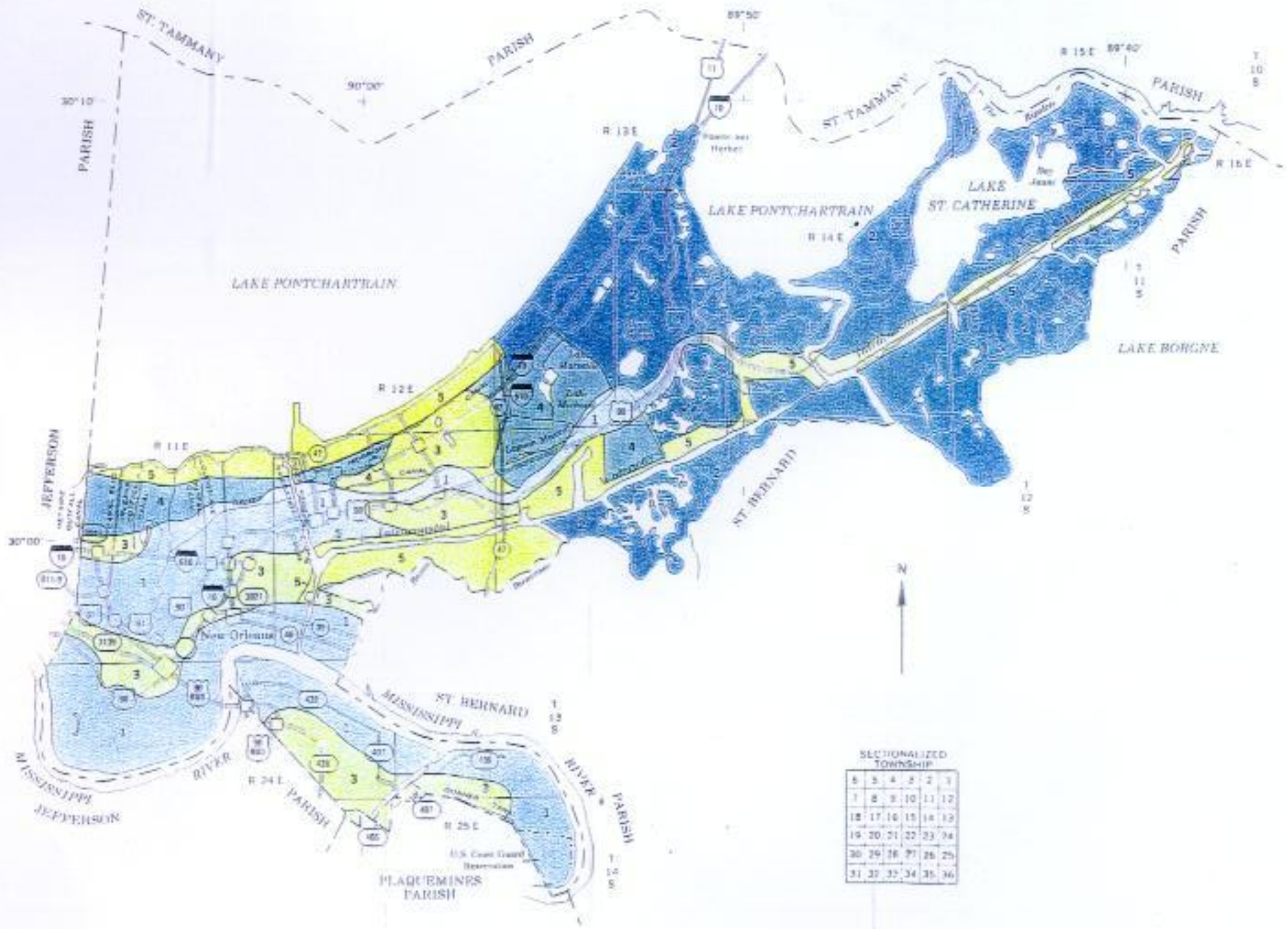
Exhibit 8
GWI Analysis

Flow Monitor ID	Basin ID	Sub-basin Area (Acres)	GWI (%)	GWI % X Area
48	F	67	0.72	48
49	F	1,194	0.60	717
50A	F	89	0.81	73
50C	F	397	0.66	261
50CA	F	131	0.46	60
50D	F	228	0.89	202
51	F	361	0.55	198
52	F	330	0.82	271
53	F	342	0.60	206
54A	F	108	0.65	70
55	F	236	0.57	134
56	F	211	0.31	64
Total		3,692		2,304
Average			0.62	

57	J	52	0.67	35
58	J	183	0.55	101
Total		235		136
Average			0.58	

59	H	135	0.00	0
60	H	59	0.39	23
Total		194		22
Average			0.12	

61	I	58	0.30	18
62	I	101	0.52	53
63A	I	111	0.68	76
64	I	59	0.48	28
Total		328		174
Average			0.53	



SECTIONALIZED TOWNSHIP

6	5	4	3	2	1
7	8	9	10	11	12
18	17	16	15	14	13
19	20	21	22	23	24
30	29	28	27	26	25
31	32	33	34	35	36

Each area outlined on the map consists of more than one kind of soil. The map is thus meant for general planning rather than a basis for decisions on the use of specific tracts.

LEGEND

SOILS ON NATURAL LEVEES THAT ARE PROTECTED FROM FLOODING

1 — Sharkey-Commerce: Level, poorly drained and somewhat poorly drained soils that have a clayey or loamy surface layer and a clayey subsoil or that are loamy throughout

SOILS IN MARSHES AND SWAMPS THAT ARE FREQUENTLY FLOODED AND PONDED

2 — Clovelly-Lafitte-Gentilly: Level, very poorly drained soils that have a moderately thick, thick, or thin mucky surface layer and clayey underlying material

SOILS IN FORMER MARSHES AND SWAMPS THAT ARE DRAINED AND PROTECTED FROM FLOODING

3 — Harahan-Westwego: Level, poorly drained soils that are clayey throughout

4 — Allemands: drained Kenner: drained: Level, poorly drained soils that have a moderately thick or thick mucky surface layer and mucky and clayey underlying material

SOILS IN SPOIL AREAS THAT ARE RARELY OR FREQUENTLY FLOODED

5 — Aquents: Level, poorly drained soils that are stratified and clayey to mucky throughout

Compiled 1989

U.S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE
LOUISIANA AGRICULTURAL EXPERIMENT STATION
LOUISIANA SOIL AND WATER CONSERVATION COMMITTEE

GENERAL SOIL MAP

ORLEANS PARISH, LOUISIANA

Scale 1:190,080

1 0 1 2 3 Miles

1 0 2 4 Km

Exhibit 9
New Orleans Soil Types

Exhibit 10
New Orleans Soil Classifications

Soil Group	Soil Map Unit	Soil Type No.	Soil Classification	Utilization	Flooding	Wetness	Slow Permeability	Salinity	Low Strength	Water Table	Shallow Excavation Limitations	Risk of Corrosion		Shrinking/ Swelling	Subsidence	Assigned Point Value
												Uncoated Steel	Concrete			
Soils on natural levees that are protected from flooding	Sharkey-Commerce	1	Level, *poorly drained* and somewhat poorl drained soils that have a ***clayey or loamy surface layer*** and a clayey subsoil or that are loamy throughout	Poorly suited to building site development, sanitary facilities, and intensively used recreation areas. Wetness, moderately slow permeability and very slow permeability, and the shrinking and swelling of the subsoil are the main limitations. In addition, the Sharkey soils are subject to rare flooding after unusually severe storms.	X	X	X		X		Severe: wetness	High	Low	X		1
Soils in marshes that are frequently flooded and ponded	Clovelly-Laffite-Gentilly	2	Level, ***very poorly drained*** soils that have a ***thick, moderately thick, or thin mucky surface layer*** and clayey underlying material	Not suited for urban uses due to severe flooding, wetness, salinity and low strength.	X	X		X	X		Severe: excess humus, ponding	High	Low/ Moderate		X	2
Soils in former swamps that are drained and protected from flooding	Harahan-Westwego	3	Level, ***poorly drained*** soils that are ***clayey throughout***	Poorly suited to most urban and intensive recreation uses. Wetness, low strenth, very slow permeability, and the shrinking and swelling of the subsoil are the main limitations, and flooding is a hazard. Adequately controlling the water table is difficult. Foundations for buildings need to be specially designed and set upon pilings.	X	X	X		X	X	Severe: excess humus, wetness	High	Moderate	X		2
Soils in former swamps that are drained and protected from flooding	Allemands, Drained-Kenner, Drained	4	Level, ***poorly drained*** soils that have a ***moderately thick or thick mucky surface layer*** and mucky and clayey underlying material; informer freshwater marches	Poorly suited to most urban uses. Wetness, low strength, and subsidence are the main limitations, and flooding is a hazard. Adequately controlling the water table and the rate of subsidence is difficult. Foundations for buildings need to be specially designed and set upon pilings.	X	X			X	X	Severe: excess humus, wetness	High	Moderate		X	2
Soils in spoil areas that are rarely or frequently flooded	Aquents	5	Level ***poorly drained*** soils that are ***stratified (with layers of clayey, loamy, mucky and sandy materials) and clayey to mucky throughout***	Severly limited for most urban and intensive recreation uses. Subsidence, wetness, salinity, low strength, and the shrinking and swelling of the soil material are the main limitations, and flooding is a hazard.	X	X		X	X		Not rated	Not rated	Not rated*	X	X	3

Notes:
Analysis based on "Soil Survey of Orleans Parish, Louisiana", USDA Soil Conservation Service, 1986.
All soil types are classified as poor for use as roadfill and topsoil.
Point values based on the existence of the following characteristics:
--Shrinking/ Swelling
--Subsidence
--Risk of Corrosion (concrete)

*Assumed to be moderate

Exhibit 11
Service Area Basin
Soil Condition Ratings

Basin	Soil Type	Point Value	% of Basin	Soil Type	Point Value	% of Basin	Soil Type	Point Value	% of Basin	Soil Type	Point Value	% of Basin	Soil Type	Point Value	% of Basin	Rating Sub-Total	Additional Rating Points*	Total Rating
Gentilly	1	1	45%	---	---	---	3	2	10%	4	2	20%	5	3	25%	1.80	1.00	**2.80**
S. Shore	1	1	5%	2	2	50%	3	2	5%	4	2	5%	5	3	35%	2.30	0.00	**2.30**
N. O. East	1	1	10%	2	2	55%	3	2	10%	4	2	10%	5	3	15%	2.05	0.00	**2.05**
Lakeview	1	1	25%	---	---	---	3	2	15%	4	2	40%	5	3	20%	1.95	0.00	**1.95**
9th Ward	1	1	55%	---	---	---	3	2	40%	---	---	---	5	3	5%	1.50	0.00	**1.50**
Algiers	1	1	60%	---	---	---	3	2	40%	---	---	---	---	---	---	1.40	0.00	**1.40**
Uptown	1	1	70%	---	---	---	3	2	30%	---	---	---	---	---	---	1.30	0.00	**1.30**
Carrollton	1	1	75%	---	---	---	3	2	25%	---	---	---	---	---	---	1.25	0.00	**1.25**
Mid-City	1	1	80%	---	---	---	3	2	20%	---	---	---	---	---	---	1.20	0.00	**1.20**
CBD/FQ	1	1	85%	---	---	---	3	2	15%	---	---	---	---	---	---	1.15	0.00	**1.15**

Notes:

Analysis based on "Soil Survey of Orleans Parish, Louisiana", USDA Soil Conservation Service, 1986.

*Additional Rating Points assigned for other known soil characteristics which adversely affect the condition of the pipe such as "running sand" in the Gentilly service area (Basin F).

Exhibit 12
Criteria Weights and Ratings

Rating Set	Rating Set Weights	Lakeview (A)	Carrollton (B)	Uptown (C)	Mid City (D)	CBD (E)	Gentilly (F)	Ninth Ward (G)	Algiers (H)	South Shore (I)	New Orleans East (J)
Work Activities	10	3.29	3.53	4.74	4.43	3.96	4.54	3.92	2.46	1.71	2.39
RDII	10	2.64	2.21	2.45	2.78	1.75	2.41	2.44	1.30	1.34	1.22
Criticality	9	89	45	86	63	78	106	93	86	47	55
Water Use	7	1.64	1.82	2.70	2.54	4.13	1.62	1.61	1.87	1.60	1.88
GWI	5	51	56	61	56	70	62	51	12	53	58
Soil Condition	4	1.95	1.25	1.30	1.20	1.15	2.80	1.50	1.40	2.30	2.05

Field Investigation Standards
Dyed Water Flooding Inspection

A. Introduction

Dyed water inspection is a rainfall simulation technique used to more accurately locate and quantify infiltration and inflow sources identified during smoke testing. This inspection is an economical method to isolate and quantify specific defects within a collection system. Dyed water inspection is also used to check for drain connections and confirm indirect cross connections. This inspection is typically used on storm drain cross-connections with the sanitary sewer or lines that are closely paralleled. Dye Water Inspection is also useful to quantify manhole defects, confirm smoke testing results, and trace line segments. This inspection is performed by injecting a fluorescent dye and water into a storm drain, sanitary sewer, open channel, roof drain, area drain, low area or any ponding area that is formed naturally or by the installation of a temporary berm, bag, or plug. Dyed water inspection usually takes place simultaneously with television inspection and/or flow isolation inspection.

B. Notification Procedures

Inspection procedures necessitate various requirements for notification of both the public and the Sewerage & Water Board of New Orleans (S&WB). The firm selected, must be familiar with both levels of notification and apply these procedures throughout the contract period. Those procedures that require notification of the public through the use of neighborhood meetings will include further coordination with not only the S&WB but agencies of the City as well.

B.1. Public Notification

Where private property access is required to be coordinated in order to conduct dyed water inspection the resident must be notified between two and seven calendar days prior to any field activities. This notification will be left at the residence or commercial property and access shall be coordinated with the resident/owner. All notifications will be documented. Flyers will be given to all residents that are notified and will be in English (see Exhibit 1).

B.2. S&WB Department Notification

The S&WB shall be notified of the area in which dye water testing will be performed on a given work day. This notification will be done by fax received no later than 7:00 a.m. the day of actual testing. The fax will include a map of the area to be tested and all streets clearly marked to show anticipated work sites for that day. An alternative to fax notification would to be to drop the above information at the Networks Engineering office prior to the initiation of work for that given day. Location of a drop box will be determined prior to contract award.

Gravity Division: telephone (504) 942-3888, fax (504) 942-3858

If the firm fails to notify the S&WB as outlined above, work will be suspended for that day. Successive failures to notify will require review by S&WB management regarding contract compliance prior to resumption of work.

The firm will maintain a log with a list of all residents and addresses requiring personal contact during the project time frame. This log will be updated daily and may be reviewed by the S&WB at any point during the project. The log will include at a minimum the resident's name, address, and date of notification for actual testing.

C. Guidelines for Inspection and Data Collection

These guidelines are written to ensure consistency of data collection and not for the express purpose of defining step-by-step instructions. Those firms responsible for conducting dyed water inspections are expected to use their experience and best professional judgment during all phases of the work.

The field procedures for dyed water inspection and data collection include; Planning, Safety, Set-up, Inspection Equipment, and Inspection and Documentation.

C.1. Planning

Dyed water inspection planning will be the primary investigation technique utilized as part of the planning process for manhole and television inspection activities. Locations for dyed water inspections will be identified from smoke inspection activities, by surface inspections along the pipeline and a review of the sanitary and storm drain system maps.

The Smoke Inspection Field Forms, maps of the sanitary sewer system and maps of the storm drain systems will be reviewed and a plan for conducting dyed water inspections ~~is~~ will be determined.

Dyed water inspection will be the primary investigation technique used in conjunction with manhole inspections and/or internal television inspection so that the infiltration or inflow of dyed water can be documented. Areas where dyed water inspections will be performed include the following:

- Storm drain lines that may be cross connected with the sanitary sewer system.
- Storm drain area drains (catch basins, curb inlets, etc.) which may be connected to the sanitary sewer.
- Canals, ditches, and storm drains that are above or adjacent to sanitary sewer lines.
- Depressed natural ground or paved areas above or adjacent to sanitary sewer lines and/or manholes. The depressed area may indicate the loss of soils into a defective sanitary sewer line.
- Depressed areas adjacent to manholes.

Sanitary sewer lines may also be dyed water inspected to trace existing sanitary sewer networks and/or field verify the pipe connection shown on the sanitary sewer base map.

Areas with significant levels of I/I as identified through flow monitoring shall also be targeted for further dyed water investigation.

The final locations for dyed water inspections shall be submitted to the S&WB in writing for approval. This submittal shall state the suspected reasons for performing this inspection. Dyed water inspection can:

- Identify sources of possible exfiltration from the sanitary sewer system to other receiving systems such as storm drains or drainage canals.
- Aid in the identification and quantification of I/I at manholes and other sanitary sewer structures.
- Trace, locate and identify service connections.

- Identify and verify sanitary sewers interconnections within the private sector such as drains, downspouts, etc.

C.2. Safety

Planning and addressing safety concerns for traffic and confined space entry must be considered before work begins to ensure that proper procedures are followed by the field crews. Entrance into any manhole is considered a Permit Required Confined Space Entry and all NIOSH-OSHA and S&WB safety standards are applicable and compliance is mandatory. Where manholes are located in the streets or driveways, adequate traffic safety devices, including safety cones, signs, flashing lights and other necessary safety equipment must be used. The S&WB and the Louisiana Department of Transportation & Development requires traffic safety procedures to be followed when work is conducted in street or highway rights-of-way.

The firm must provide the S&WB with a letter of intent to follow applicable federal, state and local safety standards for the work to be performed. This submittal shall also include the name of the firm's safety coordinator with a description of his/her job duties and level of responsibility. Failure to meet safety standards will result in immediate shutdown of the field crew and mandatory meeting with S&WB Safety department.

C.3. Set-up

General information on the test location is documented after the location for dyed water inspection is identified and before field inspection activities begin. The general information that needs to be recorded on field forms includes the following:

- Inspection date/time
- Inspection crew
- Street location
- Basin
- Sub-basin
- Main/Lateral number(s)
- Manhole(s) number and station
- Map number
- Segment length

C.4. Inspection Equipment

The firm is required to obtain a water meter from the Customer Service Division, for use by the dyed water inspection field crews (deposit will be required). The water meter and water used in conducting dyed water inspections will be at no cost, providing:

- The S&WB has a written engineering agreement for I/I studies.
- Water is only used for dyed water inspections and not for any other activity, such as line flushing, floating of television tag lines, etc., without written approval from the S&WB.
- The notification and request for the water meter and water will contain the general locations of dyed water inspections, estimated start date and estimated time for completion. When permitted the firm may use the meter to account for additional water use for other SSES requirements.
- A log will be maintained by the firm of locations and quantities used during the SSES inspections.

Several types and colors of dyes are commercially available for use and will be evaluated by the firm as to the proper use and handling. Multiple sites in close proximity may require various colors so as not to confuse the results from continuous testing. The firm shall submit to the S&WB, manufacturer's material safety documents (MSDS) for the dye products they intend to use. Copies of the MSDS information will be located at the firm's office and on all trucks that will be using this type of substance.

Following completion of a dyed water inspection all areas where dyed water has ponded and/or discolored a site will be washed down to remove the visible traces of the dyed water. All equipment and debris will be properly removed and disposed of.

Each inspection team shall have, at a minimum, the following equipment with them in the field at all times:

- Metal detector
- 300 foot measuring tape
- Air mover and hose
- manhole picks and shovels
- First Aid kit
- Various size sewer plugs
- Polaroid camera and film
- Ladder
- 2-way radios
- Safety harness and rope
- Safety cones
- Safety vests
- Fire extinguisher

C.5. Inspection and Documentation

Results from dyed water inspections will be documented on field inspection forms and photographs or video tape as applicable. When dyed water inspections are performed concurrently with manhole or television inspections, the photographs and field forms will be cross referenced and/or duplicated. Documentation by high quality color photographs or video tape (VHS standard play) of dyed water inspections must include time and date. These photos or films will show the location of dyed water application, and the approximate concentration (i.e. light, medium, or heavy) of dyed water visible in the sewer or manhole.

Photographs of the general location where dyed water is used shall be taken to show where and how dyed water is used, such as low area, ponding around a manhole, storm ditch lines, temporary plugs, bags and berms, and catch basins. The photographs should also show permanent landmarks, such as street intersections, trees, buildings, driveways, etc. Photographs shall be mounted and attached to the inspection field forms (Form 1). Information that will be documented on field forms regarding dyed water inspection results includes the following:

- Location sketch that shows locations of dyed water inspections with local fixed landmarks.
- Cross reference to any concurrent manhole inspection and/or television inspection activities.
- Location of dyed water source and information about the source such as street address, sewer line station number, etc.
- Results of the dyed water inspection - video, photographs, flow estimated for each observed flow input.
- The area and surface type that contributes to the dyed water I/I source.

D. Quality Data Review

It is the S&WB's intention and goal to obtain accurate, complete and consistent field data for dyed water inspection. To assist in accomplishing this goal the S&WB has prepared these guidelines and requires a quality control program to be administered.

The firms conducting dyed water inspections are required to employ personnel as necessary to check field data for conflict, consistency, completeness and accuracy of data as compared with other field data, S&WB supplied drawings, and other S&WB supplied data. A log of all deviations from the standard form will be maintained. Deviations and questionable data shall be submitted to the firm's field crews for correction and field verification and noted on the Weekly Accomplishment Report (See section F. Deliverables). The S&WB may, at its discretion, check the completed field work. At the S&WB's expense and at the stated contract price, a maximum of five percent of the sites may be reinspected. These sites will be reinspected by the firm as a quality assurance/quality control procedure. The site reinspections must be performed by a crew that did not perform the first test. Locations will be determined by the S&WB. If more than twenty-five percent of the QA/QC sites show deviations as determined by the S&WB, additional sites will be requested to be reinspected at the firm's expense. If the S&WB determines that the field work is significantly incomplete or incorrect, the S&WB will require the contracting firm to redo all necessary field activities, also at the firm's expense.

E. Data Format, Forms and Electronic Media

The S&WB will require the use of its standardized Dyed Water Inspection Field Form for use by all those firms conducting dyed water inspections. Guidelines and expectations for the type of information to be gathered during a dyed water inspection are outlined in section C.5. Each dyed water inspection field crew will become familiar with the S&WB form. Additional information that is not currently identified on the S&WB form, such as type of equipment and type of dye, etc. will be noted on the reverse side of the form.

The following Dyed Water Inspection form (Form 1) will be used by all crews in the field to collect and document information. This dyed water inspection form is intended to standardize information and the format of the information received by the S&WB. It

should be noted, at any time during the project, the S&WB may request to view the original forms at the firm's office. Those conducting dyed water inspections and those who evaluate the information collected are expected to use their experience and best professional judgment to complete the project and generate useable and verifiable information for the S&WB.

Information documented on the S&WB form will also be transferred to an electronic format for inclusion in the S&WB Cass Works database. The information will be submitted on PC-DOS compatible 3.5-inch high density floppy diskette in an ASCII format, tab delimited. The number of rows/records will be equal to the number of dyed water test locations and dyed water I/I locations. Each record will include the information as shown on the following Dyed Water Inspection ASCII layout (See Exhibit 2). The first line of the ASCII file will include the heading line exactly as shown. Information that is repeated will also be included for each dyed water return location. For example, the sub-basin identification will be included for each dyed water inspection location within that basin. The ASCII layout must be followed for all dyed water inspection electronic media data transfer to the S&WB. Additional information beyond the formatted fields may also be included as hard copy with the disk.

F. Deliverables

Several deliverables will be expected throughout the duration of the project. Weekly and monthly reports as well as the final submittals are mandatory for the project.

A weekly report with Weekly Accomplishments and Action Order Requests will be submitted to the S&WB's Network Engineering Office every Monday morning before 10:00 a.m. The form to be used is shown in Form 2. The Weekly Accomplishment section is a summation of line segments completed by all crews for a given week (a continuous seven day period of time generally Friday to Friday but the department will consider other start/stop dates). The Action Order Request portion of the form will identify any problems encountered during the previous work week that will require resolution before completion of the dyed water inspection for a given line segment. This could include surcharging, lack of access to manhole, inability to find manhole, etc. Conditions that can be resolved by in-house staff will be addressed and the firm will be notified via the Action Order Request which will be returned to the firm within two

weeks noting items accomplished and those that need further action with an anticipated date of completion. A final list of all Action Order items shall be generated at the end of the project. This list shall be used to review all requests and assure the department and firm that all items have been addressed and finalized.

A Monthly summation of work accomplished will be submitted to the department no later than the date specified in the engineering agreement.

S&WB Dyed Water Inspection Forms and electronic media files shall be delivered to the S&WB along with the SSES reports. A draft version of the SSES Report including the original field forms and photographs will be submitted to the department for S&WB personnel to review and comment on. These items will be returned with comments for finalization. The forms along with the original photographs of all defects, that were completed in the field, are to be included as an appendix to the final SSES report to be submitted to the S&WB. Six additional copies of the SSES report, one with copies of the forms, will also be required for completion of the project.

Dyed Water Inspection Form

Guidelines For Data Collection

A. *GENERAL*

A1. **Inspection Date.** Enter the date of inspection.

A2. **Inspection Crew.** Enter initials of company or organization doing inspections and initials of crew. Person completing the form should enter his/her initials first. Example XYZ - Acme Inspection Service.

A3. **Basin.** Enter the letter code for the basin in which test is performed.

A - Lakeview	F - Gentilly
B - Carrollton	G – Ninth Ward
C - Uptown	H - Algiers
D - Mid-City	I – South Shore
E - CBD/FQ	J - New Orleans East

A4. **Sub-basin.** Enter the sub-basin designation.

A5. **Main/Lateral Number.** Enter the main or lateral line number that is being inspected.

A6. **Map Number.** Enter the S&WB's map number which shows the area being inspected.

A7. **Upstream Manhole Number.** Enter the upstream manhole (or structure) number of the line and interceptor letter of the line segment being tested. **Blank if not coded.**

A8. **Downstream Manhole Number.** Enter the downstream manhole (or structure) number and interceptor letter of the line segment being tested. **Blank if not coded.**

A9. **Segment Length.** Length of isolated sewer line segment(s).

A10. **Street Location**. Street address or other identifier.

B. *OBSERVATIONS*

B1. **Concurrent Manhole Inspection.** Check the box if dyed water inspection was conducted concurrently with manhole inspection and/or line lamping.

B2. **Concurrent Television Inspection.** Check the box if dyed water inspection was conducted concurrently with television inspection.

B3. **Smoke Inspection.** Check the box if dyed water inspection was conducted with smoke inspection.

B4. **Ground Condition.**

1. **Dry**. Dry Conditions
2. **Moderate**. Damp Ground
3. **Wet**. Standing Water

B5. **Source - Note Address.** Enter address or station number of dyed water test site and important information about the source. Additional notes can be added in the sketch beside the source defect number.

B6. **Area Flooded with Dyed Water.**

1. Pavement Ponding Area
2. Natural Ground Ponding Area
3. Storm Drain Line
4. Storm Ditch or Stream Bed
5. Area Drain
6. Ponding around Manhole (Artificial or Natural)
7. Storm Drain Structure (Manhole, Curb Inlet or Junction Box)
8. Other

B7. **Defect Number.** Enter a number for each source. The defect number corresponds to the source location in the sketch and to the same source noted on the smoke form. For example the first source found is a downspout, the defect number (1) should be entered on the form and "#1" should be placed on the sketch showing the location of the downspout. If this downspout was smoke tested, the same defect number used on the smoke inspection form (1) should be used for the same downspout on the dye test form.

B8. **Results.**

1. **Negative**. No dyed water found in sanitary sewer system
2. **Positive (minimal)**. Small amount of dyed water observed in sanitary sewer system
3. **Positive (average)**. Dyed water observed
4. **Positive (large)**. Dyed water drained quickly into test area and directly into sewer,

5. **No Drainage**. Dyed water did not drain into test area

B9. **Sector.**
1. **Public**. Source located on public property in right-of-way or easements
2. **Private**. Source located on private property

B10. **Source Type.** Note appropriately
1. **Service Connection**. Service line defect anywhere along the service line to the building.
2. **Transition Joint**. Service line defect at the building foundation wall.
3. **Driveway Drain**. A drain in the driveway.
4. **Window Well Drain**. A drain in a basement window well.
5. **Stairwell Drain**. A drain in a stairwell.
6. **Area Drain**. A drain or open pipe in a yard or other areas which do not fit any of the other categories listed here.
7. **Downspout**. A downspout from the building gutters or roof.
8. **Downspout Connection**. The connection between the downspout and underground piping.
9. **Foundation Drain**. Underground drain around the foundation of a building evidenced by smoke around foundation.
10. **Building Inside**. Smoke inside building.
11. **Catch Basin**. A storm catch basin which leads stormwater to a storm drain or ditch.
12. **Storm Ditch**. An open storm drainage channel.
13. **Parallel Storm Ditch.** An open storm drainage channel parallel to the sanitary sewer line.
14. **Crossing Storm Ditch**. An open storm drainage channel crossing the sanitary sewer line.
15. **Storm Manhole**. A manhole in a storm drain system.
16. **Main Sewer**. The public sanitary sewer being tested.
17. **Cleanout**. A cleanout structure for service lines. Note if capped, above or below grade, condition, and if located in ponding area.
18. **MH Frame Seal**. Evidenced by smoke through ground around manhole. Note upstream manhole only on each form. Note if manhole is a junction box, siphon box, or meter station.

B11. **Location.** (Select the one most appropriate)
1. **Paved - Concrete**. Source is in paved concrete area.
2. **Paved - Asphalt**. Source is in paved asphalt area.
3. **Driveway**. Source is in driveway. Note material of construction of driveway in source-note/address or on sketch i.e., concrete, asphalt, unpaved.
4. **Sidewalk**. Source is in a sidewalk.
5. **Curb**. Source is in a curb.

6. **Yard-Front**. Source is in front yard or front grassed easement.
7. **Yard-Back**. Source located in back yard.
8. **Yard-Side**. Source located in side yard.
9. **Non-paved**. Source located in non-paved right-of-way area.
10. **Canal bottom**. Source in canal bottom or creek bank.
11. **Field**. Source located in a field.
12. **Golf Course**. Source located in a golf course.
13. **Alley**. Source located in an alley.

B12. **Area (ft2).** Estimate approximate drainage area to source. Do not measure. Visual estimate. N/A = canal bottom.

B13. **Runoff C.** Rational runoff coefficient. This value will be estimated in the office.

B14. **Flow (gpm).** The estimated flow using the runoff C and Area in gallons per minute. This value will be calculated in the office.

C. *SKETCH*

Show a plan view in sufficient detail so that others can find the test location and sources of defects. Show manhole numbers, source locations (include source defect number), drainage area, streets, houses, distances (two minimum, prefer three to four), fences, etc.

Notice

Dyed Water Testing & Sewer Survey
Sanitary Sewer Survey

Dear Resident,

In the next few days, inspection crews will be conducting a physical survey of a portion of the City of New Orleans sanitary sewer system. This study will involve the opening and entering of manholes in the streets and easements. An important task of the survey will be the "DYED WATER TESTING" of the sewer lines to locate breaks and defects in the sewer system. The dyed water that will be used is NON-TOXIC, , HARMLESS, AND HAS NO ODOR. The dyed water should not enter your home unless you have defective plumbing. If this occurs, you should consult your licensed plumber.

Some sewer lines and manholes may be located on private property. Whenever these lines require investigation, members of the inspection crews will need access to the easements for the sewer lines and manholes. Occasionally dyed water may be introduced into roof drains or area drains, with prior permission. Field personnel are uniformed and carry identification badges. Homeowners do not need to be home and AT NO TIME WILL FIELD CREWS HAVE TO ENTER YOUR BUSINESS OR RESIDENCE TO CONDUCT THE TEST.

We anticipate the Dyed Water Testing will require a few hours in your area. Your cooperation will be appreciated. The information gained from this study is being used to improve your sewer services.

Coordination of effort will be between ***Firm's Name***. and the Sewerage & Water Board of New Orleans.

