

Technical Memorandum

Phase 1 Part 2 CSO Control Plan Wellington Avenue CSO Facility

Dye Testing

Prepared for:

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J.N. 82372

INTRODUCTION

This Dye Testing Technical Memorandum (TM) has been prepared to describe the investigation procedure used, results of the investigation, and recommendations for rehabilitation of observed defects.

DESCRIPTION OF DYE TESTING

Dye testing was performed to confirm inflow sources identified as potential sources during the house to house survey and smoke testing in the three sewer catchment areas designated as priority inflow areas in the Phase 1 Part 1 CSO Control Plan report. Dye testing in Sewer Catchment Areas 1, 3 and 4, was performed between September 12 and December 22, 2006 by ADS Environmental Services (formerly Severn Trent Pipeline Services) generally between the hours of 8 AM and 5 PM.

DYE TESTING PROCEDURES

Dye testing is performed to confirm sources of inflow that were identified as potential inflow sources during house to house survey and smoke testing. A direct connection, as implied, is a drainage source that is directly connected into the sanitary collection system. Direct sources of inflow most often include cross connections between the drainage and sanitary sewer systems, or catch basins, roof leaders, driveway or yard drains, etc that are connected directly to the sewer system.

Dye testing is performed by introducing a small amount of dyed water into potential sources such as downspouts, area drains, patio drains, window well drains, stairwell drains, basement drains, floor drains, sump pits, and driveway drains while monitoring downstream sanitary sewer lines for signs of dyed water.

Prior to performing the dye test, all property owners were notified and requested an appointment prior to the dye testing. The city of Newport was notified daily of the locations where dye testing was being performed.

Dye Testing Results

- A total of 409 dye tests were performed on potential rain leader inflow sources. The dye testing program will be completed at the end of December and the additional results will be included in the Phase I Part 2 CSO Control Plan Report.

- Of those 409 suspected roof leader sources tested, 139 suspected sources (34%) were confirmed with connections to the sanitary sewer system.
- These 139 sources have an effective drainage area of approximately 116,071 square feet (sf) and are estimated to contribute approximately 1,723,000 gallons per day (gpd) of inflow.

The basis for these inflow estimates are described below.

Methodology to Estimate Inflow Calculations Contributing to the System from the Inflow Source

