Field Sampling Data Report

Long Term Control Project
Water Quality Monitoring Program
for
Hutchinson River TMDL/WLA

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Hutchinson River TMDL/WLA Field Sampling Report

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1. Introduction

1.1. Purpose

This report describes a sampling program that was executed to support the development of a waste load allocation for Hutchinson River. Data collected as part of this sampling program will be used to model pathogens in the waterbody, in an effort to develop Total Maximum Daily Loads (TMDLs), a watershed effort needed to allocate pollutant loadings where CSO receiving waters are affected by numerous sources. The CSO control strategies will be evaluated as part of the Long-Term CSO Control Plan (LTCP) for the Hutchinson River which is due to the state by September 2014. This report satisfies 2012 CSO Consent Order Appendix A milestone XI.F.2, which requires the submittal of a report on completed field sampling for the Hutchinson River by December 31, 2012.

The Hutchinson River was initially placed on the New York State 303(d) list in 2002, due to the presence of oil/grease, low dissolved oxygen (DO) levels, and pathogens attributed to urban/storm runoff and CSO. The Hutchinson River remained on the 2010 303(d) list.

1.2. Description of Sampling Program

Prior to commencement of the sampling program, the NYCDEP and NYSDEC collaborated in the establishment of sampling goals, locations, frequency, and laboratory analyses to be performed to obtain the information needed to develop the waste load allocation. The resulting sampling program was memorialized in a document entitled, "FIELD SAMPLING ANALYSIS PLAN, Long Term Control Project Water Quality Monitoring Program for Hutchinson River TMDL/WLA, May 2012," and consisted of 4 major elements:

- Ambient water quality sampling during dry and wet weather
- Point discharge sampling during wet weather at CSOs and Stormwater outfalls
- Hydrodynamic Monitoring
- Marshland Characterization

Each of these elements is discussed below.

1.2.1 Ambient Water Quality Sampling

Data collection for the Ambient Water Quality Sampling at the locations identified in **Figure 3** included the following parameters:

- Fecal Coliform
- Enterococci
- Dissolved Oxygen
- Temperature
- Salinity
- Turbidity

Both wet-weather and dry-weather conditions were sampled.

Wet Weather Intensive Sampling
Intensive sampling of surface waters during wet weather was conducted at five locations within the NYC reach of the river, and at four locations within the Westchester reach **(Figure 3)**.

Samples were collected twice per day, within 24 hours of the first indication that all monitored CSO and stormwater outfalls had discharged into the Hutchinson River after a rainfall event. Sampling continued for three consecutive days over a 12-hour period per day, to account for tidal fluctuations. The purpose of this sampling was to clearly define the attenuation of bacteria due to decay and dilution.

Dry Weather Intensive Sampling
The locations and parameters used for wet weather sample were also used for dry weather sampling **(Figure 3)**. The dry weather intensive sampling consisted of collecting samples twice per day for a single day during which no rain was observed for 48 hours prior to the sampling event.

1.2.2 Point Discharge Sampling

Two categories of point discharges were sampled: stormwater and CSO outfalls **(Figure 3)**. CSO sampling took place only within New York City limits, since there are no CSO outfalls in Westchester County.

Stormwater Outfall Point Discharge Sampling
Discharges from stormwater outfalls are point sources of pollutants to the Hutchinson River. There are more than 20 storm outfalls to the Hutchinson River within the Borough of the Bronx. To identify waste load contributions from these point sources, samples considered representative of discharges from the stormwater outfalls were collected during wet weather. Sampling events were conducted at manholes upstream from any tidal influences in stormwater conduits that flow to outfalls HP-637 and HP-639. Discrete samples were collected every half hour for two consecutive hours. The parameters sampled for and measured were the same as for the ambient water quality sampling.

CSO Outfall Point Discharge Sampling
CSO outfalls are another source of point discharge; five CSO outfalls currently discharge to the Hutchinson River. To characterize the pollutant concentrations of these outfalls, samples from two CSOs (outfalls HP-023 and HP-024) were collected directly from the sewer. In conjunction with the stormwater outfall samples and landside modeling, these results will be used to project CSO pathogen loadings. The sampling frequency and parameters were the same as those for stormwater outfall discharge sampling.

1.2.3 Flow Quantification

For the flow quantification, continuous wave area-velocity flow loggers were used. Specific flow meter used was the Teledyne Isco Model 2150 installed and maintained on a weekly basis by Flow Assessment who also retrieved the data and estimated the flows.

Upstream Flow Quantification

For development of a TMDL, the upstream loading must be defined for both calibration conditions and projection conditions. A correlation of flow to loadings or rainfall to loadings would be useful – in either case, the flowrate during sampling is needed. There is a USGS flow gauge on the Hutchinson River (USGS 01301500), located at the intersection of the Hutchinson River and Pelham Parkway. This flow gauge, which is managed and maintained by the NY Water Science Center for the USGS, takes continuous measurements that can be obtained from the USGS website. In addition, a flow meter was installed at this location to provide real-time data that can be used for flow quantification. Additionally, a wireless rain gauge was installed at the Conner Street Pump Station.

Stormwater Outfall Flow Monitoring

During wet weather, stormwater discharges were also be monitored for flow. These measurements will give a complete flow balance and will be used for watershed InfoWorks model calibration.

CSO Outfall Flow Monitoring

For the CSO outfalls, flow for HP-023 was monitored at two locations (indicated by the "M" in **Figure 1**) – the influent to the regulator chamber, and the branch connection (diverted flow).

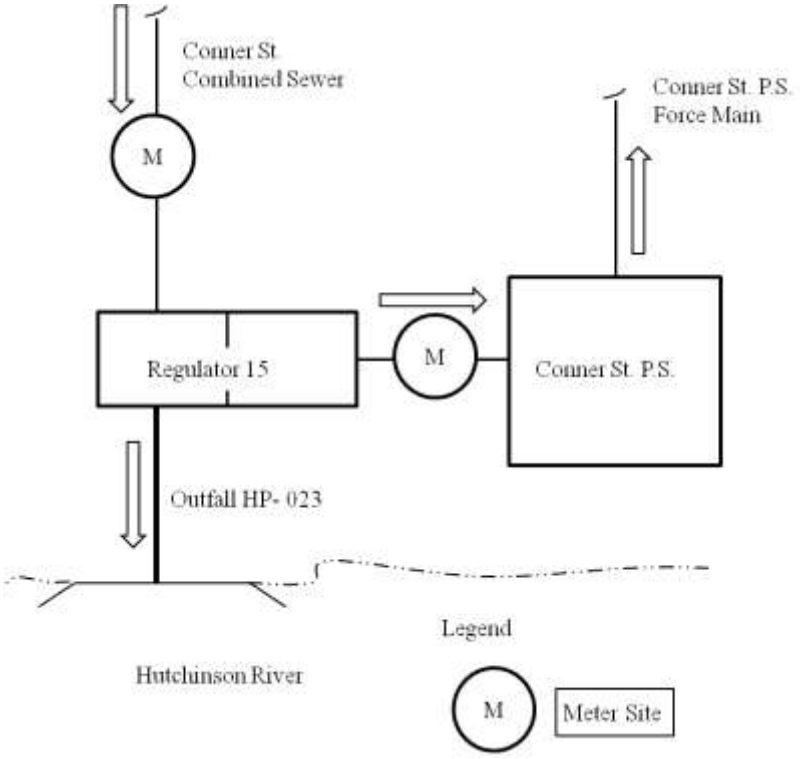


Figure 1: Schematic of CSO Flow Monitoring at HP-023

Flow was monitored at three locations for HP-024 – the influent to the regulator chamber from both the Boston Road and E 233rd Street combined sewers, and the branch connection (diverted flow), as shown in **Figure 2**.

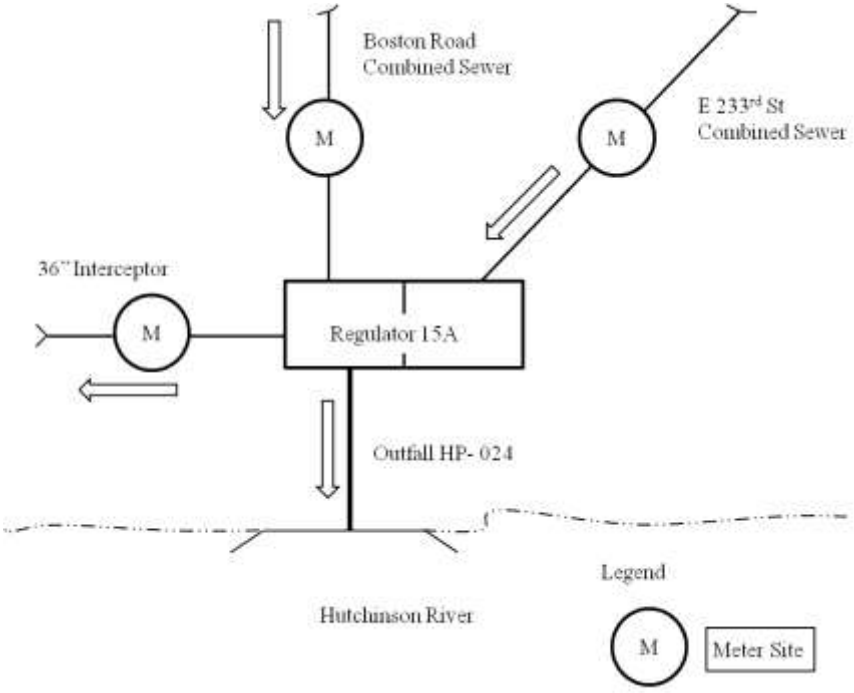


Figure 2: Schematic of CSO Flow Monitoring at HP-024

1.3. Hydrodynamic Monitoring

Sondes meters were installed at two locations and depths within the Hutchinson River, to continually measure temperature and salinity within the River. Continuous measurements were collected over a two-week period. The first meter was placed 30 feet downstream of CSO outfall HP-024, and the second was 5 feet downstream of CSO Outfall HP-023. This data will be used to calibrate the hydrodynamic model. Water surface elevations through the tidal cycle were also monitored continuously throughout the survey period.

1.4. Marshland (Wetland) Characterization

The eastern side of the Hutchinson River is a relatively large wetland. It is possible that wildlife within this wetland could contribute to coliform bacteria, particularly during the summer months. Therefore, influent and effluent concentrations to the wetland at two existing rivulets entering and exiting the wetland were monitored. Samples were collected once per hour at each location over a tidal cycle (about 12 hours).

1.5. Proposed Sampling Schedule

Table 1 and **Table 2** provide an overview of the sampling scheduled developed in the FIELD SAMPLING ANALYSIS PLAN. **Figure 3** (at the end of Section 1) maps the sampling locations.