In case of emergency, call the Sewerage & Water Board Help Line: 871-8300

Thank you for your cooperation

Project Manager
Firm's name
Firm's phone number

Exhibit 1

Dyed Water Inspection

Sewerage & Water Board of New Orleans

Project Title _____

A - General

Inspection Date/Time: _____
Inspection Crew: _____
Basin: _____
Subbasin: _____
Main/Lateral Number: _____
Sewer Map Number: _____

Upstream MH No.: _____
Downstream MH No.: _____
Segment Length: _____
Street Location: _____

B - Observations

Concurrent Manhole Inspection : ☐ Yes
Concurrent Television Inspection: ☐ Yes
Smoke Inspection: ☐ Yes

Ground:
① Dry ② Moderate ③ Wet

Source Note/Address (Full Address Name)	Area Flooded	Defect No.	Results	Sector	Source Type	Location	Area	Runoff C	Flow

	Area Flooded	Results	Sector	Source Type	Location		Area Flooded	Results	Sector	Source Type	Location
1=	Pavement Ponding	Negative	Public	Service Connection	Paved-Conc.	10=				Building Inside	Creek Bottom
2=	Natural Ponding	Positive	Private	Transition Joint	Paved-Asph.	11=				Catch Basin	Field
3=	Storm Sewer Line	Cannot Test		Driveway Drain	Driveway	12=				Storm Ditch	Golf Course
4=	Storm Ditch-Stream	+ Dye Tested		Window Well Drain	Sidewalk	13=				Parallel Ditch	Alley
5=	Area Drain	- Dye Tested		Stairwell Drain	Curb	14=				Crossing Ditch	
6=	Ponding Manhole			Area Drain	Yard-Front	15=				Storm Manhole	
7=	Storm Structure			Downspout	Yard-Back	16=				Main Sewer	
8=	Other			Dwnspt Connection	Yard-Side	17=				Cleanout	
9=				Foundation Drain	Non-Paved	18=				MH Frame Seal	

C - Sketch: (Show Placement of Dye, Source Defect Number, Drainage Area, Identify Condition)

Show North

D - Crew Comments (Any additional information pertinent to the inspection at this location)

SSES Inspection
Sewerage & Water Board of New Orleans
Project Title _____

Weekly Accomplishment Report
Week Ending: _____

A. - Work completed

	Accomplishment	Smoke Inspection	Dyed Water Inspection	Manhole Inspection	Flow Isolation	Television Inspection
1	Line Segments completed					
2	Total length of line segments					
3	Line segments unable to access					
4	Manholes accessed					
5	Manholes unable to be accessed					
6	Number of locations dyed water tested					
7	Manholes inspected (Surface only)					
8	Manholes inspected (Full inspection)					
	Days worked					
	Crew size					
	Rain days					
	Highlighted map attached					

B. - Action Order Request

Basin	Sub-basin	Main/ Lateral Number	Station	Problem encountered - Action requested	Prob. resolved	City response date

(continued)

B. - Action Order Request - continued

Basin	Sub-basin	Main/ Lateral Number	Station	Problem encountered - Action requested	Prob. resolved	City response date

Dyed Water Inspection ASCII Format

Sewerage Water Board of New Orleans

(A1)	(A2)	(A3)	(A4)	(A5)	(A6)	(A7)	(A8)	(A9)	(B1)	(B2)	(B3)
Inspection Date	Inspection Crew	Basin	Subbasin	Main / Lateral Number	Sewer Map Number	Upstream Manhole Number	Downstream Manhole Number	Segment Length (ft)	Concurrent Manhole Inspection (Y/N)	Concurrent Television Inspection (Y/N)	Smoke Inspection (Y/N)

Exhibit 2

Dyed Water Inspection ASCII Format

Sewerage Water Board of New Orleans

(B4)	(B5)	(B6)	(B7)	(B8)	(B9)	(B10)	(B11)	(B12)	(B13)	(B14)
Ground Condition	Source - Note Address	Area Flooded with Dyed Water	Defect Number	Results	Sector	Source Type	Location	Area (Sq. Ft.)	Runoff 'C'	Flow (gpm)

Exhibit 2

Field Investigation Standards
Facilities Survey

A. Introduction

The objective of this task is to provide surveyed locations and elevations and physical inventory for sewer manholes in the main sewer lines located in the project area. The firm will develop an electronic database of locations of sanitary facilities. This information will be used in the development of a computer hydraulic model and manhole inventory database. The work will also include the determination of vertical elevations of all inverts in each manhole surveyed.

This task will coordinated with manhole inspections to avoid duplication of effort. The firm will be responsible for locating, opening, inventorying and surveying the manholes.

B. Notification Procedures

Surveying procedures necessitate various requirements for notification of both the public and the Sewerage & Water Board of New Orleans (S&WB). The firm must be familiar with both levels of notification and apply these procedures throughout the contract period. Those procedures that require notification of the public through the use of neighborhood meetings will include further coordination with not only the S&WB but agencies of the City.

B.1. Public Notification

Because most of the facilities surveying activities will be performed in the right-of-way, notification of residents and commercial property shall be limited to those line segments located on private property owners and in easements that require special access coordination. Notification will be on a person-to-person basis. The crew leader shall inform residents and owners when the crew will require access to manholes on private property and what equipment if any will be necessary to perform the survey. A flyer with a description of the work to be performed shall be given to the resident or owner during the first encounter. If the resident or owner is not available for a meeting, a flyer will be left with a request for the resident/owner to contact the firm at the residence or commercial property. (See Exhibit 1)

B.2. S&WB Department Notification

The S&WB shall be notified of the areas in which facilities surveying activities will be performed on a given work day to coordinate access. This notification will be provided by fax received no later than 7:00 a.m. the day of actual inspection. An alternative to fax notification would be to deliver the above information to the Gravity Division office prior to the initiation of work for that given day. Location of a drop box will be determined prior to contract award.

Gravity Division: telephone (504) 942-3888, fax (504) 942-3858

If the firm fails to notify the S&WB of crew activity as outlined above, work will be suspended for that day. Successive failures to notify will require review by S&WB management regarding contract compliance, prior to resumption of work.

The firm will maintain a log with a list of all residents and addresses requiring personal contact during the project timeframe. This log will be updated daily and may be reviewed by the S&WB at any point during the project. The log will include at a minimum the resident's name, address, and date of notification for actual testing.

C. Guidelines for Facilities Survey Data Collection

These guidelines are written to ensure consistency of data collection and not for the express purpose of defining step-by-step instructions. The firm responsible for conducting facilities surveying is expected to use it's experience and best professional judgment during all phases of the work. Procedures for flow monitoring and data collection include: Planning, Safety, Set-Up, Equipment, and Inspection and Documentation.

C.1. Planning

The facilities survey activities shall be coordinated with those performed under Manhole Inspections in order that duplication of effort is minimized.

Cleaning of selected manholes may be required to improve poor hydraulic conditions in order to obtain required information. Recommended lines shall be cleaned to eliminate obstructions or remove excessive debris. Selection of cleaning equipment and the method for cleaning will be based on the condition of the sanitary sewer lines. Sanitary sewer lines and manholes shall be cleaned using mechanical, hydraulically propelled, and/or high velocity hydroflushing sewer cleaning equipment. The determination of the equipment best suited to

the location will be the responsibility of the cleaning crews. The firm will also check with the department for historical information on prior cleanings. Sediments and debris shall be removed from the line and disposed of by acceptable and permittable standards. Disposal of the sediments and debris is the responsibility of the firm performing the cleaning. Manholes cleaned shall be resurveyed after cleaning.

Should assistance from the S&WB be required in having the sewage pumping station water level reduced, the S&WB's Operations Department must be contacted a minimum of twenty-four (24) hour in advance. These efforts may not adequately reduce the level of the water in the specific line segments, and the firm shall use another method of flow control such as plugging or bypass pumping to achieve sufficient flow control.

C.2. Safety

Planning and addressing safety concerns for traffic and confined space entry must be considered before work begins to ensure that proper procedures are followed by the field crews. Entrance into any manhole is considered a Permit Required Confined Space Entry and all NIOSH-OSHA and S&WB safety standards are applicable and compliance is mandatory. Where manholes are located in the streets or driveways, adequate traffic safety devices, including safety cones, signs, flashing lights and other necessary safety equipment must be used. The S&WB and the Louisiana Department of Transportation and Development requires traffic safety procedures to be followed when work conducted in street or highway rights-of-way.

The firm must provide the department with a letter of intent to follow all applicable federal, state and local safety standards as necessary for the work to be performed. This submittal shall also include the name of the firm's safety coordinator with a description of his/her job duties and level of responsibility. Failure to meet safety standards will result in immediate shutdown of the field crew and mandatory meeting with S&WB management.

C.3. Set-up

The S&WB has sanitary sewer base maps that show line location, line size, manhole location, and other general information to help locate the sanitary sewer lines and manholes. These maps shall be used to locate the manholes for surveying. The correct manhole can be difficult to locate in easements or in congested areas (e.g., intersections), where several manholes may be present and some buried or paved over. Existing manholes not found or additional manholes found will be documented on survey forms and the sanitary sewer base

maps. These corrections will be included in the Weekly Accomplishment Report (see Section F. Deliverables).

Once a manhole is located, general information regarding the survey will be documented. The general information that will be recorded on field forms includes the following:

- Survey Date/Time
- Survey Crew
- Basin
- Sub-basin
- Main/Lateral number(s)
- Manhole/Pump Station Number
- Sewer Map Number

C.4. Equipment Selection

The firm will provide adequate equipment for the crew to perform all aspects of this survey in order to obtain the most accurate information possible.

Dual frequency P-code GPS receivers will be used by the firm for quality control. Differential leveling will be performed using electronic digital barcode reading levels. Conventional traversing to be performed using an electronic total station with data collector. Total station and traversing equipment shall be capable of meeting the following accuracy requirements:

- Local accuracy/positional tolerance at 95% confidence level for horizontal positions is 0.20 to 0.40 m
- Local accuracy/positional tolerance at 95% confidence level for vertical positions is 0.20 to 0.40 m
- Network accuracy/positional tolerance at 95% confidence level for positions is 0.020 to 0.040 m relative to the Louisiana HARN and first or second order NGS vertical network.

All equipment shall be in calibration/adjustment and verified against known baseline or existing control with similar relative accuracy prior to use on the project.

Manhole invert elevations will be measured from the top of rim to each invert in a 90 degree vertical to the manhole rim horizontal plane. The measurement device will be rigid or a maximum +/- 0.5 inches offset along the vertical measurement alignment.

C.5. Documentation

The firm will be responsible for gathering specific data and information on each manhole surveyed. The data will be recorded on forms as discussed in Section E. (Data Format, Forms and Electronic Media).

The specific information that will be recorded on field forms includes the following:

- X and Y coordinates of each manhole and pump station.
- Rim elevation of each manhole and of a reference point at each pump station.
- Depth or elevation of the invert at both ends of each pipe.
- Diameter of each pipe.
- Monument descriptions, survey control used.
- Maps or sketches showing any discrepancies between the provided information and the information shown on the sewer maps (e.g., new manholes/pipes discovered or not found in the field).

For manhole rim elevations, dual baseline real-time or post-processed kinematic surveys will be performed for manhole locations and supplemental control provided a minimum of two base stations are utilized. Trigonometric leveling is acceptable provided the following criteria are met:

- Sight distances can be depth to lengths that can satisfy accuracy tolerances.
- Forward and back shots are required to verify distances, height differences and Hls.
- Zenith angles and height differences are to be measured direct and reverse.
- Traverses are closed upon either primary or secondary control points. The firm shall demonstrate capability to perform least square adjustments using kinematic GPS and terrestrial survey data and geoid modeling that meets vertical positioning specification.

Manholes found in the field that are not shown on the sewer maps, but are within the system area under study, will be fully surveyed and inventoried. Payment for additional non-

documented manholes surveyed will be at the same cost for identified manholes with the area.

D. Quality Data Review

It is the S&WB's intention and goal to obtain accurate, complete and uniform field data from flow monitoring activities. To assist in accomplishing this goal, the S&WB has prepared these guidelines and is requiring a quality control program to be administered.

The firms conducting facilities surveying activities are required to employ personnel as necessary to check field data for conflict, consistency, completeness and accuracy of data as compared with other field data, S&WB supplied drawings and other S&WB supplied data. A log of all deviations from the standard form will be maintained. Deviations and questionable data shall be submitted to the firm's field crews for correction and field verification and noted on the Weekly Accomplishments Report (See Section F. Deliverables). The S&WB may, at its discretion, use the S&WB's or firm's field crews to check the completed field work. At the S&WB's expense and at the stated contract price, up to a maximum of five percent of all manholes in the project area will be reinspected by the firm as a quality assurance/quality control procedure. Reinspected manholes must be performed by a crew that did not perform the first inspection. Manholes to be reinspected will be determined by the S&WB. If more than twenty-five percent of the QA/QC manholes show significant deviations from the original inspection, as determined by the S&WB, up to five percent of the total number of manholes in the project will be requested to be reinspected at the firm's expense. If the S&WB determines that the firm's field work is significantly incomplete or incorrect, the S&WB will require the firm, at it's own expense, to redo all necessary survey activities.

E. Data Format, Forms and Electronic Media

The S&WB will require the use of its standardized Facilities Survey Field Form for use by all those conducting facilities survey activities for the S&WB. Guidelines and expectations for the type of information to be gathered during facilities survey activities are outlined in previous sections. Each facilities survey field crew shall use the S&WB facilities survey forms. Additional information that is not currently identified on the existing form(s) will be noted on the reverse side of the form.

The following Facilities Survey form (See Form 1) will be used by all crews in the field to collect and document information. These forms are intended to standardize information and

the format of the information received by the S&WB. It is not the intention of the S&WB to control the activities and analysis of the individuals who conduct facilities survey activities. Those conducting facilities survey activities and those who evaluate the information collected are expected to use their experience and best professional judgment to complete and generate usable and verifiable information for the S&WB.

Information documented on the S&WB forms will also be transferred to an electronic format as part of the deliverables for inclusion in a S&WB database. The information will be included on PC-DOS compatible 3.5-inch high density floppy diskette in an ASCII format, tab delimited. Each record will include the information as shown on the following facilities survey ASCII layout, Exhibit 2. The first line of the ASCII file will include the heading line exactly as shown. Information that is repeated will also be included for facilities survey location. For example, the subbasin identification will be included for each facilities survey flow location within that basin. The following ASCII layout will be followed for all facilities survey electronic media data transfer to the S&WB. Additional information beyond the formatted fields may also be included as hard copy attached to the disk.

F. Deliverables

Several deliverables will be expected throughout the duration of the project. Weekly and monthly reports as well as the final submittals are mandatory for the project.

Weekly updates of work completed and problems encountered will be summarized on the Weekly Accomplishment Report, which will be submitted to the S&WB Gravity Division office every Monday morning before 10:00 a.m. The form to be used is shown as Form 2. The Weekly Accomplishments Report is a summation of facilities survey activities completed by all crews for a given week (a continuous seven day period of time), generally Friday to Friday, but the department will consider other start/stop dates. The Action Order Request Section will identify any problems encountered during the previous work week that will require resolution before completion of the facilities survey project. This could include surcharging, lack of access to manhole, inability to find manhole, etc. Conditions that can be resolved by in-house staff will be addressed and the firm will be notified via the Action Order Request which will be returned to the firm within two weeks, noting items resolved and those that need further action. Those items needing further resolution will be returned with a proposed date for completion. A final list of all Action Order items shall be generated at the end of the project. This list shall be used to review all requests and assure the department and firm that all items have been addressed and finalized.

If during the course of inspection, the field crew encounters conditions that could be hazardous to the crew or public or have a possibility of imminent restriction of flow in the sewer line, the firm must notify the department verbally that working day and in writing by the next working day. The Emergency Action Order (See Form 3) form shall be used in these situations.

A monthly summation of all work accomplished will be submitted to the department no later than the date specified in the engineering agreement.

S&WB Facilities Survey Forms and electronic media files shall be delivered along with the SSES reports. A Draft version of the SSES Report including the original field forms will be submitted to the department for review and comment by S&WB personnel. These items will be returned with comments for finalization. The forms that were completed in the field are to be included as an appendix to the final SSES report to be submitted to the S&WB. Six additional copies of the SSES report, one with copies of the forms, will also be required for completion of the project.

Notice

Sanitary Sewer Facilities Survey

Dear Resident,

The Sewerage & Water Board of New Orleans is preparing to perform facilities surveying of the sanitary sewer system. The study will require the inspectors to locate, inspect and enter manholes in the streets and easements. In that some easements are located beside or behind private residences, this will require the inspector(s) in some cases to enter onto private property to perform these inspections. We would like to coordinate the survey process with those residents with manholes in their yards. According to existing engineering information, a manhole may be located on your property. Please contact me at your earliest convenience so that we may coordinate this effort.

Thank you for your cooperation

Project Manager
Firm's Name
Firm's Telephone Number

Exhibit 1

Field Investigation Standards
Flow Isolation

A. Introduction

Flow in sanitary sewer systems consists of three components: wastewater production flow or base flow, infiltration, and inflow. Separation and quantification of these components are often prime objectives of flow monitoring. Flow isolation, or night flow isolation, is a technique employed to determine the amount of extraneous water entering a reach of sewer.

The objective of a flow isolation program is to isolate small reaches of sewer and measure the infiltration rate within each of these reaches. The selection of flow measurement locations and equipment is critical in flow isolation. The low flow volumes in plugging isolation may be difficult to quantify with some metering techniques and the small flow changes in differential isolation may be clouded by general meter inaccuracies. Portable weirs are generally used in flow isolation field activities, for their relative ease of installation and direct reading of flow rates.

B. Notification Procedures

Inspection procedures necessitate various requirements for notification of both the public and the Sewerage & Water Board of New Orleans (S&WB). The firm must be familiar with both levels of notification and apply these procedures throughout the contract period. Those procedures that require notification of the public through the use of neighborhood meetings will include further coordination with not only the S&WB but agencies of the City.

B.1 Public Notification

Because most of flow isolation will be performed in the street right-of-way, notification of residents and commercial property owners shall be limited to those line segments located on private property and in easements with special access requirements. Notification shall be on a person-to-person basis. The crew leader shall inform residents and owners when the crew will require access to manholes on private property and what equipment if any will be necessary to perform the isolation procedure. A flyer with a description of the work to be performed shall be given to the resident or owner during the first meeting. If the resident or owner is not available for a meeting, the crew leader shall

leave a flyer at the residence or commercial property with a request for the resident/owner to contact the firm in order to coordinate access (see Exhibit 1).

The firm will maintain a log with a list of all residents and addresses notified during the project time frame. This log will be updated daily and may be reviewed by the S&WB at any point during the project. The log will include at a minimum the name and address. and the date of notification for actual work.

B.2. S&WB Department Notification

The S&WB shall be notified on a daily basis of the line and/or area to be isolated the next work day. This notification will be by fax no later than 7:00 a.m. the day of actual testing. The fax will include a map of the area to be tested and all streets clearly marked to show actual work sites for that day. An alternative to fax notification would to be to deliver the above information to the Networks Engineering office prior to the initiation of work for that given day. Location of a drop box will be determined prior to contract award.

Gravity Division: telephone (504) 942-3888, fax (504) 942-3858

If the firm fails to notify the S&WB of crew activity as outlined above, work will be suspended for that day. Successive failures to notify will require review by S&WB management regarding contract compliance, prior to resumption of work.

C. Guidelines for Flow Isolation and Data Collection

Guidelines are written to ensure consistency of data collection and not for the express purpose of defining step-by-step instructions. The flow isolation team members are expected to use their experience and best professional judgment during all phases of flow isolation. Once an area is identified for infiltration measurement, one of two methods will be utilized for selecting line segments for flow isolation .

The first is the single-pass method, which consists of selecting all measurement points from base maps to identify the test area and then executing field monitoring measurements during a single isolation test. The second is the multi-pass method of isolation, which involves selecting a few key measurement points for field investigation and then analyzing the results prior to the selection of further measurement points in areas

of interest. Both methods are acceptable and sewer system characteristics along with flow conditions should dictate the firm's choice.

Two methods are acceptable to assist in isolating specified lengths of sewer: plugging and differential isolation. The *plugging* method consists of physically isolating the sewer length from the rest of the system by means of plugs inserted into the sewer pipes. Plugs are usually pneumatic or mechanical and are available from several manufacturers. Plugging for flow isolation isolates the length of sewer under consideration and reduces the flow rate required to be measured downstream.

The *differential isolation* method involves subtraction of all flows coming into the section from all flows going out of the section to obtain the net increase of flow within the section itself. With this method, the flows are not physically interrupted. This will be considered if there are possible problems with upstream storage when lines are plugged.

C1. Planning

Areas to be studied by flow isolation will be selected from locations where known or suspected significant amounts of I/I may occur. Best conditions for flow isolation usually occur during the winter or spring (wet weather season) when the soil conditions are wet and the ground water table is normally high. Flow isolation will not occur when the ground is saturated during or after a rain. The ground is considered saturated if roadside ditches or other local low areas have ponding or flowing water.

For economical and reliable execution of a flow isolation program, an accurate map of the system is highly desirable. The proper selection of measurement points is critical to the success of an isolation program, and the S&WB sewer maps reflect the layout of the system for proper selection of these points. The S&WB has sanitary sewer base maps at a 1" = 100" scale and a 1" = 60' scale that show line locations, line sizes, manhole locations, manhole station numbers, and other general information to help locate the sanitary sewer lines and manholes. These maps will be used to locate manholes necessary for flow isolation. Manhole inspection forms will be reviewed, if available, for manhole accessibility, cleanliness of pipes, sizes of lines, and estimates of flow rates.

C.2. Safety

Planning and addressing safety concerns for traffic and confined space entry must be considered before work begins to ensure that proper procedures are followed by the field

crews. Entrance into any manhole is considered a Permit Required Confined Space Entry and all NIOSH-OSHA and S&WB safety standards are applicable and compliance is mandatory. Where manholes are located in the streets or driveways, adequate traffic safety devices, including safety cones, signs, flashing lights and other necessary safety equipment must be used. The S&WB and the Louisiana Department of Transportation and Development requires traffic safety procedures to be followed when working in street or highway right-of-ways.

The firm must provide the S&WB with a letter of intent to follow all applicable federal, state and local safety standards as necessary for the work to be performed. This submittal shall also include the name of the firm's safety coordinator with a description of his/her job duties and level of responsibility. Failure to meet safety standards will result in immediate shutdown of the field crew and a mandatory meeting with department management.

C.3. Set-Up

Plugs and/or flow measurement devices, depending upon technique selected, will be placed in the line(s) where flows enter the manhole of the test line segment. Care during the isolation process must be taken to ensure that water head in the upstream sewers does not develop to a level that would interrupt service to any customer or create hazardous conditions.

Failure of plugs is not uncommon; workers near or downstream of plugs must exercise extreme caution at all times. Safety procedures for installation, inspection, and removal of plugs will be reviewed with all crew members as per the firm's safety standards.

Plugs inserted in the pipe will interrupt the existing flow and cause wastewater to be stored behind the plug and into the upstream collection system. Prior to plugging, several aspects of the system shall be reviewed. The flow rate, the low point in the system, and the relative elevation of the pipe for the area being plugged shall be determined and indicated on the inspection form. The volume of storage in the system upstream of the plug shall be estimated to determine the safe length of time the plug may be left in the line. These calculations shall also be recorded on the inspection form. The relationship of the safe plugging time to the drain down time of the pipe will determine the maximum length of sewer that is feasible to isolate by plugging; however, the estimated safe plug

time will not be relied on to avoid flooding of homes. Frequent visual observation of actual water depths in upstream manholes will be required during a plugging operation.

Portable weirs are generally used to measure flows for quantitative and relative measurements. The firm is responsible for ensuring:

- The weir is installed level;
- The weir is properly seated and watertight at its perimeter;
- The nappe is aerated;
- The velocity of approach is small;
- The flow over the weir has reached an equilibrium condition; and
- The weir is properly read.

The equipment used is the firm's responsibility and will be used in the manner the firm and manufacturer determines to give the best results. Manufacturer's literature will be reviewed and applied as the firm deems necessary to produce the most accurate results.

During the set-up the field crew leader will begin documenting general information on the field forms, including the following information:

- Flow Isolation Date and Time Interval
- Inspection Crew (company/organization and names)
- Basin
- Sub-basin
- Main/Lateral number(s)
- Manhole Numbers
- S&WB Sewer Map Number
- Ground Conditions - General Soil Observations

After a section of sewer is isolated by plugging, sufficient time must be allowed for the residual upstream wastewater flows in the pipe to drain before any measurements are attempted. This time will be dependent on the length of sewer isolated and the average slope of the sewer. Verification that flows are not passing the plugs must be made before any test measurements are taken. Then an equilibrium flow situation must be verified at the point of measurement by the method of successive readings.

C.4. Equipment

This inspection procedure requires various equipment for identifying quantities of flows, isolating flows, pumping flows or assuring flows can be obtained for a given length of a system. Therefore, it is the firm's responsibility to verify that all equipment is in good working order. Due to the complexity of flow metering and flow isolation, the calculation of accurate flow rates, and the constant inspection of line conditions for storage complications during testing procedures, the firm will review all equipment for soundness and calibration prior to start-up of each test.

Equipment shall include portable weirs, mechanical or pneumatic plugs, and velocity probes for this procedure. Use of this equipment is dependent upon the method the firm wishes to use to perform the flow calculations. Upon selecting the method to be used, the firm shall submit to the department the proposed plan for performing flow isolation and the method for calculating the flows in the particular segment of the system.

Each inspection team shall have, at a minimum, the following equipment with them in the field at all times:

- Metal detector
- 300 foot measuring tape
- Air mover and hose
- manhole picks and shovels
- First Aid kit
- Various size sewer plugs
- Polaroid camera and film
- Ladder
- 2-way radios
- Safety harness and rope
- Safety cones
- Safety vests
- Fire extinguisher

C.5. Flow Measurement and Documentation

Portable weirs are a common measurement device used in flow isolation. Portable V-notch (or other) weirs are commercially available to fit circular pipes, and are inserted into the incoming pipe at a manhole. An advantage of portable weirs is the relative ease of installation, and they generally are calibrated for direct reading of flow rates. Sufficient care will be taken when installing any flow device to minimize adverse conditions that might affect flow measurement readings.

The *velocity-area method* of estimating flow rate at a measurement point uses the relationship; $Q = VA$, where Q = flow, V = mean velocity, and A = cross-sectional area of flow. To utilize this relationship, both the cross sectional area of flow "A" and the mean velocity "V" must be obtained by actual measurement.

The cross sectional area of flow can be obtained by first measuring the depth of flow at the point where the velocity reading is obtained. If sediment is present, the depth of debris must be determined also. The cross sectional area of flow "A" may be computed by reference to prepared tables or by geometry. The sediment area should be subtracted from the total wetted area to obtain the actual area of flow.

The mean velocity "V" of the flow may be obtained by using magnetic or propeller current meters, by interval timing, or by timing of a floating object. The use of magnetic or propeller current meters to measure open channel flow velocity is the acceptable means of velocity measurements for flow isolation. Other velocity measurement equipment or techniques such as dye interval timing or fluorometric methods will not be acceptable without prior written approval from the S&WB.

To obtain a reliable net flow rate using the differential isolation method, sufficient care must be taken to ensure that upstream measurements do not have an adverse effect on downstream measurements. The entire system associated with the isolation of a given section of sewer should be in equilibrium. This is very important when using portable weirs for flow isolation, and requires a certain period of time to stabilize the weirs after installation. This can be achieved first by setting all weirs and allowing the entire system to reach equilibrium before taking any readings. Weirs will be monitored continuously to ensure they are working properly and not causing flow restrictions or blockages. All weirs will be kept clean and free of debris accumulation.

Plug removal is the most critical part of the plugging operation. When a plug is removed, a surge of water may be propagated for some distance downstream. This may interfere with downstream measurements, may blow downstream plugs that are lightly seated, or may even flood low-lying downstream homes. For these reasons, plug removal will be as gradual as possible and properly sequenced with other operations conducted within the same sewer. The manufacturer's instructions on the proper use and maintenance of plugs will always be followed to avoid injury or property damage. All equipment will be removed immediately following flow isolation and the removal of plugs will be documented on the field form.

Once the flow measurement device(s) is/are installed and flow established, the flow rate will be determined and documented on three minute intervals. Flow measurements will

continue until flow equilibrium has been established. Flow equilibrium is established when five consecutive flow measurements demonstrate a steady state condition. The flows should not be increasing or decreasing with any magnitude and the five consecutive flow measurements are within a ten percent range of each other. The five consecutive flow measurements taken to determine flow equilibrium will be averaged and documented along with the appropriate flow units.

The time of flow measurements will be recorded along with the raw flow measurements, if flow rates are not read directly from the metering device. For example, if the velocity area method is used to measure flow rates, then the actual velocity probe readings and cross sectional measurements will be recorded. The flow rate will then be determined and recorded in the field to ensure that measurements taken are representative and not in error.

D. Quality Data Review

The S&WB's intention and goal is to obtain accurate, complete and uniform field data from flow isolation activities. To assist in accomplishing this goal the S&WB has prepared these guidelines and is requiring a quality control program to be administered.

The firm conducting flow isolations for the S&WB is required to employ personnel as necessary to check field data for conflicts, consistency, completeness, and S&WB supplied drawings and other S&WB supplied data. A log of all deviations from the standard form will be maintained. Deviations and questionable data shall be submitted to the firm's field crews for correction and field verification and noted on the Weekly Accomplishment Report (see section F. Deliverables). The S&WB, may at its discretion, use the S&WB's or firm's field crews to check the completed field work. At the S&WB's expense and at the stated contract price, up to a maximum of five percent of all line segments previously isolated in the project will be reinspected by the firm as a quality assurance/quality control procedure. Line segment reinspection must be performed by a crew that did not perform the first inspection and at locations determined by the S&WB. If more than twenty-five percent of the QA/QC segments show significant deviations as determined by the S&WB, additional line segments will be requested to be reinspected at the firm's expense. If the S&WB determines that the field work is significantly incomplete or incorrect, the S&WB will require the contracting firm to redo all necessary field activities, also at the firm's expense.

E. Data Format, Forms and Electronic Media

The S&WB will require the use of its standardized Flow Isolation Form in the field for those firms conducting flow isolations for the S&WB. Guidelines and expectations for the type of information to be gathered during a flow isolation effort are outlined in the previous section. Each flow isolation field crew will use the S&WB form. Additional information that is not currently identified on the S&WB form will be noted on the reverse side of the form.

The following Flow Isolation Inspection form (Form 1) will be used by all crews in the field to collect and document information. This flow isolation form is intended to standardize the format of information received by the S&WB. At any time during the project the S&WB may request to view the original forms at the firm's office. It is not the intention of the S&WB to control the activities and analysis of the individuals who conduct flow isolation. Those conducting flow isolations and those who evaluate the information collected are expected to use their experience and best professional judgment to complete the project and generate useable and verifiable information for the S&WB.

Information documented on the S&WB form will in turn be transferred to an electronic format for inclusion in a S&WB database. The information will be submitted on PC-DOS compatible 3.5-inch high density floppy diskette in ASCII format, tab delimited. Each record will include the information as shown on the following Flow Isolation ASCII format (See Exhibit 2). The first line of the ASCII file will include the heading line exactly as shown. The ASCII layout must be followed for all flow isolation electronic media data transferred to the S&WB. Additional information beyond the formatted fields may also be included as hard copy included with the disk.

F. Deliverables

Several deliverables will be expected throughout the duration of the project. Weekly and monthly reports as well as the final submittals are mandatory for the project.

A weekly report with Weekly Accomplishments and Action Order Requests will be submitted to the S&WB's Network Engineering Office every Monday morning before 10:00 a.m. The form to be used is shown as Form 2. The Weekly Accomplishments section is a summation of line segments isolated by all crews for a given week (a continuous seven day period of time generally Friday to Friday but the department will consider other start/stop dates). The Action Order Request portion of the form will

identify any problems encountered during the previous work week that will require resolution before completion of the flow isolation for a given line segment or area. This could include surcharging, lack of access to manhole, inability to find manhole, etc. Conditions that can be resolved by in-house staff will be addressed and the firm will be notified via the Action Order Request which will be returned to the firm within two weeks noting items accomplished and those that need further action with an anticipated date of completion. A final list of all Action Order items shall be generated at the end of the project. This list shall be used to review all requests and assure the department and firm that all items have been addressed and finalized

A monthly summation of work accomplished will be submitted to the department no later than the date specified in the engineering agreement.

The S&WB Flow Isolation Forms and electronic media files shall be delivered along with the SSES reports. A draft version of the SSES Report including the original field forms and photographs will be submitted to the department for review and comment. These items will be returned with comments for finalization. The forms along with the original photographs of all defects, that were completed in the field, are to be included as an appendix to the final SSES report to be submitted to the S&WB. Six additional copies of the SSES report, one with copies of the forms, will also be required for completion of the project.

Flow Isolation Form
Guidelines For Data Collection

A. *GENERAL*

A1. **Inspection Date.** Enter the date of flow isolation.