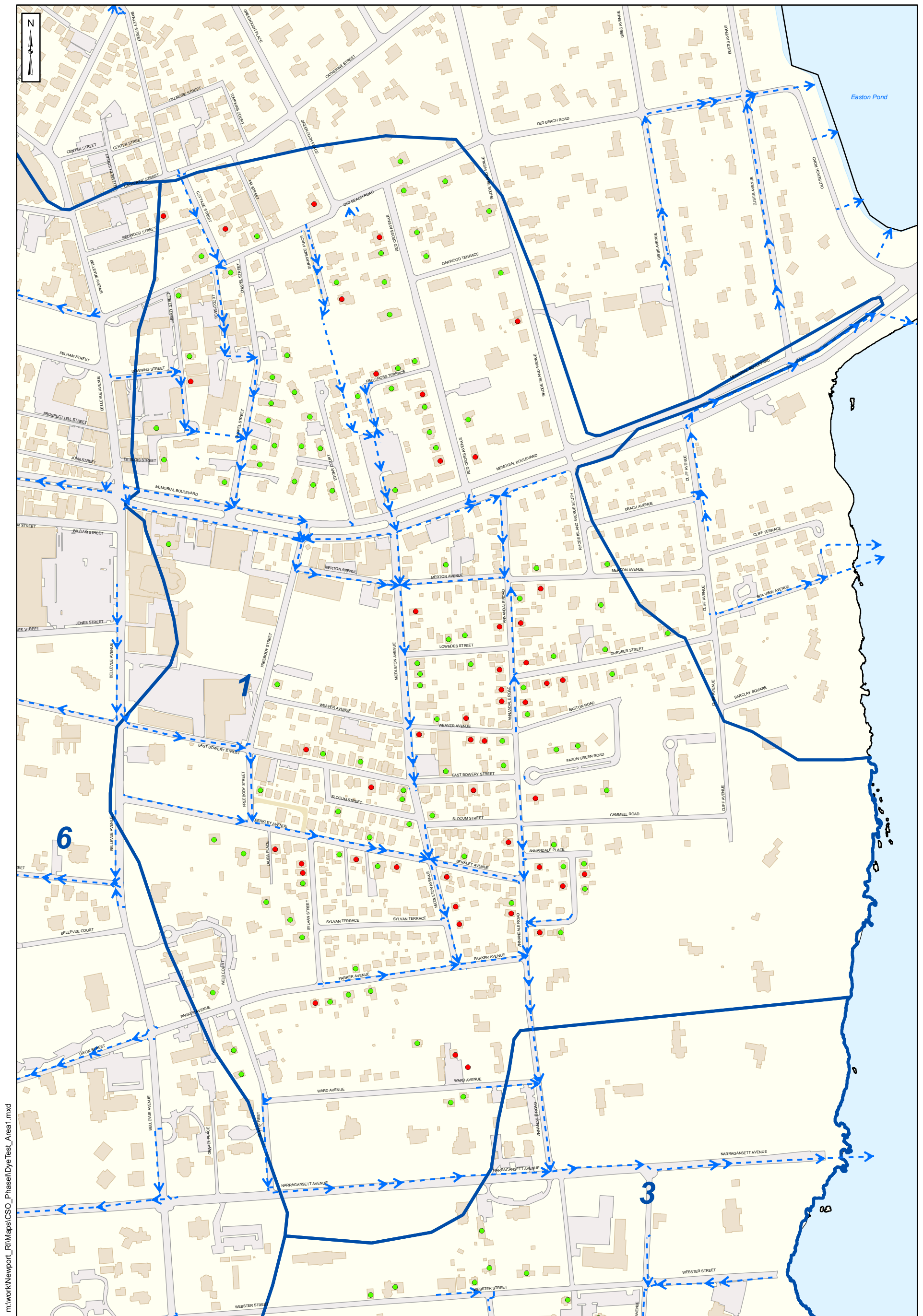
The Rational Equation was used to determine peak discharge entering into the sewer system as identified during smoke testing. The Rational Equation is $Q = ciA$, where:

- Q = Peak Inflow Rate (gpd)
- c = Rational method runoff coefficient
- i = Rainfall intensity (inches/hr)
- A = Drainage area (square feet)

The runoff coefficient (c) and the drainage area (A) were determined in the field upon conducting the smoke testing. The runoff coefficient is typically a function of the soil type and slope of the drainage area surrounding the inflow source. For this analysis, a runoff coefficient of 0.9 was used for impervious surfaces (asphalt and rooftops) and a coefficient of 0.3 was used for pervious surfaces (grass and native soils). All inflow estimates are based upon a storm with a maximum hourly intensity of 1.00 inches per hour. This intensity is approximately the peak intensity of a 1-year, 6-hour storm event. Tables 1 and 2 present a summary of inflow sources by sub-system. Tables 3, 4 and 5 provide a more detailed summary table identifying the specific sources within each sub-system and the estimated amount of inflow associated with each source. Figures 1, 2, and 3 show the approximate locations of each of the catch basins and rain leaders organized by sewer catchment area. The detailed dye testing reports will be submitted with the final Phase I Part 2 Report.