Table 1: Proposed Sampling Schedule for Hutchinson River Sampling Program – NYC

SUMMARY OF SAMPLING WORK PLAN - NYC REACH OF HUTCHINSON RIVER									
	Tasks	Duration	# of Events	Daily Frequency	# Locations	Sampling Locations	By	Daily Samp	Comments
A. Waterbody/Watershed Characterization (Sampled parameters: Fecal, Entero, DO, Temperature, Salinity, Turbidity)									
1. Ambient WQ Sampling (Tasks in series)	Wet Weather Intensive Sampling	3 Consecutive Days	4 Wet Weather Events (> 0.40 in. Rain)	2x, T&B	5	Stations HR01, HR02, HR03, HR04, HR05	LTCP Team	21	Wet weather intensive samples in NYC waters (5 sta) will be collected at two depths to capture stratification of wet weather discharges that may take place in the ambient waters, where possible.
	Dry Weather Intensive Sampling	1 Day	4 Dry Weather Events (> 48 Hrs w/o Rain)	2x	5		LTCP Team	11	
2. Point of Discharge Sampling	Stormwater Outfall	2 Hrs	4	every 1/2 hr (4)	2	Manhole upstream of HP-637 and HP-639 HP-023 and HP-024	LTCP Team	9	Sampled using ISCO at manholes.
	CSO Outfall	2 Hrs	4	every 1/2 hr (4)	2		LTCP Team	9	Sampled using ISCO at upstream sewers or plant influent.
B. Flow Quantification									
	Upstream Flow Quantification	2 Months	Continuous	Continuous	1	USGS Gauge near Station HR09 Manhole upstream of HP-637 and HP-639. In and out of HP-023 and HP-024	USGS	NA	A USGS gauge taking continuous measurements will be used.
	Stormwater Outfall	N/A	4	Continuous	2		LTCP Team	NA	Incoming and outgoing flows at HP-637 and HP-639 to be metered by Flow Assessment.
	CSO Outfall	N/A	4	Continuous	2		LTCP Team	NA	Incoming and outgoing flows at HP-023 and HP-024 to be metered by Flow Assessment.
C. Hydrodynamic Monitoring									
	Hydrodynamic Monitoring	2 Weeks	Continuous	Continuous	2	Stations HR03 and HR05	LTCP Team	NA	Temp and Salinity at 2 depths
D. Marshland Characterization (Sampled parameters: Fecal, Entero, DO, Temperature, Salinity, Turbidity)									
	Wetland Influent and Effluent Sampling	2 Months	2x/Month	every hr for 12 hrs (13)	2	Marsh Station 1 and 2, at rivulets entering and exiting wetland	LTCP Team	28	It is preferred that half of the samplings be conducted during wet weather.
	Flow Estimation							NA	

Table 2: Proposed Sampling Schedule for the Hutchinson River Sampling Program – Westchester County

SUMMARY OF SAMPLING WORK PLAN - WESTCHESTER REACH OF HUTCHINSON RIVER									
	Tasks	Duration	# of Events	Daily Frequency	# Locations	Sampling Locations	By	Daily Sampl	Comments
A. Waterbody/Watershed Characterization (Sampled parameters: Fecal, Entero, DO, Temperature, Salinity, Turbidity)									
1. Ambient WQ Sampling (Tasks in series)	Wet Weather Intensive Sampling	3 Consecutive Days	4 Wet Weather Events (> 0.40 in. Rain)	2x	4	HR06, HR07, HR08, HR09	LTCP Team	11	Wet weather intensive samples at HR06 will be collected at two depths to capture stratification of wet weather discharges that may take place in the ambient waters.
	Dry Weather Intensive Sampling	1 Day	4 Dry Weather Events (> 48 Hrs w/o Rain)	2x	4		LTCP Team	9	
2. Point of Discharge Sampling	Stormwater Outfall	2 Hrs	4	every 1/2 hr (4)	2	HR-06, HR-08	LTCP Team	9	Sampled using ISCO at manholes.
B. Flow Quantification									
Stormwater Outfall		N/A	4	Continuous	2	HR-06, HR-08	LTCP Team	NA	Farrell Ave is a split pipe, so monitoring sensors will need to be placed in each pipe, for a total of 3 monitoring sites

1.6. Sampling Protocol

1.6.1 Ambient Water Quality Sampling

Bacteriological samples were collected using a Kemmerer sampler, and samples were placed directly into the laboratory-provided sterile sample containers. During wet weather events, samples were collected at two depths – two feet below the surface, and two feet above the bottom.

The Kemmerer sampler was rinsed with site water prior to collection of each sample, to avoid cross-contamination. Samples were stored in a cooler with ice for transport to a New York State approved testing laboratory within required the six-hour holding time. The measured parameters of dissolved oxygen, temperature, turbidity and salinity (conductivity) were performed in the field, using the YSI 6820 V2 Probe. The same methodology was used for dry-weather and wet-weather samples.

All collected samples were prepared for delivery at the dock facility (located at Evers Marina, 1470 Outlook Ave., Bronx, NY), where the courier met the boat and land crews for transfer of coolers to the laboratory.

1.6.2 Point of Discharge Sampling

Bacteriological samples were collected using an automatic ISCO sampler during wet weather, and by direct grab during dry weather. Samples were placed into the laboratory-provided sterile sample containers. Samples were stored in a cooler with ice for transport to a New York State approved testing laboratory within the required six-hour holding time. The measured parameters of dissolved oxygen, temperature, turbidity and salinity (conductivity) were performed in the field, using the YSI 6820 V2 Probe.

1.6.3 Marshland Sampling

Bacteriological samples were collected using a Kemmerer sampler, and samples were placed directly into the laboratory-provided sterile sample containers. Samples were stored in a cooler with ice for transport to a NYS approved testing laboratory within the required six-hour holding time. The measured parameters of dissolved oxygen, temperature, turbidity and salinity (conductivity) were performed in the field, using the YSI 6820 V2 Probe.

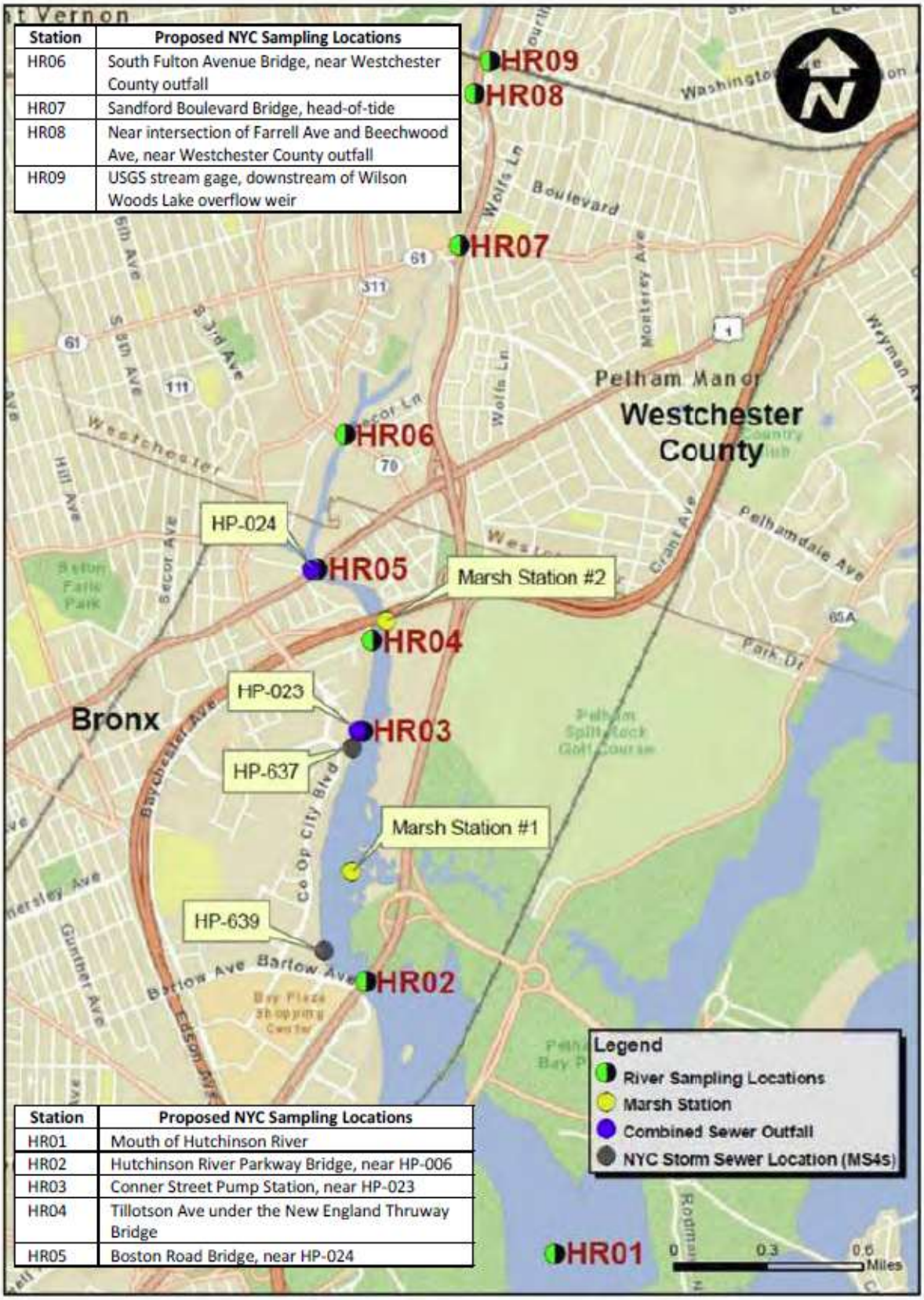


Figure 3: Map of Sampling Locations

2. Description of Sampling Events

All aspects of the sampling program were ready for execution in late May 2012. The sampling program was conducted from May 21 through September 25, collecting the appropriate number of dry and wet ambient sampling events, point of discharge events, and marshland sampling events. **Table 4** (next page) summarizes the sampling event dates, type of sampling was performed, and time when coolers were transferred to the laboratory, and provides any notes or observations concerning events during the sampling day.

2.1. Manhole Flow Quantification

Meters were installed between 4/18/12 and 5/10/12, and manhole flow data were collected between 4/18/12 and 10/15/12. **Table 3** tabulates the location and duration of each meter installations and the type of meter installed, and **Table 5** presents any observations or issues that occurred at the flow monitoring sites during the sampling program.