A2. **Inspection Crew.** Enter initials of company or organization doing the flow isolation and initials of crew person completing the form should enter his/her initial first. Example XYZ - Inspection Service.

A3. **Basin.** Enter the basin name of the interceptor.

A - Lakeview	F - Gentilly
B - Carrollton	G – Ninth Ward
C - Uptown	H - Algiers
D - Mid-City	I – South Shore
E - CBD/FQ	J - New Orleans East

A4. **Sub-basin.** Enter the sub-basin designation.

A5. **Main/Lateral Number.** Enter the main or lateral line number that is being flow isolated.

A6. **Sewer Map Number.** Enter the S&WB's map number that shows the sewer line segment being isolated.

A7. **Upstream Manhole Number.** Enter the upstream manhole number of the manhole which is the most upstream manhole in the test area being isolated. **Blank if not coded**.

A8. **Downstream Manhole Number.** Enter the manhole (or structure) number of the manhole where the flow monitoring device is located. **Blank if not coded.**

A9. **Segment Length.** Length of isolated sewer line segment(s).

B. *OBSERVATIONS*

B1. **Isolation Approach.**
1. **Plugging Isolation** (includes pumping and/or diverting of flows)
2. **Differential Isolation**

B2. **Ground Condition.**
1. **Dry**. Dry Conditions
2. **Moderate**. Damp Ground
3. **Wet**. Standing Water

B3. **Main/Lateral Number.** Enter the main or lateral number of the sewer line in which the plug or temporary meter was placed for flow isolation.

B4. **Station Manhole Installation.** Enter the line station of the manhole in which the plug or temporary meter was placed for flow isolation.

B5. **Plug or Meter Installed.** Enter a "P" for plug installed at location. Enter an "M" for portable meter installed at location.

B6. **Line Size.** Enter the sewer line size at the location where the plug or meter is installed, in inches.

B7. **Flow Meter Type.**
1. V-notch Weir
2. Rectangular Weir
3. Trapezoidal Weir
4. Velocity-Area Method
5. Flume Insert (Parshall, Palmer-Bowlus)
6. Direct Flow Metering Device (ISCO Flow Poke)
7. Recording Metering Device (Flow Tote, etc.)
8. Dye Interval
9. Fluorometric
10. Other

B8. **Time.** Enter the time a flow measurement is recorded.

B9. **Downstream Measured Flow (1).** Enter the measured flow rate at the downstream flow meter installed for the test.

B10. **Upstream Measured Flow (2).** Enter the measured flow rate at the upstream flow meter if differential isolation is used for the test.

B11. **Upstream Measured Flow (3).** Enter the measured flow rate at the upstream flow meter if differential isolation is used for the test.

B12. **Upstream Measured Flow (4).** Enter the measured flow rate at the upstream flow meter if differential isolation is used for the test.

B13. **Upstream Measured Flow (5).** Enter the measured flow rate at the upstream flow meter if differential isolation is used for the test.

B14. **Infiltration Rate (gpd/in-mi.).** The calculated infiltration rate. This will be calculated in the office.

B15. **Downstream Equilibrium Average (Flow 1).** Enter the average of the measured flow recorded for the downstream recorded flow once flow equilibrium is established. (a minimum of five flow measurements at equilibrium are required)

B16. **Upstream Equilibrium Average (Flow 2).** Enter the average of the measured flow for the upstream flow rate recorded once flow equilibrium is established. (a minimum of five flow measurements at equilibrium are required)

B17. **Upstream Equilibrium Average (Flow 3).** Enter the average of the measured flow for the upstream flow rate recorded once flow equilibrium is established. (a minimum of five flow measurements at equilibrium are required)

B18. **Upstream Equilibrium Average (Flow 4).** Enter the average of the measured flow for the upstream flow rate recorded once flow equilibrium is established. (a minimum of five flow measurements at equilibrium are required)

B19. **Upstream Equilibrium Average (Flow 5).** Enter the average of the measured flow for the upstream flow rate recorded once flow equilibrium is established. (a minimum of five flow measurements at equilibrium are required)

B20. **Average Infiltration Rate.** Enter the average of the calculated infiltration/inflow once flow equilibrium is established. (a minimum of five flow measurements at equilibrium are required)

C. *SKETCH*

Show plan view in sufficient detail so that others can relocate in field without photograph. Show placement of plugs and meters, manhole numbers, streets, houses, distances (two), fences, etc.

Flow Isolation Inspection

Sewerage & Water Board of New Orleans

Project Title _____

A - General

Inspection Date: _____
Inspection Crew: _____
Basin: _____
Subbasin: _____
Main/Lateral Number: _____
Sewer Map Number: _____

Upstream MH No.: _____
Downstream MH No.: _____
Equipment Calibration (y/n): _____
Plug Removed (y/n, date): _____

B - Observations

Isolation Approach: ① = Plugging Isolation
② = Differential Isolation

Ground Condition: ① = Dry
② = Moderate
③ = Wet

Meter and Plug Installations

Main / Lateral Number	Station Manhole Installation	Plug or Meter Installed	Line Size	Flow Meter Type

Test results

Time	Downstream Measured Flow	Upstream Measured Flow	Upstream Measured Flow	Upstream Measured Flow	Upstream Measured Flow	Calculate Infiltration
Eq. Ave.						

Flow Meter Type:

1 = V-Notch Weir 2 = Rectangular Weir 3 = Trapezoidal Weir Insert 4 = Velocity-Area 5 = Flume

6 = Direct Meter 7= Recording Meter 8 = Dye Interval 9 = Fluorometric 10 = Other types

C - Sketch: (Show area being isolated and location of flow divides and flow restrictors)

Show North

D - Crew Comments (Any additional information pertinent to the inspection at this location)

Notice

Flow Isolation Testing
Sanitary Sewer Survey

Dear Resident,

Firm's Name is under contract with the Sewerage & Water Board of New Orleans to perform inspections and physical surveys of the sanitary sewer system. The study will require the inspectors to locate, inspect and enter manholes in the streets and easements. In that some easements are located beside or behind private residences, this will require the inspector(s) in some cases to enter onto private property to perform these inspections. We would like to coordinate the survey process with those residents with manholes in their yards. According to existing engineering information a manhole may be located on your property. Please contact me at your earliest convenience so that we may coordinate this effort

Thank you for your cooperation

Project Manager
Firm's name
Firm's phone number

Exhibit 1

SSES Inspection
Sewerage & Water Board of New Orleans
Project Title _____

Weekly Accomplishment Report
Week Ending: _____

A. - Work completed

	Accomplishment	Smoke Inspection	Dyed Water Inspection	Manhole Inspection	Flow Isolation	Television Inspection
1	Line Segments completed					
2	Total length of line segments					
3	Line segments unable to access					
4	Manholes accessed					
5	Manholes unable to be accessed					
6	Number of locations dyed water tested					
7	Manholes inspected (Surface only)					
8	Manholes inspected (Full inspection)					
	Days worked					
	Crew size					
	Rain days					
	Highlighted map attached					

B. - Action Order Request

Basin	Sub-basin	Main/ Lateral Number	Station	Problem encountered - Action requested	Prob. resolved	City response date

(continued)

B. - Action Order Request - continued

Basin	Sub-basin	Main/ Lateral Number	Station	Problem encountered - Action requested	Prob. resolved	City response date

Flow Isolation ASCII Format

Sewerage and Water Board of New Orleans

(A1)	(A2)	(A3)	(A4)	(A5)	(A6)	(A7)	(A8)	(A9)	(B1)	(B2)	(B3)	(B4)
Inspection Date	Inspection Crew	Basin	Subbasin	Main / Lateral Number	Sewer Map Number	Upstream Manhole Number	Downstream Manhole Number	Segment Length (ft)	Isolation Approach	Ground Condition	Main / Lateral Number	Station Manhole Installed

Exhibit 2

Flow Isolation ASCII Format

Sewerage and Water Board of New Orleans

(B5) Plug or Meter Installed (P or M)	(B6) Line Size (inch)	(B7) Flow Meter Type	(B8) Time	(B9) Downstream Measured Flow (1)	(B10) Upstream Measured Flow (2)	(B11) Upstream Measured Flow (3)	(B12) Upstream Measured Flow (4)	(B13) Upstream Measured Flow (5)	(B14) Infiltration Rate (gpd/in.mi)	(B15) Downstream Equilibrium Average Measured	(B16) Upstream Equilibrium Average Measured

Exhibit 2

Flow Isolation ASCII Format

Sewerage and Water Board of New Orleans

(B17) Upstream Equilibrium Average Measured	(B18) Upstream Equilibrium Average Measured	(B19) Upstream Equilibrium Average Measured	(B20) Average Infiltration Rate

Exhibit 2

Flow Quantification Standards
Flow Monitoring

A. Introduction

Continuous short-term monitoring is used in I/I and SSES Programs to monitor flow rates for a variety of flow conditions and to ultimately determine the quantities of flow components making up the total flow in dry weather and wet weather conditions. A simultaneous installation of several continuously recording flow meters will be planned at selected locations in the tributary area of study. The monitoring period shall be at least eight weeks, although the actual monitoring period will be determined on the basis of the precipitation that occurs, along with consideration of the monitoring goals and objectives.

A continuous short-term flow monitoring program includes the following components:

- Simultaneous flow monitoring sites
- Continuous monitoring period duration of at least eight weeks
- Accurate measurement record of depth and velocity at pre-determined time intervals
- Continuous record of flow depth, velocity, and flow direction.
- Rainfall monitoring during the same period (see Rainfall Measurement Standard)

The completion of any hydraulic study of an existing sanitary sewer system will require the successful completion of a flow monitoring program. The following standard is for the selection, location, installation and data collection procedures as set forth by the Sewerage and Water Board of New Orleans (S&WB).

B. Notification Procedures

Flow monitoring procedures necessitate various requirements for notification of both the public and the S&WB. The firm must be familiar with both levels of notification and apply these procedures throughout the contract period.

B.1. Public Notification

In that the predominant amount of flow monitoring will be performed in the right-of-way, notification of residents and commercial property shall be limited to those flow monitor sites located on private property and in easements. Notification will be on a person-to-

person basis. The crew leader shall inform residents and owners when the crew will require access to manholes on private property and what equipment, if any, will be necessary to perform the inspection. The property owner shall be informed that continuous access will be required throughout the duration of the flow monitoring procedure. A flyer with a description of the work to be performed shall be given to the resident or owner during that meeting. If the resident or owner is not available for a meeting the flyer will be left at the residence or commercial property (See Exhibit 1). The firm must eventually meet with the resident/property owner to get permission for repetitive access to the property.

The firm will maintain a data file with a list of all residents and addresses notified during the project time frame. This list will be updated daily and may be reviewed by the S&WB at any point during the project. The data file will include, at a minimum, the resident's name and address and the date of notification for actual flow monitor installation and maintenance.

B.2. S&WB Notification

The S&WB shall be notified of the installation time and date of the flow meter(s) at the agreed upon location(s). This notification will be by fax no later than 7:00 a.m. the day of actual installation. The fax will include a map of the area with the flow meter location clearly marked to show actual work site(s) for that day. An alternative to fax notification would ~~to~~ be to deliver the above information to the S&WB Network Engineering office prior to 7:00 a.m. and prior to the initiation of work for that given day. Location of a drop box will be determined prior to contract award.

Gravity Division: telephone (504) 942-3888, fax (504) 942-3858

If the firm fails to notify the S&WB of crew activity as outlined above, then work will be suspended for that day. Successive failures to notify will require review by S&WB management regarding contract compliance prior to resumption of work.

C. Guidelines for Monitoring and Data Collection

The goal of a short-term monitoring program is to monitor flows from as many significant rainfall "events" as possible to allow subsequent analysis of the relationship between rainfall intensity and volume, and wastewater flow response. The more data that is collected during rainfall periods, the better the relationship that can be developed.

Sufficient data needs to be collected during dry and wet weather periods to define base flow, infiltration, and inflow components of the total flow.

These guidelines are written to ensure consistency of monitoring and data collection and not for the express purpose of defining step-by-step instructions. The flow monitoring team is expected to use their experience and best professional judgment during all phases of flow monitoring.

C.1. Planning

The flow monitoring program will produce a continuous record of flow depth, velocity, and flow direction at each monitored site. The flow data will be used to produce hydrographs for dry and wet weather conditions for each monitored site. Planning the flow monitoring program must at least take into account the following:

- Monitoring period duration
- The number of flowmeters needed
- Selection of locations for flow monitoring
- Selection of equipment
- Type of data needed for subsequent hydraulic modeling.

C.1.a. Monitoring Periods

The first parameter that must be considered is the duration of time the flow monitoring device needs to be in the system to obtain credible hydraulic information. Six to eight measurable rainfall events should be monitored during the program, including at least three significant rainfall events with more than 0.5 inch of rainfall in 24 hours. Also, the monitoring program should include a dry period of at least two weeks. If these events are not achieved within 56 days of the onset of the monitoring program, the firm shall request in writing a time extension, which shall be submitted to the S&WB for approval. This request shall be submitted at a minimum one week prior to completion of the 56 day monitoring period.

Monitoring is usually performed during months that historically have more precipitation. The National Weather Service or NOAA are sources that can provide this information for the New Orleans area.

Wastewater flows shall be monitored during historically dry weather seasons also to examine if there are any seasonal differences between groundwater infiltration in wet

seasons versus groundwater infiltration in dry seasons. Two to four weeks of flow monitoring data will be obtained to sufficiently meet this goal. The firm shall inform the S&WB of the proposed monitoring periods and any deviations that may occur during the actual monitoring.

C.1.b. Flowmeters

The number of flowmeters depends on the size of the study area, topography, and the system configuration. The typical range of meter density is approximately one meter every 20,000 to 40,000 linear feet of sewer. Selection of smaller sewered areas will be determined by an evaluation that considers the quantity of flowmeters versus the other field investigations that will need to be done and the magnitude of the problems in the area. At a minimum, 20% of the sub-basins monitored will be a maximum of 40 acres in size. Age of the sewers or materials of construction should also influence the evaluation. For example, an older part of the City with older sewers may be expected to have greater amounts of I/I than newly developed parts of the City. Also to be considered are areas of known I/I problems, or collection systems that were constructed with sewer materials or manhole types that are known to be associated with greater amounts of I/I. These areas will be considered for a greater density of flowmeters than other areas. In addition, the number and location of existing flowmeters in the tributary area affects the number of temporary meters. With more existing meters in a tributary area, fewer temporary meters will be necessary.

Additional flow meters may be necessary for monitoring flow inputs and flow outputs from the sub-basin. Flow inputs that originate from other sewer systems or sub-basins that do not currently have meter stations will need to be monitored by the firm in order to isolate flow quantities not generated in the sub-basin being evaluated. System cross-connections may exist between sub-basins and will need to be monitored in some manner to account for flows. The firm will evaluate the sub-basin to assure itself that the most effective and efficient number of flowmeters are used to obtain the information the S&WB requires to meet its SSES needs.

C.1.c. Site Selection

Potential locations for flowmeter installations will be reviewed for hydraulic characteristics and accessibility prior to installation. Sewer maps must be reviewed and then verified with a site visit to assess suitability of conditions. The installation site should possess the following characteristics:

- Sewers upstream and downstream of the installation manhole should be free of debris, grease, and sediment. Debris and sediment are usually indicators of poor slope, velocity, or the possibility of sewage backup because of downstream conditions.
- Smooth straight transition between inlet and outlet pipes and the manhole channels.
- Manhole should not have side inlets entering the manhole. Preferably there will only be one entering and one exiting line in the manhole to be monitored. Manholes with additional lines shall be reviewed and approved by the S&WB prior to flow monitor installation. Also, the manhole recommended should not have a severe change of direction in the channel with respect to the entering and exiting pipes.
- The sewer should not surcharge on a regular basis or be close to an interceptor that surcharges; the monitoring site should be of sufficient distance upstream of pump stations so that wet well levels will not affect flow.
- The monitoring site will allow the velocity sensor to be mounted at or near the bottom of the inlet pipe to the manhole.
- The installation manhole will allow for meter probe or sensor placement within the upstream and/or downstream pipe.
- Sewers upstream and downstream of the monitoring site should be free of excessive directional or slope changes.
- Pipe cross-sections should be circular or rectangular. Egg-shaped or odd-shaped cross-sections shall be avoided.
- Minimum flow level should be at least 2 inches.
- Minimum velocity should be greater than 1 foot per second.
- Sewers should have base flows that tend to have uniform/steady-state flow.
- Sites shall be accessible by a standard-equipped field crew.

The following types of manholes or situations should be avoided for safety reasons:

- Sewers where wastewater temperatures exceed 105 F°
- Drop manholes
- Sewers that convey wastewater with a high degree of industrial discharges
- Manholes located in busy roads and intersections
- Stepped or offset manholes

- Hazardous conditions to personnel (structural integrity, access, gasses, etc.)

Sewers will be considered for hydraulic cleaning by the contractor prior to installation of flow monitoring equipment. The cleaning equipment will be capable of removing sand, grease, rocks, roots, and other deleterious materials and obstructions from sewer mains and manholes. All solids or semi-solids resulting from the cleaning operations shall be removed from the site and deposited at the grit facility located at the Sewerage and Water Board East Bank Sewage Treatment Plant at 6501 Florida Avenue or another Board approved facility within Orleans Parish. Only trucks utilizing mechanical scrapers will be allowed to dump at Board approved facilities. The removal of material from the grit chambers of the cleaning trucks or trailers by means of pressurized water will not be permitted.

C.2. Safety

Planning and addressing safety concerns for traffic and confined space entry must be considered before work begins, to ensure that proper procedures are followed by the field crews. Where manholes are located in the streets or driveways, adequate traffic safety devices, including safety cones, signs, flashing lights, and other necessary safety equipment must be used. The S&WB and the Louisiana Department of Transportation and Development requires traffic safety procedures to be followed when work is conducted in street or highway right-of-ways. Installation, maintenance, and calibration of flowmeters will require entering the manholes. Entrance into any manhole is considered a *Permit-Required Confined Space Entry* and all NIOSH-OSHA and S&WB safety standards are applicable and compliance is mandatory.

The firm must provide the S&WB with a letter of intent to follow all applicable federal, state, and local safety standards as necessary for the work to be performed. Failure to meet safety standards will result in immediate shutdown of the field crew operations and a mandatory meeting with safety management.

C.3. Set-up

Installation procedures of the flow monitoring equipment will vary depending on the type of flowmeter selected, and therefore procedures stipulated by the manufacturer should be considered along with the firm's experience with the equipment.

Many flowmeters used for temporary flow monitoring in open channels are based on the depth-velocity discharge method. Sewers selected for flow monitoring will have cross-sections that are symmetrical with respect to a vertical axis drawn through the midpoint to the cross-section. The flowmeter sensor will be placed on the sewer invert where the vertical axis intersects the bottom if possible. For sewers with constantly high flow levels or excessive debris and sediment buildup, an alternative meter site will be considered. If the flow monitoring site must be located at a manhole with previously noted adverse conditions mounting on the side of the sewer may be recommended but will require substantiation from the firm. The accuracy of this installation, in general, will be reviewed and tested to assure the probe location does not adversely affect the outcome of the monitoring.

Flow and depth measurements will be recorded every 5 minutes.

A flow monitoring program will also take into account the data that will be needed for hydraulic models of the collection system. Most hydraulic models require the input of:

- Average, minimum, and peak base wastewater flow (during dry weather/low groundwater conditions)
- Average, minimum, and wet weather peak infiltration
- Inflow rates for various rainfall events and projected I/I for design rainfall events
- Measurable variations in sediment

C.4. Equipment

Most portable flowmeter systems consist of three primary hardware ingredients: the mounting bands, velocity/depth sensors, and metering device/control unit, which includes the CPU, solid-state memory system, and synchronized clock. The selection of flow monitoring equipment includes several factors. At a minimum, the selected flowmeter system will include the following features:

- Ability to measure depth (level) with ultrasonic or pressure sensors. Ability to measure depth (level) to an accuracy of 0.1 inch. Ability to measure flow levels ranging from 2 inches in depth to a level that the deepest manhole in the drainage area may potentially experience (that is, the ability to measure surcharged conditions).
- Ability to measure depth and velocity when flow is surcharged
- Ability to measure velocity by profile or other averaging methods
- Flow monitoring device with a rated accuracy of plus or minus five (5) percent
- Design of the flowmeter sensor minimizes the effect on the wastewater flow
- Ability to record at varying time intervals to as low as 2-minute intervals
- Installation of flowmeter probes inside the pipe; and equipment installation entirely inside the manhole
- Battery-powered electronics, solid-state device
- Data storage with memory chips, so that stored data can be read and interpreted in the field
- Ability to interrogate the unit at the installation location in order to obtain data in the field
- Rapid service, repair, or replacement provided by manufacturer. Once the monitoring program has begun, if a meter fails, a repair or replacement unit shall be installed in less than 24 hours from the time it is found to be defective
- Materials are durable and corrosion-resistant
- Sensing elements will conform to ratings for NEC Class 1, Division 1, Group D locations and be able to withstand submergence
- System will satisfy specific installation circumstances such as access issues, range of pipe diameters, depth of manholes, and any access structures other than manholes.
- Flow monitors and rain gauges shall be synchronized to within $\pm$ 15 seconds of each other and to within $\pm$ 15 seconds of Central Standard Time.

C.4.a. Calibration

Each manufacturer recommends different procedures for calibration. Calibration will be done during initial set-up of the flowmeter and will be checked every week to assure accuracy. Field calibration will be performed by manually measuring depth and velocity conditions over a range of flow levels at each monitoring site with the use of a separate portable velocity meter and depth gage. Velocity will be manually measured with a

portable device to check the equipment that automatically integrates area and velocity to produce flow rates. If meter measurements from the installed unit do not match field verification measurements, then the meter will be adjusted or replaced. Severe discrepancies will be reviewed and additional verification measurements shall be taken. Large discrepancies may indicate the need to replace a meter.

In order to develop a mean velocity that will be used in the calculation of flow, it is necessary to obtain velocities for different depths of flow, or a velocity profile. Typically, when there is three inches of flow or less, a mean velocity of 0.9 times maximum velocity is used. With flow depths greater than 3 inches, the preferred method of obtaining a velocity profile is by measuring velocity at 0.2, 0.4, and 0.8 times depth for three cross-sections along the width of flow: between the left sewer wall and the center, at the center, and between the center and the right sewer wall. The average of these nine readings is computed to represent the average velocity. A portable velocity meter shall be used to obtain these velocity measurements. Manual measurements of the flow depth from inside the manhole shall be done concurrently with the velocity measurements. These velocities and depths will be recorded on the site calibration form. These depths and velocities are compared to real-time meter readings immediately with the manual measurements. At the completion of the velocity profile, for flows where the depth is less than 12 inches, the flow level must be within 10% of the original depth as measured at the onset of the calibration. This percentage shall be 5%, for flow depths in excess of 12 inches. If depths change beyond these acceptable percentages during the calibration process, the profile shall be repeated when the flow is more stable. Also a comparison between the calibration data and the flow monitor data will be used for verification of data and consistency.

This information is used to develop a site calibration coefficient for each monitoring site. This value is used to convert the point velocity measurement from the sensor to an average velocity for the entire pipe cross-section. The coefficient is programmed into the meter along with other information such as the size and shape of the sewer. Once the site calibration coefficient is determined, depending on the equipment being used the coefficient should be downloaded into the flowmeter with the other site-specific information. Then real-time flow readings will be taken to establish a record of flow measurements for the particular site. This data will be recorded on the site calibration form.

A series of calibration readings from the independent meter will be obtained at each site at various times during the diurnal flow pattern. The on-site maintenance visits must be scheduled so that calibration readings at low, medium, and high flow levels are obtained. Low flow calibration readings are typically collected at night between 1:00 am and 5:00 am when no wet weather has occurred for several days. Medium or average flow calibration readings are collected during the daytime hours, and flow calibration readings for peak flows are collected during or immediately following rainfall.

C.4.b. Maintenance

Immediately after installation of the flowmeters, a regular program for maintenance shall be provided to assure proper meter and sensor operation. At a minimum, flowmeter maintenance must be performed twice weekly. During the first week, the sites will be inspected two or three times. Following the first week, an assessment will be made on the basis of site and flow conditions that determines the level of maintenance required thereafter.

Proper monitoring of flow requires a clean channel for the meter. Therefore, on-site visits will include inspection of the channel and manhole to determine if there has been any debris or siltation build-up in the channel or on the flow monitoring equipment that will disrupt or prevent acquisition of flow information. A site visit before and after a major storm event is advisable to confirm meter conditions and condition of the channel.

C.5. Analysis and Documentation

Documentation of all field work is mandatory and will involve the use of S&WB generated forms and files. All reports shall include the following general information for each site:

- Installation date
- Inspection crew
- Basin
- Sub-basin
- Main/lateral number(s)
- Sewer Map Number
- Street Location
- Flowmeter number and serial number of unit

- Description of flowmeter location (sewer diameter in inches, nearest street intersection) with a plan view of the area
- Monitoring period

The flow monitoring data that shall be reported are the following:

- Date
- Recording time increment (time period over which measurements are averaged)
- Measurement time increment
- Depth of flow (inches)
- Velocity of flow (feet per second)
- Flow rate (MGD)

Data collected must be reviewed for accuracy. Unusual data such as negative velocities or constant flow and/or depths will be evaluated and reviewed. If it is apparent that it is erroneous or misleading, that data shall be marked erroneous with an explanation identifying possible reasons. Other data considerations include if upstream and downstream sets of flowmeters have been installed, the upstream and downstream flows should balance when flows from the evaluated system have been determined.

For each monitored location, minimum data presentation will include:

- Graphical plot of all rainfall events for each rain gauge with cumulative rainfall totals.
- Tabulated printout of rainfall for each rain gauge with cumulative totals.
- Graphical plots of uncalibrated depth, flow and velocity data for each monitor to a scale such that individual storms can be easily examined.
- Details of any equipment failure or locational problems, e.g. silting, excessive ragging, high, low or layered/variable velocity and an indication of the "drift" in depth measurement for each monitor.
- Summary of the week's results including comments on the suitability of monitor sites and rain gauge locations and rainfall events.
- Copies of the site check sheets of velocity and depth.

The software used to produce the graphical presentation of the hydrographs will have the capability of incorporating rainfall intensity data associated with each site. Additional graphical and tabular information the firm deems important and relevant to the project should also be included.

D. Quality Data Review

It is the S&WB's intention and goal to obtain accurate and complete flow monitoring data. As part of the effort to accomplish this goal, the S&WB has prepared these guidelines and is requiring a quality control program to be administered.

The firms conducting flow monitoring for the S&WB are required to employ personnel as necessary to check field data for conflicts, consistency, completeness, and accuracy of data. A log of all deviations will be maintained. Deviations and questionable data that require adjustments to equipment or procedures, corrections, or verification shall be submitted to the firm's field crews for appropriate adjustments, correction, or field verification. Any correction of data shall be made prior to submittal of the data to the S&WB. The firm shall submit the raw data along with the corrected data. The S&WB may at its discretion use the S&WB's or firm's crews to check the field work of the firm.

During the process of flow monitoring the firm shall collect data from the flowmeter on a bi-weekly basis and review this data to determine its accuracy and reliability. Should the data indicate the flowmeter is not operating properly (i.e. flow line is a straight line for long periods of time, flows go to zero all day, etc.) the firm shall report this to the S&WB and request in writing additional monitoring time. Complete and accurate flow information is the end result the S&WB is looking for.

E. Data Format, Field Forms, and Electronic Media

The S&WB requests all firms performing this work to follow standard procedures as to the recording of information collected at the flow meter locations and the generation of electronic media files for submittal to the S&WB. All other reporting functions are typically found in the software provided by the equipment vendor or in the firm's reporting format and the data can be reported in tabular and graphical formats in the format the firm deems most effective and efficient. The format of the final presentation of this information shall be at the firm's discretion.

E.1. Field Form

The S&WB will require the use of its standardized flow monitoring field forms for installation, maintenance, and calibration for those firms conducting flow monitoring. Guidelines and expectations for the type of information to be gathered during the flow monitoring period are outlined in a previous section. Each flow monitoring crew will become familiar with the S&WB's forms. Additional information that is not currently identified on the S&WB forms will be noted on the reverse side of the form.

Field forms must be prepared for the reconnaissance and installation of each flowmeter. The Flow Monitoring Reconnaissance & Installation Form is shown in Form 1. This form includes an area for a sketch of a location map showing the flow monitoring manhole with respect to the local surroundings and manhole installation sketches (plan and cross-sectional views showing the exact placement of the meter and probe within the manhole). A new form shall be prepared if the probe or sensor is relocated within the same manhole at a later time during the flow monitoring period. After installation this form will be used to acknowledge each visit whether calibration of the meter takes place or not.

The Flow Monitoring Calibration Form (Form 2) must be used for recording data during each site calibration and for conducting velocity profiles at each site. The "Comments" section should include notes on whether real-time measurements are consistent or inconsistent with measurements recorded during previous visits, and notes on investigation and correction of any problem contributing to inconsistent measurements.

E.2. Data Transfer and Electronic Media

Certain documented information will be transferred to an electronic format for inclusion in the S&WB's Cass Works database. The information will be submitted on a PC-compatible 3.5-inch high density floppy diskette in ASCII format, tab delimited. This ASCII layout must be followed for all transfer of identified data to the S&WB, and additional information beyond the formatted fields may also be included as hard copy included with the disk.

Information on each flowmeter installation will be formatted in ASCII as shown in Exhibit 2. The first line of the ASCII file will include the heading line as shown. The number of rows or records will be equal to the number of flowmeter locations, and each record will include flowmeter installation information on a specific flowmeter.

F. Deliverables

Several deliverables will be required throughout the duration of the project. They will include installation, maintenance and calibration forms for the equipment and reports during and at the completion of the project.

At the beginning of the flow monitoring procedure, Installation forms (Form 1) will be required to be submitted to the S&WB. During the actual flow monitoring period the firm must maintain, for each monitored site, a maintenance and calibration log (Form 2) that will be included in the final document. A weekly report (Form 3) showing the firm's activities and accomplishments will be required. Form 3 is to be used to report actual visits to each meter site during a given week in place of sending copies of Form 1, which should remain with the field crews. Also included on Form 3 is the Action Order Request section for notifying the S&WB of problems that will need their assistance to rectify.

A meeting between the firm and the S&WB will be required no more than thirty days after the completion of the flow monitoring phase. The purpose of this meeting will be to discuss the results of the flow monitoring and the format of the final report. The draft version of the final report will then be submitted within forty-five days of the above meeting. The original field forms will be included in the report for review and comment. These items will be returned with comments for finalization. The original field forms are to be included as an appendix to the finished original Monitoring Program Report. Six additional copies of the Monitoring Program Report, one with copies of all the forms, will be required for completion of the project.

Flow Monitoring Installation & Reconnaissance Form
Guidelines for Data Collection

A. *GENERAL*

A1. **Inspection Date**. Enter the date of installation.

A2. **Inspection Crew**. Enter initials of company or organization doing installations and initials of crew - person completing the form should enter his/her initial's first. Example XYZ, Inc. - REN, JPG.

A3. **Basin**. Enter the name of the major basin or one letter code.

A - Lakeview	F - Gentilly
B - Carrollton	G - Ninth Ward
C - Uptown	H - Algiers
D - Mid-City	I - South Shore
E - CBD/FQ	J - New Orleans East

A4. **Subbasin**. Enter the sub-basin designation.

A5. **Main/Lateral Number**. Enter the main or lateral line number that is being inspected.

A6. **Sewer Map Book Number**. Enter the S&WB map number which shows the area being inspected.

A7. **Manhole Number.** Enter manhole number. **Blank if not coded**

A8. **Street Location**. Enter the address or other identifier.

B. *INSTALLATION DATA*

B1. **Flowmeter Manufacturer**. Enter the name of the manufacturer of the flowmeter being installed.

B2. **Flowmeter Model Number**. Enter the model number of the flowmeter being installed.

B3. **Flowmeter Serial Number**. Enter the serial number of the flowmeter being installed.

B4. **Manhole Depth (feet)**. Enter the depth of the manhole, measuring from the rim to the invert.

B5. **Manhole Diameter (inches)**. Enter the barrel diameter of the manhole.

B6. **Pipe Material**. For the sewer line in which the meter probe is installed, enter the material the pipe is made of.

B7. **Pipe Diameter (inches)**. Enter the pipe diameter of the pipe the flow meter is being installed in.

B8. **Weather**. Enter the weather condition at the time of the installation of the flowmeter.

B9. **Ground**. Enter the ground conditions (dry, moderate, or wet) at the time of the installation of the flowmeter.

C. *RECONNAISSANCE*

C1. **Date**. Enter the date of the inspection.