Table 1 – Summary of Potential Inflow Sources Dye Tested By Catchment Area

Sewer Catchment Area	Total Buildings Dye Tested
1	150
3	156
4	103
Total	409



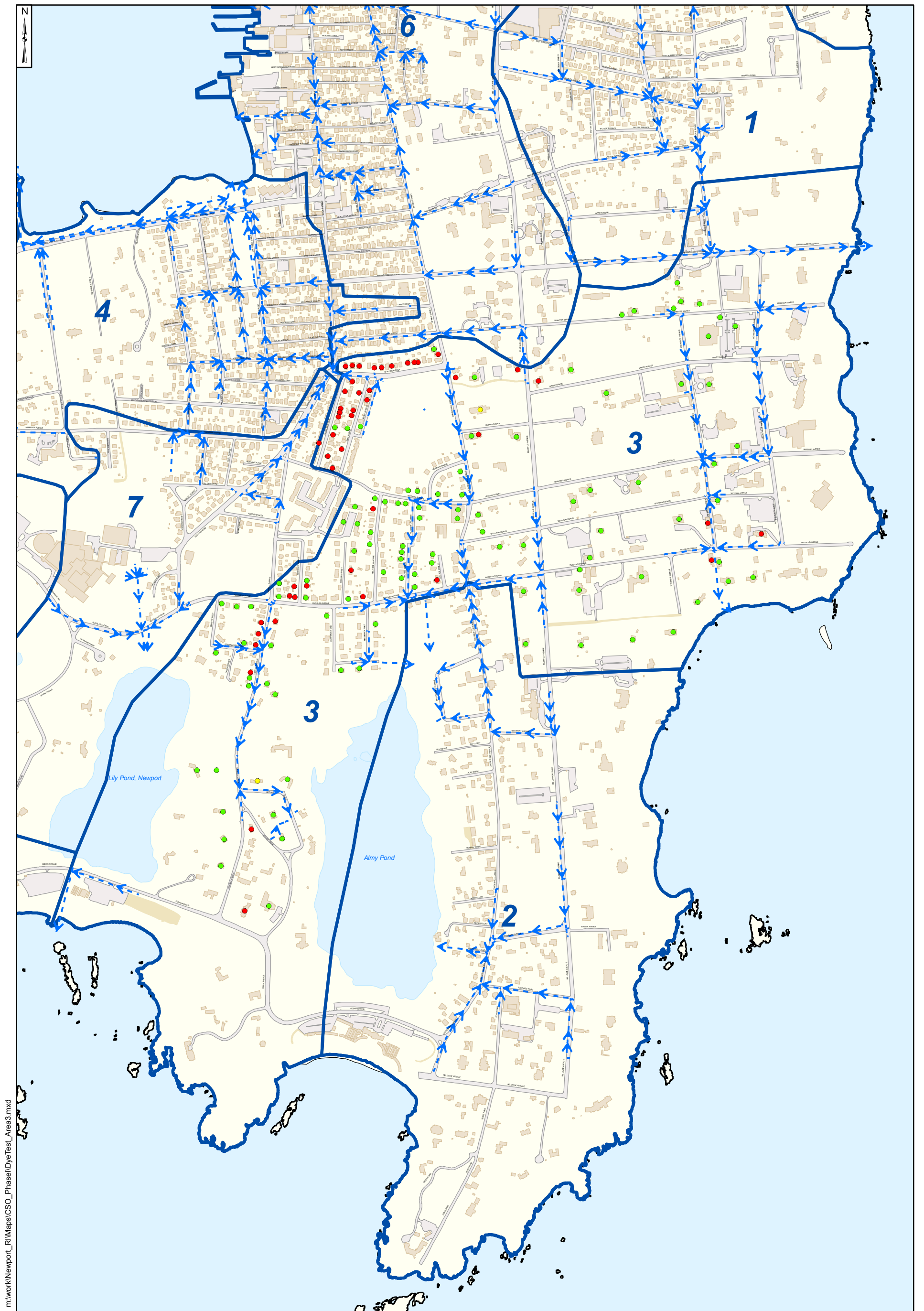
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JANUARY 2007

SCALE 1" = 400'
 0 200 400
 Feet

- LEGEND:
- Sewer District Boundary
 - Buildings
 - Docks
 - Paved Roads and Parking
 - Unpaved Roads and Parking
 - Connected To Sanitary
 - Not Connected to Sanitary
 - ➔ Drainage Pipes