Table 3: Flow Monitoring Site Configuration

SITE CONFIGURATION			
Site	**Location**	**Duration**	**Meter**
HP023	Conner St. Pump Station	4/25/12 - 10/15/12	Area Velocity Flow Meter installed in an existing 145"H x 102"W custom shaped line
HP023Int	Conner St. Pump Station	5/10/12 - 10/15/12	Area Velocity Flow Meter installed in an existing 36" diameter line
HP024	East 233rd Street	4/25/12 - 10/15/12	Area Velocity Flow Meter installed in an existing 61"H x 96"W custom shaped line
HP024	East 233rd Street & Boston Road	4/25/12 - 10/15/12	Area Velocity Flow Meter installed in an existing 120"H x 146"W custom shaped line
HP024Int	East 233rd Street & Boston Road	4/25/12 - 10/15/12	Area Velocity Flow Meter installed in an existing 35" diameter line
HP637	99 Dreiser Loop	4/25/12 - 10/15/12	Area Velocity Flow Meter installed in an existing 60" diameter line
HP639	Baychester Avenue & Bartow Avenue	4/25/12 - 10/15/12	Area Velocity Flow Meter installed in an existing 30" diameter line
HR06	770 South Columbus Street	5/10/12 - 10/15/12	Area Velocity Flow Meter installed in an existing 72" diameter line
HR08a	35 Farrel Street	5/9/12 - 9/18/12	Area Velocity Flow Meter installed in an existing 72" diameter line
HR08b	35 Farrel Street	5/10/12 - 10/15/12	Area Velocity Flow Meter installed in an existing 72" diameter line
Hutch River	Sparks Avenue R.O.W.	5/11/12 - 10/15/12	Area Velocity Flow Meter installed in an existing 12"H x 20"W custom shaped line
Rain	Conner St. Pump Station	4/25/12 - 10/15/12	Tipping bucket rain collector and electronic data logger

Table 4: Sampling Event Details and Observations

Date	Sampling Type	Cooler Delivery	Pickup #1	Pickup #2	Pickup #3	Remarks
5/21/2012	Point of Discharge (Canceled)					Sampling cancelled. First flush could not be captured.
5/22/2012	Marshland Sampling WET	6:00	11:35	15:20	19:20	
5/29/2012	Point of Discharge		0:50	1:05		4th sample of HP-023 is probably tide gate leaking salt water. Sampler on HP-639 malfunctioned. Rain started 5/29/12 at 19:35 and continued until 5/29/12 21:00. The total precipitation registered for this event was 0.310 inches.
5/30/2012	Wet Weather Sampling		11:15	15:05	16:38	
5/31/2012	Wet Weather Sampling		11:30	14:40		
6/1/2012	Wet Weather Sampling		10:50	13:35		
6/6/2012	Marshland Sampling WET	6:00	11:00	15:00	19:00	
6/11/2012	Marshland Sampling DRY		10:45	15:30	18:50	
6/12/2012	Point of Discharge		18:40			Got a composite on HP-639 all samples pumped into one bottle. HP-024 did not overflow as of 21:00. Rain started 6/12/12 at 11:50 and continued until 6/13/12 at 3:05. The total precipitation registered for this event was 1.070 inches.
6/13/2012	Wet Weather Sampling		10:00	15:00		

Date	Sampling Type	Cooler Delivery	Pickup #1	Pickup #2	Pickup #3	Remarks
6/14/2012	Wet Weather Sampling		9:00	15:02		
6/15/2012	Wet Weather Sampling		9:05	12:30		
6/20/2012	Dry Weather Sampling		11:00	16:35		
6/25/2012	Point of discharge		9:48	10:15		Crew on site from 12:00am. Started samplers around 7:30am. Some issues: HR-08 MH cover blown out onto street and hose got ripped off. HR-06 hose didn't fill the bottles, one composit sample was filled for testing. Rain started 6/25/12 at 6:00 and continued until 6/25/12 at 15:45. The total precipitation registered for this event was 1.580 inches.
6/26/2012	Wet Weather Sampling		10:14	15:00		
6/27/2012	Wet Weather Sampling		10:00	15:05		
6/28/2012	Wet Weather Sampling		9:50	14:25		
7/10/2012	Dry Weather Sampling		9:55	14:30		
7/11/2012	Marshland Sampling DRY		11:00	15:00	19:00	
7/15/2012	Point of Discharge		13:19			Rain started 7/15/12 at 6.45 and continued until 7/15/12 at 21:00. The total precipitation registered for this event was 0.500 inches.

Date	Sampling Type	Cooler Delivery	Pickup #1	Pickup #2	Pickup #3	Remarks
7/16/2012	Point of Discharge		0:57			
7/16/2012	Wet Weather Sampling		9:50	15:00		
7/17/2012	Wet Weather Sampling		10:30	15:10		
7/18/2012	Wet Weather Sampling		6:50	12:25		
7/23/2012	Dry Weather Sampling		9:22	15:10		
7/26/2012	Point of Discharge		23:30			HP-024 did not overflow. HP-08 did not take sample at 21:10. HR-08 at 21:40 One barrel took a fill sample and the other barrel took a very small sample, but still made an equal composite. Rain started 7/26/12 at 8:30 and continued until 7/26/12 at 20:30. The total precipitation registered for this event was 0.360 inches.
7/27/2012	Wet Weather Sampling		9:30	15:10		
7/28/2012	Wet Weather Sampling		9:20	14:50		
7/29/2012	Wet Weather Sampling		9:13	14:34		Sampling started on July 27 but it rained again on July 28 so the sampling continued three more days after the rain event.
7/30/2012	Wet Weather Sampling		9:30	14:35		
7/31/2012	Wet Weather Sampling / Dry weather sampling		9:48	15:10		

Date	Sampling Type	Cooler Delivery	Pickup #1	Pickup #2	Pickup #3	Remarks
7/31/2012	Dry Weather Sampling		9:48	15:10		
8/21/2012	Dry Weather Sampling		9:15	14:55		
8/28/2012	Point of Discharge		9:30			HR-08 is not a composite. The hose in the north barrel is pinched. Rain started 8/28/12 at 3:55 and continued until 8/28/12 at 6:35. The total precipitation registered for this event was 0.220 inches.
8/28/2012	Wet Weather Sampling		12:00	17:19		
8/29/2012	Wet Weather Sampling		9:03	15:03		
8/30/2012	Wet Weather Sampling		6:57	12:35		
9/12/2012	Dry Weather Sampling at Manholes		9:17	14:20		
9/18/2012	Point of Discharge		10:10	22:00		For HR-06 time between samples not exactly 30 mins. Isco sampler failed so grab samples were taken instead. Rain started 9/18/12 at 4:15 and continued until 8/28/12 at 21:05/ The total precipitation registered for this event was 1.710 inches.
9/19/2012	Wet Weather Sampling		9:00	14:47		
9/20/2012	Wet Weather Sampling		9:00	15:00		

Date	Sampling Type	Cooler Delivery	Pickup #1	Pickup #2	Pickup #3	Remarks
9/21/2012	Wet Weather Sampling		8:50	15:20		
9/21/2012	Dry Weather Sampling at Manholes		8:50	15:20		
9/25/2012	Dry Weather Sampling at Manholes		9:03	14:35		

Table 5: Notes and Observations for Flow Monitoring Locations

LOCATION	NOTES AND OBSERVATIONS
HP023Int	On 6/29/12 @ 2010 to 7/3/12 @ 8:15 the sensor within the pipe was knocked out of the flow and was reinstalled during the next service visit. On 7/27/12 @ 8:20 to 8/6/12 @ 9:45 the sensor malfunctioned and was replaced during the next service visit. On 8/16/12@12:50 to 8/31/12@23:55 the meter malfunctioned and was replaced during the next service visit. On 8/16/12@12:50 to 9/13/@10:30 the meter sensor became fouled with debris. The sensor was cleared. The sensor was found to have debris built-up again during the next service visit, and was relocated to a different location within the same line. For the periods indicated above, the data is unavailable. From 9/13/12@10:45 to the end of the data recorded, the recorded data is only available in 15 minute increments.
HP637	Negative velocities were recorded during rain events.
HR08a	On 9/18/12@19:15 to the end of the recorded data, the meter malfunctioned. No data is available for this period.
HR08b	On 9/11/12@19:10 to 9/25/12@14:30 the meter malfunctioned. The sensor was replaced during the next service visit. No data is available for this period.
HR06	This metering location appears to be tidally effected.

2.2. Hydrodynamic Monitoring

The stream was monitored at two stations along the Hutchinson River, between 7/10/12 and 7/26/12. Each station monitored water level, conductivity and temperature at two depths, as summarized in **Table 6**. Station 1 was located 30 feet downstream of CSO outfall HP-024, and Station 2 was located 5feet downstream of CSO outfall HP-023.

Table 6: Site Configurations for Hydrodynamic Monitoring Equipment

Site	Location	Duration	Type of Meter
NYC Upper 1	30ft downstream of HP024 CSO Outfall	7/10/12 - 7/26/12	Electronic data logger, with level, conductivity and temperature sensors. Sensor set at 2 ft from river surface.
NYC Lower 1	30ft downstream of HP024 CSO Outfall	7/10/12 - 7/26/12	Electronic data logger, with level, conductivity and temperature sensors. Sensor set at 2 ft from river bottom.
NYC Upper 2	5 ft downstream of HP023 CSO Outfall	7/10/12 - 7/26/12	Electronic data logger, with level, conductivity and temperature sensors. Sensor set at 2 ft from river surface.
NYC Lower 2	5 ft downstream of HP023 CSO Outfall	7/10/12 - 7/26/12	Electronic data logger, with level, conductivity and temperature sensors. Sensor set at 2 ft from river bottom.

3. Data Analysis and Discussion

3.1. Rainfall Impacts

The following trends were noticed when considering rainfall impacts on parameters measured:

- The stream samples show a higher stratification closer to the rain event.
- After a rain event, there is a gradual drop in the pathogens concentrations with time, at stations HR-01 to HR-06 and station HR-09. Stations HR-07 and HR-08 show consistently high pathogen concentrations.
- Tidal influence is observed in parameters such as dissolved oxygen (DO) and salinity.
- There is a clear barrier between stations HR-06 and HR-07 with respect to salinity and DO. The salinity is much greater from stations HR-01 to HR-06, and DO is much higher from stations HR-07 to HR-09.

3.2. Pathogen Concentrations

The following observations can be made about pathogen concentrations measured during the sampling program:

- Enterococcus concentrations were shown to be relatively low, and do not demonstrate much variation from station HR-01 to station HR-06 (within the tidal zone). Stations HR-07 to HR-09 show higher concentrations, and a peak is consistently observed at station HR-08.
- Fecal coliform concentrations are shown to be more variable, with a consistent peak at station HR-08.

3.3. Marshland Sampling

The parameters sampled during the marshland sampling do not show a clear influence of the tide or the weather conditions. However, during dry weather, the DO concentration increased as the tide ebbs.