C2. **Time**. Enter the time the velocity and depth measurements were taken.

C3. **Velocity (fps)**. Enter the velocity of the flow as recorded by the in-place flowmeter.

C4. **Depth of Flow (inches)**. Enter the depth of the flow as recorded by the in-place flowmeter.

C5. **Depth of Debris (inches)**. Enter the depth of debris measured at the time of the inspection.

C6. **Surcharge Evidence**. Indicate if there had been evidence of surcharged conditions.

C7. **Surcharge Depth (feet)**. Enter the depth of the surcharge. This should be a depth measured from the invert.

C8. **Battery Power**. Check to see power capacity is sufficient for operating the meter until the next visit.

C8. **Comments**. Enter any comments relative to the condition of the meter, manhole, pipe, or any indication of surcharged condition in addition to the above.

Flow Monitoring Calibration Form

A. *GENERAL*

A1. **Basin**. Enter the location by address, or for interceptors, the name of the interceptors.

A - Lakeview	F - Gentilly
B - Carrollton	G - Ninth Ward
C - Uptown	H - Algiers
D - Mid-City	I - South Shore
E - CBD/FQ	J - New Orleans East

A2. **Subbasin**. Enter the sub-basin designation.

A3. **Main/Lateral Number**. Enter the main or lateral line number that is being inspected.

A4. **Sewer Map Number**. Enter the S&WB's map number which shows the area being inspected.

A5. **Manhole Number.** Enter manhole number. **Blank if not coded.**

A6. **Street Location**. Enter the address or other identifier.

A7. **Pipe Diameter (inches)**. Enter diameter of pipe in which velocity probe is installed.

B. *CALIBRATION DATA*

B1. **Calibration Date**. Enter the date of calibration.

B2. **Calibration Time.** Enter the time the calibration was performed.

B3. **Calibration Crew**. Enter initials of company or organization doing calibrations and initials of crew - person completing the form should enter his/her initial's first. Example XYZ, Inc. - REN, JPG.

B4. **Measured Depth (inches)**. Enter the depth of flow in the channel close to the velocity probe.

B5. **Meter Indicated Depth (inches)**. Enter the depth of flow as recorded by the installed flow meter.

B6. **Depth of Debris (inches)**. Enter the depth of debris in the channel of the manhole.

B7. **Left 0.2 (fps)**. Enter the reading at this point in the flow stream. See diagram.

B8. **Left 0.4 (fps)**. Enter the reading at this point in the flow stream. See diagram.

B9. **Left 0.8 (fps)**. Enter the reading at this point in the flow stream. See diagram.

B10. **Center 0.2 (fps)**. Enter the reading at this point in the flow stream. See diagram.

B11. **Center 0.4 (fps)**. Enter the reading at this point in the flow stream. See diagram.

B12. **Center 0.8 (fps)**. Enter the reading at this point in the flow stream. See diagram.

B13. **Right 0.2 (fps)**. Enter the reading at this point in the flow stream. See diagram.

B14. **Right 0.4 (fps)**. Enter the reading at this point in the flow stream. See diagram.

B15. **Right 0.8 (fps)**. Enter the reading at this point in the flow stream. See diagram.

B16. **Velocity Average or Reading (fps)**. For flows less than 3" in depth enter the single reading recorded by the portable meter used for calibration of installed meter. For flows in excess of 3" used the averaged flow as calculated form the nine readings taken at the various locations in the flow.

B17. **Installed Meter Reading (fps)**. Enter the flow rate as shown on the installed meter during the calibration procedures.

Notice

Flow Monitoring
Sanitary Sewer Survey

Dear Resident,

Firm's Name is under contract with the S&WB to perform inspections and physical surveys of the City's existing sanitary sewer system. The study will require the inspectors to locate, inspect and enter manholes in the streets and easements and possibly install monitoring equipment for a short period of time. Installation of equipment will require continued access during the monitoring period. This could be as frequently as every other day or as infrequently as once every week. In that some easements are located beside or behind private residences, this will require the inspector(s) in some cases to enter onto private property to perform these assignments. We would like to coordinate the survey process with those residents with manholes in their yards. According to existing engineering information a manhole is located on your property. Please contact me at your earliest convenience so that we may coordinate this effort

Thank you for your cooperation

Project Manager
Firm's name
Firm's phone number

Exhibit 1

Flow Monitoring Installation & Reconnaissance

Sewerage and Water Board of New Orleans

Project Title _____

A - General

Installation Date:_____ **Manhole No.:**_____

Installation Crew:_____ **Main/Lateral Number:**_____

Basin: _____ **Sewer Map Number:**_____

Subbasin:_____ **Street Location:**_____

B - Installation Data

Flowmeter Manufacturer:_____ **Manhole Depth:**_____

Flowmeter Model Number:_____ **Manhole Diameter:**_____

Meter Serial Number:_____ **Pipe Material:**_____

Pipe Diameter:_____

Weather:	**Ground:**
① Dry	① Dry
② Moderate	② Moderate
③ Wet	③ Wet

C - Inspection Data

Date	Time	Velocity	Depth of Flow	Depth of Debris	Surcharge Evidence	Surcharge Depth	Battery Power	Comments

Form 1

D - Sketch:
(Show Placement of Flow Monitoring Device include plan view of area and profile of structure)

E. - Comments

Flow Monitoring Calibration Form
Sewerage and Water Board of New Orleans
Project Title _____

A - General

Basin: _____ **Main/Lateral Number:** _____ **Manhole No:** _____

Subbasin: _____ **Sewer Map Number:** _____

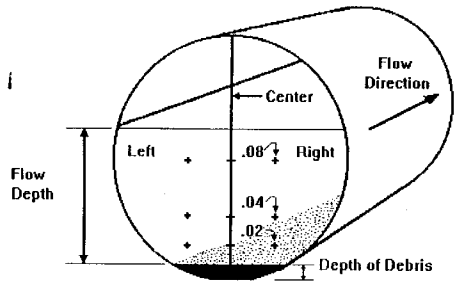
Pipe Diameter: _____ **Street Location:** _____

B - Calibration Data

Sewer flows less than 3 inches in depth require only one reading at the center of the channel and at half the flow's depth.

Date	Time	Crew	Site Visit Measured Depth	Installed Meter Indicated Depth	Depth of Debris	Left 0.2	Left 0.4	Left 0.8	Center 0.2	Center 0.4	Center 0.8	Right 0.2	Right 0.4	Right 0.8	Site Visit Veloci Average or Reading	Installed Velocity Met Reading

D - Sketch: (Show Placement of Flow Monitoring Device include plan view of area and profile of structure)



E - Comments

Monitoring Report

Sewerage and Water Board of New Orleans
Project Title _____

Weekly Accomplishment Report
Week Ending:_____

A. - Work completed

Number of flow meters installed _____
Number of flow meters interrogated _____
Number of rain gauges installed _____
Number of rain gauges interrogated _____

Days worked _____
Rain days _____

Date	Flowmeter number	Depth of Flow	Velocity of Flow	Flow Rate	Rain gauge Number	Total Rain

B. - Action Order Request

Basin	Sub-basin	Main/ Lateral Number	Flow Meter Number	Rain Gauge Number	Problem encountered - Action requested

Form 3

Flow Monitoring I/R ASCII Format

Sewerage and Water Board of New Orleans

(A1) Inspection Date	(A2) Inspection Crew	(A3) Basin	(A4) Subbasin	(A5) Main/Lateral Number	(A6) Sewer Map Number	(A7) Manhole Number	(A8) Street Location	(B1) Flowmeter Manufacturer	(B2) Flowmeter Model No.	(B3) Flowmeter Serial No.	(B4) Manhole Depth	(B5) Manhole Diameter	(B6) Pipe Material	(B7) Pipe Diameter

Exhibit 2

Flow Monitoring I/R ASCII Format
Sewerage and Water Board of New Orleans

(B8)	(B9)	(C1)	(C2)	(C3)	(C4)	(C5)	(C6)	(C7)	(C8)
Weather	Ground	Date	Time	Velocity	Depth of Flow	Depth of Debris	Surcharge Evidence	Surcharge Depth	Comments

Exhibit 2

Flow Monitoring Calibration Form ASCII Format

Sewerage and Water Board of New Orleans

(A1)	(A2)	(A3)	(A4)	(A5)	(A6)	(A7)	(B1)	(B2)	(B3)	(B4)	(B5)	(B6)	(B7)	(B8)	(B9)	(B10)	(B11)	(B12)	)	(B14)	(B15)	(B16)	(B17)
Basin	Subbasin	Main/ Lateral Number	Sewer Map Number	Manhole Number	Street Location	Pipe Dia.	Calibration Date	Calibration Time	Calibration Crew	Site Visit Measured Depth	Installed Meter Indicated Depth	Depth of Debris	Left 0.2	Left 0.4	Left 0.8	Center 0.2	Center 0.4	Center 0.8	Right 0.2	Right 0.4	Right 0.8	Site Visit Velocity Average or reading	Installed Velocity Meter Reading

Exhibit 3

Field Investigation Standards
Manhole Inspection

A. Introduction

Manhole inspection and sewer line lamping are two of several methods used to determine the physical condition of a sewer system. Manhole inspection is often performed in an area previously identified or suspected of having excessive Infiltration /Inflow (I/I). The purpose of manhole inspections is to identify sources of I/I, examine the structural condition of the manhole and to update the sewer system inventory.

There are two types of manhole inspection. The first type is an "above ground inspection" that is performed from the surface and includes examining the condition of the surface around the manhole (including the manhole lid), manhole frame, and the barrel and bottom of the manhole. The second type is an "internal inspection" that includes the examination of the condition of the inlet and outlet sewers, a more rigorous inspection of the barrel, bench and channel, in addition to the items done for above ground manhole inspection. Full inspection requires manhole entry in order to lamp (shine a beam of light up a pipe) the inlet and outlet sewers. In shallower manholes, lamping can sometimes be accomplished without manhole entry depending on site conditions. Newer technology using cameras and video tape may also be used to conduct "internal inspections" without entering the manhole.

Manhole inspection is best performed during periods of high groundwater and low wastewater flow so that more of the physical conditions of the manhole, including evidence of infiltration, can be observed. Manhole inspections may also be conducted concurrently with flow monitoring, smoke inspection, dyed water inspection and television inspection. Dyed water inspection can be used to help identify sources and severity of manhole I/I.

B. Notification Procedures

Inspection procedures necessitate various requirements for notification of both the public and the Sewerage & Water Board of New Orleans (S&WB). The firm must be familiar with both levels of notification and apply these procedures throughout the contract period. Those procedures that may require notification of the public through the use of

neighborhood meetings will include further coordination with not only the S&WB but agencies of the City.

B.1 Public Notification

Because most manhole inspections will be performed in the street right-of-way, notification of residents and commercial property owners shall be limited to those manholes located on private property and/or in easements that require special access. Notification will be on a person-to-person basis. The crew leader shall inform residents and owners when the crew will require access to manholes on private property and what equipment if any will be necessary to perform the inspection. A flyer with a description of the work to be performed shall be given to the resident or owner during that meeting. If the resident or owner is not available for a meeting the flyer will be left at the residence or commercial property (see Exhibit 1).

The firm will maintain a log with a list of all residents and addresses notified during the project time frame. This log will be updated daily and may be reviewed by the S&WB at any point during the project. The log will include at a minimum the residents name and address, and the date of notification for actual inspection.

B.2. S&WB Notification

The S&WB shall be notified on a daily basis of the area to be inspected. This notification will be done by fax received no later than 7:00 a.m. the day of actual inspection. An alternative to fax notification would to be to deliver the above information to the Gravity Division office prior to the initiation of work for that given day. Location of a drop box will be determined prior to contract award. The fax will include a map of the area with manholes clearly marked to show actual work sites for that day.

Gravity Division: telephone (504) 942-3888, fax (504) 942-3858

If the firm fails to notify the S&WB of crew activity as outlined above, work will be suspended for that day. Successive failures to notify will require review by S&WB management regarding contract compliance prior to resumption of work.

C. Guidelines for Inspection and Data Collection

These guidelines are written to provide consistency of data collection and not for the express purpose of defining step-by-step instructions. The group responsible for conducting manhole inspections is expected to use their experience and best professional judgment during all phases of manhole inspection.

The field procedures for manhole inspection and data collection include; Planning, Safety, Set-up, Equipment, and Inspection and Documentation. Field Inspection includes surface inspection and internal inspection.

C.1. Planning

The planning required to perform manhole inspection is straightforward and usually consists of providing the manhole inspection crews with accurate sewer system maps, manhole field inspection forms, photographic equipment and safety equipment. The sewer maps should show line numbers, manhole numbers or station, the manholes to be inspected, and if needed, the sub-basin identifiers.

C.2. Safety

Planning, and addressing safety concerns for traffic and confined space entry must be considered before work begins to ensure that proper procedures are followed by the field crews. Entrance into any manhole is considered a Permit Required Confined Space Entry and all NIOSH-OSHA and S&WB safety standards are applicable and compliance is mandatory. Where manholes are located in the streets or driveways, then adequate traffic safety devices, including safety cones, signs, flashing lights and other necessary safety equipment must be used. The S&WB and the Louisiana Department of Transportation and Development requires traffic safety procedures to be followed when work is conducted in street or highway rights-of-way.

The firm must provide the department with a letter of intent to follow all applicable federal, state and local safety standards as necessary for the work to be performed. This submittal shall also include the name of the firm's safety coordinator with a description of his/her job duties and level of responsibility. Failure to meet safety standards will result in immediate shutdown of the field crew and mandatory meeting with safety department management.

C.3. Set-up

The S&WB has sanitary sewer base maps that show line location, line size, manhole location, manhole station number, and other general information to help locate the sanitary sewer lines and manholes. These maps shall be used to locate the correct manholes for inspection. The correct manhole can be difficult to locate in easements or in congested areas (e.g. intersections), where several manholes may be present and some buried or paved over. Existing manholes not found or additional manholes found will be documented on inspection forms and the sanitary sewer base maps. These corrections will be included in the Weekly Accomplishment Report (see section F. Deliverables).

Once a manhole is located, general information regarding the inspection will be documented before inspection is begun. The general information that will be recorded on field forms includes the following:

- Inspection Date/Time
- Inspection Crew
- Basin
- Sub-basin
- Main/Lateral number(s)
- Manhole Number and Station
- Map Number
- Street location

C.4. Equipment

The firm will provide adequate equipment for the crew to perform all aspects of this inspection in order to obtain the most accurate information possible. In that permit required confined space entry is necessary for completion of all inspection aspects, the firm shall provide all equipment necessary for a safe working condition. All electrical equipment will be properly charged and in good working order. Safety and emergency apparatus in conformance with the section C.2. Safety shall be on-site.

Entry into the manhole can not depend upon the use of existing manhole steps. Without knowledge of the condition of the steps safe entry cannot be assumed. All crews shall

have equipment for alternative methods of entry available for use during the inspection of manholes. This equipment shall be in conformance with section C.2. Safety.

Each inspection team shall have, at a minimum, the following equipment with them in the field at all times:

- Metal detector
- 300 foot measuring tape
- Air mover and hose
- manhole picks and shovels
- First Aid kit
- Various size sewer plugs
- Polaroid camera and film
- Ladder
- 2-way radios
- Safety harness and rope
- Safety cones
- Safety vests
- Fire extinguisher

C.5. Inspection and Documentation

Field inspection can be divided into surface inspection and internal inspection. The surface inspection documents identifiable sources of inflow while the internal inspection documents sources of infiltration. During an internal manhole inspection, line lamping will also be performed.

Surface Inspection. Following the documentation of general information, a surface inspection is begun. Information that will be recorded on field forms from a surface inspection includes the following:

- Location Sketch requested if manhole location is not obvious to normal survey crews (i.e. obstructed view due to vegetation, buildings or other structures)
- Surface around the manhole, type of material and condition of surface material
- Traffic situation at the manhole location
- Weather/Ground conditions
- Type of structure being inspected; manhole, junction box, siphon box, etc.
- If the manhole is subject to ponding, drainage, or flooding.
- Manhole Cover Information; type, fit, condition, pick holes, vent holes
- Cover Frame Information; dimensions, condition, seal, above or below grade, I/I location and quantity (if I/I is unmeasureable, groundwater table is below structure or cracks appear dry, refer to Table 3)
- Chimney Information; depth, diameter, material, condition, I/I location(s) and quantity (if I/I is unmeasureable, groundwater table is below structure or cracks appear dry, refer to Table 3)

- Overflow evidence will be noted

Internal Inspection: Following completion of the surface inspection, an internal inspection shall be performed. Confined space permit entry procedures and all other applicable NIOSH and OSHA safety standards/procedures will be followed (see section C.2. Safety). The type of inspection performed and how information is gathered will be documented on the field forms. Adequate lighting and flash photography are necessary for the correct identification and documentation of the manhole components and defects. Information that will be recorded on field forms from an internal inspection includes the following:

- Cone Information; shape, material, condition, defects, defect location, I/I location(s) and quantity (if I/I is unmeasureable, groundwater table is below structure or cracks appear dry, refer to Table 3)
- Wall Information; dimensions, material, condition, defects, defect location, I/I location(s) and quantity (if I/I is unmeasureable, groundwater table is below structure or cracks appear dry, refer to Table 3)
- Bench Information; material, condition, I/I location(s) and quantity (if I/I is unmeasureable, groundwater table is below structure or cracks appear dry, refer to Table 3)
- Channel Information; material, condition, hydraulic conditions, I/I location(s) and quantity(if I/I is unmeasureable, groundwater table is below structure or cracks appear dry, refer to Table 3)
- Manhole Steps; material, condition
- Surcharge and overflow evidence and level
- Photographs of extraordinary conditions are requested

Comments regarding any unusual manhole characteristics or observations are to be documented in a comment section on the field forms. Examples include loose mortar or bricks, hydrogen sulfide damage, exposed re-bar, dislocated cone, off center frame, open lift holes, etc.

Lamping or visual pipe inspections are performed during the internal manhole inspection. Information regarding the inlet and outlet sewer pipes shall be documented on field forms during the internal inspection of the manhole. If the manhole is not entered, information

regarding inlet and outlet sewer pipes will be documented from the surface inspection. The field forms must indicate how the information was gathered.

The general information that can be gathered from a surface inspection, such as a sketch of inlet and outlet sewer locations, will be documented before entering the manhole, thereby reducing the time a person is in the manhole. Adequate lighting is necessary for the correct identification and documentation of pipe characteristics and defects. The use of mirrors or other devices may be necessary for the examination of wall connections, drop connections, and pipeline conditions. Information that will be recorded on field forms from a lamping (visual pipe) inspection includes the following:

- Repeat general information for cross-referencing
- Sketch the location(s) of inlet and outlet sewer pipes, identify drop connections
- Document line types; primary, service line, diversion, force main, etc.
- Pipeline dimensions, shapes and materials
- Flow depth, velocity and characteristics
- Sediment deposition; depth, location and type
- Pipe Seal at manhole; condition, construction, I/I location and quantity
- Pipeline depths measured from the pipe invert to manhole rim
- Root intrusion condition
- Condition of the pipeline structure; corrosion, cracks, gapped, dropped gaskets, etc.
- Approximate length or number of joints observed from lamping procedure

Comments regarding any unusual inlet and outlet pipeline characteristics or observations are to be documented in a comments section on the field forms. Note whether a pipeline would be difficult to television inspect and include reasons for difficulty, such as, collapsed pipe, offset joints, dropped gaskets, heavy root intrusion etc.

Manholes found in the field, that are not shown on the sanitary sewer base maps, but within the system area under study, will be fully inspected, including line lamping. Payment for additional non-documented manholes inspected will be at the same cost for identified manholes within the area.

D. Quality Data Review

It is the S&WB's intention and goal to obtain accurate, complete and uniform field data for manhole and lamping inspection activities. To assist in accomplishing this goal, the S&WB has prepared these guidelines and is requiring a quality control program to be administered.

The firms conducting manhole and lamping inspections are required to employ personnel as necessary to check field data for conflict, consistency, completeness and accuracy of data as compared with other field data, S&WB supplied drawings and other S&WB supplied data. A log of all deviations from the standard form will be maintained. Deviations and questionable data shall be submitted to the firm's field crews for correction and field verification and noted on the Weekly Accomplishments Report (See section F. Deliverables). The S&WB may at its discretion use the S&WB's or firm's field crews to check the completed field work. At the S&WB's expense and at the stated contract price, up to a maximum of five percent of all manholes in the project will be reinspected by the firm as a quality assurance/quality control procedure. Manhole reinspections must be performed by a crew that did not perform the first inspection. Manholes to be reinspected will be determined by the S&WB. If more than twenty-five percent of the QA/QC manholes show significant deviations from the original inspection, as determined by the S&WB, additional manholes will be requested to be reinspected at the firm's expense. If the S&WB determines that the firm's field work is significantly incomplete or incorrect, the S&WB will require the firm, at their own expense, to redo all necessary field activities.

E. Data Format, Forms and Electronic Media

The S&WB will require the use of its standardized Manhole/Lamping Inspection Field Forms for use by all those conducting inspections for the S&WB. Guidelines and expectations for the type of information to be gathered during a manhole/lamping inspection are outlined in the previous sections. Each manhole/lamping inspection field crew will become familiar with the S&WB form. Additional information that is not currently identified on the existing form(s) such as safety equipment used and entry procedures, etc. will be noted on the reverse side of the form.

The Manhole and Lamping Inspection forms (Form 1 and 1A) will be used by all crews in the field to collect and document information. These inspection forms are intended to standardize information and the format of the information received by the S&WB. Also, all photographs will be mounted and attached to the Inspection forms. Those conducting inspections and those who evaluate the information collected are expected to use their experience and best professional judgment to complete and generate usable and verifiable information for the S&WB.

Information documented on the S&WB forms will also be transferred to an electronic format, as part of the deliverables, for inclusion in a S&WB database. The information will be included on PC-DOS compatible 3.5-inch high density floppy diskette in an ASCII format, tab delimited. The number of lines or records will be dependent on the number of manholes inspected plus the number of manholes that were not inspected, not found or buried. Each record will include the information as shown on the Manhole Inspection ASCII layout and Lamping Inspection ACSII layout (see Exhibits 2 and 3). The first line of the ASCII file will include the heading line exactly as shown. Information that is repeated will also be included for each manhole location, for example, the sub-basin identification will be included for each manhole within that basin. The ASCII layout will be followed for all manhole inspection electronic media data transfer to the S&WB. Additional information beyond the formatted fields may also be included as hard copy attached to the disk.

F. Deliverables

Several deliverables will be expected throughout the duration of the project. Weekly and monthly reports as well as the final submittals are mandatory for the project.

A weekly report with Weekly Accomplishments and Action Order Requests will be submitted to the S&WB Gravity Division office every Monday morning before 10:00 a.m. The form to be used is shown as Form 2. The Weekly Accomplishment Report is a summation of manhole inspections completed by all crews for a given week (a continuous seven day period of time generally Friday to Friday but the department will consider other start/stop dates). The Action Order Request Section will identify any problems encountered during the previous work week that will require resolution before completion of the manhole inspection project. This could include surcharging, lack of

access to manhole, inability to find manhole, etc. Conditions that can be resolved by in-house staff will be addressed and the firm will be notified via the Action Order Request which will be returned to the firm within two weeks noting items resolved and those that need further action with an anticipated date of completion. A final list of all Action Order items shall be generated at the end of the project. This list shall be used to review all requests and assure the department and firm that all items have been addressed and finalized. A final list of all Action Order items shall be generated at the end of the project. This list shall be used to review all requests and assure the department and firm that all items have been addressed and finalized.

A Monthly summary of all work accomplished will be submitted to the department no later than the date specified in the engineering agreement.

S&WB Manhole Inspection Form and electronic media files shall be delivered along with the SSES reports. A draft version of the SSES Report including the original field forms and photographs will be submitted to the department for review and comment by S&WB personnel. These items will be returned with comments for finalization. The original forms, along with the original photographs and videotapes, that were completed in the field are to be included as an appendix to the final SSES report to be submitted to the S&WB. Six additional copies of the SSES report, one with copies of the forms, will also be required for completion of the project.

Manhole Inspection Form
Guidelines for Data Collection

A. ***GENERAL***

A1. **Inspection Date**. Enter the date of inspection.

A2. **Inspection Crew**. Enter initials of company or organization doing inspections and initials of crew - person completing the form should enter his/her initial's first. Example XYZ, Inc. - REN, JPG.

A3. **Basin**. Enter the location by address or for interceptors, the name of the interceptors.

A - Lakeview	F - Gentilly
B - Carrollton	G – Ninth Ward
C - Uptown	H - Algiers
D - Mid-City	I – South Shore
E - CBD/FQ	J - New Orleans East

A4. **Sub-basin**. Enter the sub-basin designation.

A5. **Main/Lateral Number**. Enter the main or lateral line number that is being inspected.

A6. **Sewer Map Book Number**. Enter the S&WB map number which shows the area being inspected.

A7. **Manhole Number**. Enter manhole number. **Blank if not coded.**

B. ***SITE***

B1. **Status**.

1. **Surface Inspected**. Inspected without entering manhole.
2. **Internal Inspected**. Manhole entered during inspection, or videotaped from surface with remote camera.
3. **Not Inspected**. Manhole that is found but not inspected due to hazardous conditions, cover cannot be opened, etc. Explain reason manhole was not inspected.
4. **Not Found**. Manhole was not found.
5. **Buried**. Manhole was found but was buried. (Note the estimated depth below grade.)

B2. **Location**. (Select the one most appropriate)

1. **Paved - Concrete**. Part or all of manhole frame and cover is in paved concrete area.
2. **Paved - Asphalt**. Part or all of manhole frame and cover is in paved asphalt area.
3. **Driveway**. Part or all of manhole frame and cover is in driveway. Note material of construction of driveway i.e., concrete, asphalt, unpaved.
4. **Sidewalk**. Part or all of manhole frame and cover is in a sidewalk.
5. **Curb**. Part or all of manhole frame and cover is in a curb.
6. **Yard-Front**. Manhole located in front yard or front grassed easement.
7. **Yard-Back**. Manhole located in back yard.
8. **Yard-Side**. Manhole located in side yard between structures.
9. **Non-Paved**. Manhole located in non-paved area.
10. **Canal Bottom**. Manhole in canal bottom.
11. **Field**. Manhole located in a field
12. **Golf Course**. Manhole located in a golf course.

B3. **Traffic**.

1. **Two Lane**. Two lane road.
2. **Three-Four Lane**. Three or four lane road.
3. **Highway**. A county, state, or federal highway.
4. **Parking**. Parking lot.
5. **Alley**. Alley
6. **Driveway**. Driveway
7. **Other**. Note,

B4. **Volume/Access**. Enter appropriate description for volume of traffic and/or access to manhole.

1. **Low/Good**. Traffic considerations minimal. Easy to work in traffic to get around work area. Can drive heavy equipment to area.
2. **Medium/Fair**. Traffic considerations moderate. Requires a vehicle and cones to control. Can drive light equipment only to site.
3. **High/Poor**. Traffic considerations high. Requires multiple vehicles, electric signs, and other special traffic control devices. Cannot drive to site.

B5. **Structure Type**.

1. **Manhole -** any configuration of manhole connected to a sewer main/lateral or service line.

2. **Siphon Box**. Siphon exits or enters manhole.
3. **Junction Box**. Tow or more inlet pipes with singular exit pipe.
4. **Other**.

B6. **Ground Condition**.
1. **Dry**. Dry conditions.
2. **Moderate**. Damp ground.
3. **Wet**. Standing water.

C. ***MH COVER***.

C1. **Cover Type**.
1. **Pick Hole**. One or two pickholes on the cover edge.
2. **Pick Slot**. A pickhole which does not go all the way through the cover.
3. **Gasketed**. A cover that has a gasket or groove for a gasket. Also note if frame has gasket or a groove for a gasket.
4. **Bolted**. A cover that is the bolted type with bolt holes and/or bolts. Used primarily in floodplain areas. (Enter number of bolt holes).
5. **Vent**. A cover with multiple holes in the cover on collection sewer and cover with vent stack on interceptors.
6. **Storm**. A cover made for a storm drain.
7. **Other**. Any other type of manhole cover

C2. **Cover Fit**.
1. **Good**. Cover does not rock. About 1/8 inch gap between frame and cover.
2. **Tight**. Cover has little or no gap between frame and cover or is tight on a "side". Difficult to remove.
3. **Loose**. Greater than 1/4 inch gap between frame and cover.
4. **Rocking**. Cover "rocks" when standing on edges of cover.
5. **None**. No Cover. **ADVISE S&WB IMMEDIATELY.**

C3. **Cover Condition**. (Multiple Entry as necessary)
1. **Good**. General condition is sound. No cracks and low corrosion.
2. **No Gasket**. Cover or frame designed to have a gasket does not have a gasket.
3. **No Bolts**. Cover designed to have bolts and is missing or has no bolts.
4. **Corroded/Pitted**. Cover and/or cover bearing surface are pitted with obvious signs of corrosion.
5. **Cracked**. Cover is cracked or broken.

C4. **Number of Holes**. Check appropriate item for the number of holes in the cover. (do not count concealed pick holes or bolt holes).

C5. **Ponding Depth (Inches)**. Estimate the depth of water that can exist over the cover during a 1-year storm event. Use 1/8-inch to 1/4-inch for sheeting action for manholes in paved drainage areas. Try to visualize conditions during intense rainfall. ì0î = no ponding. N/A - canal bottom.

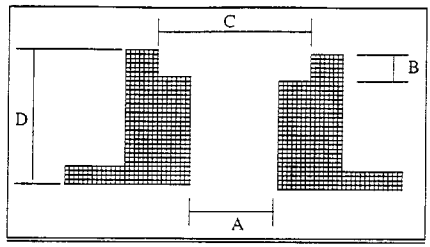
C6. **Grade (+/-) (Inches)**. Measure the rim elevation to adjacent surface elevation. Positive numbers would be for manholes sticking out of the ground and negative for manhole rims located in holes or low lying areas. For manholes on a slope or for manholes with mixed grade "eyeball" an average point and measure.

C7. **Drainage Area (ft x ft)**. Estimate approximate drainage area to manhole. Think in terms of magnitude, i.e., 1 x 1, 10 x 10, 100 x 100, 100 x 500, etc. Do not measure. Visual estimate. N/A - canal bottom.

C8. **Cover Manufacturer**. Note cover manufacturer. The following list are the most common: 1. Bass & Hayes 2. Vulcan 3. Neenah 4. Trinity Valley 5. Other. If #5 is chosen define in comment area what type was found.

D. ***MH FRAME***

D1. **Frame Size (inches)**. Note the dimensions as shown.



A = Clear opening
B = Depth (Cover)
C = Cover Opening at bearing surface
D = Frame depth

D2. **Frame Offset (inches)**. Measure the maximum frame offset from the chimney section if greater than 2 inches.

D3. **Frame Condition**. (Refer to Table 2 - Manhole Structural Rating for condition classifications)

E. ***FRAME SEAL***.

E1. **Frame Seal Condition**. (Refer to Table 2 - Manhole Structural Rating for condition classifications)

E2. **Frame/Frame Seal Inflow**. (Refer to Table 3 - Manhole I/I Flow Rating Schedule)

E3. **Observed Frame/Frame Seal Inflow**. Measure or estimate observed leakage in gpm.

F. ***CHIMNEY***.

F1. **Chimney Depth (inches)**. Measure from bottom of frame to chimney/cone joint. For brick manholes with unclear chimney/cone joints estimate using outside frame diameter as limit of chimney.

F2. **Chimney Minimum Diameter (inches)**. Measure the minimum chimney diameter.

F3. **Chimney Construction**. Note appropriately method of construction.

F4. **Chimney Condition**. (Refer to Table 2 - Manhole Structural Rating for condition classifications)

F5. **Chimney Inflow**. (Refer to Table 3 - Manhole I/I Flow Rating Schedule)

F6. **Observed Chimney Inflow**. Measure or estimate in gpm.

G. ***CONE***.

G1. **Cone Depth (inches)**. Enter the cone depth in inches.

G2. **Cone Shape**. Note appropriately.

G3. **Cone Construction**. Note appropriate type of construction.

G4. **Cone Condition**. (Refer to Table 2 - Manhole Structural Rating for condition classifications)

G5. **Cone Inflow**. (Refer to Table 3 - Manhole I/I Flow Rating Schedule)

G6. **Cone Defect Location**. Check appropriate box. Note that the cone and chimney joint is a chimney seal.

G7. **Cone Defect Quantity**. Check appropriate box.

G8. **Observed Cone Inflow**. Measure or estimate in gpm.