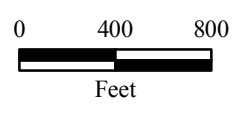
FIGURE 1
CATCHMENT AREA 1
DYE TESTING RESULTS
PHASE I PART 2 CSO CONTROL PLAN



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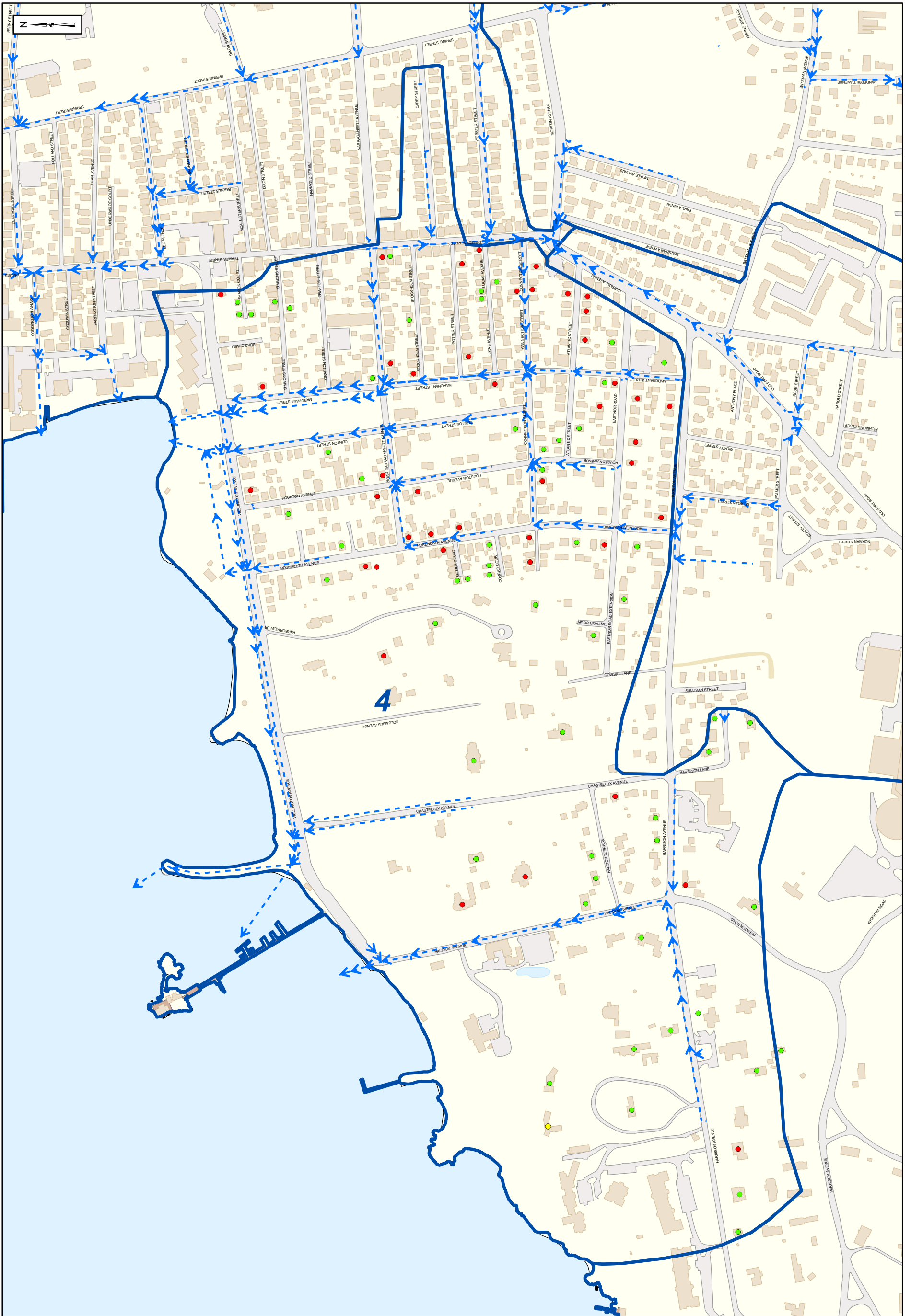
SCALE 1" = 800'



LEGEND:

- Sewer District Boundary
- Buildings
- Docks
- Paved Roads and Parking
- Unpaved Roads and Parking
- Connected To Sanitary
- Not Connected to Sanitary
- Unknown
- Drainage Pipes

FIGURE 2
CATCHMENT AREA 3
DYE TESTING RESULTS
PHASE I PART 2 CSO CONTROL PLAN



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SCALE 1" = 400'
 0 200 400
 Feet