3.4 CSO Flow Monitoring

Area velocity flowmeters were installed in CSO outfall HP-023 and HP-024 233rd Street, as indicated in **Error! Reference source not found.** and **Error! Reference source not found.**, respectively**.**

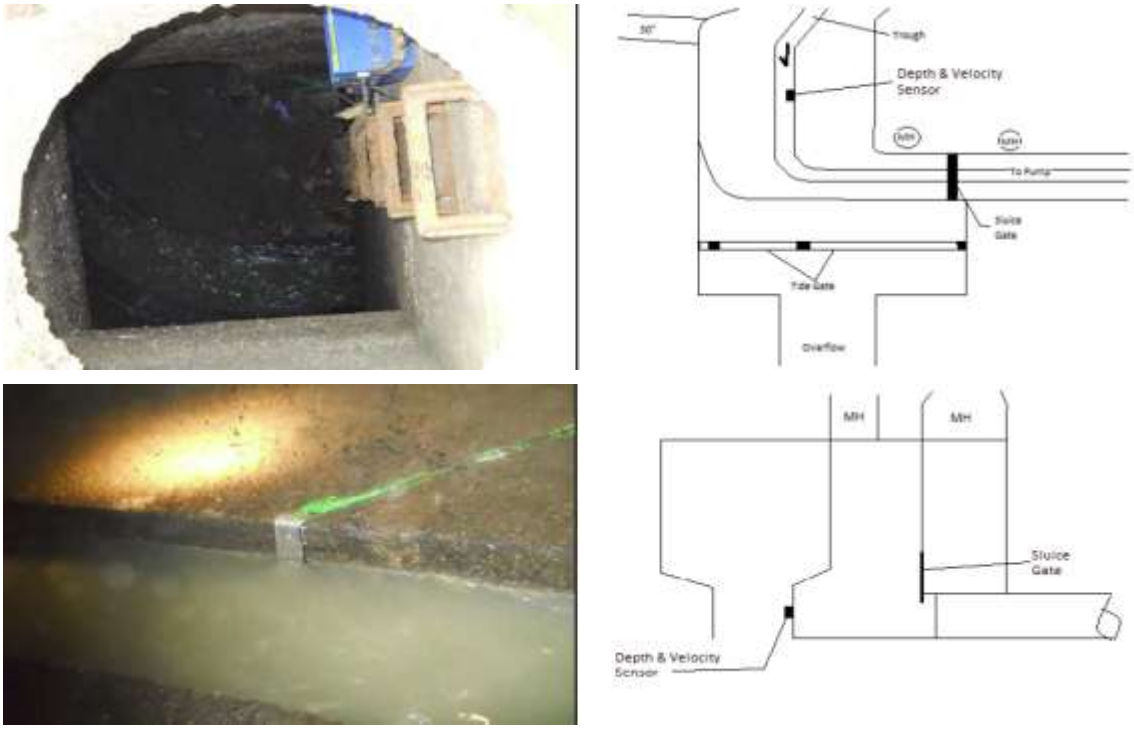


Figure 4: Velocity Flowmeters at Outfall HP-023

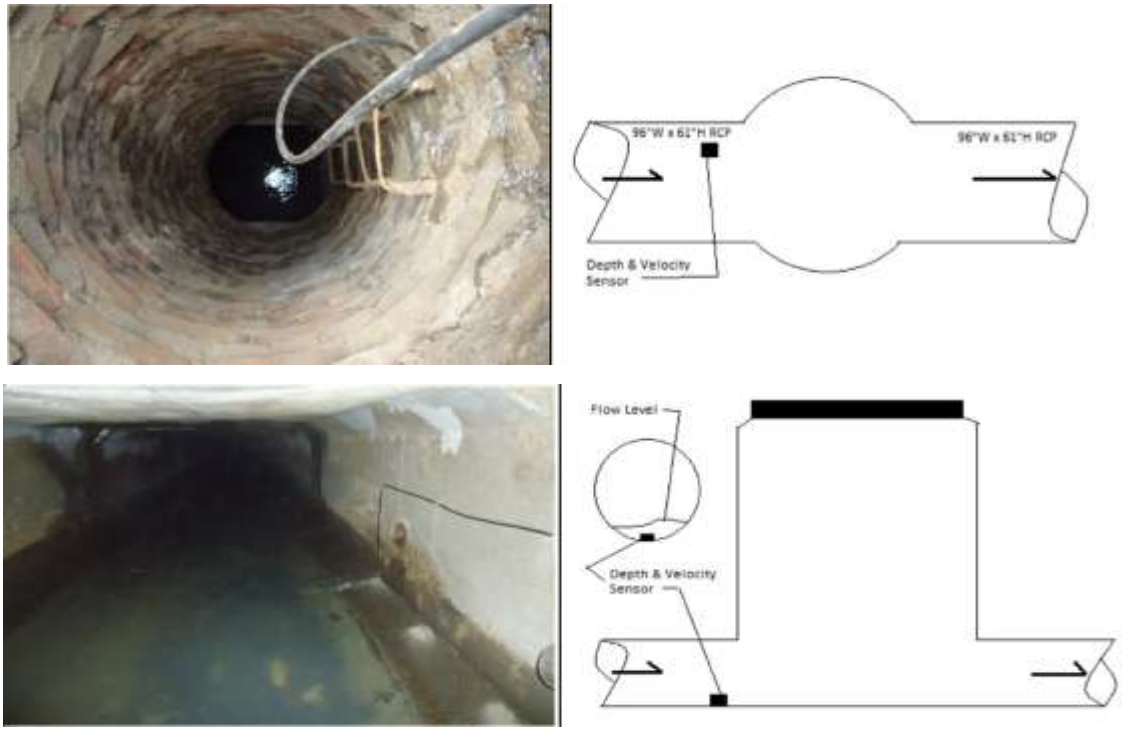


Figure 5: Velocity Flowmeters at Outfall HP-024

Area velocity flowmeters were also installed in the CSO outfall HP-024 insituform line (HP-024 Int), as indicated in **Figure 6** and at Boston Road, as shown in **Figure 7**.

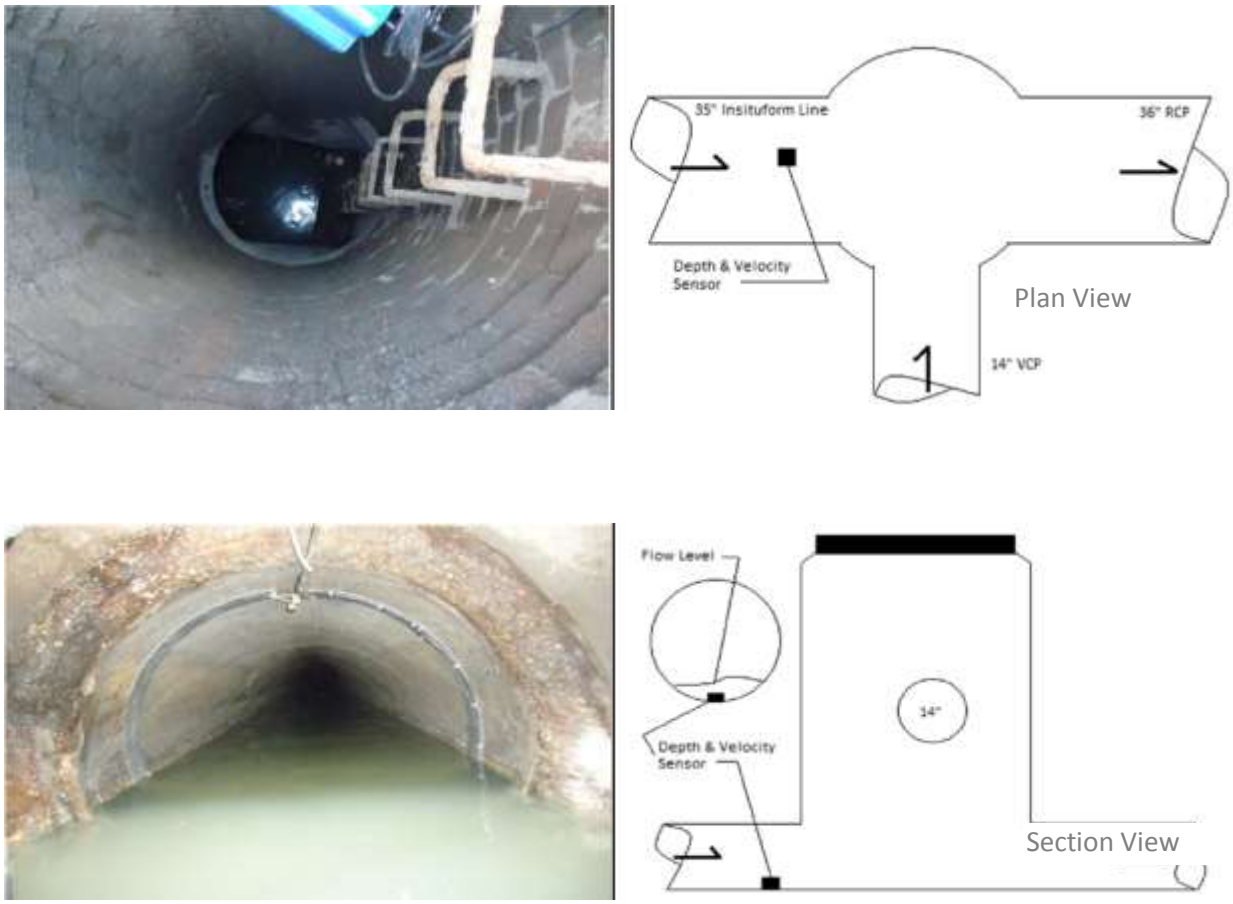


Figure 6: Velocity Meter at HP-024 Int.

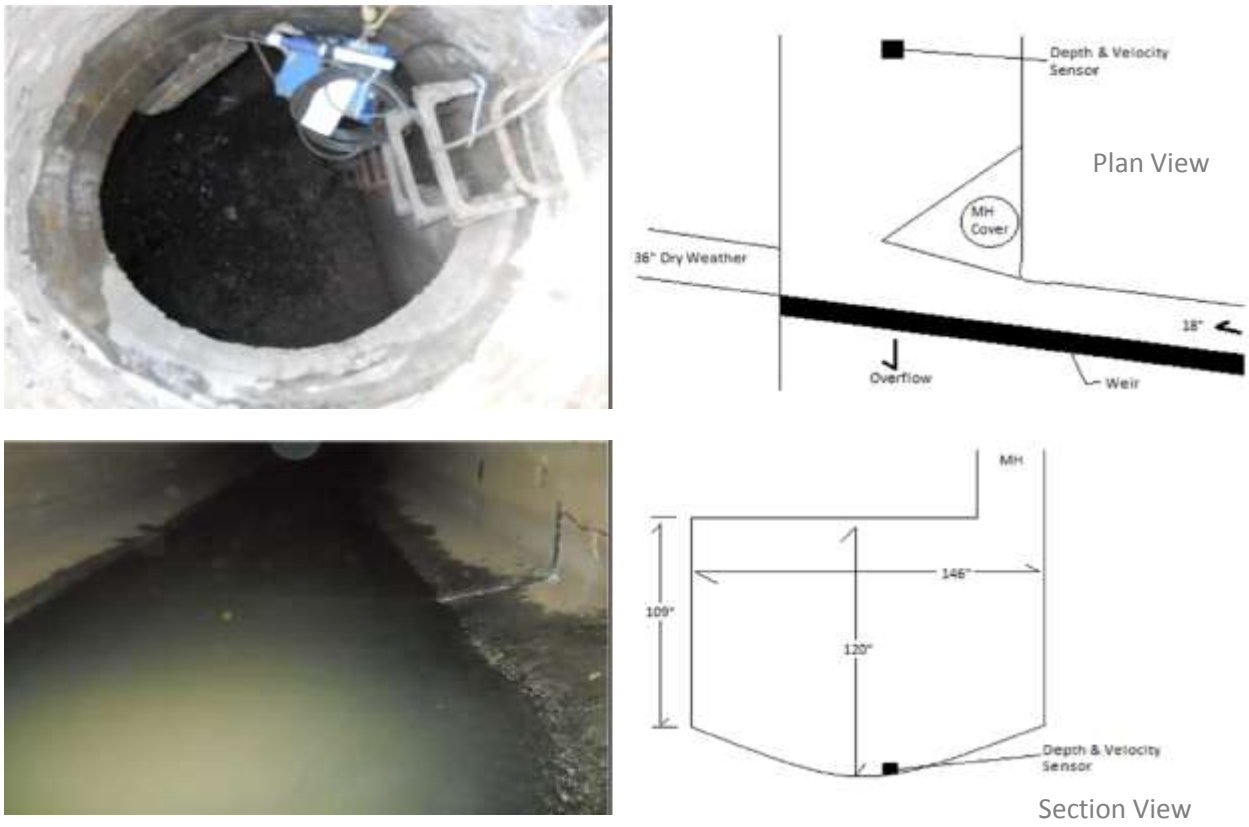


Figure 7: Velocity Meter at HP-024 – Boston Road

CSOs Volumes and Durations were estimated by doing a mass balance of the flow measurements coming in and out of the regulators and are indicated in **Table 7** below.