H. ***WALL***.

H1. **Barrel Diameter**. Measure the barrel diameter of the manhole near the bottom of the manhole.

H2. **Wall Construction**. Note appropriate type of construction.

H3. **Wall Condition**. (Refer to Table 2 - Manhole Structural Rating for condition classifications)

H4. **Wall Infiltration**. (Refer to Table 3 - Manhole I/I Flow Rating Schedule)

H5. **Observed Infiltration.** Measure or estimate approximate infiltration

I. ***BENCH.***

I1. **Bench Construction**. Note appropriate type of construction.

I2. **Bench Condition**. (Refer to Table 2 - Manhole Structural Rating for condition classifications)

I3. **Bench Infiltration**. (Refer to Table 3 - Manhole I/I Flow Rating Schedule)

I4. **Observed Bench Infiltration**. Measure or estimate in gpm. Includes bench to wall seal - not bench to channel seal.

J. ***CHANNEL.***

J1. **Channel Construction**. Note appropriate type of construction.

J2. **Channel Condition**. (Refer to Table 2 - Manhole Structural Rating for condition classifications)

J3. **Channel Infiltration**. (Refer to Table 3 - Manhole I/I Flow Rating Schedule)

J4. **Channel Hydraulics**.

1. **Good**. Smooth flow through manhole.
2. **Minor**. Minor turbulence.
3. **Fair**. Some restriction of channel. Channel not smooth.
4. **Poor**. Significant turbulence, poorly formed channel.
5. **Deteriorated**. Hydraulically restricted.

J5. **Observed Channel Infiltration**. Measure or estimate in gpm. Includes channel to bench joint.

K. ***STEPS.***

K1. **Step Construction**. Not appropriate type of construction.

K2. **Step Condition**. (Refer to Table 2 - Manhole Structural Rating for condition classifications)

L. ***OTHER.***

L1. **Evidence of Surcharging (Feet)**. Measure from the channel center (invert \) to the evidence of surcharge.

L2. **Note 1**: Work field at user's discretion. Enter "yes" or "no" if overflow has or has not occurred.

L3. **Note 2**: Work field at user's discretion.

M. ***Comments.***

M1. Comments: Enter notes and memos.

Lamping Inspection Form
Guidelines for Data Collection

General information not necessary if manhole inspection general information has been completed and forms are attached.

A. ***GENERAL.***

A1. **Inspection Date**. Enter the date of inspection.

A2. **Inspection Crew**. Enter initials of company or organization doing inspection sand initials of crew - person completing the form should enter his/her initial's first. Example XYZ, Inc. - TEN, JPG.

A3. **Basin**. Enter the location by address or for interceptors, the name of the interceptors.

A - Lakeview	F - Gentilly
B - Carrollton	G – Ninth Ward
C - Uptown	H - Algiers
D - Mid-City	I – South Shore
E - CBD/FQ	J - New Orleans East

A4. **Sub-basin**. Enter the sub-basin designation.

A5. **Main/Lateral Number**. Enter the main or lateral line number this is being inspected.

A.6. **Sewer Map Number**. Enter the S&WB's map number which shows the area being inspected.

A7. **Manhole Number**. Enter the manhole (or structure) number. **Blank if not coded.**

B. ***SAFETY/CONFINED SPACE ENTRY.***

B1. **Oxygen Level**. Record the tested oxygen level prior to entry.

B2. **LEL Level.** Record the tested LEL level prior to entry.

B3. **Toxic level**. Record the tested toxics level prior to entry.

C. *OBSERVATIONS/LAMPING.*

C1. **Connecting Manhole**. Enter line number and manhole station for manhole at far end of line being lamped.

C2. **Flow Direction**. Note appropriately.

C3. **Pipe Diameter**. Note measured pipe diameter.

C4. **Rim to Invert**. Measurement to the nearest 0.1 feet (not required if Item D3 is completed).

C5. **Visible Distance**. Indicate the distance into the line that can be seen during the lamping procedure.

C6. **Line Type**.

1. **Main/Lateral**. A collector, main, or interceptor sewer.
2. **Diversion**. An interconnection pipe between a primary and parallel sewer.
3. **Force Main**. A force main from a pump station.
4. **Siphon**. A siphon pipe.
5. **Service Line**. A building service line.
6. **Offset Connection**.

C7. **Sewer Shape**. Note appropriate geometric shape.

C8. **Pipe Material**. Note appropriate material of construction.

C9. **Flow Depth (inches)**. Total depth of water at the effluent pipe wall connection.

C10. **Deposition Depth (inches)**. Depth of most significant deposition in channel inside manhole structure.

C11. **Flow Characteristics**. Note appropriately.

C12. **Flow Velocity (fps)**. Note flow velocity.

C13. **Method of Velocity Measurement**. Note appropriately.

C14. **Root Growth**.

1. **None**. No observable root growth.
2. **Light**. Hairline, less than 10 percent of circumference.
3. **Medium**. 10-25 percent of circumference.

4. **Heavy**. 10-25 percent of circumference of multiple joints on one or more joints with greater than 25 percent circumference.
5. **Severe**. Greater than 50 percent of circumference and pipe area.

C15. Pipe Structure.

1. **Good**. No cracks, offsets, breaks.
2. **Radial Crack**. A crack running around the pipe.
3. **Longitudinal Crack**. A crack running along the pipe.
4. **Broken**. Both radial and longitudinal cracks and/or pieces missing.
5. **Minor Corrosion**. Some evidence of corrosion.
6. **Major Corrosion**. More than 1 inch of pipe gone, re-bar showing, or join gaskets showing.
7. **Collapsed**. More than 25 percent out of round or broken. Not allowing passage of camera if TV'd.
8. **Gapped**. One (1) inch or greater gap at pipe joint.

C16. Line and Grade.

1. **Good**. Straight pipe.
2. **Sag**. Dips greater than 1 inch.
3. **Offset Single**. One joint offset greater than 1 inch.
4. **Offset Multiple**. More than one joint offset greater than 1 inch.

C17. Pipe Seal Construction. Note appropriately.

C18. Pipe Seal Condition. (Refer to Table 2 - Manhole Structural Rating for condition classifications).

C19. Pipe Seal Infiltration. (Refer to Table 3 - Manhole I/I Flow Rating Schedule).

C20. Television Inspection. Note appropriately if line should have television inspection. If line is marked 1 = Yes, 2 = No. Add remarks to memo describing the reason(s).

C21. Observed Pipe Seal Infiltration. Measure or estimate in gpm.

C22. Comments: Enter notes and memos.

D. *SKETCHES*

D1. Location Sketch. Show plan view in sufficient detail so that others can find the location at a later time. Street names and house numbers are suggested. This only required for those manholes that are difficult to find and are obstructed from view by vegetation, buildings and other structures. Add north arrow for referencing purposes.

D2. **Manhole Profile**. Show profile sketch of manhole with emphasis on surface features (manhole cover with respect to below or above surrounding grade line) and channels.

D3. **Line/POE.** On the plan view shown on the inspection sheet , show lines going in and out of the manhole. The line number in the sketch shall refer to the line number at the top of the columns on the right hand side of the form titled Observations. For consistency line 1 shall be the primary line carrying flow out of the manhole. Add north arrow for referencing purposes.

Notice

Manhole Inspection
Sanitary Sewer Survey

Dear Resident,

Firmís Name is under contract with the Sewerage & Water Board of New Orleans to perform inspections and physical surveys of the sanitary sewer system. The study will require the inspectors to locate, inspect and enter manholes in the streets and easements. In that some easements are located beside or behind private residences, this will require the inspector(s) in some cases to enter onto private property to perform these inspections. We would like to coordinate the survey process with those residents with manholes in their yards. According to existing engineering information a manhole may be located on your property. Please contact me at your earliest convenience so that we may coordinate this effort

Thank you for your cooperation

Project Manager
Firmís name
Firmís phone number

Exhibit 1

Tables

The following tables identifying definitions, ratings, and visual descriptions shall be used in all correspondence and deliveries to the S&WB.

Table one is a descriptive table of all parts of a manhole that shall be used throughout the standards.

Table 1
Manhole Components

Manhole Component	Definition
Cover	The lid which provides access to the interior of the manhole
Frame	The cast or ductile iron ring which supports the lid.
Frame Seal	Material or device to prevent intrusion of water at joint between the frame and the chimney, at frame and cone, or at frame and flat-top slab
Clear Opening	The smallest dimension through the entry-way into the manhole
Chimney	The narrow vertical section built from brick or from concrete adjusting rings that extends from the top of the cone to the frame and cover
Joint Seal	Material or device to prevent intrusion of water at the joint between precast wall sections or cone and wall section
Cone	The reducing section which tapers concentrically or eccentrically from the top wall joint to the chimney or the frame and cover (sometimes referred to as corbel when make of brick).
Wall	The vertical barrel portion extending just above the bench joint to the cone. Includes grout lines and joints between wall and cone or bench.
Pipe Seal	The material or device at the pipe and wall or cone interface for preventing entry of water
Drop Inlet	Inlet connections entering at both the invert and at some higher elevation through the manhole wall. The height inlet is on grade with the incoming gravity line to facilitate cleaning and inspection. The invert inlet is connected to direct the flows through the channel. Drop inlets can be outside or inside the manhole structure.
Bench	The concrete/brick floor of a manhole generally shaped as a fillet to direct incoming flows to the outlet piping and to minimize build-up. Includes wall/bench joint.
Channel	The shaped flow-way within the bench. Includes bench/channel joint.
Invert	The sewer line of lowest elevation along the bottom of the channel.
Base	The supporting slab structure of the manhole.

Table 2 is the structural rating table to be used in describing those components identified in the Manhole Inspection form. All physical items are identified in this table.

Table 2
Manhole Structural Rating Schedule

Component		Rating/Description				
		1	2	3	4	5
Cover Fit		Good	Tight	Loose	Rocking	None
Cover Condition		Good	No Gasket	No Bolts	Corroded/ Pitted	Cracked/ Deteriorated
Frame		Good	Chipped/ Corroded/Pitted	Cracked	Broken (Missing Pieces)	Deteriorated (Combination of 2,3,4)
Frame Seal		Good	Cracked (1/16i)	Cracked (1/8i) or Misalligned (>3i)	Cracked (1/4i) w/Open Joint	Deteriorated
Chimney	Brick	Sound	Cracked Mortar	Missing Mortar	Missing Bricks	Deteriorated
	Precast/ Poured	Good	Hairline Crack(s)	Cracks (1/16i) Chipped (any)	Cracks (1/4i) Chipped (10%)	Cracks, Pieces Missing, Exposed Reinforcing
Wall or Cone	Brick	Good	Cracked Mortar	Missing Mortar	Missing Bricks	Deteriorated
	Precast/ Poured	Good	Hairline Crack(s)	Cracks (1/16i) Chips (any)	Cracks (1/4i) Chipped (10%)	Cracks, Pieces Missing, Exposed Reinforcing
Pipe Seal-Brick		Good	Cracked Mortar	Missing Mortar	Missing Bricks/ Grout	Exposed Soil, Missing Bricks None
	Precast/	Good	Hairline Crack(s)	Cracks (1/16i) Chipped (any)	Cracks (1/4i) Chipped (10%)	Cracks, Pieces Missing, Exposed Soil, None
Bench	Brick	Good	Cracked Mortar	Missing Mortar	Missing Bricks/ Grout	Exposed Soil, Missing Bricks, None.
	Precast Poured	Good	Hairline Crack(s)	Cracks (1/16i) Chipped (only)	Cracks (1/4i) Chipped (10%)	Cracks, Pieces Missing, Exposed Soil, None
Channel	Brick	Good	Cracked Mortar	Missing Mortar	Missing Bricks/ Grout	Exposed Soil, Missing Bricks, None
	Precast\	Good	Hairline Crack(s)	Cracks (1/16i) Chipped Only	Cracks (1/4i) Chips (10%)	Cracks, Pieces Missing, Exposed Soil, None
Steps		Good	Slight Corrosion/Chip	Corrosion (25%)		

Table 3 is to identify the approximate anticipated flow rates due to I/I. All parts of the manhole that appear on the Manhole Inspection Form are listed in this table.

Table 3
Manhole I/I Flow Rating Schedule

	Rating/Description/Default Flow (gpm)				
	None	**Minor**	**Moderate**	**Heavy**	**Severe**
Component	1	2	3	4	5
Cover	(Based on type of cover, condition, and ponding depth.)				
Frame Seal	0.0	0.2	0.4	0.8	≥1.6 gpm
	No Evidence	Water Marks	Some Soil Present at Cracks	Heavy soil/roots/ 1/8I Gap in Drainage Area	≥ 1/8I Gap in Drainage Area
Chimney	0.0	0.2	0.4	0.8	≥1.6 gpm
	No Evidence	Water Marks 1 Location	Water Marks 2-3 Locations or Mineral Deposits, Joint Leak (<10%)	Multi Water marks Mineral Deposits Joint Leak (<25%)	Multi Water Marks Mineral Deposits Drainage Area Joint Leak (>25%)
Cone	0.0	0.2	0.4	0.8	≥1.6 gpm
	No Evidence	Water Marks 1-2 Locations	Water Marks. 3-4 Locations or Mineral Deposits, Joint Leak (10%)	Multi Water Marks or Mineral Deposits. Joint Leak (25%)	Multi Water Marks Mineral Deposits or Soil Present, Joint Leak (>25%)
Wall	0.0	0.1	0.2	0.4	≥0.8 gpm
	No Evidence	Water Marks 1-2 Locations	Water Marks. 3-4 Locations or Mineral Deposits, Joint Leak (10%)	Multi Water Marks or Mineral Deposits. Joint Leak (25%)	Multi Water Marks. Mineral Deposit or Soil Present. Joint Leak (>25%)
Pipe Seal	0.0	0.1	0.2	0.4	≥ 0.8 gpm
	No Evidence	Water Marks 1-2 Locations	Water Marks. 3-4 Locations or Mineral Deposits. Seal Leak (10%)	Multi Water marks or Mineral Deposits. Seal Leak (25%)	Multi Water Marks. Mineral Deposit or Soil Present. Seal Leak (>25%)
Bench	0.0	0.1	0.2	0.4	≥ 0.8 gpm
	No Evidence	Water Marks 1-2 Locations	Water marks. 3-4 Locations or Mineral Deposits. Joint Leak (10%)	Multi Water Marks or Mineral Deposits. Joint Leak (25%)	Multi Water Marks. Mineral Deposit or Soil Present. Joint Leak (>25%)
Channel	0.0	0.1	0.2	0.4	≥ 0.8 gpm
	No Evidence	Water Marks hairline Crack Beneath Flow	Water Marks. Mineral Deposits or 1/8I Crack Beneath Flow	Water Marks and Mineral Deposits. 1/8I Crack Beneath Flow.	Mineral Deposits. Soil. 1/4I Crack Beneath Flow.

Manhole Inspection - Form 1
Sewerage & Water Board Of New Orleans

Project Title: _____

Inspection Date/Time: _____ Manhole No.: _____
Inspection Crew: _____ Sewer Map No.: _____
Basin: _____ Street Location: _____
Sub Basin: _____
Main/Lateral Number: _____

General

Status: [1] Surface Inspected [2] Internal Inspected [3] Not Inspected [4] Not Found [5] Buried

Location: [1] Paved-Conc. [2] Paved-Asph [3] Driveway [4] Sidewalk [5] Curb [6] Yard-Front [7] Yard-Back [8] Yard-Side [9] Non-Paved [10] Creek Bottom [11] Field [12] Golf Course

Traffic: [1] Two Lane [2] 3-4 Lane [3] Highway [4] Parking [5] Alley [6] Driveway [7] Other

Volume/ Access: [1] Low/Good [2] Medium/Fair [3] High/Poor

Structure/ Type: [1] Manhole [2] Siphon Box [3] Junction Box [4] Other [5] Meter Sta. #

Cover

Type: [1] Pick hole [2] Pick shot [3] Gasketed [4] Bolted # [ ] [5] Vent [6] Storm [7] Other

Fit: [1] Good [2] Tight [3] Loose [4] Rocking [5] None

Condition: [1] Good [2] No Gasket [3] No Bolts [4] Corroded/Pitted [5] Cracked/Broken [6] Missing

No. of Holes: [1] None [2] Pick (1) [3] Pick (2) [4] 3-5 [5] 6-8 [6] >8

Pending Depth (in): [ ] *Grade (+/-) (in):* [ ]

Drainage Area: [ ] X [ ] = [ ] Area (ft²) *Cover No./Type:* [ ]

Frame

Size (in): [ ] / [ ] / [ ] / [ ]

Condition: [1] Good [2] Minor [3] Fair [4] Poor [5] Deteriorated

Frame Offset (in.): [ ]

Frame Seal

Condition: [1] Good [2] Minor [3] Fair [4] Poor [5] Deteriorated

Inflow: [1] Good [2] Minor [3] Fair [4] Poor [5] Deteriorated

Observed Inflow (gpm): [ ]

Chimney

Depth (in): [ ] *Min (Dia (in):* [ ]

Const: [1] None [2] Precast [3] Brick [4] Block [5] Poured [6] Other

Condition: [1] Good [2] Minor [3] Fair [4] Poor [5] Deteriorated

Inflow: [1] None [2] Low [3] Moderate [4] Heavy [5] Severe

Observed Inflow (gmp): [ ]

Cone

Depth (in): [ ]

Shape: [1] Concentric [2] Eccentric [3] Flat Top [4] Other

Const: [1] None [2] Precast [3] Brick [4] Block [5] Poured [6] Other

Condition: [1] Good [2] Fair [3] Minor [4] Poor [5] Deteriorated

Inflow: [1] None [2] Low [3] Moderate [4] Heavy [5] Severe

Defect Location: [1] Wall/Cone Joint [2] Cone Surface [3] Chimney/Cone Joint

Defect Location: [1] 1 [2] 2 [3] 3 [4] 4 [5] Multiple

Observed Inflow (gpm): [ ]

Wall

Barrel Diameter (in): [ ]

Const: [1] None [2] Precast [3] Brick [4] Block [5] Poured [6] Other

Condition: [1] Good [2] Fair [3] Minor [4] Poor [5] Deteriorated

Infiltration: [1] None [2] Low [3] Moderate [4] Heavy [5] Severe

Observed Infiltration (gpm): [ ]

Bench

Const: [1] None [2] Precast [3] Brick [4] Block [5] Poured [6] Other

Condition: [1] Good [2] Fair [3] Minor [4] Poor [5] Deteriorated

Infiltration: [1] None [2] Low [3] Moderate [4] Heavy [5] Severe

Observed Infiltration (gpm): [ ]

Channel

Const: [1] None [2] Precast [3] Brick [4] Block [5] Poured [6] Other

Condition: [1] Good [2] Fair [3] Minor [4] Poor [5] Deteriorated

Infiltration: [1] None [2] Low [3] Moderate [4] Heavy [5] Severe

Hydraulics: [1] None [2] Low [3] Moderate [4] Heavy [5] Severe

Observed Infiltration (gpm): [ ]

Step

Const: [1] None [2] Precast [3] Brick [4] Block [5] Poured [6] Other

Condition: [1] Good [2] Fair [3] Minor [4] Poor [5] Deteriorated

Surcharge Evidence (ft): [ ]

Note 1 (Overflow Yes/No): [ ]

Note 2: [ ]

Comments

_____
_____
_____
_____
_____
_____

Lamping Inspection - Form 1A
Sewerage & Water Board Of New Orleans

Project Title: _____

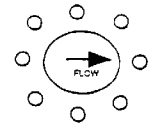
Inspection Date/Time: _____
Inspection Crew: _____
Basin: _____
Sub Basin: _____
Main/Lateral Number: _____

Manhole No.: _____
Sewer Map No.: _____
Street Location: _____

Point of Entry

Line/POE
1
2
3
4
5

Enter POE Numbers in Small Circles



Safety/ Confined Space Entry

O2 _____ %
LEL: _____ %
Tox: _____ ppm

Location Sketch

(Not To Scale)

Manhole Profile

(Show Approx. Dim. of Grade Changes)

Comments

_____
_____
_____
_____
_____

Observations

	Line 1	Line 2	Line 3	Line 4	Line 5
Connecting Manhole:					
Flow Dirt:					
1-Into MH 2-Out of MH					
Pipe Diameter:					
Rim to Invert (0.1 ft):					
Line Type:					
1-Main/Lateral 2-Division 3-Force Main 4-Siphon 5-Service Line 6-Offset Connection					
Sewer Shape:					
1-Circular 2-Box 3-Oblong 4-Horshoe 5-Egg					
Pipe Material:					
1-ABS 2-D/CIP 3-CMP 4-PVC 5-RCP 6-VCP 7-Block 8-Brick 9-Other					
Flow Depth (in):					
Deposition Depth (In):					
Flow Characteristics:					
1-Laminar 2-Mixed 3-Turbulent 4-Restricted					
Flow Velocity:					
Method of Velocity:					
1-Estimated 2-Measured (Max. Point) 3-Profile					
Root Growth:					
1-None 2-Light 3-Medium 4-Heavy 5-Severe					
Pipe Structure:					
1-Good 2-Radial Crack 3-Long Crack 4-Broken 5-Minor Corrosion 6-Major Corrosion 7-Collapsed 8-Gapped					
Line & Grader:					
1-Good 2-SAO 3-Offset Single 4-Offset Multiple					
Pipe Seal Construction:					
1-None 2-Mortar 3-Gasket 4-Brick 5-Block 6-Other					
Pipe Seal Condition:					
1-Good 2-Fair 3-Minor 4-Poor 5-Deteriorated					
Pipe Seal Infiltration:					
1-None 2-Low 3-Moderate 4-Heavy 5-Severe					
Recommend Television Inspection:					
1-Yes 2-No					
Observed Pipe Seal Infiltration (gpm):					

SSES Inspection
Sewerage & Water Board of New Orleans
Project Title _____

Weekly Accomplishment Report
Week Ending: _____

A. - Work completed

	Accomplishment	Smoke Inspection	Dyed Water Inspection	Manhole Inspection	Flow Isolation	Television Inspection
1	Line Segments completed					
2	Total length of line segments					
3	Line segments unable to access					
4	Manholes accessed					
5	Manholes unable to be accessed					
6	Number of locations dyed water tested					
7	Manholes inspected (Surface only)					
8	Manholes inspected (Full inspection)					
	Days worked					
	Crew size					
	Rain days					
	Highlighted map attached					

B. - Action Order Request

Basin	Sub-basin	Main/ Lateral Number	Station	Problem encountered - Action requested	Prob. resolved	City response date

(continued)

B. - Action Order Request - continued

Basin	Sub-basin	Main/ Lateral Number	Station	Problem encountered - Action requested	Prob. resolved	City response date

Manhole Inspection ASCII Format

Sewerage and Water Board of New Orleans

(A1)	(A2)	(A3)	(A4)	(A5)	(A6)	(A7)	(B1)	(B2)	(B3)	(B4)	(B5)	(B6)	(C1)	(C2)	(C3)	(C4)	(C5)
Inspection Date	Inspection Crew	Basin	Subbasin	Main/ Lateral Number	Sewer Map Number	Manhole Number	Inspection Status	Manhole Location	Traffic	Volume/ Access	Structure Type	Ground Conditions	Cover Type	Cover Fit	Cover Condition	Number of Holes	Ponding Depth (inches)

Exhibit 2

Manhole Inspection ASCII Format

Sewerage and Water Board of New Orleans

(C6)	(C7)	(C8)	(D1)	(D2)	(D3)	(E1)	(E2)	(E3)	(F1)	(F2)	(F3)	(F4)	(F5)	(F6)	(G1)	(G2)
Grade +/- (inches)	Drainage Area (ft x ft)	Cover Number / Type	Frame Size (inches)	Frame Offset (inches)	Frame Condition	Frame Seal Condition	Frame / Frame Seal Inflow	Observed Frame/Frame Seal Inflow (gpm)	Chimney Depth (inches)	Chimney Minimum Diameter (inches)	Chimney Construction	Chimney Condition	Chimney Inflow	Observed Chimney Inflow (gpm)	Cone Depth (inches)	Cone Shape

Exhibit 2

Manhole Inspection ASCII Format

Sewerage and Water Board of New Orleans

(G3) Cone Construction	(G4) Cone Condition	(G5) Cone Inflow	(G6) Cone Defect Location	(G7) Cone Defect Quantity	(G8) Observed Cone Inflow (gpm)	(H1) Barrel Diameter (inches)	(H2) Wall Construction	(H3) Wall Condition	(H4) Wall Infiltraiton	(I1) Bench Construction	(I2) Bench Condition	(I3) Bench Infiltration	(I4) Observed Bench Infiltraiton (gpm)	(J1) Channel Construction

Exhibit 2

Manhole Inspection ASCII Format

Sewerage and Water Board of New Orleans

(J2)	(J3)	(J4)	(J5)	(K1)	(K2)	(L1)	(L2)	(L3)
Channel Condition	Channel Infiltration	Channel Hydraulics	Observed Channel Infiltration (gpm)	Step Construction	Step Condition	Evidence of Surcharging (feet)	Note 1	Note 2

Exhibit 2

Manhole Inspection ASCII Format

Sewerage and Water Board of New Orleans

(MI)
Comments

Exhibit 2

Flow Quantification Standards
Rainfall Measurement

A. Introduction

The measurement of precipitation is an important parameter in the analysis of sewer systems for infiltration/inflow and in providing support for the calibration of computer flow models. Precipitation includes rainfall, snowfall, and other processes by which water falls to the land surface, such as hail and sleet. Rainfall patterns can vary over time and area.

A continuous record of rainfall conditions during a monitoring period is necessary. Rainfall depths and intensities are obtained from the measurements, and are used in the evaluation of a particular storm over a defined area such as an area tributary to a flow monitoring site. Rainfall hyetographs are plots of rainfall amount versus time, showing the intensity for each period (usually hourly) of a storm.

Rainfall measurements may be accomplished by installing a network of rain gauges or by obtaining or leasing a software and radar service package that integrates high resolution radar data. These two methods are discussed in the sections below.

B. Notification Procedures

Monitoring procedures necessitate various requirements for notification of both the public and the Sewerage and Water Board of New Orleans (S&WB). The firm must be familiar with both levels of notification and apply these procedures throughout the contract period.

B.1. Public Notification

Rainfall monitoring shall be performed in locations where access to private property will not generally be required. However, in some circumstances locations may require access through or onto residential and commercial property. In those cases the firm shall notify residents and owners of the conditions and access requirements. Notification will be on a person-to-person basis. The crew leader shall inform residents and owners when the crew will require access to equipment on private property and what equipment if any will be necessary to perform maintenance and calibration procedures. The property owner shall be informed that continuous access will be required throughout the duration of the monitoring procedure. A flyer with a description of the work to be performed shall be given to the resident or owner during that

meeting. If the resident or owner is not available for a meeting the flyer will be left at the residence or commercial property (see Exhibit 1).

The firm will maintain a log with a list of all residents and addresses notified during the project time frame. This list will be updated daily and may be reviewed by the S&WB at any point during the project. The log will include, at a minimum, the resident's name and address and the date of notification for actual rain gauge installation and maintenance.

B.2. S&WB Notification

The S&WB shall be notified of the proposed monitored area and provided the location where a rain gauge will be installed. This notification will be done by fax, received no later than 7:00 a.m. the day of actual installation. The fax will include a map of the area with rain gauge sites clearly marked to show actual work sites for that day.

Gravity Division: telephone (504) 942-3888, fax (504) 942-3858

If the firm fails to notify the S&WB of crew activity as outlined above, work will be suspended for that day. Successive failures to notify will require review by the S&WB management regarding contract compliance prior to resumption of work.

C. Guidelines for Monitoring and Data Collection

Guidelines are written to ensure consistency of monitoring and data collection and not for the express purpose of defining step-by-step instructions. The firm performing rainfall measurement is expected to use their experience and best professional judgment during all phases of the monitoring program.

C.1. Planning

Locations of rain gauges are important because the rainfall distribution pattern across the study area needs to be understood. The distribution of precipitation over a large area varies, so more accurate rainfall measurements can be obtained when multiple rain gauges are installed. The quantity of rain gauges will be sufficient to clearly identify and quantify rain events during the monitoring period. A rain gauge network will be planned with the following considerations:

- Size of the entire study area
- Locations of flow meters in the study area
- Sizes of areas tributary to each flow meter
- Historical patterns of rainfall intensity, duration, and frequency in the study area

- Prevailing storm travel patterns

The rain gauges will be strategically placed so that when two or three flow meters are relatively nearby (are impacted by the same storm), coverage for the entire study area is achieved, and typical storm patterns have been considered. Rainfall isohyetal maps of the study area and the S&WB's rainfall records will be reviewed to determine if portions of the study area tend to have storms with greater intensities or durations than other portions of the study area. A general rule of thumb for density of rain gauges is one every 2 square miles, or about every 1200 acres.

C.1.a. Monitoring Period

The monitoring period for the rain gauges shall be the same as the flow meters. These devices shall be installed in conjunction with the flow meters and therefore shall remain in service until the flow meters are removed.

C.1.b. Site Selection

The rain gauge is usually located on a flat surface, such as a roof. The roof must be located away from trees and other overhead obstructions that could cause debris to fall into the gauge and block the drain port, or cause inaccurate readings. In addition, the site should be easily accessible for data retrieval and in a secure place where equipment will not be interfered with or vandalized. Common installation sites are public facilities such as fire stations, schools, or other municipal buildings; S&WB property is preferred. If private property is selected as an installation site, then the firm will contact the property owner for approval per notification procedures (see Section B.1.).

Once the site is selected, the gauge shall be installed and leveled. A level indicator will be on the base of the rain gauge unit. The electronic data recorder shall be directly connected to the gauge but can be remotely located with respect to the rain gauge site. The recorder will be located inside a building whenever possible. If this is not possible, the recorder shall be installed in a weather-proof container.

C.2. Safety

Planning and addressing safety concerns for traffic must be considered before work begins to ensure that proper procedures are followed by the field crews. Where work is to be performed near streets or driveways, adequate traffic safety devices, including safety cones, signs, flashing lights, and other necessary safety equipment must be used. The S&WB and the Louisiana Department of Transportation and Development require traffic safety procedures to be followed when work is conducted in street or highway right-of-ways.

The firm must provide the S&WB with a letter of intent to follow all applicable federal, state, and local safety standards as necessary for the work to be performed. Failure to meet safety standards will result in immediate shutdown of the field crew and mandatory meeting with safety department management.

C.4. Equipment

The tipping bucket type of recording rain gauge will be used. The device operates by collecting rainfall by filling one bucket, which overbalances, directing the flow of water into the second bucket. The flip-flop motion of the tipping buckets is transmitted to the recording device and provides a measure of the rainfall intensity. Rain gauges will be constructed from durable, corrosion-resistant materials. Rain gauges will have back-up power available if AC power is used as primary power source and should be interrupted.

At a minimum, the rain gauge will include the following features:

- Tipping bucket type of recording rain gauge with a 0.01-inch accuracy.
- Volumetric tip of not more than 0.01 inch depth of rainfall.
- Flow monitors and rain gauges shall be synchronized to within $\pm$ 15 seconds of each other and to within $\pm$ 15 seconds of Central Standard Time.

Rainfall intensity, duration, and the time of day shall be recorded by an electronic recorder. The unit will be operated as a pulse recorder. Data will be stored electronically, so that data may be read and transferred in the field.

Immediately after installation, the equipment will be programmed and calibrated according to the manufacturer's instructions. While installed, rain gauge and recorder equipment will be inspected weekly for debris collecting on parts of the gauge and to ensure that the data recorder is dry. The data retrieval process will be in conformance with the manufacturer's instructions.

An alternative to rain gauge networks is integrated rainfall measurement systems that use radar to provide accurate rainfall data. Software and radar service packages, such as CALAMAR or NEXRAD are available. These packages integrate high resolution radar data with rainfall measurement collected from permanent rain gauges to produce rainfall data on a localized basis. Radar data will be calibrated based on data from the S&WB's existing permanent rain gauges (if available) and other permanently installed rain gauge devices used by local meteorologists. A minimum of one rain gauge for every 2 square miles is required for calibration purposes. If the

permanent rain gauges do not meet these criteria, they will be supplemented with temporary rain gauges. All proposed rain gauges shall be submitted to the S&WB for review and comment prior to initiation of remote radar measurement procedures.

C.4.a. Calibration

Each manufacturer recommends different procedures for calibration. Calibration will be done during initial set-up of the rain gauge. Field calibration will also be performed according to manufacturers recommended procedures at intervals as recommended by the manufacturer. If gauge measurements from the installed unit do not match field verification measurements, then the gauge will be adjusted. Severe discrepancies shall be reviewed and additional verification measurements shall be taken. Large discrepancies may indicate the need to replace a gauge. The gauges shall be checked for obstructions and debris that would effect the operation of the gauge on the same schedule as the flow meters.