- LEGEND:
- Sewer District Boundary
 - Buildings
 - Docks
 - Paved Roads and Parking
 - Unpaved Roads and Parking
 - Connected To Sanitary
 - Not Connected to Sanitary
 - Unknown
 - Drainage Pipes

FIGURE 3
CATCHMENT AREA 4
DYE TESTING RESULTS
PHASE I PART 2 CSO CONTROL PLAN

Table 2 – Summary of Inflow Estimates in Priority Sewer Catchment Areas

Sewer Catchment Area	Quantity of Buildings Connected to Sanitary Sewer	Total Inflow (gpd)
1	47	843,768
3	49	481,917
4	43	396,513
Total	139	1,722,198

A breakdown of the estimated flows presented in Table 2 is presented on the following pages.

OBSERVATIONS AND EVALUATIONS

The following tables present the locations, type and estimated inflow of the inflow sources in the catchment areas where dye testing was performed:

**Table 3
Catchment Area 1**

Location	No. Of Roof Leaders To Ground/Foundation	Dye Test Result	Effective Drainage Area (SQ FT)	Estimated Peak Inflow Rate 1.0 IN/HR (GPD)	
22	Annandale Road	1	Left Rear RL to Sanitary Sewer	1,620	24,037
23	Annandale Road	2	Left Front RL to SMH 095-60.1	211	3,125
30	Annandale Road	1	Middle Side RL to Wet Well and Discharges to SMH 095-57	243	3,605
31	Annandale Road	2	Right Front RL to SMH 095-61	259	3,846
35	Annandale Road	5	Left Side RL to Sanitary Sewer	5,400	80,122
37	Annandale Road	1	Right Front RL to Sanitary Sewer	2,250	33,384
40	Annandale Road	2	Left Side RL to Sanitary Sewer	3,240	48,073
63	Annandale Road	2	Right Side RL to Sanitary Sewer	540	8,012
77	Annandale Road	2	Right Front RL to Sanitary Sewer	2,700	40,061
82	Annandale Road	1	Right Front RL to Sanitary Sewer	540	8,012
1	Annandale Terrace	1	Right Front RL to Sanitary Sewer	2,160	32,049
16	Annandale Terrace	2	Right Front RL to Sanitary Sewer	540	8,012
17	Annandale Terrace	3	Left Rear RL to SMH 102-14	211	3,125
19	Berkley Avenue	2	Left Front RL to Sanitary Sewer	1,080	16,024
35	Berkley Avenue	4	Right Front RL to SMH 102-4	259	3,846
41	Berkley Avenue	7	Middle Front RL to SMH 102-4	292	4,327
45	Berkley Avenue	4	Right Front RL to Sanitary Sewer	1,800	26,707

Location	No. Of Roof Leaders To Ground/Foundation	Dye Test Result	Effective Drainage Area (SQ FT)	Estimated Peak Inflow Rate 1.0 IN/HR (GPD)	
10	Cottage Street	2	Right Rear RL to SMH 081-91	411	6,098
5	Dresser Street	1	Left Side RL to Sanitary Sewer	1,080	16,024
7	Dresser Street	1	Left Side Roof Leader to Sanitary Sewer	1,800	26,707
28	East Bowery Street	1	Middle Rear RL to SMH 102-2	300	4,451
41	East Bowery Street	3	Left Front RL to SMH 102-2	270	4,006
61	East Bowery Street	4	Left Side RL to Sanitary Sewer	3,240	48,073
14	Faxon Green Road	4	Left Rear RL to SMH 102-9	1,824	27,063
30	Greenough Place	6	Middle Front RL to SMH 081-91	1,125	16,692
22	Liberty Street	1	Right Front RL to Sanitary Sewer	1,440	21,366
43	Merton Avenue	1	Left Front RL to SMH 095-61	320	4,748
20	Middleton Avenue	3	Left Front RL to Sanitary Sewer	720	10,683
44	Middleton Avenue	2	Left Front RL to Sanitary Sewer	1,080	16,024
82	Middleton Avenue	3	Left Front RL to Sanitary Sewer	1,800	26,707
86	Middleton Avenue	4	Right Front RL to Sanitary Sewer	1,080	16,024
27	Parker Avenue	1	Left Front RL to SMH 101-25	373	5,528
29	Red Cross Avenue	4	Left Side RL to Sanitary Sewer	1,080	16,024
40	Red Cross Avenue	5	Middle Front RL to Sanitary Sewer	1,800	26,707
41, 43	Red Cross Avenue	4	Left Side RL to Sanitary Sewer	4,320	64,098
5	Red Cross Terrace	1	Left Front RL to SMH 088-26	315	4,674
1A AND 1B	Red Cross Avenue	3	Left Front RL to Sanitary Sewer	2,160	32,049
12	Redwood Street	6	RL to SMH 081-3	304	4,507
175	Rhode Island Avenue	1	Left Front RL to SMH 089-1	600	8,902
12	Sunnyside Place	5	Right Front RL to SMH 088-26	486	7,211
3	Sylvan Street	2	Right Front RL to Sanitary Sewer	1,080	16,024
5	Sylvan Street	3	Right Front RL to SMH 101-23	1,220	18,102
32	Ward Avenue	4	Left Rear RL to SMH 112-72	1,258	18,665
34	Ward Avenue	2	Left Front RL to SMH 112-72	1,064	15,787
41	Weaver Avenue	2	Middle Front RL to SMH 102-1	130	1,923
42	Weaver Avenue	4	Left Side RL to SMH 102-1	480	7,122
45	Weaver Avenue	2	Right Front RL to SMH 059-69	365	5,408
Total Estimated Inflow From Catchment Area 1					843,768