Table 7: CSO Duration and Estimated Volume of CSO Discharges During Wet Weather

Date	Manhole	Event 1 Duration (Mins)	Event 1 Volume (MG)	Event 2 Duration (Mins)	Event 2 Volume (MG)	Remarks
5/29/2012	HP-023	75	1.1			
	HP-024	35	1			
6/12/2012	HP-023	50	0.402			
	HP-024	940	0.441			Very small flows during a very long time. No sampling possible with such small overflows
6/25/2012	HP-023	115	3			
	HP-024	145	5.2			
7/15/2012	HP-023	60	0.3	75	0.3	
	HP-024	25	0.3	75	0.2	
7/26/2012	HP-023	160	1			
	HP-024	50	0.1			Overflow too small to sample
8/28/2012	HP-023					No flow data available for interceptor
	HP-024	60	0.2			
9/18/2012	HP-023	375	2.6			
	HP-024			155	11.5	

Teledyne Isco specifications for the flow meter used show a level of accuracy of ±0.01ft from 0.033ft to 10ft, and a velocity accuracy (in water with uniform velocity profile, speed of sound = 4850 ft/s, for indicated velocity range) ±0.1 ft/s from -5 to 5 ft/s ; ±2% of reading from 5 to 20 ft/s.

Flow Assessment services provided weekly maintenance of the flow meters which included onsite data analysis, level calibration, velocity verification (if anomalous readings noted), equipment maintenance or replacement as needed, and probe cleaning as needed.

3.5 Source Flow Data

3.5.1 Storm Sewer Flow Monitoring

Area velocity flowmeters were installed in stormwater outfall HP-637, as indicated in **Figure 8.**

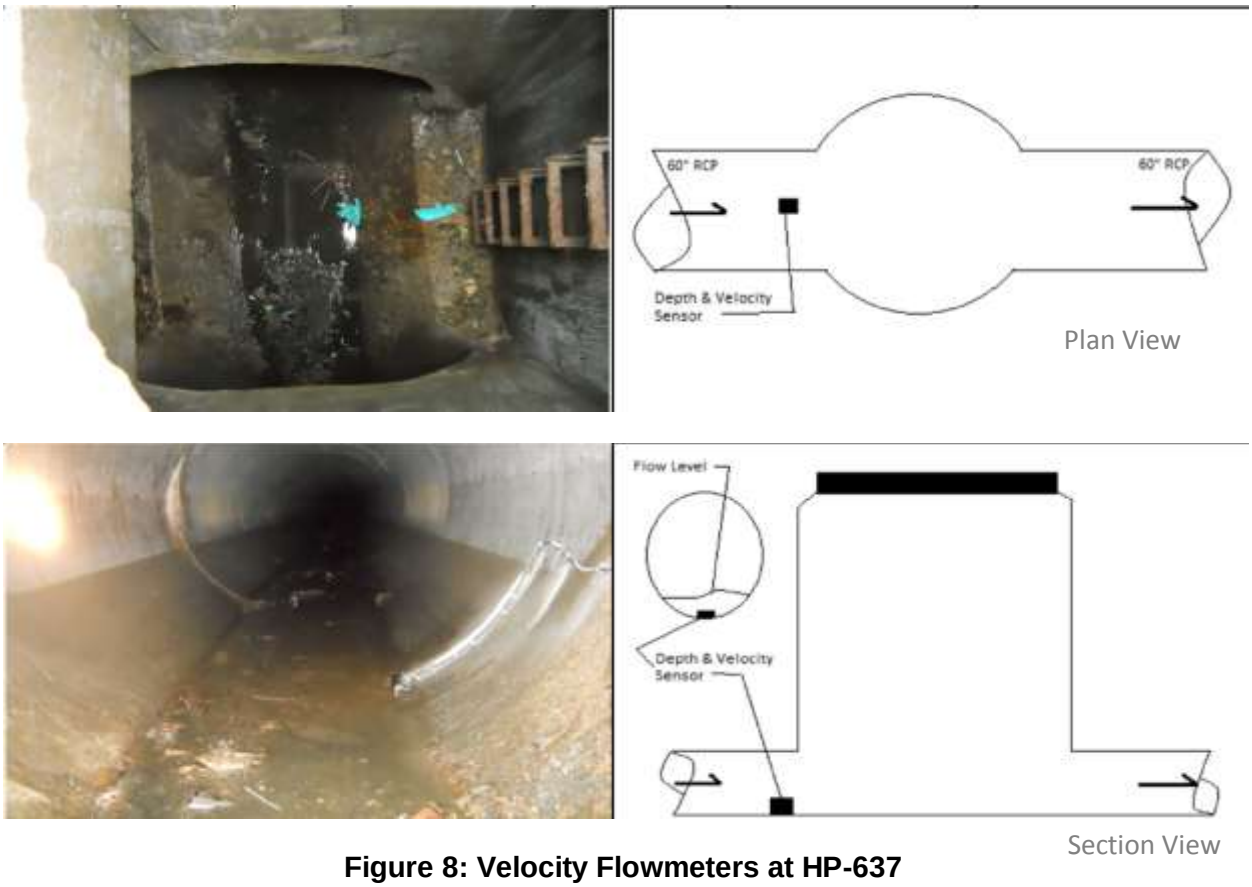


Figure 8: Velocity Flowmeters at HP-637

This outfall shows flows that are associated with rain events, as illustrated in **Figure 9 and Figure 10** (next page). **Figure 10** depicts the period between 6/11/12 and 6/14/12, which includes both dry and wet conditions. No flow is observed during dry weather.

Figure 9: Flow and Rain vs. Time on Manhole HP-637, May – October 2012

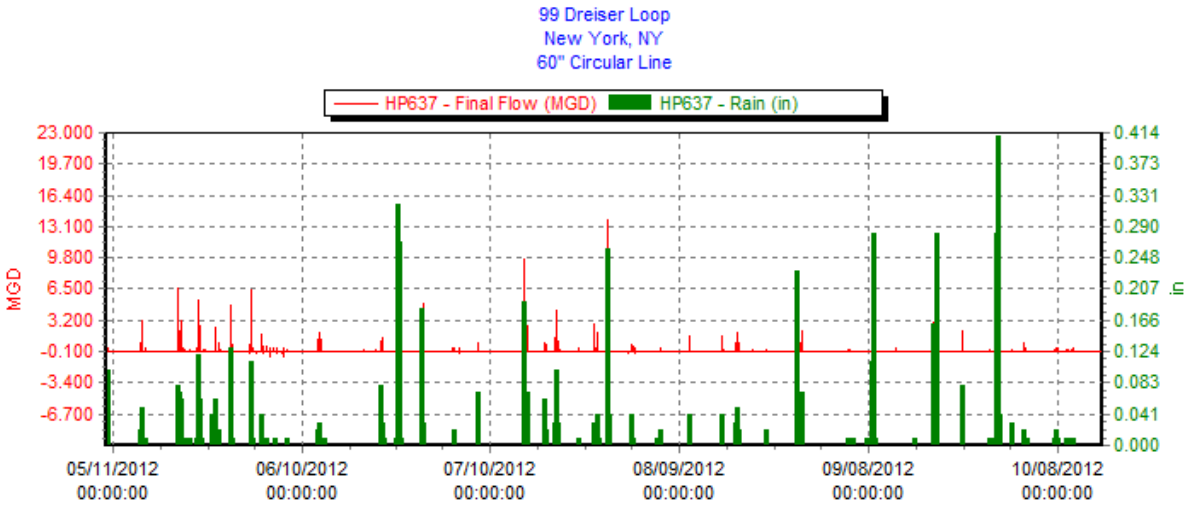
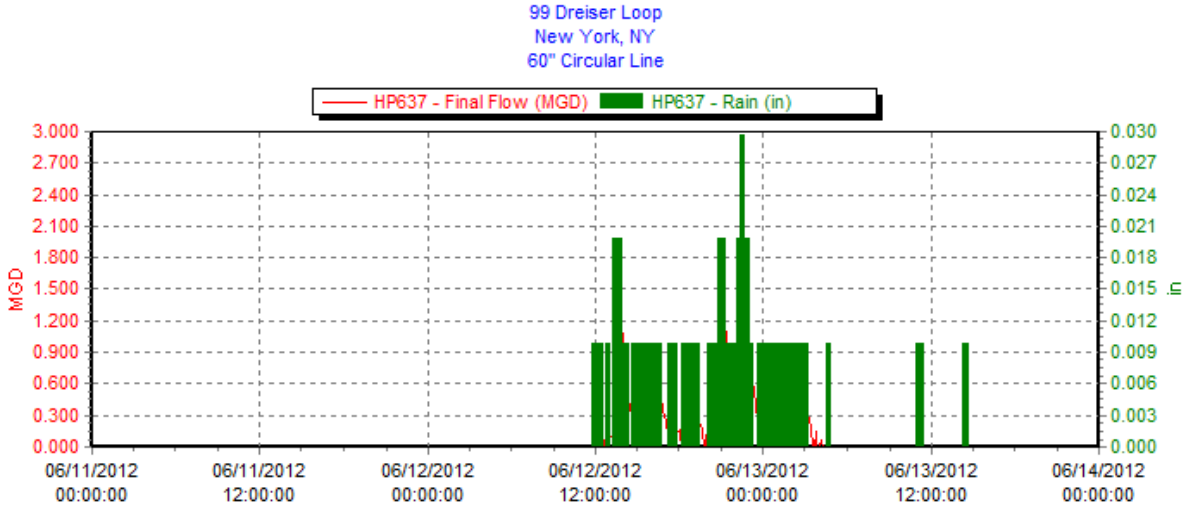


Figure 10: Flow and Rain vs. Time at Manhole HP-637, June 11-14, 2012



Area velocity flowmeters were installed in stormwater outfall HP-639, as indicated in **Figure 11.**