C.4.b. Maintenance

Immediately after installation of the rain gauges, a regular program for maintenance needs to be established to assure proper gauge, sensor, and data recorder operation. At a minimum, rain gauge maintenance will be performed weekly. During the first week, the sites will be inspected two or three times and coordinated with the flow meter inspections. Following the first week, an assessment will be made on the basis of site and rain conditions that determines the level of maintenance required thereafter; maintenance may be required more frequently than once a week depending on these parameters.

Proper monitoring of rainfall requires clean buckets for the gauge. Therefore on-site visits will include inspection of the buckets and surrounding area to determine if there has been any debris or siltation building up in the buckets or on the rain gauge equipment that will disrupt or prevent acquisition of rainfall information. A site visit after a major storm event is advisable to confirm gauge conditions and condition of the surrounding area.

C.5. Analysis and Documentation

Documentation of field work will be mandatory and will involve the use of S&WB accepted forms and files. All reports shall include the following general information:

- Installation date
- Installation crew
- Basin
- Sub-basin
- Nearest main/lateral number(s)

- Sewer Map Number
- Manhole or access structure number closest to where the meter is located
- Rain gauge number and serial number of unit
- Description of rain gauge location (address or nearest street intersection)

The rainfall monitoring data that shall be reported are the following:

- Date
- Interrogation time (Actual time the gauge is being read)
- Inspection crew
- Total rainfall during recording period
- Peak rainfall rate
- Battery check

Data collected will be reviewed for accuracy. Unusual data and/or recordings such as when no event occurred will be reviewed and evaluated. Data that can be shown to be incorrect or misleading shall be discarded. Data will be based on 5 minute intervals and coordinated with the flow meter information. After review of the data, a rainfall monitoring report for each monitored location will be generated to include at a minimum the following tabular information:

- Total rainfall (inches)
- Number of rain events
- Average rainfall (in/event)
- Peak rainfall rates per event (inches/hour)
- Total rainfall per event (inches)
- Total time per event
- Average time per event

Additional information that will be collected to be correlated with the flow monitoring information is as follows:

- Rainfall average intensity (in/hr)
- Rainfall maximum intensity (in/hr)
- Rainfall minimum intensity (in/hr)
- Rainfall totalizer amount in 24 hour periods

The software used to produce the graphical presentation of the hyetographs will have the capability of incorporating rainfall intensity data associated with each site. Additional graphical

and tabular information the firm deems important and relevant to the project **will** also be included.

For each storm, for areas tributary to each flow monitoring site, a storm hyetograph will be produced in both graphic and tabular form. The hyetograph will be produced in ten minute increments of time. For each storm, data obtained from the system will be used to develop contours of rainfall intensity.

For firms proposing to use radar data collection systems, all data collected and proposed to be submitted to the S&WB will follow the guidelines given in Section F of this standard. Raw radar images and the rain gauge data obtained from the permanent and/or temporary rain gauges will be stored on the computer system and saved in data files in ASCII format. The rain gauge data and the raw radar images shall be processed and transformed into more precise local rainfall intensity images. The exact address and equipment numbers of the permanent rain gauges used in the calibration process must be reported. In addition, storm hyetographs and intensity contour maps will be stored in electronic files and be able to be transferred to the S&WB in ASCII format.

D. Quality Data Review

It is the S&WB's intention and goal to obtain accurate and complete flow monitoring data. To partially accomplish this goal, the S&WB has prepared these guidelines and is requiring a quality control program to be administered.

The firms conducting rainfall measurement for the S&WB are required to employ personnel, as necessary, to check field data for conflicts, consistency, completeness, and accuracy of data. A log of all deviations will be maintained. Deviations and questionable data that require adjustments to equipment or procedures, corrections, or verification shall be submitted to the firm's field crews for appropriate action. Any correction of data shall be made prior to submittal of the data to the S&WB. The S&WB may, at its discretion, use the S&WB's or the firm's crews to check the field work of the firm.

Rainfall data will be retrieved at each of the rain gauges weekly at the same time flow monitoring data is collected. In addition, the firm will obtain data from the S&WB permanent rain gauges within the study area. For each storm and for each rain gauge, a storm hyetograph will be produced in both graphic and tabular form. The hyetograph will be produced in five minute increments.

E. Data Format, Field Forms, and Electronic Media

The standard field forms to be used are intended to standardize information and the format of the information received by the S&WB. At any time during the project the S&WB may request to view the original forms at the firm's office. It is not the intention of the S&WB to control the activities and analysis of the individuals who conduct rainfall measurement and evaluate the information collected. Those conducting rainfall measurement and those who evaluate the information collected are expected to use their experience and best professional judgment to complete the project and generate useable information for the S&WB.

E.1. Field Forms

Standard field forms must be used throughout the monitoring program for installation and maintenance of rain gauges. The S&WB will require the use of its standardized rainfall measurement field form for rain gauge installation and maintenance. Each field crew will become familiar with the S&WB form. Additional information that is not currently identified on the S&WB form will be noted on the reverse side of the forms.

One standard form will be used during the rainfall monitoring program for the installation and maintenance of the rain gauges, and is shown as Form 1. This form will be used by all crews in the field to collect data on all rain gauges. The other standard form to be used will be a form for logging each rain event. This form (Rainfall Monitoring Event Log - Form 2) identifies each rain event with its duration, total amount of rain, intensities and comments. Each rain gauge shall have an Event Log and each rain event identified on the log shall have a graphical representation of that event attached to the form.

E.2. Data Transfer and Electronic Media

Certain information documented will be transferred to an electronic format for inclusion in the S&WB Cass Works database. The information will be submitted on a PC-compatible 3.5-inch high density floppy diskette in ASCII format, tab delimited. This ASCII layout must be followed for all transfer of data to the S&WB, specified below, and additional information beyond the formatted fields will also be included as hard copy with the disk.

Information on each rain gauge installation will be formatted in ASCII as shown in Exhibit 2. The first line of the ASCII file will include the heading line as shown. The number of rows or records will be equal to the number of rain gauges times the number of visits, and each record will include rain gauge installation information on a specific rain gauge. Exhibit 3 is the ASCII file format for the Rainfall Monitoring Event Log Form. This file format shall be used for the electronic data input for the Event Log information.

If the firm requests the S&WB to allow the use of radar collection systems for data acquisition and the S&WB approves the request, the firm will be responsible for also submitting to the S&WB the proposed formats for the data collection and presentation. This technology allows for alternative methods and will require additional S&WB review for conformance.

Tabular data and graphical plots will be stored in data files compatible with ASCII format. Examples of these types of results are storm hyetographs and intensity contour maps.

F. Deliverables

Several deliverables will be required throughout the duration of the project. They will include installation, maintenance and calibration forms for the equipment and reports during and at the completion of the project.

At the beginning of the rain monitoring procedure, a copy of the completed to date Installation and Reconnaissance Form (Form 1) will be required to be submitted to the S&WB. During the actual rain monitoring period the firm must maintain the monitoring section of the Installation and Reconnaissance Form (Form 1). Also during the monitoring period the firm shall record calibration information on the comment field of the same form. A weekly report (Form 3) showing the firm's activities and accomplishments will be required. Form 3 is to be used to report actual visits to each meter site during a given week in place of sending copies of Form 1, which will remain with the field crews. Also included on Form 3 is the Action Order Request section for notifying the S&WB of problems that will need their assistance to rectify.

A meeting between the firm and the S&WB will be required within thirty days of the completion of the rain monitoring phase. This meeting will be to discuss the results of the rain monitoring and the format of the final report. The draft version of the final report will be submitted within thirty days of this meeting. The original field forms will be included in the report for review and comment. These items will be returned with comments for finalization. The original field forms are to be included as an appendix to the finished original Monitoring Program Report. Six additional copies of the Monitoring Program Report, one with copies of all the forms, will be required for completion of the project.

Rainfall Monitoring Gauge Installation and Reconnaissance Form

Guidelines for Data Collection

A. *GENERAL*

A1. **Installation Date**. Enter the date of inspection.

A2. **Installation Crew**. Enter initials of company or organization doing inspections and initials of crew - person completing the form should enter his/her initial's first. Example XYZ, Inc. - REN, JPG.

A3. **Basin**. Enter the major basin location for the rain gage, the code to be used and the name of the major basins are as follows:

A - Lakeview	F - Gentilly
B - Carrollton	G – Ninth Ward
C - Uptown	H - Algiers
D - Mid-City	I – South Shore
E - CBD/FQ	J - New Orleans East

A4. **Subbasin**. Enter the sub-basin designation.

A5. **Main/Lateral Number**. Enter the main or lateral line number closest to the rain gauge location.

A6. **Sewer Map Number**. Enter the S&WB's map number which shows the location of the rain gauge.

A7. **Manhole Number**. Enter manhole number nearest to rain gauge installation location. **Blank if not coded.**

A9. **Street Location**. Enter the address or other identifier.

B. *INSTALLATION DATA*

B1. **Rain Gauge Manufacturer**. Enter the name of the manufacturer of the rain gauge being installed.

B2. **Rain gauge Model Number**. Enter the model number of the rain gauge being installed.

B3. **Rain gauge Serial Number**. Enter the serial number of the rain gauge being installed.

C. *RECONNAISSANCE*

C1. **Date**. Enter the date of the installation.

C2. **Time**. Enter the time the rain gauge was installed..

C3. **Crew**. Enter the crew number or identification name.

C4. **Total Rainfall (inches)**. Enter the total rainfall recorded since the last visit and inspection.

C5. **Peak Rainfall (inches/hour)**. Enter the peak rainfall recorded since the last visit and inspection.

C6. **Battery Check**. Enter whether the battery power was checked and determined sufficient until the next visit.

C7. **Gauge Inspection**. Identify if rain gauge was inspected and cleaned during the site visit. Yes or No.

C8. **Comments**. Enter any comments relative to the condition of the meter, manhole, pipe or any indication of surcharged condition in addition to the above.

Rainfall Measurement Event Log

A. *GENERAL*

A1. **Basin**. Enter the major basin location for the rain gage, the code to be used and the name of the major basins are as follows:

A - Lakeview	F - Gentilly
B - Carrollton	G – Ninth Ward
C - Uptown	H - Algiers
D - Mid-City	I – South Shore
E - CBD/FQ	J - New Orleans East

A2. **Subbasin**. Enter the sub-basin designation.

A3. **Main/Lateral Number**. Enter the main or lateral line number closest to the rain gauge location.

A4. **Manhole Number.** Enter manhole number nearest to rain gauge installation location. **Blank if not coded.**

A6. **Sewer Map Number**. Enter the S&WB's map number which shows the location of the rain gauge.

A7. **Street Location**. Enter the address or other identifier.

B. *EVENT DATA*

B1. **Event Number.** Enter unique occurrence number for the rain event.

B2. **Date.** Enter start date for rain event.

B3. **Duration**. Enter duration of rain event in hours.

B4. **Total Rainfall (inches)**. Indicate total rainfall for rain event. Measure should be to the 0.01 inch.

B5. **Maximum Intensity (inches/hour).** Indicate the maximum intensity during the rain event. This is for a 10 minute interval.

B6. **Minimum Intensity (inches/hour)**. Indicate the minimum intensity during the rain event. This is for a 10 minute interval.

B7. **Comments**. Enter any additional information of significance in this area.

Rainfall Monitoring Gauge Installation & Reconnaissance

Sewerage and Water Board of New Orleans

Project Title _____

A - General

Installation Date:_____ Manhole No.:_____

Installation Crew:_____ Main/Lateral Number:_____

_____

Basin: _____ Sewer Map Book Number:_____

Subbasin:_____ Street Location:_____

B - Installation Data

Rain gauge Manufacturer:_____

Rain gauge Model Number:_____

Gauge Serial Number:_____

Weather:	Ground:
① Dry	① Dry
② Moderate	② Moderate
③ Wet	③ Wet

C - Monitoring Data

Date	Time	Crew	Total Rainfall	Peak Rainfall	Battery Check	Gauge Inspect.	Comments (Note if calibration is done)

Notice

Rainfall Monitoring
Sanitary Sewer Survey

Dear Resident,

Firm's Name is under contract with the Sewerage and Water Board of New Orleans to perform inspections and physical surveys of the City's existing sanitary sewer system. The study will require the inspectors to locate, inspect and enter manholes in the streets and easements and possibly install monitoring equipment for a short period of time. Installation of equipment will require continued access during the monitoring period. Along with the installation of flow monitoring equipment, rainfall monitoring equipment must also be installed. Rainfall equipment will require a clear area space so that it may properly function during rain events. It appears, based on survey information, your property would be an appropriate location for one of these devices and we would appreciate your cooperation in installing this device on your property. The monitor will be serviced on a regular basis which could be as frequently as every other day or as infrequently as once every week. In that some easements are located beside or behind private residences, this will require the inspector(s) in some cases to enter onto private property to perform these assignments. We would like to coordinate the survey process with those residents with property that appear to be good locations for this equipment. Please contact me at your earliest convenience so that we may coordinate this effort.

Thank you for cooperation

Project Manager
Firm's name
Firm's phone number

Exhibit 1

Rainfall Monitoring Event Log

Sewerage and Water Board of New Orleans

Project Title _____

A - General

Basin: _____ Manhole No.: _____ Sewer Map Number: _____

Subbasin: _____ Manhole Station: _____ Street Location: _____

Main/Lateral Number: _____

B - Event Data

Event Number	Date	Duration	Total Rainfall	Maximum Intensity	Minimum Intensity	Comments

Monitoring Report

Sewerage and Water Board of New Orleans
Project Title _____

Weekly Accomplishment Report
Week Ending:_____

A. - Work completed

Number of flow meters installed _____ Days worked _____
Number of flow meters interrogated _____ Rain days _____
Number of rain gauges installed _____
Number of rain gauges interrogated _____

Date	Flowmeter number	Depth of Flow	Velocity of Flow	Flow Rate	Rain gauge Number	Total Rain

Form 3

B. - Action Order Request

Basin	Sub-basin	Main/ Lateral Number	Flow Meter Number	Rain Gauge Number	Problem encountered - Action requested

Form 3

Rainfall Monitoring ASCII Format

Sewerage and Water Board of New Orleans

(A1)	(A2)	(A3)	(A4)	(A5)	(A6)	(A7)	(A8)	(B1)	(B2)	(B3)	(B4)	(B5)	(C1)
Inspection Date	Inspection Crew	Basin	Subbasin	Main/ Lateral Number	Manhole Number	Sewer Map Number	Street Location	Rain Gauge Manufacturer	Rain Gauge Model No.	Rain Gauge Serial No.	Weather	Ground	Date

Rainfall Monitoring ASCII Format

Sewerage and Water Board of New Olreans

(C2)	(C3)	(C4)	(C5)	(C6)	(C7)	(C8)
Time	Crew	Total Rainfall	Peak Rainfall	Battery Check	Gauge Inspect.	Comments

Exhibit 2

Field Investigation Standards
Smoke Inspection

A. Introduction

Smoke inspection is one of several source detection techniques used to identify sources of infiltration/inflow (I/I) in a collection system. In smoke inspection, a non-toxic smoke is introduced into sanitary sewers to find sources of I/I. Smoke inspection is performed during dry weather when the groundwater is lowest and the soil is dry. Under these conditions, many shallow infiltration sources, as well as direct inflow sources can be detected. Smoke inspection can identify the following:

- Sources of direct inflow;
  - Illegal connections to the sanitary sewer, such as roof leaders and yard drains;
  - Cross connections with underground storm drain system.
- Infiltration sources in shallow pipes, service laterals, and around manhole structures;
- Potential public health hazards such as improperly plumbed buildings;

Once these sources of I/I are identified by smoke inspection, the Sewerage Sewer Evaluation Study (SSES) Consultant will recommend corrective actions to eliminate the sources. The Sewerage and Water Board of New Orleans (S&WB) will notify property owners to correct illegal or improper connections. I/I sources and sewer system defects identified by smoke inspection will be further studied by flow monitoring, manhole inspection, pipeline lamping, dyed water inspection or internal television inspection.

Field Investigation Standards for Smoke Inspection include guidelines for public notification, field inspection approach, data collection, data documentation, and format for data delivery to the S&WB. These standards are intended to ensure consistency of smoke inspection field activities and documentation so that smoke inspections conducted by consultants, contractors, or S&WB crews, at various locations and dates will be comparable. Standards will improve the S&WB's ability to compile and track information collected by smoke inspection activities.

B. Notification Procedures

Inspection procedures necessitate various requirements for notification of both the public and the S&WB. The firm must be familiar with both levels of notification and apply these procedures throughout the contract period. Those procedures that require notification of the public through the use of neighborhood meetings will include further coordination with not only the S&WB but other agencies of the City.

B.1 Public Notification

Public notification in areas scheduled for smoke inspection is very important and must be performed prior to the field work. Public notification must include a newspaper announcement, letters/mailers to property owners and flyers distributed to residents within the study area. Notification is essential since crew members enter onto private property, occasionally into buildings to document smoke returns, and large quantities of smoke often result in the fire department being notified. Also, it is possible for smoke to enter a private residence or building through dry traps, open floor drains, improper plumbing, and other sewer access points. Such situations have the potential to generate considerable concern on the part of the general public and will be anticipated. All crew personnel will be trained to deal with situations where residents have discovered smoke in their homes.

The firm will coordinate a neighborhood meeting to include the residents of the area designated to be smoke tested, the S&WB, New Orleans City Council members from the district impacted, and the firm. Date, time, and location for this meeting will be coordinated with the S&WB prior to formal letter notification to all residents. Upon finalization of meeting parameters, at least two weeks prior to the meeting date, notification by letter to all residents in the affected area must be accomplished. The firm will develop the agenda for the meeting to include such subjects as the work method, notification procedures, complaint procedures, and other pertinent items. This agenda

will be reviewed and approved by the S&WB Network Engineering Department in advance of the meeting.

Highly visible colored paper flyers must be delivered to customers/residents within the study area prior to the work being done. The flyers will describe the work efforts and process of smoke testing, provide the dates and approximate times for work to be done and include a list of contact phone numbers. See Exhibit 1 for an example of the notification flyer. Flyers will be distributed between two and five days prior to smoke inspection. If weather conditions prevent smoke inspection from being accomplished during this time period, the flyers will be redistributed a minimum of twenty-four hours prior to smoke inspection being performed.

Public institutions, such as schools, nursing homes and hospitals must be contacted directly. The firm's project engineer shall personally contact the head of each institution to inform and discuss the coordination of smoke testing that might impact their facility. This will be done well in advance of actual testing to assure the institution can make any preparations and notifications necessary internally.

B.2. S&WB Department Notification

The S&WB shall be notified of the area to be smoke tested the next work day. This notification will be done before 4:00 p.m. the afternoon before the actual work day and by fax received no later than 7:00 a.m. the day of actual testing. The fax will include a map of the area to be tested and all streets clearly marked to show actual work sites for that day. In addition, the New Orleans Fire Department Central Fire Dispatch Office must be notified by telephone and facsimile by 7:00 A.M., outlining the area of work for that day. Any fire stations located in the area of smoke inspection must also be notified daily.

Gravity Division: telephone (504) 942-3888, fax (504) 942-3858

Fire Department: telephone (504) 483-2550

If the firm fails to notify the S&WB and/or the Fire Department of crew activity as outlined above, work will be suspended for that day. Successive failures to notify will require review by S&WB management regarding contract compliance prior to resumption of work.

The firm will maintain a data file with a list of all residents and addresses notified during the project time frame. This list will be updated daily and may be reviewed by the S&WB at any point during the project. The data file will include at a minimum the resident's name, address, date of neighborhood meeting notification and date of notification for actual testing. Documentation of coordination efforts with larger institutions will also be maintained and available for review.

C. Guidelines for Inspection and Data Collection

Guidelines are written to ensure consistency of data collection and not for the express purpose of defining step-by-step instructions. The smoke inspection team is expected to use their experience and best professional judgment during all phases of smoke inspection.

The field procedures for smoke inspection include; Planning, Set-up, Equipment Operation, Leak Documentation and Equipment Removal.

C.1. Planning

A firm's project scope will identify a project area with specific boundaries. All line segments of the sanitary sewer system (including service lines) in the project area are to be smoke inspected to begin identifying sources of I/I.

Best conditions for smoke inspection are usually when the soil conditions are the driest. Smoke inspection will not occur when the ground is saturated after a rain or during an extremely windy day. The effectiveness of smoke inspection is dependent on field conditions at the time the work is performed. In order for smoke to freely escape from

the sewers and travel through the soil to the ground surface, the soil must be dry (providing maximum soil shrinkage). Saturated or wet soil will act as a filter, draining groundwater continuously, or swell, reducing its porosity, and block the smoke. The ground is considered saturated if local low areas have ponded or flowing water. Testing will be performed when groundwater conditions allow for significant results (both inflow and infiltration points can be identified). Smoke testing shall not be conducted within seven (7) days following a rainfall of more than 0.5-inches. The S&WB will be notified as to ground conditions during the project duration and have input as to reliability of data being gathered. High wind conditions will be avoided because the smoke is difficult to detect. Also, smoke inspection will not occur if there is a possibility of significant smoke concentrations interfering with vehicular traffic by being blown into traffic or concentrated at a location.

C.2. Safety

Planning, and addressing safety concerns for traffic and confined space entry must be considered before work begins to ensure that proper procedures are followed by the field crews. Entrance into any manhole is considered a Permit Required Confined Space Entry and all NIOSH-OSHA and S&WB safety standards are applicable and compliance is mandatory. Where manholes are located in the streets or driveways, adequate traffic safety devices, including safety cones, signs, flashing lights and other necessary safety equipment must be used. The S&WB and the Louisiana Department of Transportation and Development requires traffic safety procedures to be followed when work is conducted in street or highway right-of-ways. The placement of plugs or sandbags for the control and concentration of smoke may require entering the manholes.

The firm must provide the department with a letter of intent to follow all applicable federal, state and local safety standards as necessary for the work to be performed. Failure to meet safety standards will result in immediate shutdown of the field crew and mandatory meeting with safety department management.

C.3. Set-Up

Mechanical or pneumatic plugs and/or nylon reinforced sandbags will be placed in the lines entering the far upstream manhole of the test line segments and the line exiting the far downstream manhole of the test line segment. If sandbags are used, care must be taken in their use and removal so that the bag or their contents are not dropped into the sewer system. Should this occur the firm will be responsible for the removal of debris at its expense. Care must also be taken to ensure that water head developed in the sewers is not large enough to interrupt service to any citizen or to create hazardous conditions. Special field conditions and/or procedures or equipment, such as high capacity blowers may be employed that will not require the blocking of lines. Actual field conditions vary and smoke may travel upstream or downstream more effectively, therefore the field location of the manhole(s) where smoke is to be blown will be determined by the field crew leader. The minimum blower capacity of 2,500 cubic feet per minute of air will be required for each line segment. The firm may opt for one or two blowers to meet this requirement. Up to two reaches, or approximately 800 linear feet can be smoke tested at a time, with or without plugging, depending on the conditions.

During set-up the field crew leader will begin documenting general information on the field forms, including the following information:

- Inspection Date/Time
- Inspection Crew (company/organization and names)
- Location/Interceptor
- Sub-basin
- Main/Lateral number(s)
- Manhole Numbers
- Map Number
- Weather/Ground Conditions - General Soil Observations
- Agencies Notified

Note any surcharged line sections at this time. Smoke will not pass through a flooded section. Additional set-ups may be required. In addition, the crew leader will need to sketch the sewers and streets that make up each setup configuration.

C.4. Inspection Equipment

The smoke blower(s) will be installed and started to ventilate and establish an airflow through the system. The blower shall be placed to minimize leakage from under the blower and around the manhole frame. A non-toxic, odorless, and non-staining smoke shall then be introduced and forced through the system. Smoke introduction shall continue into the system, until the smoke returns at the far end of the line segment and building vent stacks show smoke for a minimum of five minutes. When necessary, smoke introduction will continue past five minutes until all smoke returns are identified and photographed discharging smoke.

Additional guidelines for equipment operation depend upon the type of equipment used and the method by which smoke is generated, and are not in the scope of these guidelines. Equipment manufacturers and smoke generating materials recommended procedures will be followed. The firm shall supply to the S&WB all manufacturers' specifications for smoke source material, including Material Safety Data Sheet (MSDS), prior to beginning inspection procedures.

All smoke testing equipment will be removed immediately following smoke inspection. The manhole lid will be replaced properly. All survey flags will be removed and all used smoke candles and any other debris will be disposed of properly.

Each inspection team shall have, at a minimum, the following equipment with them in the field at all times:

- Metal detector
- 300 foot measuring tape
- Air mover and hose
- manhole picks and shovels
- First Aid kit
- Various size sewer plugs
- Polaroid camera and film
- Ladder
- 2-way radios
- Safety harness and rope
- Safety cones
- Safety vests
- Fire extinguisher

C.5. Inspection and Documentation

Smoke inspection team members documenting smoke return locations will have field forms, smoke return identification flags and cameras. As smoke spreads throughout the sewers being tested, the crew members will search for smoke returns according to a prearranged plan. A typical plan consists of one crew member per side of street, or one crew member for each pipe segment being smoke tested.

Initially, crew members need to mark the locations of, and photograph, all smoke returns. Marking a smoke return is done by placing a small surveyor flag (2-inch by 2-inch plastic square on 14-inch wire) at a smoke return source. Color flags shall be used to indicate the intensity of smoke; heavy intensity - red, medium intensity - yellow, light intensity - blue. If the smoke return comes from a roof drain or downspout, a surveyor flag shall be placed on the ground near the vent or downspout to identify the location.

Immediately after marking a smoke return location, a high quality color photograph (35mm) with time and date stamp shall be taken. The photograph must show smoke coming from the defect(s), and include permanent landmarks such as trees, driveways, buildings, etc. Documentation, such as film roll and picture number and recording of the pictures taken will be established on the field form. Polaroid film or self developing film color photographs may also be used in addition to the high quality color photograph, but only as a backup. Where smoke is too dense to photograph the defect source, a second photograph shall be taken after the smoke dissipates, to show the defect location. The date, address, and location shall be written on the self developing picture with a permanent marker and attached to the field form. These pictures can aid in identification of picture locations once prints are made from the 35 mm roll, and aid in the recall of a smoke location during completion of the field form. After film processing, the address and location must be written on the back of the picture with a permanent marker and attached to the field form.

It may be necessary to gain access to building roofs in areas where the roof drains cannot be observed from the ground. Typical buildings where this may be necessary include apartment complexes, hospitals, and office buildings.

After all the smoke returns are identified and photographed, crew members shall return to each location and document the smoke returns on a smoke inspection field form. The Polaroid or self developing film photographs will aid in the locating and recalling of smoke returns and intensities. The following are observations that must be documented on the field form:

- All smoke return locations, whether on private property or in a street or easement (such as smoke returns from a sewer or catch basin).
- If the location is on private property, record house number and street name.
- Where possible, indicate whether or not smoke entered the house.
- If the location is in a street or easement, record the street name and distance from upstream manhole if address is not available.
- Indicate if smoke was or was not observed from ventstacks, including street address.
- Type of defect (area drain, catch basin, defective cleanout, downspout, etc.).
- Surface of the drainage area around the defect (asphalt, concrete, dirt, gravel, etc.).
- An estimate of the drainage area that drains into a defect (smoke return).
- Ground condition (i.e. dry, damp, or wet).
- Any other unusual conditions noted during the smoke inspection.
- Additional information per the crew's determination should also be recorded as necessary.

D. Quality Data Review

It is the S&WB's intention and goal to obtain accurate, complete and uniform field data for smoke inspection activities. To assist in accomplishing this goal the S&WB has prepared these guidelines and is requiring a quality control program to be administered.

The firms conducting smoke inspections for the S&WB are required to employ personnel as necessary to check field data for conflicts, consistency, completeness and accuracy of data as compared with other field data, S&WB supplied drawings and other S&WB supplied data. A log of all deviations from the standard form will be maintained. Deviations and questionable data shall be submitted to the firm's field crews for correction and field verification and noted in the Weekly Accomplishments Report (See Section F. Deliverables). The S&WB may at its discretion use the S&WB's or firm's field crews to check the completed field work. At the S&WB's expense and at the stated contract price, up to a maximum of five percent of all line segments in the project will be reinspected by the firm as a quality assurance/quality control procedure. Reinspected line segments must be performed by a crew that did not perform the first inspection and locations will be determined by the S&WB. If more than twenty-five percent of the QA/QC segments show significant deviations, as determined by the S&WB, additional line segments will be requested to be reinspected by the firm at no expense to the S&WB. If the S&WB determines that the field work is significantly incomplete or incorrect, the S&WB will require the contracting firm to redo all necessary field activities, also at no expense to the S&WB.

E. Data Format, Forms and Electronic Media

The S&WB will require the use of its standardized Smoke Inspection Form in the field for those firms conducting smoke inspections for the S&WB. Guidelines and expectations for the type of information to be gathered during a smoke inspection are outlined in the previous section. Each smoke inspection field crew will become familiar with the S&WB form. Additional information that is not currently identified on the S&WB form, such as type of equipment used and model numbers, etc. will be noted on the reverse side of the form.

The Smoke Inspection form (Form 1) will be used by all crews in the field to collect and document information. This smoke inspection form is intended to standardize information

and the format of the information received by the S&WB. At any time during the project the S&WB may request to view the original forms at the firm's office. Those conducting smoke inspections and those who evaluate the information collected are expected to use their experience and best professional judgment to complete the project and generate useable and verifiable information for the S&WB.

Information documented on the S&WB form will in turn be transferred to an electronic format for inclusion in the S&WB Cass Works database. The information will be submitted on PC-DOS compatible 3.5-inch high density floppy diskette in a ASCII format, tab delimited. The number of rows/records will be equal to the number of I/I locations or smoke returns. Each record will include the information as shown on the following smoke inspection ASCII layout (See Exhibit 2). The first line of the ASCII file will include the heading line exactly as shown. Information that is repeated will also be included for each smoke return location, for example the sub-basin identification will be included for each smoke return located within that basin. The ASCII layout must be followed for all smoke inspection electronic media data transfer to the S&WB. Additional information beyond the formatted fields may also be included as hard copy included with the disk.

F. Deliverables

Several deliverables will be expected throughout the duration of the project. Weekly and monthly reports as well as the final submittals are mandatory for the project.

A weekly report with Weekly Accomplishments and Action Order Requests will be submitted to the S&WB every Monday morning before 10:00 a.m. The form to be used is shown in Form 2. The Weekly Accomplishments section is a summation of line segments completed by all crews for a given week. The Action Order Request portion of the form will identify any problems encountered during the previous work week that will require resolution before completion of the smoke inspection for a given line segment. This could include surcharging, lack of access to manhole, inability to find manhole, etc.

Conditions that can be resolved by in-house staff will be addressed and the firm will be notified via the Action Order Request which will be returned to the firm within two weeks noting items accomplished and those that need further action with an anticipated date of completion.

A monthly summation of work accomplished will be submitted to the department no later than the date specified in the engineering agreement.

S&WB Smoke Inspection Forms and electronic media files shall be delivered along with the SSES reports. A draft version of the SSES Report including the original field forms and photographs will be submitted to the department for review and comment. These items will be returned with comments for finalization. The forms along with the original photographs of all defects, that were completed in the field, are to be included as an appendix to the finished SSES report to be submitted to the S&WB. Six additional copies of the SSES report, one with copies of the forms and photographs, will also be required for completion of the project.

Smoke Inspection Form
Guidelines For Data Collection

A. *GENERAL*

A1. **Inspection Date.** Enter the date and time of inspection.

A2. **Inspection Crew.** Enter initials of company or organization doing inspections and initials of crew person completing the form should enter his/her initials first. Example XYZ - Inspection Service.

A3. **Basin.** Enter the location of inspection by the basin or interceptor two letter identification.

A - Lakeview	F - Gentilly
B - Carrollton	G – Ninth Ward
C - Uptown	H - Algiers
D - Mid-City	I – South Shore
E - CBD/FQ	J - New Orleans East

A4. **Sub-basin.** Enter the sub-basin designation

A5. **Main/Lateral Number.** Enter the main or lateral line number that is being inspected.

A6. **Sewer Map.** Enter the S&WB's map number which shows the area being inspected.

A7. **Upstream Manhole Number.** Enter the upstream manhole (or structure) number of the line segment being tested. **Blank if not coded.**

A8. **Downstream Manhole Number.** Enter the downstream manhole (or structure) number segment being tested. **Blank if not coded.**

A9. **Street Location.** Street address or other identifier.