Based on the results of the dye testing in Sewer Catchment Area 1, approximately 843,768 gallons per day (gpd) potentially enters the system through direct connections to the sanitary system.

**Table 4
Catchment Area 3**

Location	No. of Roof Leaders To Ground Surface/Foundation	Dye Test Result	Effective Drainage Area (SQ FT)	Estimated Peak Inflow Rate 1.0 IN/HR (GPD)	
20	Bateman Avenue	1	Left Front RL To SMH 128-80	504	7,478
453	Bellevue Avenue	2	Middle Front RL To SMH 119-17	700	10,386
110	Carroll Avenue	1	Middle Rear RL To SMH 151-27	900	13,354
115	Carroll Avenue	2	Right Front RL To SMH 151-27	434	6,439
119	Carroll Avenue	4	Left Side RL To SMH 151-30	1,000	14,837
123	Carroll Avenue	4	Left Front RL To SMH 151-30	625	9,273
133	Carroll Avenue	1	Middle Front RL To SMH 151-32	256	3,798
208	Carroll Avenue	1	Left Front RL To SMH 163-71	320	4,748
228	Carroll Avenue	1	Middle Rear RL To SMH 174-5	950	14,096
4	Coggeshall Avenue	2	Left Front RL To SMH 118-123	149	2,203
3	Earl Avenue	1	Left Front FL To SMH 118-14	446	6,610
11	Earl Avenue	4	Left Side, Middle Rear, and Right Side RL To Ground Surface, Right Front RL To SMH 129-95	32	481
15	Earl Avenue	2	Left Front RL To SMH 129-94	392	5,816
33	Earl Avenue	3	Right Front RL To SMH 129-97	223	3,305
7	Florence Avenue	2	Right Front RL To SMH 152-43	162	2,404
8	Florence Avenue	3	Right Front RL To SMH 151-28	675	10,015
4	Hazard Road	4	Left Front RL To SMH 140-62	680	10,095
108e	Lawrence Avenue	2	Middle Rear RL to SMH 142-4	540	8,012
2	Leroy Avenue	4	Right Front RL to SMH 119-27	1,248	18,517
3	Meikle Avenue	2	Right Side RL To SMH 118-14	401	5,949
7	Meikle Avenue	2	Left Rear RL To SMH 118-14	292	4,327
7	Morton Avenue	2	Right Side RL To SMH 118-14	1,136	16,855
8	Morton Avenue	3	Left Front RL To SMH 118-14	405	6,009
10	Morton Avenue	4	Right Side RL To SMH 118-14	1,440	21,366
12	Morton Avenue	1	Right Front RL To SMH 118-14	400	5,935
32	Morton Avenue	2	Right Front RL To SMH 118-125	1,000	14,837
34	Morton Avenue	1	Right Rear RL To SMH 118-14	243	3,605
38	Morton Avenue	2	Left Front RL To SMH 118-125	415	6,158
44	Morton Avenue	3	Right Side RL To SMH 118-125	1,000	14,837
48	Morton Avenue	2	Right Side RL To SMH 118-124	446	6,610
50	Morton Avenue	1	Left Side RL To SMH 118-124	800	11,870
94	Ruggles Avenue	4	Right Front RL To SMH 151-28	1,192	17,686
96	Ruggles Avenue	2	Right Front RL To SMH 151-28	1,300	19,289
124	Ruggles Avenue	3	Right Front RL To SMH 152-44	800	11,870
142	Ruggles Avenue	5	Right Side RL To SMH 140-53.1	162	2,404
172	Ruggles Avenue	6	Middle Front RL To SMH 141-75	535	7,932
221	Ruggles Avenue	1	Left Side RL To SMH 142-5	500	7,419
234	Ruggles Avenue	4	Middle Rear RL to SMH 142-4	2,500	37,093
11	Shields Street	2	Middle Front RL To SMH 140-50	1,035	15,357
513	Spring Street	1	Right Side RL to SMH 118-123	400	5,935
573	Spring Street	1	Right Side RL to SMH 118-123	400	5,935
4	Vaughan Avenue	3	Right Side RL To SMH 118-14	365	5,408
12	Vaughan Avenue	1	Right Front RL To SMH 118-14. Right Front RL is Disconnected	324	4,807
14	Vaughan Avenue	2	Right Front RL To SMH 118-14	896	13,294