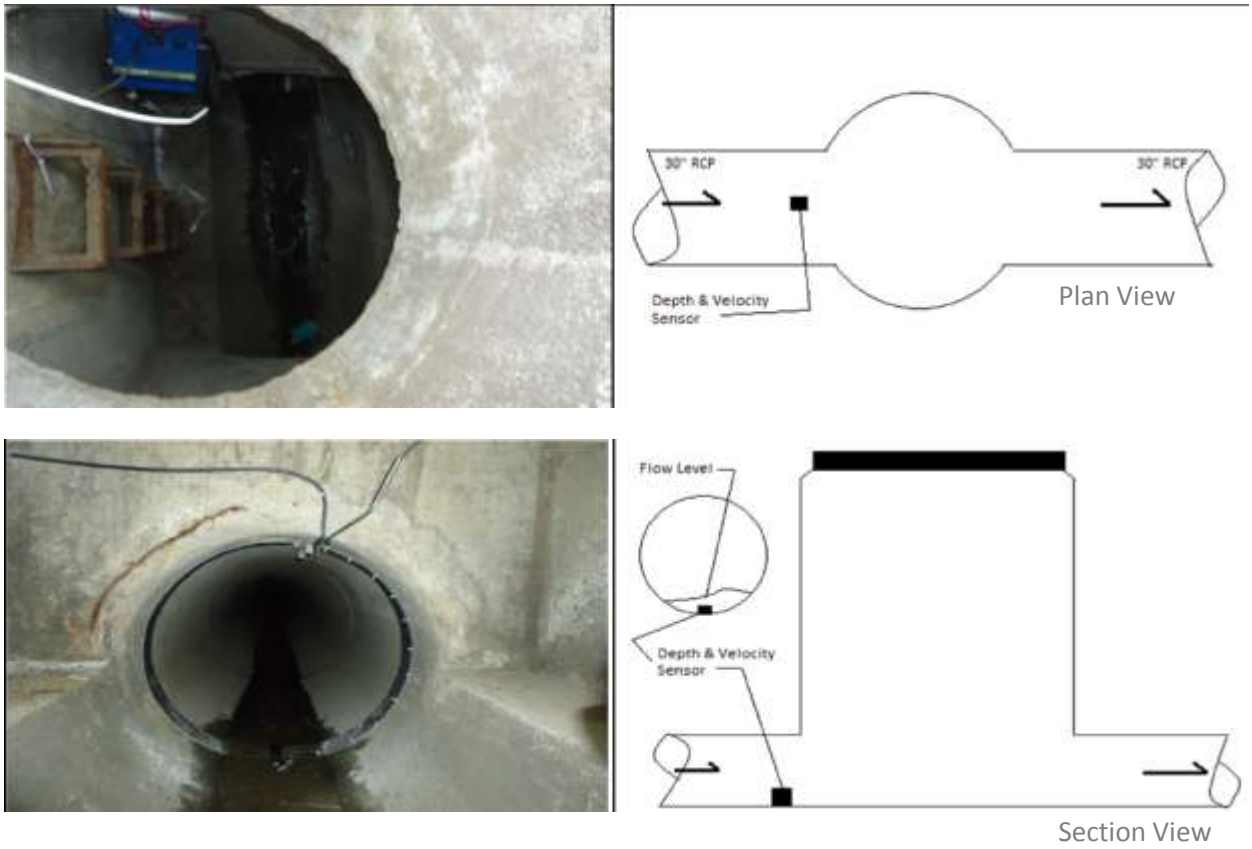


Figure 11: Velocity Flowmeters at Outfall HP-639

This outfall shows flows that are associated with rain events, as illustrated in **Figure 12 and Figure 13**. **Figure 13** show the period between 6/11/12 and 6/14/12, which includes both dry and wet conditions. No flow is observed during dry weather.

Figure 12: Flow and Rain vs. Time at Manhole HP-639, May - October 2012

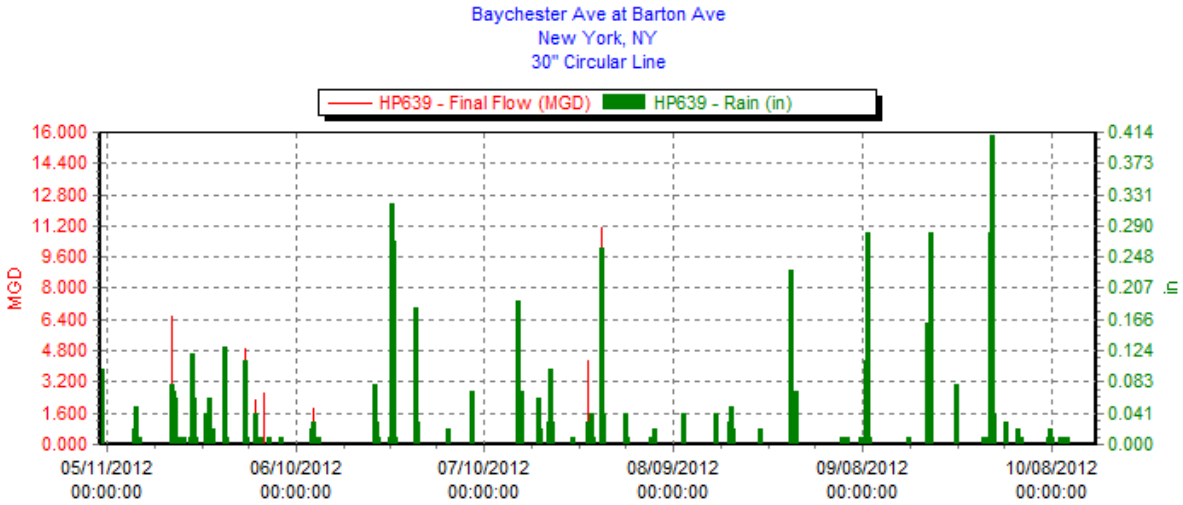
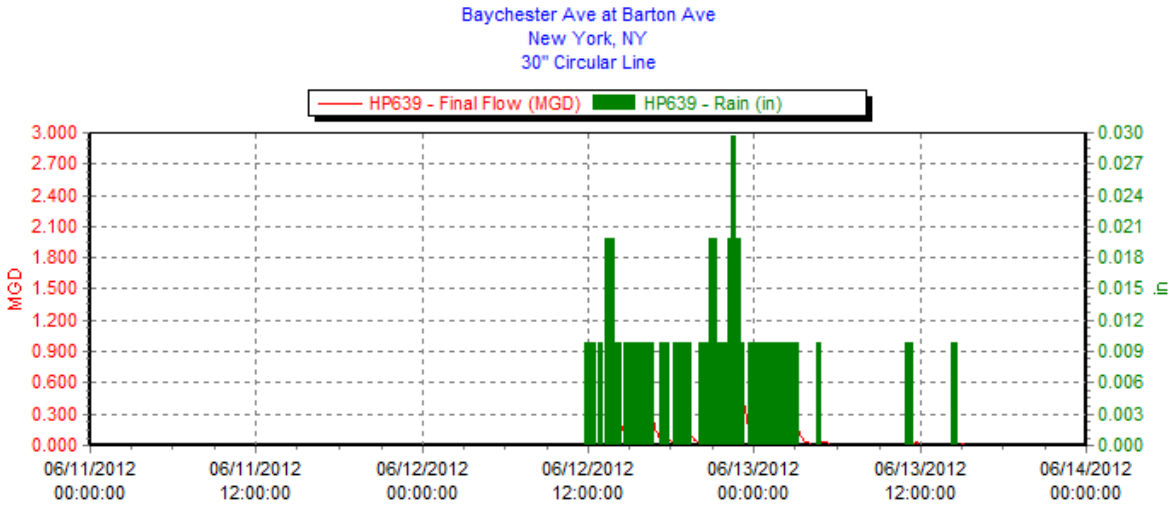


Figure 13: Flow and Rain vs. Time at Manhole HP-639, June 11-14, 2012



Area velocity flowmeters were installed in stormwater outfall HR-06, as indicated in **Figure 14.**

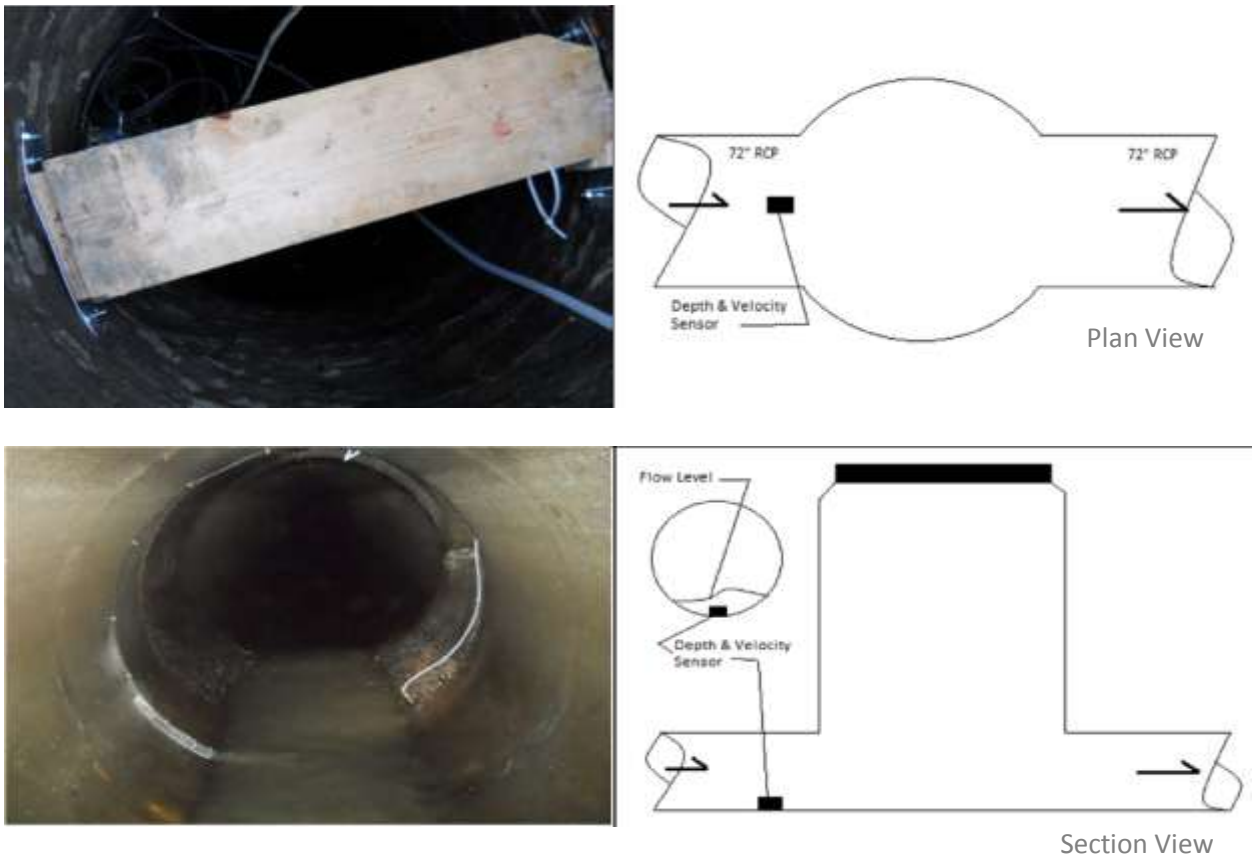


Figure 14: Velocity Meters at Outfall HR-06

Stormwater outfall HR-06 shows flow that is not associated with rain events. These flows are associated with the tidal fluctuation, as shown in **Figure 15 and Figure 16**. **Figure 16** depicts the period between 6/11/12 and 6/14/12, which includes both dry and wet conditions. It can be observed that the flow in the manhole during dry weather is cyclical with a period of 12 hours.