B. *OBSERVATIONS*

B1. **Line Plugged.** Check appropriate categories as to whether line was sand bagged or plugged and plugs were removed. Electronic data input should be a three digit format (i.e. 111 or 211) one digit for each response to each question in this category.

B2. **Weather/Ground.**
1. **Dry**. Dry Conditions
2. **Moderate**. Damp Ground
3. **Wet**. Standing Water

B3. **Source-Note/Address.** Enter address of smoke source and any important information about the source. For full neighborhood verification inspections, each address can be input with smoke sources being listed as defect numbers and addresses with no smoke sources identified with "0" in the defect number field. Additional notes can be added in the sketch beside the source defect number.

B4. **Defect number.** Enter a number for each smoke source. The defect number corresponds to the source location in the sketch and to the same source noted on the smoke form. For example, if the first smoke source is a downspout, the defect number (1) should be entered on the form and "#1" should be placed on the sketch showing the location of the downspout. If this downspout was dye tested later, the same defect number used on the smoke inspection form (1) should be used for the same downspout on the dye test form.

B5. **Results.**
1. **Negative**. No smoke detected from source
2. **Positive**. Smoke detected from source
3. **Cannot Test**. Unable to smoke test
4. **No Smoke + Spot Dye Tested**. Spot dye tested with positive results
5. **No Smoke - Spot Dye Tested**. Spot dye tested with negative results

Some locations will appear to be sources of inflow or infiltration but not respond to smoke inspection. If the crew has dye available and can spot test a possible source then the use of response 4 & 5 should be used.

B6. **Sector.**
1. **Public**. Source located on public property
2. **Private**. Source located on private property

B7. **Source Type.** Note appropriately
1. **Service Connection**. Service line defect anywhere along the main line to the building.
2. **Transition Joint**. Service line defect at the building foundation wall.

3. **Driveway Drain**. A drain in the driveway.
4. **Window Well Drain**. A drain in a basement window well.
5. **Stairwell Drain**. A drain in a stairwell.
6. **Area Drain**. A drain or open pipe in a yard or other areas which do not fit any of the other categories listed here.
7. **Downspout**. A downspout from the building gutters or roof.
8. **Downspout Connection**. The connection between the downspout and underground piping.
9. **Foundation Drain**. Underground drain around the foundation of a building evidenced by smoke around foundation.
10. **Building Inside**. Smoke inside building.
11. **Catch Basin**. A storm catch basin which leads stormwater to a storm sewer or ditch.
12. **Storm Ditch**. An open storm drainage channel.
13. **Storm Manhole**. A manhole in a storm drain system.
14. **Main Sewer**. The public sanitary sewer being tested.
15. **Cleanout**. A cleanout structure for service lines. Note if capped, above or below grade, condition, and if located in ponding area.
16. **MH Frame Seal**. Evidenced by smoke through ground around manhole. Note upstream manhole only on each form. Note if manhole is a junction box, siphon box, or meter station.
17. **Other**. Any location not referenced in the above 16 items.

B8. **Location.** (Select the one most appropriate)

1. **Paved - Concrete**. Source is in paved concrete area.
2. **Paved - Asphalt**. Source is in paved asphalt area.
3. **Driveway**. Source is in driveway. Note material of construction of driveway in source-note/address or on sketch i.e., concrete, asphalt, unpaved.
4. **Sidewalk**. Source is in a sidewalk.
5. **Curb**. Source is in a curb.
6. **Yard-Front**. Source is in front yard or front grassed easement.
7. **Yard-Back**. Source located in back yard.
8. **Yard-Side**. Source located in side yard.
9. **Non-paved**. Source located in non-paved area.
10. **Canal bank**. Source in canal bank.
11. **Field**. Source located in a field.
12. **Golf Course**. Source located in a golf course.
13. **Alley**. Source located in an alley.

B9. **Area (ft^2).** Estimate approximate drainage area to source. **DO NOT MEASURE**. Visual estimate. N/A = creek bottom.

B10. **Runoff C.** Rational runoff coefficient. This will be estimated in the office. Identify if the runoff surface is different than the source location identified in **B9** (roof, driveway, grass).

B11. **Flow (gpm).** The estimated flow using the runoff C and Area in gallons per minute. This will be calculated in the office.

Film Roll Number. Enter the number of the roll of film used to photograph the defect. This field is not to be recorded on the electronic format files.

Frame Number. Enter the frame number of the photograph of the defect. This field is not to be recorded on the electronic format files.

C. *SKETCH*

Show plan view in sufficient detail so that others can relocate in field without photograph. Show placement smoke blower, manhole numbers, smoke source locations (include source defect number), drainage area, streets, houses, distances (two), fences, etc.

Notice

Smoke Testing
Sanitary Sewer Survey

In the next few days, inspection crews will be conducting a physical survey of a portion of the New Orleans sanitary sewer system. This study will involve the opening and entering of manholes in the streets and easements. An important task of the survey will be the "SMOKE TESTING" of the sewer lines to locate breaks and defects in the sewer system. The smoke that you see coming from the vent stacks on houses or holes in the ground is NON-TOXIC, HARMLESS, HAS NO ODOR, AND CREATES NO FIRE HAZARD. The smoke should not enter your home unless you have defective plumbing or dried up drain traps. If this occurs, you should consult your licensed plumber. In any event, if the harmless smoke can enter through faulty plumbing, the potential exists for dangerous sewer gases to enter your home. Should smoke enter your home, you may contact a member of the smoke testing crew working in the area and he will be pleased to check with you as to where and why the smoke has entered you home. If you have any seldom used drains, please pour water in the drain to fill the trap, which will prevent smoke from entering there. Drain traps should always be filled with water to prevent sewer gases or odors from entering the building. It is recommended that the central air conditioning condensation trap also be filled. This can be accomplished by running the unit several hours prior to smoke testing.

Some sewer lines and manholes may be located on the backyard easement property line. Whenever these lines require investigation, members of the inspection crews will need access to the easements for the sewer lines and manholes. ***Firm's Name*** personnel are uniformed and carry identification badges. Homeowners do not need to be home and AT NO TIME WILL FIELD CREWS HAVE TO ENTER YOUR BUSINESS OR RESIDENCE.

Photographs will be made of leaks occurring in the system. We anticipate the smoke testing will require a few hours in your area. Your cooperation is appreciated. The information gained from this study will be used to improve your sewer services.

In case of emergency, call the S&WB Help Line: 871-8300

Exhibit 1

Smoke Inspection

Sewerage and Water Board of New Orleans

Project Title _____

A - General

Inspection Date/Time: _____
Inspection Crew: _____
Basin: _____
Subbasin: _____
Main/Lateral Number: _____
Sewer Map Number: _____

Upstream MH No.: _____
Downstream MH No.: _____

Segment Length: _____
Street Location: _____

B - Observations

Date of Notification

Fort Worth Fire Dept.: / /
Fort Worth Water Dept.: / /

Line Plugged for Tests

Upstream ①=Yes ②=No
Downstream ①=Yes ②=No
Plug(s) Removed ①=Yes ②=No

Weather/Ground:

① Dry
② Moderate
③ Wet

Source Note/Address	Defect Number	Results	Sector	Source Type	Location	Area	Runoff C	Flow

	Results	Sector	Source Type	Location		Results	Sector	Source Type	Location
1=	Negative	Public	Service Connection	Paved-Conc.	9=			Foundation Drain	Non-Paved
2=	Positive	Private	Transition Joint	Paved-Asph.	10=			Building Inside	Canal Bottom
3=	Cannot Test		Driveway Drain	Driveway	11=			Catch Basin	Field
4=	- Dye Tested		Window Well Drain	Sidewalk	12=			Storm Ditch	Golf Course
5=	- Dye Tested		Stairwell Drain	Curb	13=			Storm Manhole	
6=			Area Drain	Yard-Front	14=			Main Sewer	
7=			Downspout	Yard-Back	15=			Cleanout	
8=			Dwnspt Connection	Yard-Side	16=			MH Frame Seal	

C - Sketch: (Show Placement of Blowers, Source Defect Number, Drainage Area, Identify Condition)

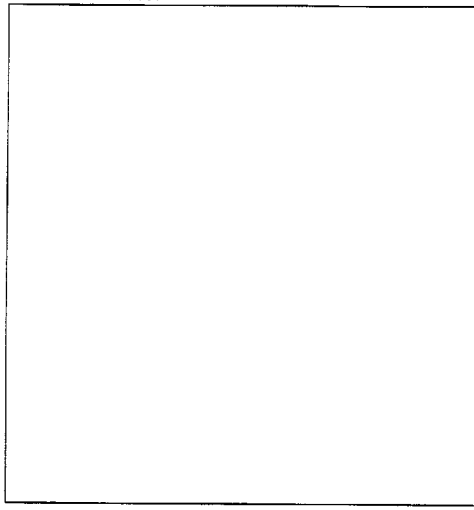
Show North

D - Crew Comments (Any additional information pertinent to the inspection at this location)

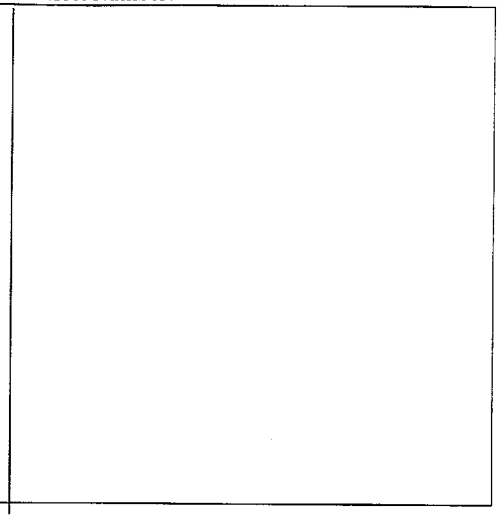
Photographs

Date:_____ **Main/Lateral Number:**_____ **Address:**_____

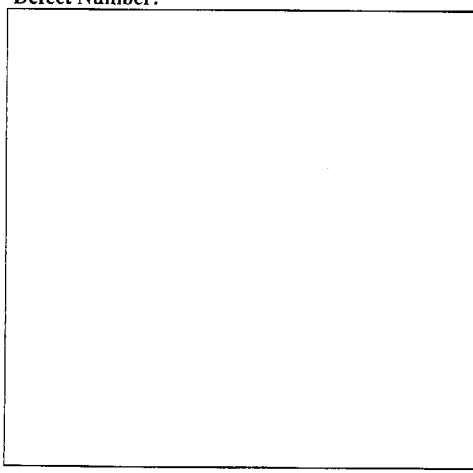
Defect Number:



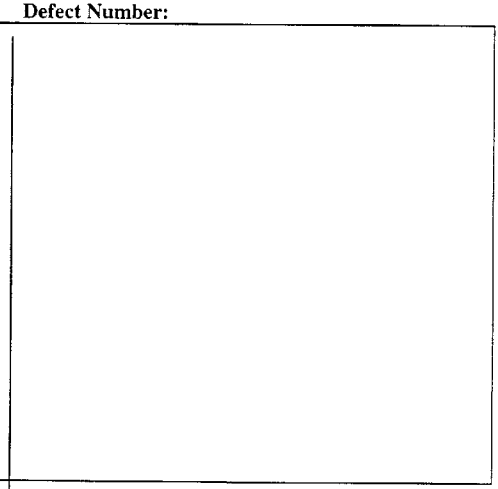
Defect Number:



Defect Number:



Defect Number:



Smoke Inspection

Sewerage and Water Board of New Orleans
Project Title _____

Weekly Accomplishment Report
Week Ending_____

A. - Work completed

Number of line segments completed _____
Total length of line segments _____
Number of line segments not completed _____
Number of manholes accessed _____
Number of manholes unable to be accessed _____

Days worked _____
Crew size _____
Rain days _____

Map attached highlighting completed line segments - Yes or No
circle one

B. - Action Order Request

Basin	Sub-basin	Main/ Lateral Number	Problem encountered - Action requested

Smoke Inspection ASCII Format

Sewerage and Water Board of New Orleans

(A1)	(A2)	(A3)	(A4)	(A5)	(A6)	(A7)	(A8)	(A9)	(A10)	(B1)	(B2)	(B3)
Inspection Date	Inspection Crew	Basin	Subbasin	Main / Lateral Number	Sewer Map Number	Upstream Manhole Number	Downstream Manhole Number	Segment Length (ft)	Street Location	Line Plugged	Weather / Ground	Source - Note Address

Exhibit 2

Smoke Inspection ASCII Format

Sewerage and Water Board of New Orleans

(B4)	(B5)	(B6)	(B7)	(B8)	(B9)	(B10)	(B11)
Defect Number	Results	Sector	Source Type	Location	Area (Sq. Ft.)	Runoff 'C'	Flow (gpm)

Exhibit 2

Field Investigation Standards
Television Inspection

A. Introduction

Television or TV inspection of sanitary sewer line segments is used to identify structural problems and sources of infiltration/inflow (I/I). TV inspection is the process of inserting a closed circuit television camera specifically designed for sewer inspection into a sewer to "see" the actual condition of a pipe. Information and data collected from television inspection is permanently stored on videocassette tapes, which can later be used during sewer rehabilitation design. Information from television inspection allows the design engineer to select the rehabilitation or replacement method that is most appropriate for a given reach of sewer.

Typical sewer defects that are documented by television inspection include open and offset joints, cracks (longitudinal and radial), corrosion, root intrusion, broken or crushed pipes, and pipe misalignments. TV inspection of a sewer locates improper service connections (protruding taps), undocumented connections, cross connections, and sources of extraneous flow.

Television inspection will not identify defects or infiltration sources below the wastewater flow or covered by sediments. If the flow depths in the line obscure the camera view and/or significantly decrease the line cross-sectional, bypass pumping or other flow control measures will be necessary. Sanitary sewer lines are normally cleaned before television inspection and will be regarded as a minimum acceptable effort to ensure safe passage of the camera and improve conditions for identifying defects.

B. Notification Procedures

Inspection procedures shall include proper notification of both the public and the Sewerage & Water Board of New Orleans (S&WB). The firm must be familiar with both levels of notification and apply these procedures throughout the contract period. Those procedures that require notification of the public through the use of neighborhood meetings will include further coordination with not only the S&WB but agencies of the City.

B.1 Public Notification

Because most television inspection will be performed in the right-of-way, notification of residents and commercial property shall be limited to those line segments located on private property and in easements that require special access. Notification will be on a person-to-person basis. The crew leader shall inform residents and owners when the crew will require access to manholes on private property and what equipment if any will be necessary to perform the inspection. A flyer with a description of the work to be performed shall be given to the resident or owner during the first meeting. If the resident or owner is not available for a meeting leave a flyer at the residence or commercial property (see Exhibit 1).

The firm will maintain a log with a list of all residents and addresses notified during the project time frame. This log will be updated daily and may be reviewed by the S&WB at any point during the project. The log will include at a minimum the residents name and address, and the date of notification for actual inspection.

B.2. S&WB Department Notification

The S&WB shall be notified on a daily basis of the line segments to be televised. This notification will be by fax no later than 7:00 a.m. the day of actual testing. An alternative to fax notification would be to deliver the above information to the Gravity Division office prior to the initiation of work for that given day. Location of a drop box will be determined prior to contract award. The fax will include a map of the line segments to be televised and all streets clearly marked to show actual work sites for that day.

Gravity Division: telephone (504) 942-3888, fax (504) 942-3858

If the firm fails to notify the S&WB of crew activity as outlined above, work may be suspended for that day. Successive failures to notify will require review by S&WB management regarding contract compliance, prior to resumption of work.

C. Guidelines for Television Inspection Data Collection

Guidelines are written to ensure consistency of data collection and not for the express purpose of defining step-by-step instructions. The firm responsible for conducting television inspection of sanitary sewer lines is expected to use their experience and best

professional judgment during all phases of television inspection. Procedures for television inspection and data collection include, Planning, Safety, Set-Up, Equipment, and Inspection and Documentation.

C.1. Planning:

Television inspection will be conducted in areas where excessive I/I has been identified by flow monitoring and the potential of structural defects have been identified by smoke, dye or manhole inspections. The firm shall submit a list of recommended line segments to the department for review based on departmental existing records and the firm's SSES investigative work. The list must include justification for proposed locations and be approved by the department prior to performance of cleaning and television inspection.

The S&WB has sanitary sewer base maps that indicate line location, line size, manhole location, manhole station number, and other general information to help locate the sanitary sewer lines and manholes. These maps shall be used to locate manholes and line segments for television inspection. The sewer base maps do not include profile or grade information. The S&WB record drawings will be reviewed to determine line depths, grades and structural situations that may create access difficulties. These structural situations may include: vertical grade and horizontal alignment changes without a manhole, reducing or enlarging sections, gates/stop logs, and siphons.

Sanitary sewers scheduled for television inspection shall be cleaned no more than seven days prior to television inspection. Cleaning the lines removes grease and debris, which in some cases prevents the passage of the camera, covers up defects or blocks the view of the camera lens. Another advantage to cleaning is identification of access restrictions. If the cleaning equipment does not travel through the line segment, neither will television equipment.

Selection of cleaning equipment and the method for cleaning will be based on the condition of the sanitary sewer lines at the time the work commences. Sanitary sewer lines and manholes shall be cleaned using mechanical, hydraulically propelled, and/or high velocity hydroflushing sewer cleaning equipment. The determination of the equipment best suited to the location will be the responsibility of the cleaning crews. The firm will also check with the department for historical information on prior cleanings.

Sediments and debris shall be removed from the line and disposed of by acceptable and permittable standards. Disposal of the sediments and debris is the responsibility of the firm performing the cleaning.

Flow conditions will be considered before television activities are scheduled. High flow conditions during daytime hours may require the scheduling of television inspection during nighttime hours or low flow conditions (typically 2 a.m. to 6 a.m.). High flow conditions may also exist during and following rainfall events. The S&WB staff may have field knowledge that will aid in identifying a low flow time period.

Flow conditions shall exist or be suitably controlled so the depth of wastewater flow, as measured in the manhole, will not exceed the following:

- 6-inch to 10-inch Diameter Pipe ..... 20% of pipe diameter
- 12-inch to 24-inch Diameter Pipe ..... 25% of pipe diameter
- Over 24-inch Diameter Pipe..... 30% of pipe diameter

When the depth of flow at the upstream manhole of the sewer segment being televised is above the maximum allowable for television inspection, the firm has a choice of alternatives that would allow for compliance. The possible alternatives to lower levels are by temporarily restricting the flow with mechanical devices or by pumping. The use of these alternatives is the responsibility of the inspection firm. Care will be taken to assure service is not interrupted to upstream properties. Another alternative would be to schedule work at low flow hours.

C.2. Safety

Planning, and addressing safety concerns for traffic and confined space entry must be considered before work begins to ensure that proper procedures are followed by the field crews. Entrance into any manhole is considered a Permit Required Confined Space Entry and all NIOSH-OSHA and S&WB safety standards are applicable and compliance is mandatory. Where manholes are located in the streets or driveways, adequate traffic safety devices, including safety cones, signs, flashing lights and other necessary safety equipment must be used. The S&WB and the Louisiana Department of Transportation

and Development requires traffic safety procedures to be followed when work is conducted in street or highway rights-of-way.

The firm must provide the department with a letter of intent to follow all applicable federal, state and local safety standards as necessary for the work to be performed. This submittal shall also include the name of the firm's safety coordinator with a description of his/her job duties and level of responsibility. Failure to meet safety standards will result in immediate shutdown of the field crew and mandatory meeting with safety management.

C.3. Set-Up

During set-up the field crew leader will begin documenting general information on the field forms, including the following information:

- Inspection Date/Time
- Inspection Crew (company/organization and names)
- Basin
- Sub-basin
- Main/Lateral number(s)
- Manhole Numbers and Stations
- Sewer Map Number
- Street Location

Note any surcharged line sections or evidence of surcharging at this time. Surcharge conditions are likely to occur during the course of this project and additional set-ups may be required.

C.4. Equipment Selection

Television inspection equipment is specifically designed for sewer inspection. There are several configurations of closed-circuit systems for sewer inspections that can be used by the firm. The unit must meet the following features:

- Power for operation generated on site
- Power control
- Transport winches

- Video (color) and lighting control
- Recording equipment and documentation capability
- Camera communication

Systems that allow the television operator to control both the speed and travel of the camera and that allow for remote control of the camera itself are most efficient, provide the highest quality pictures, and shall be utilized for this effort.

The Engineer shall have available for use, within 24 hours of request from the Board, a camera capable of inspecting 6-inch lateral lines between the cleanout and the main line. The camera must be capable of televising laterals up to 125 feet in length, and shall be capable of negotiating bends and other fittings. It is not mandatory that this system be capable of color TV inspection.

The field and line conditions will dictate the use of a mini camera, standard camera, skids, floats or other television inspection equipment and/or techniques. To assure that maximum quality and accuracy in television inspections is obtained for the S&WB the following minimum video equipment standards will apply:

- Equipment will have an accurate footage counter that displays on the monitor and is recorded on the VHS tape during the entire inspection.
- Footage counter shall be able to maintain measurement accuracy within 2 percent.
- Camera height shall be adjustable.
- Remote and/or automatic focus and aperture control
- Simultaneous audio recording
- Camera will have a rotating head with remote operator control

Each inspection team shall have, at a minimum, the following equipment with them in the field at all times:

- Metal detector
- 300 foot measuring tape
- Air mover and hose
- manhole picks and shovels
- First Aid kit
- Various size sewer plugs
- Polaroid camera and film
- Ladder
- 2-way radios
- Safety harness and rope
- Safety cones
- Safety vests
- Fire extinguisher

C.5. Inspection and Documentation:

Television inspection has two data formats. One that conforms to the standards outlined in the SSES Standards (both forms and data files) and the other is the video tape of the actual sewer. It is the S&WB's intention to have both formats submitted at the end of the project. Defects and observations recorded on the video tape will be identified and logged on the television inspection field forms. General guidelines for video taping of sanitary sewers include the following:

- The video tapes shall be recorded in VHS format at standard play speed.
- The original VHS tapes shall be rated high quality or better and shall become the property of the S&WB.
- The camera height shall be adjusted such that the camera lens is always positioned at one half the sewer inside diameter or higher during actual inspection and taping. The operator shall verbally identify on the video tape the approximate height of the camera lens in the sewer line prior to pulling the equipment through a given line segment.
- At no time shall the television camera be pulled or propelled through the line at a speed greater than 30 feet per minute.
- The lighting system shall be adequate for quality pictures.
- The video will be color, unless the S&WB gives written approval for black and white **prior** to the inspection.
- At the beginning of each line segment, the following information, at a minimum, will be entered on the video screen and recorded on the video tape; main/lateral number, beginning and ending manhole stations, direction of travel (upstream, downstream), line diameter, date and time of inspection.
- While taping the line segment, date, footage, and main/lateral number will be constantly displayed generally on the lower center of the screen. When inspection requires viewing the lower portion of the screen the display shall be moveable. The footage counter will also include the actual line stationing.
- The camera will be stopped at all defects so that a clear picture of the defect remains on the video screen for a period of time long enough for the operator to verbally describe the defect and its rating on the tape, usually ten to thirty seconds.

- The defect being described will be identified with an arrow cursor on the video, if available.
- General observations and comments of the pipe condition and defects will be verbally described on the video and recorded on the television field form.
- The television inspection crew will diligently pursue passage of the camera through the line segment but shall not take undue risks that may result in lodgment of the camera.
- In some cases, due to obstruction and blockage, a reverse set-up will be considered. The firm shall document the procedure prior to inspecting the line in this manner.

Each video tape delivered to the S&WB will be permanently labeled and will include the following information:

Project Title: _____ Tape Number: _____ Inspection Dates: _____
Inspection Crew:_____ Main/Lateral Number(s): _____
Upstream MH No.: _____ Downstream MH No.: _____
Street Location: _____

As noted above, general information about the line segment inspected, defects noted and a rating of the defect problem will be documented on the television inspection field form. Information that is to be documented includes the following:

- General information; street location, main/lateral number, date, inspection crew, basin, sub-basin, camera travel direction, upstream and downstream manhole numbers, type of surface cover and traffic condition.
- Line material, diameter, pipe joint length, overall footage inspected
- Weather and ground conditions
- Information on line cleaning performed prior to television inspection
- The location and description of each sewer defect including a separate rating according to the magnitude of the defect.
- The location and description of each sewer defect entered on the inspection form shall correspond to the pipe footage and counter displayed on the video tape.

- Defects that are to be noted and rated include, but are not limited to the following; radial cracks, longitudinal cracks, misaligned joints, broken joints, root intrusion, infiltration, protruding tap, collapsed pipe, hanging gaskets, debris, grease and pipe corrosion.
- For locations with multiple defects, each one will be noted and rated individually.
- Information on concurrent dyed water inspection performed during television inspection.
- Estimation of an observed rate of infiltration at specific sources.

D. Quality Data Review

It is the S&WB's intention and goal to obtain accurate, complete and uniform field data from television inspection activities. To assist in accomplishing this goal, the S&WB has prepared these guidelines and is requiring a quality control program to be administered.

The firms conducting television inspections are required to employ personnel as necessary to check field data for conflicts, consistency, completeness and accuracy of data as compared with other field data, S&WB supplied drawings and other S&WB supplied data. A log of all deviations from the standard form will be maintained. Deviations and questionable data shall be submitted to the firm's field crews for correction and field verification and noted on the Weekly Accomplishment Report (see Section F. Deliverables). The S&WB may at its discretion use the S&WB's or firm's field crews to check the field work of the firm. At the S&WB's expense, up to a maximum of five percent of all line segments will be rechecked for completeness and accuracy with respect to information shown on the video tape and television inspection form. The firm, as a quality assurance/quality control procedure, will make available the video tapes and inspection forms for the S&WB to review. If more than twenty-five percent of the QA/QC line segments show significant deviations between the video tape and the inspection form, as determined by the S&WB, additional line segments will be requested to be reviewed at the firm's expense. If the S&WB determines that the firm's inspection forms are significantly incomplete or incorrect, the S&WB will require the firm, at its own expense, to review an additional five percent of the tapes and forms. If, during the review, it is determined that the tapes are of poor quality or do not conform to the standards as stated previously, the S&WB will request those lines to be re-taped at the firm's expense.

E. Data Format, Forms and Electronic Media

The S&WB will require the use of its standardized Television Inspection Field Form for use by all those conducting inspections for the S&WB. Guidelines and expectations for the type of information to be gathered during a television inspection are outlined in previous sections. Each television inspection field crew shall use the S&WB inspection forms. Additional information that is not currently identified on the existing form(s) will be noted on the reverse side of the form.

The following Television Inspection form (see Form 1) will be used by all crews in the field to collect and document information. These inspection forms are intended to standardize information and the format of the information received by the S&WB. Those conducting inspections and those who evaluate the information collected are expected to use their experience and best professional judgment to complete and generate usable and verifiable information for the S&WB.

Information documented on the S&WB forms will also be transferred to an electronic format as part of the deliverables for inclusion in the S&WB CASS WORS database. The information will be included on PC-DOS compatible 3.5-inch high density floppy diskette in an ASCII format, tab delimited. Each line or record will be dependent on the number of defects found. Each record will include the information as shown on the following television inspection ASCII layout, Exhibit 2. The first line of the ASCII file will include the heading line exactly as shown. Information that is repeated will also be included for each line segment. For example, the sub-basin identification will be included for each line segment within that basin. The ASCII layout will be followed for all television inspection electronic media data transfer to the S&WB. Additional information beyond the formatted fields may also be included as hard copy attached to the disk.

F. Deliverables

Several deliverables will be expected throughout the duration of the project. Weekly and monthly reports as well as the final submittals are mandatory for the project.

Weekly updates of work completed and problems encountered will be summarized on the Weekly Accomplishment Report, which will be submitted to the S&WB Gravity Division

office every Monday morning before 10:00 a.m. The form to be used is shown as Form 2. The Weekly Accomplishments Report is a summation of line segment inspections completed by all crews for a given week (a continuous seven day period of time generally Friday to Friday, but the Gravity Division will consider other start/stop dates). The Action Order Request Section will identify any problems encountered during the previous work week that will require resolution before completion of the television inspection project. This could include surcharging, lack of access to manhole, inability to find manhole, etc. Conditions that can be resolved by in-house staff will be addressed and the firm will be notified via the Action Order Request which will be returned to the firm within two weeks, noting items resolved and those that need further action. Those items needing further resolution will be returned with a proposed date for completion . A final list of all Action Order items shall be generated at the end of the project. This list shall be used to review all requests and assure the Gravity Division and firm that all items have been addressed and finalized

If during the course of inspection, the field crew encounters conditions that could be hazardous to the crew or public or have a possibility of imminent restriction of flow in the sewer line, the firm must notify the Gravity Division verbally that working day and in writing by the next working day. The Emergency Action Order (See Form 3) form shall be used in these situations.

A monthly summation of all work accomplished will be submitted to the department no later than the date specified in the engineering agreement.

S&WB Television Inspection Forms, video tapes, and electronic media files shall be delivered along with the SSES reports. A Draft version of the SSES Report including the original field forms and video tapes will be submitted to the department for review and comment by S&WB personnel. These items will be returned with comments for finalization. The forms along with the original video tapes, that were completed in the field, are to be included as an appendix to the final SSES report to be submitted to the S&WB. Six additional copies of the SSES report, one with copies of the forms, will also be required for completion of the project.

Television Inspection Form
Guidelines for Data Collection

A. *GENERAL*

A1. **Inspection Date**: Enter the date of inspection.

A2. **Inspection Crew**: Enter initials of company or organization doing inspections and initials of crew - person completing the form should enter his/her initials first. Example TRA - REN, JPG.

A3. **Basin**. Enter the letter code for the name of the interceptor.

A - Lakeview	F - Gentilly
B - Carrollton	G – Ninth Ward
C - Uptown	H - Algiers
D - Mid-City	I – South Shore
E - CBD/FQ	J - New Orleans East

A4. **Sub-basin**: Enter the sub-basin designation.

A5. **Main/Lateral Number**: Enter the main or lateral number for the line that is being imported.

A6. **Sewer Map Number.** Enter the page number of the S&WB Sewer Map Number.

A7. **Upstream Manhole Number**: Enter the upstream manhole (or structure) number. **Blank if not coded.**

A8. **Downstream Manhole Number**: Enter the downstream manhole (or structure) number. **Blank if not coded.**

A9. **Segment Length**: Enter the segment length that is to be inspected. Calculate the segment length from available plans.

A10. **Street Location**: Enter address or other identifier

B. *OBSERVATIONS*

B1. **RO Number**: Departmental numbering system for television activities

B2. **Tape Number**: Identify tape number

B3. **Direction of Travel**: Note the appropriate direction of travel.

B4. **Pipe Diameter (In.)**: Enter diameter of pipe being inspected, in inches.

B5. **Joint Length (ft)**: Enter the observed distance between pipeline joints, in feet.

B6. **Pipe Material**:

1. **VCP.** Vitrified Clay Pipe
2. **RCP.** Reinforced Concrete Pipe
3. **CMP.** Corrugated Metal Pipe
4. **PVC.** Polyvinylchloride
5. **D/CIP.** Ductile/Cast Iron Pipe
6. **HDPE.** High Density Polyethylene (black plastic pipe)
7. **Brick/Block.** Brick or Concrete Block
8. **AC.** Asbestos Concrete
9. **Other.** Note

B7. **Ground Condition**:

1. **Dry.** Dry Conditions
2. **Moderate.** Damp Ground
3. **Wet.** Standing Water

B8. **Cleaning Performed**: Indicate the cleaning which was done in the sewer segment prior to televising.

B9. **Location**: (Select the one most appropriate for setup manhole).

1. **Paved - Concrete**. Part or all of manhole casting is in paved concrete area.
2. **Paved - Asphalt**. Part or all of manhole casting is in paved asphalt area.
3. **Driveway** part or all of manhole casting is in driveway. Note material of construction of driveway i.e., concrete, asphalt, unpaved.
4. **Sidewalk**. Part of all of manhole casting is in a sidewalk.
5. **Curb**. Part or all of manhole casting is in a curb.
6. **Yard-Front**. Manhole located in front yard or front grassed easement.
7. **Yard-Back**. Manhole located in back yard.

8. **Yard-Side**. Manhole located in side yard.
9. **Non-Paved**. Manhole located in non-paved area.
10. **Canal Bottom**. Manhole in canal bottom.
11. **Field**. Manhole located in a field.
12. **Golf Course**. Manhole located in a golf course.