Location	No. of Roof Leaders To Ground Surface/Foundation	Dye Test Result	Effective Drainage Area (SQ FT)	Estimated Peak Inflow Rate 1.0 IN/HR (GPD)	
16	Vaughan Avenue	2	Right Front RL To SMH 129-95	1,056	15,668
24	Vaughan Avenue	3	Left Side RL To SMH 129-95	1,152	17,093
27	Vaughan Avenue	4	Right Front RL To SMH 129-95	259	3,846
34	Vaughan Avenue	3	Left Side RL To SMH 129-95	672	9,971
5	Weatherly Avenue	2	Left Side RL To SMH 14-55	720	10,683
Total Estimated Inflow From Catchment Area 3				481,917	

Based on the results of the dye testing in Sewer Catchment Area 3, approximately 481,917 gallons per day (gpd) potentially enters the system through direct connections to the sanitary system.

Table 5
Catchment Area 4

Location	No. Of Roof Leaders To Ground/Foundation	Dye Test Result	Effective Drainage Area (SQ FT)	Estimated Peak Inflow Rate 1.0 IN/HR (GPD)	
5	Atlantic Street	2	Left Side RL To SMH 128-75	680	10,095
6	Atlantic Street	2	Left Side RL To SMH 128-75	680	10,095
9	Atlantic Street	1	Left Side RL To SMH 128-76	448	6,647
15	Atlantic Street	3	Left Side RL To SMH 128-76	405	6,009
2	Brenton Road	4	Right Front To Ground, Left Front RL To SMH 127-49	486	7,211
35	Chastellux Avenue	7	Right Front RL To SMH 108-17	2,000	29,675
53	Chastellux Avenue	4	Left Rear RL To SMH 127-54	832	12,345
17	Connection Street	3	Left Side RL To SMH 118-10	500	7,411
21	Connection Street	1	Right Side RL To SMH 118-10	194	2,884
24	Connection Street	1	Front Side RL To SMH 118-10	1,037	15,383
111	Connection Street	2	Rear Side RL To SMH 117-95	540	8,012
130	Connection Street	3	Left Front RL To SMH 117-95.1	446	6,610
24	Eastnor Road	2	Right Front RL To SMH 128-77	203	3,005
25, 27	Eastnor Road	1	Middle Front RL To SMH 128-77	286	4,243
36	Eastnor Road	2	Right Front RL To SMH 128-84	1,472	21,841
40	Eastnor Road	2	Right Side RL To SMH 128-84	486	7,211
8A & B	Halidon Avenue	3	Left Front RL To SMH 116-81	1,200	17,805
3	Harborview Drive	2	Left Front RL To SMH 108-16	1,575	23,369
13	Harrison Avenue	1	Left Side RL To SMH 128-81	480	7,122
39	Harrison Avenue	2	Right Front RL To 128-92	1,632	24,215
106	Harrison Avenue	1	Right Front RL To SMH 126-45	360	5,341
57	Houston Avenue	1	Left Side RL To SMH 109-35.1	456	6,766
60	Houston Avenue	1	Right Side RL To SMH 109-35.1	640	9,496
63	Houston Avenue	2	Right Front RL to SMH 117-91	1,320	19,585
5	Marchant Street	4	Right Rear RL To SMH 109-24; Right Front RL Clogged.	594	8,813
61	Marchant Street	1	Left Side RL To SMH 117-106	680	10,095