Figure 15: Flow and Rain vs. Time at Manhole HR-06

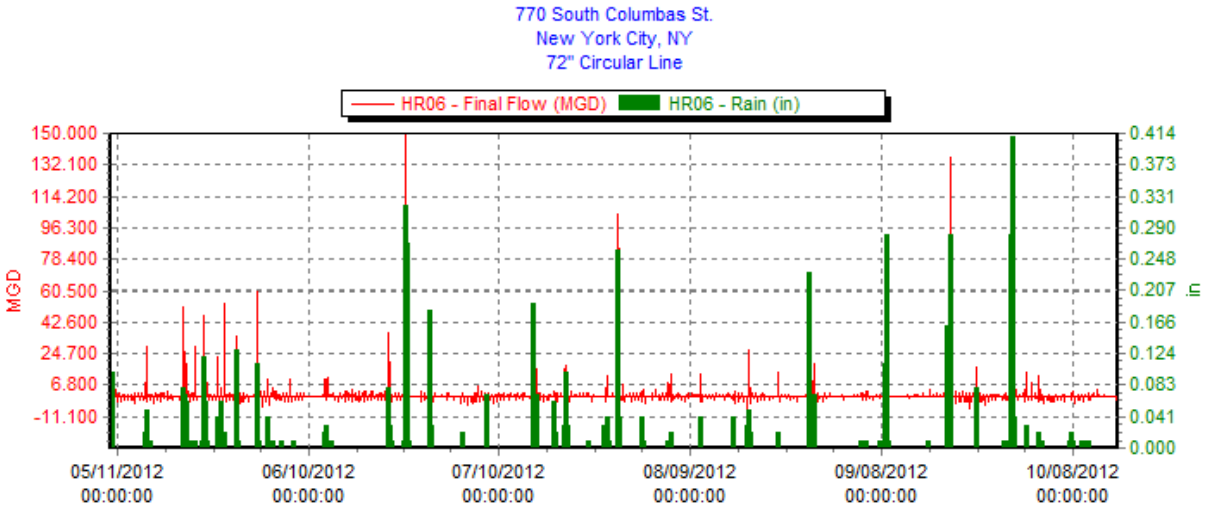
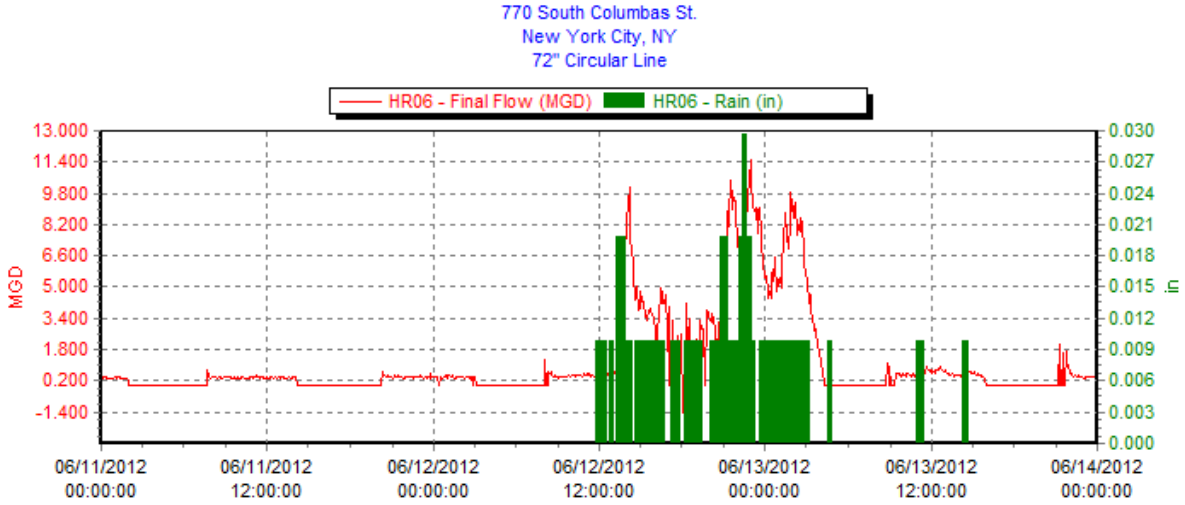


Figure 16: Flow and Rain vs. Time at Manhole HR-06, June 6-14, 2012



Area velocity flowmeters were installed in stormwater outfall HR-08, as indicated in **Figure 17**.

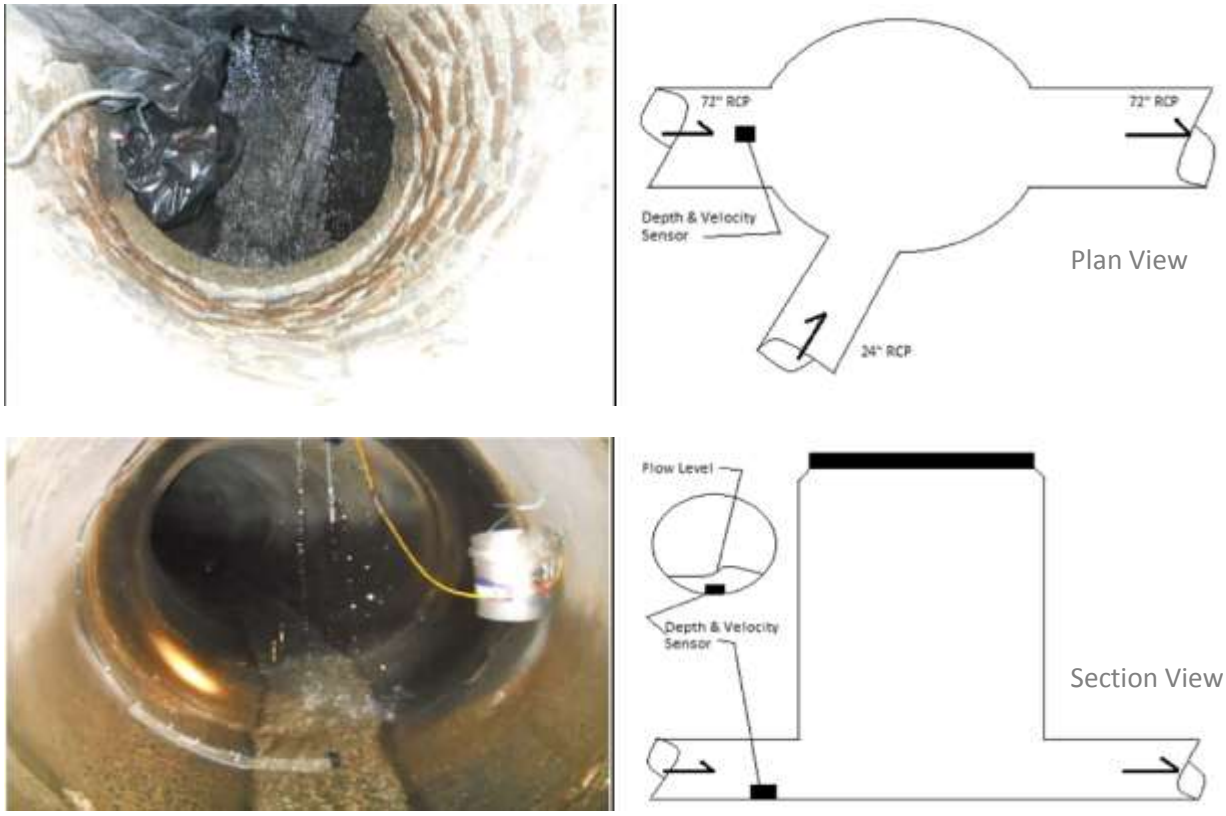


Figure 17: Velocity Flowmeters at Outfall HR-08

Stormwater outfall HR-08 shows a permanent baseflow that is not associated with rain events, as shown in **Figure 18, Figure 19, Figure 20, and Figure 21**. **Figure 19** shows the flow on Manhole HR-08a South for the period between 6/11/12 and 6/14/12, which includes both dry and wet conditions. It can be observed that this manhole has a constant flow during dry weather.