B10. **Traffic**:

1. **Two Lane**. Two Lane road.
2. **Three-Four Lane**. Three or four lane road.
3. **Highway**. A county, state, or federal highway.
4. **Parking**. Parking lot.
5. **Alley**. Alley
6. **Driveway**. Driveway
7. **Other**. Note

B11. **Volume/Access**. Enter appropriate description for volume of traffic and/or access to manhole.

1. **Low/Good**. Traffic considerations minimal. Easy to work in traffic to get around work area. Can drive heavy equipment to area.
2. **Medium/Fair**. Traffic considerations moderate. Requires a vehicle and cones to control. Can drive light equipment only to site.
3. **High/Poor**. Traffic considerations high. Requires multiple vehicles, electric signs, and other special traffic control devices. Cannot drive to site.

B12. **Surface**. Enter appropriate description of surface cover directly above the sewer segment.

1. **Open**. No obstructions above sewer segment
2. **Fence**. Fence located above sewer segment
3. **Trees**. Trees or heavy brush located above sewer segment
4. **Utilities**. Telephone poles, power lines, gas lines, etc.
5. **2, 3, and/or 4**. Any combination of fence, trees and utilities located above the sewer segment.

B13. **Concurrent Dye Test**. Indicates whether a dyed water test was performed in conjunction with the television testing.

C. *DEFECT IDENTIFICATION.*

C1. **Defect Number**. (No entry required). For each defect observed in the sewer, a defect identification number is assigned.

C2. **Footage**. Distance of the defect in feet from the setup manhole. Note footage = 0 at setup manhole.

C3. **Observation**. Enter type of defect or appurtenance for the indicated footage.

1. **Upstream manhole**
2. **Downstream manhole**
3. **Unknown manhole**
4. **Lens submerged**
5. **Lens emerged**
6. **Wye service**
7. **Break-in service**
8. **Protruding tap**
9. **Roots**
10. **Offset**
11. **Gapped Joint**
12. **Crack - Radial**
13. **Crack - Horizontal (Longitudinal)**
14. **Loose Bricks**
15. **Broken Pipe**
16. **Collapsed Pipe**
17. **Corrosion**
18. **Debris**
19. **Grease**
20. **Other**

C4. **Observation Location**. Indicate the location of the defect or appurtenance relative to the camera picture.

1. **Crown**. Defect is located in the crown of the pipe
2. **Right**. Defect is located in the right side of the pipe
3. **Left**. Defect is located in the left side of the pipe
4. **Invert**. Defect is located in the bottom of the pipe
5. **See Dyed Water**. Refer to defect noted on dye test form
6. **Multiple**. Any combination of 1 through 5.
7. **Joint**. Defect is located in the pipe joint
8. **Quadrant 1**. Defect is located in the upper right side of the pipe
9. **Quadrant 2**. Defect is located in the lower right side of the pipe
10. **Quadrant 3**. Defect is located in the lower left side of the pipe
11. **Quadrant 4**. Defect is located in the upper left side of the pipe

C5. **Rating**. Condition rating for the severity of the observed defect (See Table 1 - Television Rating Table).

C6. **Observed Infiltration**. Estimated infiltration rate (in gpm) if flow is observable.

C7. **Comment**. Additional description of observed infiltration sources.

Television Inspection

Sewerage & Water Board of New Orleans

Project Title _____

A - General

Inspection Date: _____ **Upstream MH No.:** _____

Inspection Crew: _____ **Downstream MH No.:** _____

Basin: _____

Subbasin: _____

Main/Lateral Number: _____ **Segment Length:** _____

Sewer Map Number: _____ **Street Location:** _____

B - Observations

RO Number: _____ **Tape Number:** _____

Direction of Travel: ①Upstream ②Downstream **Pipe Diameter:** _____in. **Joint Length:** _____ft.

Pipe Material:

①VCP ④PV ⑦Brick/Block

②RCP ⑤D/C ⑧AC

③CMP ⑥HDPE ⑨Other

Ground Condition:

①Dry

②Moderate

③Wet

Cleaning Performed

①None ④Root Cut

②Flush ⑤Bucket

③Jet ⑥Other

Location:

①Paved-Conc. ⑦Yard-Back

②Paved-Asph. ⑧Yard-Side

③Driveway ⑨Non-Paved

④Sidewalk ⑩Canal Bottom

⑤Curb 11 Field

⑥Yard-Front 12 Golf Course

Traffic:

①Two Lane

②3-4 Lane

③Highway

④Parking

⑤Alley

⑥Driveway

⑦Other

Volume/Access:

①Low/Good

②Medium/Fair

③High/Poor

Surface:

①Open

②Fence

③Trees

④Utilities

⑤2,3,&/or 4

Concurrent Dye Test: ①Yes ②No

C - Observations

Observation:		
1 = Upstream manhole	8 = Protruding top	15 = Broken pipe
2 = Downstream manhole	9 = Roots	16 = Collapsed pipe
3 = Unknown manhole	10 = Offset	17 = Corrosion
4 = Lens submerged	11 = Gapped joint	18 = Debris
5 = Lens emerges	12 = Crack-Radial	19 = Grease
6 = Wye service	13 = Crack-Horizontal	20 = Other
7 = Break-In service	14 = Loose bricks	

Location		Rating
1 = Crown	8 = Quadrant 1	0 = Not Applicable
2 = Right	9 = Quadrant 2	1 = Good
3 = Left	10 = Quadrant 3	2 = Minor
4 = Invert	11 = Quadrant 4	3 = Fair
5 = See Dyed Water		4 = Poor
6 = Multiple		5 = Deteriorated
7 = Joint		

Obser. Number:	Footage	Obser	Obser. Loc.	Rating	Obser. Infil	Comment
1						
2						
3						
4						
5						
6						
7						

Television Inspection

Sewerage & Water Board of New Orleans

Project Title _____

C - Observations

Observation:			Location:		Rating
1 = Upstream manhole	8 = Protruding top	15 = Broken pipe	1 = Crown	8 = Quadrant 1	0 = Not Applicable
2 = Downstream manhole	9 = Roots	16 = Collapsed pipe	2 = Right	9 = Quadrant 2	1 = Good
3 = Unknown manhole	10 = Offset	17 = Corrosion	3 = Left	10 = Quadrant 3	2 = Minor
4 = Lens submerged	11 = Gapped joint	18 = Debris	4 = Invert	11 = Quadrant 4	3 = Fair
5 = Lens emerged	12 = Crack-radial	19 = Grease	5 = See Dyed Water		4 = Poor
6 = Wye service	13 = Crack-horizontal	20 = Other	6 = Multiple		5 = Deteriorated
7 = Break-In service	14 = Loose		7 = Joint		

Obser. Number	Footage	Obser.	Obser. Loc.	Rating	Obser. Infil.	Comment
8						
9						
10						
11						
12						
13						
14						
15						
16						
17						
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33						

Notice

Television Inspection
Sanitary Sewer Survey

Dear Resident,

According to existing engineering information a manhole may be located on your property. ***Firm's name*** is under contract with the Sewerage & Water Board of New Orleans to perform television inspections and physical surveys of the sanitary sewer system. The study will require the inspectors to locate, inspect and enter manholes in the streets and easements. In that some easements are located beside or behind private residences, this may require the inspector(s) to enter onto private property to perform these inspections.

We would like to coordinate the survey process with those residents with manholes in their yards. Please contact me at your earliest convenience so that we may coordinate this effort

Thank you for your cooperation

Project Manager
Firm's Name
Firm's Telephone Number

TABLE 1

Television Defect Rating Schedule

	Rating/Description				
Defect Observation	1	2	3	4	5
1. Upstream manhole	Acknowledged				
2. Downstream manhole	Acknowledged				
3. Unknown manhole	Acknowledged				
4. Lens submerged	Acknowledged				
5. Lens emerged	Acknowledged				
6. Wye Service	Good	Hairline crack	Minor crack <1/8"	Alligator cracks not out of round	Broken - alligator cracks and out of round
7. Break-in or tap service	Good	Fair - Hairline crack or misaligned	Minor - crack <1/8"	Poor - multiple cracks	Deteriorated - multiple cracks, missing pieces
8. Protruding Tap	Good	Fair - Hairline crack or misalignment	Minor - crack >1/8" or > 2" into pipe	Poor - Multiple Cracks >3"	Deteriorated - Multiple cracks, out of round, missing pieces
9. Roots	None	Light - hairline	Medium - covers 25% of pipe wall	Heavy - covers 50% of pipe wall	Severe - covers over 75% of pipe wall
10. Offset	None	Visible - just beginning	Visible - can see edge of next joint	Visible - can see outer pipe wall	Visible - can see exposed earth
11. Gapped joint	Gasket material visible	Gasket hanging <1"	Gasket hanging >1"	Gap visible - can see outer pipe wall gasket hanging 2 to 4 "	Gap visible - can see exposed earth, gasket hanging across flowline
12. Cracked pipe - Radial	Staining no visible crack	Hairline crack	< 1/8" wide crack	> 1/8" wide crack	Multiple cracks
13. Cracked pipe - Horiz. Longitudinal	Staining no visible crack	Hairline crack	< 1/8" wide crack	> 1/8" wide crack	Multiple cracks
14. Loose bricks	Mortar missing - bricks appear secure	Mortar missing - bricks out of place or shifted	Mortar secure - bricks missing	Mortar missing - a few bricks missing	Mortar missing - many bricks missing
15. Broken pipe	Hairline cracks	Hairline cracks both radially and longitudinally	Pipe wall and joints show signs of cracking	Large cracks with exposed earth	Pieces of pipe wall missing - not out of round
16. Collapsed pipe	No entry	No entry	Pipe showing signs of being out of round	Camera will not pass - > 50 % of area open	Camera will not pass - < 50% of area open
17. Corrosion	Staining or discoloration	Light aggregate exposure	Heavy aggregate exposure	Reinforcing steel exposed	Missing part of pipe - earth exposed
18. Debris	Slight indication	Low - 0 to 10% of pipe diameter	Medium - 10 to 25% of pipe diameter	Heavy - 25 to 50% of pipe diameter	Severe - 50 to 100% of pipe diameter
19. Grease	Slight indication	Low - 0 to 10% of pipe diameter	Medium - 10 to 25% of pipe diameter	Heavy - 25 to 50% of pipe diameter	Severe - 50 to 100% of pipe diameter

SSES Inspection
Sewerage & Water Board of New Orleans
Project Title _____

Weekly Accomplishment Report
Week Ending: _____

A. - Work completed

	Accomplishment	Smoke Inspection	Dyed Water Inspection	Manhole Inspection	Flow Isolation	Television Inspection
1	Line Segments completed					
2	Total length of line segments					
3	Line segments unable to access					
4	Manholes accessed					
5	Manholes unable to be accessed					
6	Number of locations dyed water tested					
7	Manholes inspected (Surface only)					
8	Manholes inspected (Full inspection)					
	Days worked					
	Crew size					
	Rain days					
	Highlighted map attached					

B. - Action Order Request

Basin	Sub-basin	Main/ Lateral Number	Station	Problem encountered - Action requested	Prob. resolved	City response date

(continued)

B. - Action Order Request - continued

Basin	Sub-basin	Main/ Lateral Number	Station	Problem encountered - Action requested	Prob. resolved	City response date

TV Emergency Action Form

Sewerage & Water Board of New Orleans

Project Title _____

A - General

Inspection Date/Time: _____ **Upstream MH No.:** _____

Inspection Crew: _____ **Downstream MH No.:** _____

Basin: _____

Subbasin: _____

Main/Lateral Number: _____ **Segment Length:** _____

Sewer Map Number: _____ **Street Location:** _____

B - Observations

RO Number: _____ **Tape Number:** _____

Direction of Travel: ①Upstream ②Downstream **Pipe Diameter:** _____in. **Joint Length:** _____ft.

Pipe Material:

①VCP ④PVC ⑦Brick/Block
②RCP ⑤D/CIP ⑧AC
③CMP ⑥HDPE ⑨Other

Ground:

①Dry
②Moderate
③Wet

Cleaning Performed

①None ④Root Cut
②Flush ⑤Bucket
③Jet ⑥Other

Location:

①Paved-Conc. ⑦Yard-Back
②Paved-Asph. ⑧Yard-Side
③Driveway ⑨Non-Paved
④Sidewalk ⑩Canal Bottom
⑤Curb 11 Field
⑥Yard-Front 12 Golf Course

Traffic:

①Two Lane
②3-4 Lane
③Highway
④Parking
⑤Alley
⑥Driveway
⑦Other

Volume/Access:

①Low/Good
②Medium/Fair
③High/Poor

Surface:

①Open
②Fence
③Trees
④Utilities
⑤2,3,&/or 4

Concurrent Dye Test: ①Yes ②No

C - Emergency Condition

Identify Hazardous Condition:

_____

_____

_____

_____

_____

Sketch Location and Condition:

Give references to existing structures if possible

Television Inspection ASCII Format

Sewerage and Water Board of New Orleans

(A1)	(A2)	(A3)	(A4)	(A5)	(A6)	(A7)	(A8)	(A9)	(A10)	(B1)	(B2)	(B3)	(B4)	(B5)	(B6)
Inspection Date	Inspection Crew	Basin	Subbasin	Main / Lateral Number	Sewer Map Number	Upstream Manhole Number	Downstream Manhole Number	Segment Length (ft)	Street Location	RO Number	Tape Number	Direction of Travel	Pipe Diameter (inches)	Pipe Joint Length (feet)	Pipe Material

Exhibit 2

Television Inspection ASCII Format

Sewerage and Water Board of New Orleans

(B7)	(B8)	(B9)	(B10)	(B11)	(B12)	(B13)	(C1)	(C2)	(C3)	(C4)	(C5)	(C6)
Ground Condition	Cleaning Performed	Location	Traffic	Volume / Access	Surface	Concurrent Dye Test (Y/N)	Observation Number	Footage	Observation	Observation Location	Rating	Observed Infiltration

Exhibit 2

Television Inspection ASCII Format

Sewerage and Water Board of New Orleans

(C7)
Comments

Exhibit 2

GLOSSARY AND ABBREVIATIONS

Average Dry Weather Flow (ADWF) or Base Wastewater Flow (BWF) is the daily wastewater production flow rate during dry weather/low groundwater conditions. Includes *Wastewater Production Flow* and *Dry Weather Infiltration* only.

Capacity (Theoretical) is the flow quantity that would exist if the pipe were full with no downstream constrictions inhibiting flow.

Cleanout is a component of a service sewer line used to insert a cleaning device. It normally consists of a 4-6 inch steeply sloped vertical pipe that connects a plugged hole at the surface with the sewer line.

Continuity Equation is an equation used to compute liquid flow in a pipe that takes into account the depth and average velocity of that flow. ($Q = A * V$)

Continuous Flow Monitoring is that process by which sewer flows are determined. Velocity and depth measurements are electronically obtained at regular (15 minute, typical) intervals and flows are continuously computed. Continuous flow monitoring can be either short term or permanent. For short term monitoring, large sanitary drainage areas are divided into smaller tributary areas, averaging 6,000 - 30,000 linear feet. Monitors are installed at the exit point of each tributary area.

Cross Connections are improper connections between a storm and sanitary sewer where storm water can enter the sanitary sewer (typical) or sanitary sewage can enter the storm sewer. This defect consists of either an actual open pipe connection (direct) or a transfer of flow due to the close proximity of the storm and sanitary sewers (indirect).

Cumulative Flow represents the total flow at a flow meter inclusive of flow from all upstream systems. This is distinguished from *Net* flow which has all upstream flows subtracted.

Defect is a condition in a *Main, Lateral, Service Line,* or *Manhole* such as cracked, broken or corroded pipe, offset joints, cracked manhole walls, or maintenance related problems such as debris/grease that is evidence of sewer system degradation. Defects usually, but do not necessarily, *Leak.*

Diurnal Flow is a term describing the repeatable pattern of flow for a typical day at a particular site. Normally, a residential diurnal pattern consists of minimum flow between midnight and 6:00 AM, with primary peak flows occurring between 8:00 and 11:00 AM, and a secondary, lesser peak occurring between 6:00 and 8:00 PM. Business and industrial areas also normally exhibit repeatable flow patterns that may be different from residential patterns and are dependent on the types of industry present in an area.

Dry Weather Infiltration or Groundwater Infiltration (GWI) is the water entering a sewer system and service connections through the ground from sources such as defective pipes, joints, connections or through manhole walls that can not be attributed to a rain event. This infiltration occurs even during dry weather/low groundwater conditions.

Dye Dilution or Fluorometric is a method of measuring instantaneous flow at a point in the system downstream of the point of injection. The Procedure consists of injecting a known quantity of dye into the system and computing the concentration of dye downstream. The more diluted the concentration is the greater the flow quantity.

Dyed Water Inspection is a rainfall simulation technique used to more accurately locate and quantify I/I defects identified during smoke testing. Dyed water inspections can also be used to check for drain connections and confirm source connections. The method is typically used on storm sewer sections, ditch sections, stream sections, and on potential main sewer defects. Possible leaks are flooded with a dyed water solution in order to simulate a storm event.

Flow Isolation or Night Flow Isolation is the process to isolate small reaches of sewer and measure the infiltration (usually *wet weather infiltration*) rate within the reach of the mini-system. Its purpose is to identify portions of the sewer system subject to possible excessive infiltration. This process is accomplished by measuring flow during periods of minimum sewage contribution normally between midnight and 6:00 AM, at one point in time and subtracting or removing any upstream contribution.

Flow Meter is an electronic device installed in a sewer pipe that continuously records elements of sewer flow, typically velocity and depth, at regular intervals.

Flow Meter Calibration or Hydraulic Calibration is the process where velocity and depth data recorded by a flow meter is compared with independently measured velocity and depth data.

Groundwater is the water that exists in the ground on a more or less continuous basis. The level of groundwater is higher or lower depending upon the season of the year and rainfall. If groundwater levels exceed pipe elevations and a pipe is defective, then *Infiltration* results.

Hydraulic Grade Line (HGL) is a line connecting the points to which a liquid would rise at various places along any pipe or open channel if piezometer tubes were inserted in the liquid. It also is a measure of the pressure head available at those points. When water flows in an open channel, the hydraulic grade line approximately coincides with the surface of the water.

Hydrograph is a plot of flow rate versus time for a specific location.

Hyetograph is a plot of rainfall depth for each defined time period of a rainfall event. Usually shown as a bar chart of rainfall depth in inches for each hour of a rainfall event in a given location of the service area.

Inch-Mile (in-mi) is a unit of measurement that takes into account a pipeís length and diameter.

$$IN\text{-}MI = \Sigma\ [LENGTH(FT) \times DIA(IN)]/5{,}280\ LF/MI$$

Since *Infiltration* is the result of groundwater surrounding the pipe, the diameter component is very useful in summarizing infiltration results (i.e., GPD/in-mi).

Infiltration is water entering the wastewater collection system and service connections through defective pipes, pipe joints, connections, and manhole structures below the manhole cone. The rate of infiltration depends on the depth of groundwater above the defects, the size of the defects, and the percentage of the collection system submerged. The variation in groundwater levels and the associated infiltration is seasonal and weather-dependent.

Infiltration/Inflow (I/I) is all of the water from infiltration and inflow sources, without distinguishing the source.

Inflow is rainfall-related water that enters the collection system from sources such as service connections, private sewer laterals, downspouts, foundation drains, yard and area drains, stormwater sump pumps, manholes, defective piping, catch basins, and cross-connections from storm drains. Inflow is directly influenced by the intensity and duration of a storm event and by the antecedent soil conditions, and therefore is not a fixed quantity.

Leak is a sewer system *defect* that is either observed to be actively contributing I/I or exhibits evidence that I/I has occurred or will occur.

Line Cleaning is the process where mud, sand, debris, and/or grease are removed from a sewer line. Although other methods are available, cleaning is often accomplished by pulling a high pressure water nozzle back through a pipe thus scrubbing the walls with water and also moving debris back towards the water source for removal. Line cleaning is normally conducted prior to *TV Inspection.*

Line Segment is the defined length of the *main* or *lateral* sewer between an upstream and downstream *manhole.*

Main Sewer Line is a sanitary sewer line which serves a large area. The main sanitary sewer lines, collect flow from smaller lateral pipes in the Sewerage & Water Board service area. These larger diameter pipes, ten inch and greater, carry flow to the treatment plant or major pump station. The largest sewer lines can also be referred to as an interceptor or outfall lines.

Maintenance is the function of clearing debris, grease or blockages in sewer lines and the repairing of pipe defects. Maintenance is primarily conducted in order to improve hydraulic efficiency, maximize capacity, eliminate overflows, and reduce complaint calls.

Manhole is a point of service entry where people can observe or maintain the sewer pipe. An upstream manhole receives sewage and through its outgoing line contributes flow towards a downstream manhole. Manholes are numbered and are referenced to the sewer base maps.

Manhole Inspection is the process of collecting a variety of information concerning *Manholes*. This information includes dimensions, construction materials, general structural conditions and *Defects/Leaks*. Manhole inspections are either 1) above ground, in which observations are made without descending into the manhole, or 2) below ground, where the manhole is either descended into or observed by some type of viewing device. Below ground manhole inspections usually include line lamping from that portion of each *Line Segment* that can be observed from the manhole being inspected.

Manningís Equation is an equation used to compute liquid flow in a pipe that takes into account the depth of flow, the slope of the pipe and the roughness of the pipe. The Manningís equation is only valid if *open channel* free flow conditions exist. This means that a sewer line is not *surcharged*, and nothing downstream restricts flow efficiency.

$$Q=(1.486/n)\ A\ R^{2/3}\ S^{1/2}$$

Migration is when flow is removed from one defect and travels through the soil or surrounding area and enters the system through another defect that has not been *Rehabilitated*. This can reduce the effectiveness of I/I removal if all areas are not rehabilitated.

Municipal Service is that part of a *service line* located between the *main line*, *lateral* or *manhole* and the street right-of-way line. It directs flow from a residence or business to the collection system (i.e. *main line, service line* or *manhole*). The municipal service is that portion of the service line located within the street right-of-way (or utility easement).

Net Flow is the resultant flow from a particular sewered area where no flow is considered from any upstream systems. This is accomplished by subtracting flow components from upstream systems from the downstream *Cumulative Flow* components.

Open Channel Flow is flow in a ditch, trough or in a non-*Surcharged Line*. Open channel flow always has a free surface (i.e., it is not flowing under pressure or restriction).

Overflow Condition or Overflow Line is a sewer line segment in which the calculated or observed *hydraulic grade line* is at a higher elevation than the ground or manhole rim elevation.

Peak Flow is the highest recorded or projected flow rate from all sources of infiltration, inflow and wastewater contribution. It is generally determined from flow monitoring during or following a rain event.

Ponding or Inundated is a general term indicating that water drains to and ponds over or floods a *leak* source. This is to be distinguished from water moving over a source. Inundation often results in a severe leaking defect.

Private Service is that portion of the service line located on private property.

Quantification is the process by which flow *rates* are determined for leaking *defects*. *Leak* rates are assigned based upon observed extraneous flow, evidence of I/I, the type of defect and drainage potential.

Rainfall Event is a period of rain of measurable quantity and duration. A rainfall event may be continuous for a short period or sporadic for a longer period (even multi-day). However, rainfall measured following a 24-hour period of no rain is considered a separate rainfall event. Not all rainfall events are appropriate for I/I analysis.

Rain Gauge is an electronic or mechanical device used to continuously measure rainfall amounts.

Rainfall Dependent Infiltration/Inflow is extraneous water that enters the sewer system in direct response to rainfall. It is the combination of direct stormwater inflow which enters through storm drains and surface sources such as leaky manhole covers, and rainfall dependent infiltration, from rainwater that infiltrates into the soil and enters the system through defects in sewer pipes and manhole walls.

Rapid Infiltration is a component of *wet weather infiltration*. It can occur during and/or immediately after a *Rain Event* as a result of *run-off* entering the sewer trench and entering the pipe through, typically, infiltration defects but acting in the same manner as does *inflow*. In most cases, without considerable investigation, it is not distinguishable from *inflow*.

Rate is a volume of flow per period of time. Generally expressed as gallons per minute (**gpm**), gallons per day (**GPD**), million gallons per day (**MGD**), or cubic feet per second (**cfs**).

Recovery Day is normally the first calendar day following a wet day in which no *inflow* occurs. *Wet weather infiltration* is computed for this day by comparing recovery day flows with minimum *daily diurnal flow*.

Rehabilitation is the process by which *leaks* and *defects* are repaired or upgraded. Rehabilitation is often performed to reduce the amount of I/I entering a *sanitary sewer system* or correct structural problems.

Relief Sewer is a new sanitary sewer line constructed adjacent to or within proximity of an existing line. The new line provides additional capacity for conveyance of flow. A relief sewer could also connect one area to another in order to relieve flow capacity problems.

Replacement Sewer is a new sanitary sewer line that replaces an existing sanitary sewer to provide sufficient capacity to transport flow without *surcharging* or replace an aging line with structural defects with possibilities of eminent collapse.

Run-Off is that portion of storm water that remains primarily at the ground surface as opposed to penetrating the soil barriers.

Sanitary Sewer System is a *main or sewer lateral line*, *service lines* and *manholes* maintained by a municipality, county or other agency.

Service Line is a pipe line that directs flow from a residence or business to either a *main, lateral* or *manhole*. Municipal service is that portion of the service line located within the street right-of-way (or utility easement). The private service line is located on private property and is the property owner's responsibility.

Sewer Basin is generally a larger natural drainage area in which larger sanitary sewer interceptors follow the natural drainage feature, creek or river. The natural runoff drainage area dividing line may not always follow the Major Sewer Basin dividing line due to sanitary sewer collection features such as deep sewer/tunnels or lift stations.

Sewer Lateral is a sanitary sewer line which serves a relatively small service area. Sewer laterals drain into *main sewer lines* and are generally the six and eight inch sewer lines.

Sewer Sub-areas are smaller areas within a *sub-basin* which are established to characterize the total area, sewered area, population, employment, etc., which serve as the basis for estimating wastewater contributions to the sanitary sewer. The boundaries of each *sub-area* are established such that the wastewater from the *sub-area* drains to a single point in the Sewerage & Water Board's wastewater master plan.

Sewer Sub-basin is an area within a *sewer basin* which consists of a network of sewers which discharge at a single point into a major interceptor. *Sub-basins* can include one or more mains.

Sewer System Evaluation Survey (SSES) is the process by which sources of *infiltration* and *inflow* are located, quantified and recommended for rehabilitation. An I/I Source Detection Project typically consists of work phases including:

- Continuous Flow Monitoring
- Manhole Inspection
- Smoke Inspection/Dye Inspection
- Flow Isolation
- Wet Weather Inspection
- Cleaning/TV Inspection
- Hydraulic Modeling
- Analysis and Recommendations

Smoke Testing is the process where smoke is introduced into the system under pressure usually by means of a mechanical blower. The method is best used to detect inflow sources such as roof leaders, area drains, foundation drains, abandoned building sewers, faulty connections, illegal connection and storm sewer connections. Smoke exits the system at the points where *inflow* can enter the system.

Surcharged Condition or Surcharged Line is a sewer line segment in which the calculated or observed *hydraulic grade line* is at a higher elevation than the top or crown of the pipe. Depth of flow is greater than the pipeís diameter. Surcharge occurs when flow exceeds the capacity of the

outgoing line of a manhole, exceeds the capacity of a downstream pump station, or a downstream constriction causes the sewer to back up.

Swag or Sag is a depression or dip in a sewer line. Swags decrease sewer efficiency and cause grease and solids accumulation.

TV Inspection is the process by which sewer pipe is viewed with a closed circuit television camera. The image is observed on a TV monitor above ground and allows the viewer to see pipe condition. Documentation is made by video tapes or with photographs from the monitor. TV inspection normally follows *line cleaning.*

Tap is the point where a service line connects to the *main or sewer lateral.* This is a frequent location for a *defect.* Cracks and breaks at this connection often result in *leaks.* A service line may protrude into the *main or lateral* resulting in inefficient hydraulics. Service taps are sometimes referred to as hammer taps when not properly connected or factory taps when properly connected.

Total Infiltration is the maximum or peak infiltration flow that enters the wastewater collection system during high groundwater conditions.

Wastewater Production Flow (WWP) is the wastewater exclusive of infiltration and inflow. Generally estimated from water use records during months when most of the water consumption is returned to the wastewater collection system (January, February, March). WWP includes domestic, commercial, and industrial flows.

Weir is a device temporarily installed into a sewer line in order to measure instantaneous flow rates. The flow rate is determined by noting the level of flow pooling behind the typically ìVî shaped weir face. Weirs are used to calibrate *flow meters* and in conducting *flow isolation* studies.

Wet Weather Infiltration or Rainfall-Dependent Infiltration (RDI) is the water entering a sewer system and service connections through the ground from sources such as defective pipes, joints, connections or through manhole walls that can be attributed to a rain event. This extraneous flow enters the wastewater collection system via high groundwater conditions during rain events and continues after the inflow effects of the rain event have ended. It is generally determined by subtracting *average dry weather flow* from the flow recorded during and immediately after wet weather.

Wet Weather Inspection is the process by which a sewer system is observed during a storm event. Manholes are opened to check the effects of inflow, areas are observed to confirm ponding and inundation and *dye tests* may be conducted.

Abbreviations

A - cross-sectional area of the fluid in a pipe segment

ADWF - average daily dry weather flow

CFS - cubic feet per second

CO - cleanout

DIA - diameter of a pipe segment

DIP - ductile iron pipe

GPCD - gallons per capita day

GPD - gallons per day

GPD/IDM - gallons per day per inch-diameter-mile

GPM - gallons per minute

GWI - groundwater infiltration

HDPE - high density polyethylene pipe

HGL - hydraulic grade line

I/I - inflow/ infiltration

IDM - inch-diameter-miles. The product of sewer pipe diameter in inches and length of sewer in feet divided by 5280 feet.

LF - linear feet

MG - million gallons

MGD - million gallons per day

MH - manhole

n - Manningís coefficient of roughness

PVC - polyvinyl chloride pipe

Q - calculated quantity of flow

R - hydraulic radius of a given pipe segment

r - radius of a given pipe segment

RCP - reinforced concrete pipe

RDI - rainfall dependent infiltration

RDII - rainfall dependent infiltration/inflow

S - slope of a given length of pipe

SSES - Sewer System Evaluation Survey

V - velocity of flow in a given pipe segment

VCP - vitrified clay pipe

WWP - wastewater production (flow)

WWTP - wastewater treatment plant

Sewerage & Water Board of New Orleans
Sewer System Evaluation and Rehabilitation Program
Appendix Volume II

Pump Station (150 - 190) Testing and Evaluation Report

Station Number	Station Name	Station Address
150	K-Mart	Desire at Old Gentilly Road
151	Lake Forest	10451 Lake Forest Boulevard
152	Lakeland Terrace	5057 Warren Drive
153	Lakewood South	Country Club Drive at Marcia
154	Lamb	6450 Morrison Road
155	Lawrence	7900 Morrison Road
156	Liggett	2500 Morrison Road
157	Meco	3855 France Road
158	Michoud	4400 Michoud Boulevard
159	Oak Island	14201 Michoud Boulevard
160	Pine Village	6155 Dwyer Road
161	Plum Orchard	7300 Chef Highway
162	Shorewood	14441 Morrison
163	Southern Scrap	Harbor Road
164	Venetian Isles	20711 Old Spanish Trail
165	Victoria	3620 Victoria Street
166	Village D'Lest	13324 Dwyer Road
167	Weber 10141	Morrison Road
168	Willowbrook	Willowbrook Drive at Michoud Boulevard
169	Wilson	7709 Wilson Avenue
170	English Turn #1	2503 Stanton Road
171	English Turn #2	123 ½ Oak Alley Drive
172	Eton	3440 Eton Street
173	Garden Oaks	3201 Memorial
174	Holiday	3800 Herschel Street
175	Horace	3301 Lawrence Street
176	Huntlee	3201 Huntlee Drive
177	Lower Coast	3700 Belle Chase Highway 406
178	Memorial	2501 Memorial Park Drive
179	Park Timbers	4100 Lennox Boulevard
180	Tall Timbers	3800 Tall Pines Drive
181	Forest Isles	5631 West Forest Isles Drive
182	Woodland	4150 Woodland Drive
183	Wright	Lake Forest Boulevard at Wright Road

Sewerage & Water Board of New Orleans
Sewer System Evaluation and Rehabilitation Program
Appendix Volume II

Pump Station (150 - 190) Testing and Evaluation Report

Station Number	Station Name	Station Address
184	Aurora	6000 Carlisle Court
185	Blair	3800 Blair Street
186	Bridge Plaza	2914 Vespasian Street
187	SPS "D"	2801 Florida Avenue
188	SPS "C"	1107 Pacific Street
190	McCoy	McCoy Street at Old Gentilly Road