	Location	No. Of Roof Leaders To Ground/Foundation	Dye Test Result	Effective Drainage Area (SQ FT)	Estimated Peak Inflow Rate 1.0 IN/HR (GPD)
82	Marchant Street	1	Left Side RL To SMH 128-76	162	2,404
1A	Potter Street	3	Right Front RL To SMH 117-103	324	4,807
31	Potter Street	1	Right Rear RL To SMH 117-103	528	7,834
49	Roseneath Avenue	2	Right Front RL To SMH 109-29	324	4,807
51	Roseneath Avenue	2	Left Front RL To SMH 109-29	194	2,884
66	Roseneath Avenue	2	Left Side RL To SMH 117-91	405	6,009
67	Roseneath Avenue	1	Left Front RL To SMH 117-96	540	8,012
68 1/2	Roseneath Avenue	2	Right Front RL To SMH 117-96	324	4,807
70	Roseneath Avenue	1	Right Front RL To SMH 117-96	320	4,748
83	Roseneath Avenue	4	Left Side RL To SMH 117-95.1	270	4,006
95	Roseneath Avenue	3	Right and Left Front RL To SMH 117-95	486	7,211
34	Stockholm Street	1	Left Front RL To SMH 117-100	216	3,205
651e	Thames Street	1	Left Side RL To SMH 117-100	900	13,354
675	Thames Street	2	Right Rear RL To SMH 118-9	640	9,469
7	Wellington Avenue	2	Left Front RL To SMH 109-28	600	8,902
101	Wellington Avenue	1	Left Side RL To SMH 109-35	454	6,730
37	W. Narragansett Avenue	2	Right Side RL To SMH 117-100	405	6,009
Total Estimated Inflow From Catchment Area 4					396,513

Based on the results of the dye testing in Sewer Catchment Area 4, approximately 396,513 gallons per day (gpd) enters the system through direct and indirect connections to the sanitary system.

REHABILITATION RECOMMENDATIONS

Based on the results of the dye testing, the inflow sources from rain leaders to the sanitary sewer system have been confirmed with in the three priority sewer catchments. Rain leaders are direct connections and require immediate correction or rehabilitation to prevent inflow from entering the sanitary system. The following are recommendations to eliminate reduce inflow into the sanitary sewer:

- Notify private property owners to disconnect roof drains and rain leaders from sanitary sewer and redirecting flow on the ground surface.
- The Catchment Areas observed should be addressed in the following order, prioritized by inflow contribution to the sanitary sewer system:

**Table 6
 Prioritization of Catchment Areas By Estimated By Inflow**

Location	Estimated Inflow Contribution (gpd)	Priority
Catchment Area 1	843,768	1
Catchment Area 3	481,917	2
Catchment Area 4	396,513	3

Estimated Cost to Remove Inflow

Costs will need to be determined on a case by case basis. Private connections will need to be resolved by developing a program for disconnection by the property owners. As most of the direct connections are rain leaders, the home owner may simply disconnect the down spout from the in ground connection, cap the connection, and direct the water out and away from their house. The City may wish to provide guidance to the homeowners regarding proper disconnection procedures to prevent inflow from continuing to enter the sanitary system through open cleanouts or disconnected rain leader pipes.

CONCLUSIONS AND RECOMMENDATIONS

The City should develop a program requiring private property owners to disconnect rain leaders and yard drains.