Figure 18: Flow and Rain vs. Time on Manhole HR-08a South May – October, 2012

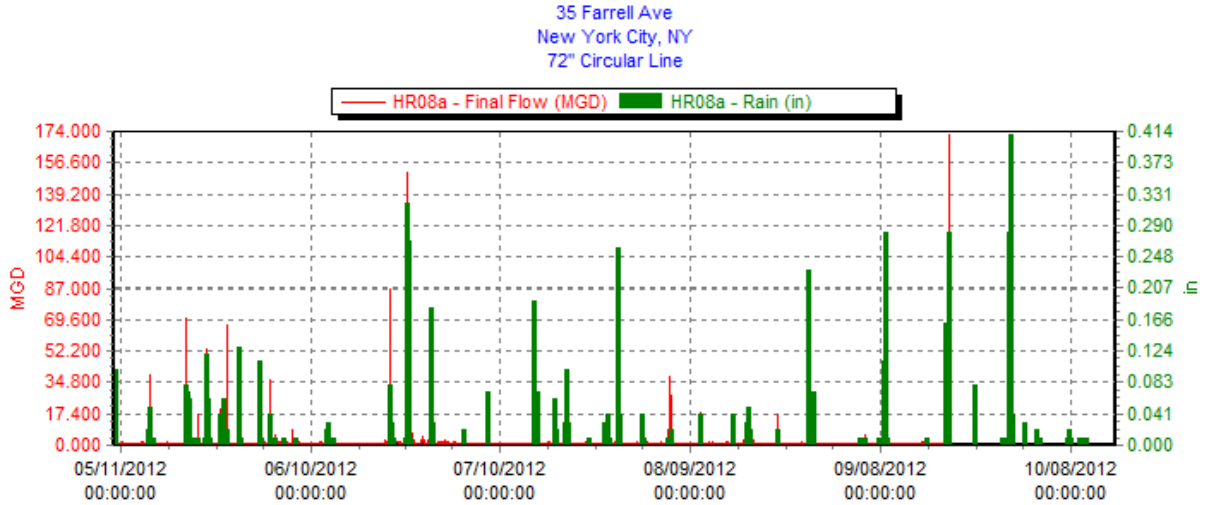


Figure 19: Flow and Rain vs. Time on Manhole HR-08a South, June 11-14, 2012

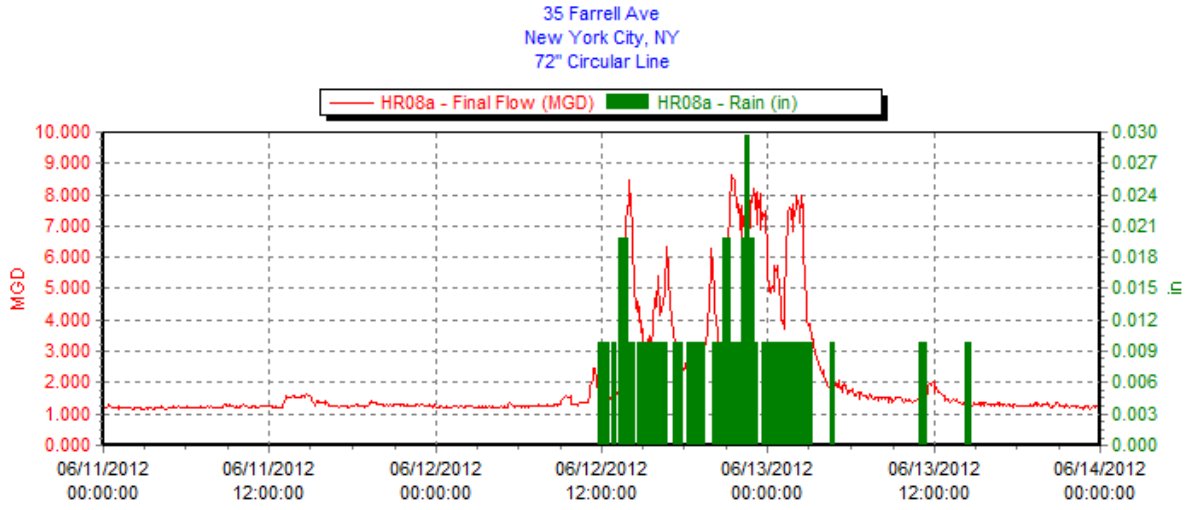


Figure 20: Flow and Rain vs. Time on Manhole HR-08b North, May – October, 2012

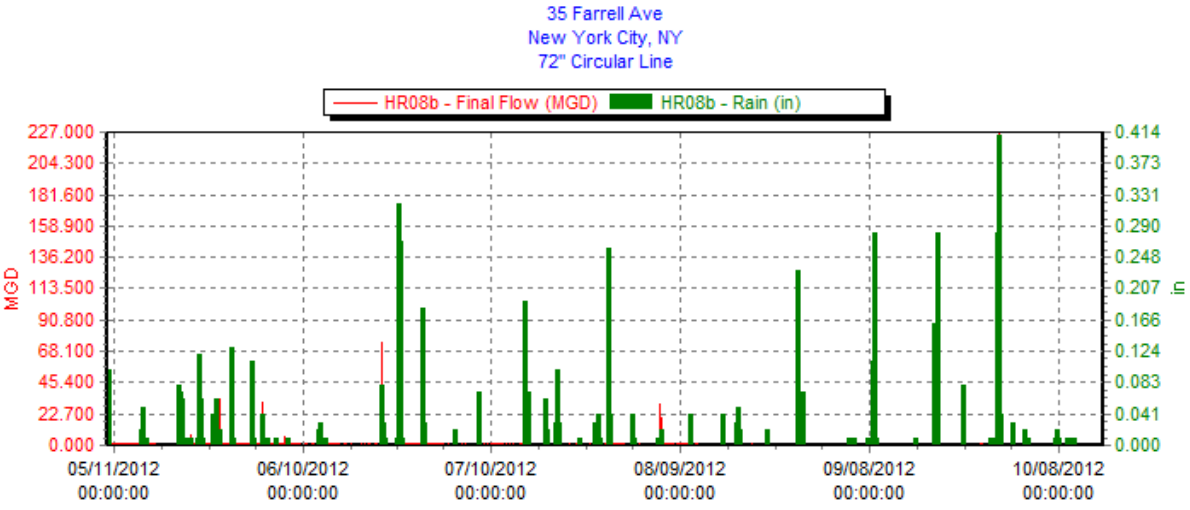
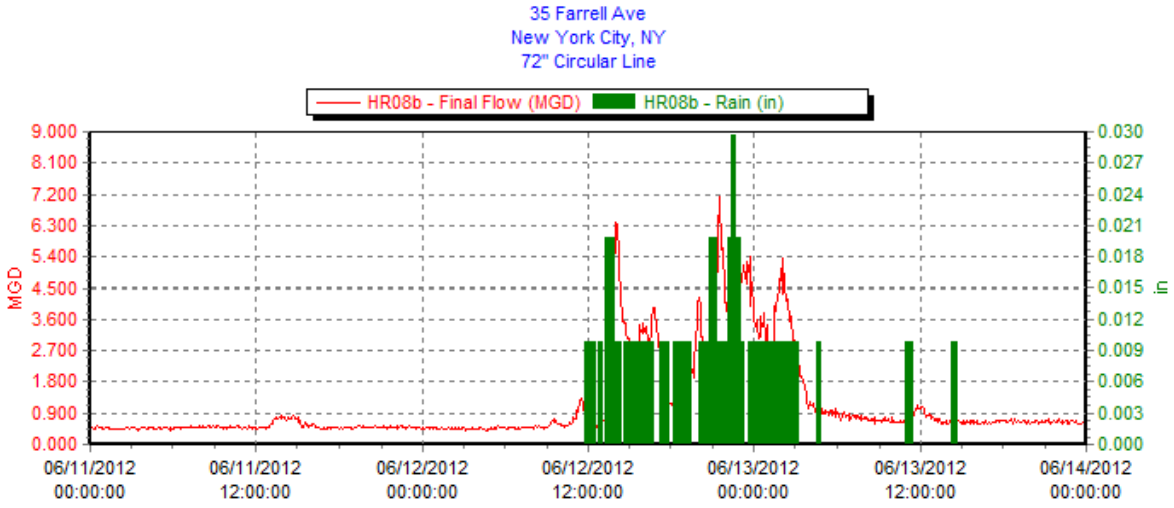


Figure 21 shows the flow at Manhole HR-08b North for the period between 6/11/12 and 6/14/12, which includes both dry and wet conditions. It can be observed that this manhole has a constant flow during dry weather.

Figure 21: Flow and Rain vs. Time on Manhole HR-08b North, June 11-14, 2012



3.5.2 River Flow Monitoring

An area velocity flow meter was installed in an existing 12'H x 20'W custom shaped line to measure the river flow, as indicated in **Figure 22**.

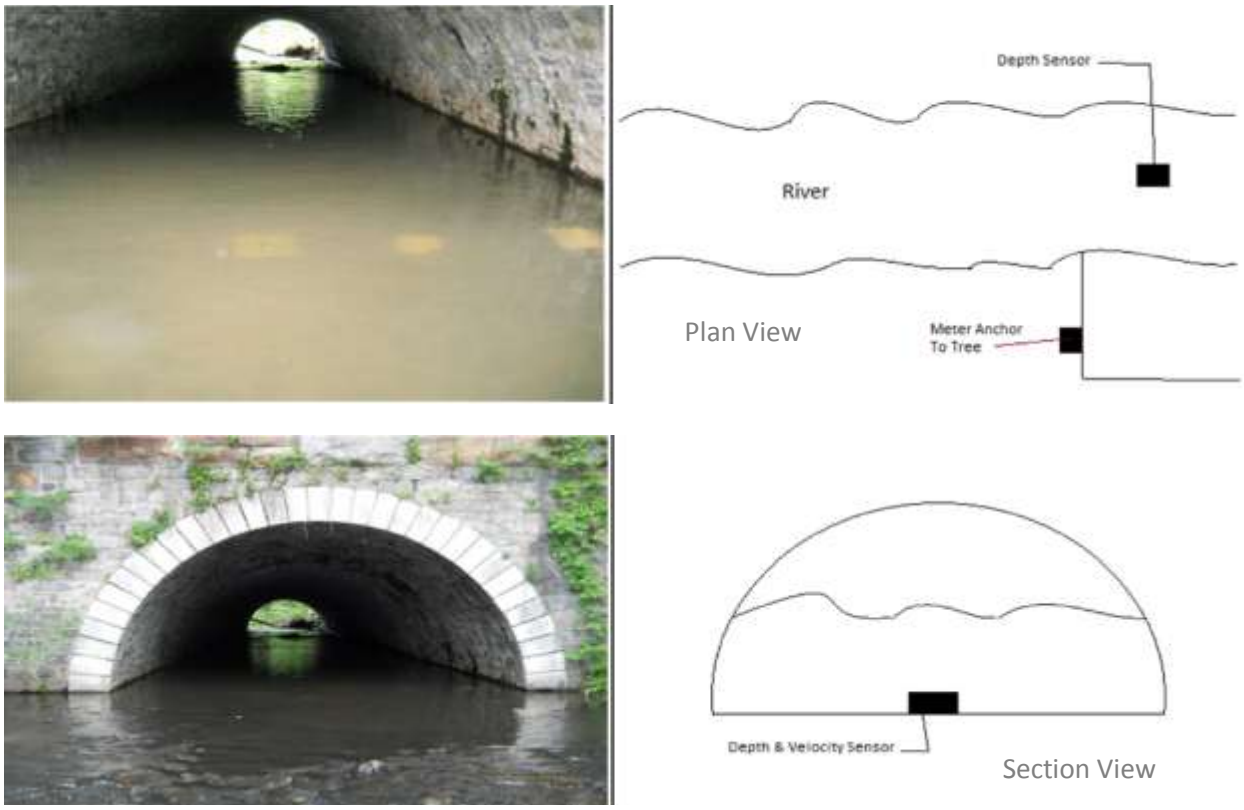


Figure 22: Velocity Flow Meter to Measure River Flow

The data collected for the entire period is shown in **Figure 23**, below. **Figure 24** shows the Hutchinson River flow at the location illustrated in **Figure 22**, for the period between 6/11/12 and 6/14/12, which includes both dry and wet conditions.

Figure 23: Hutchinson River Flows, May-October, 2012

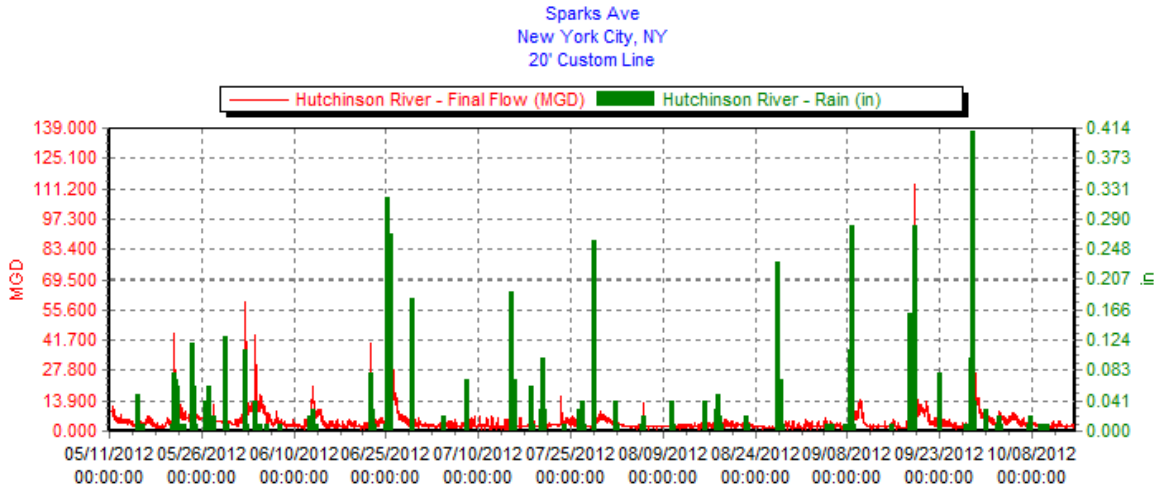
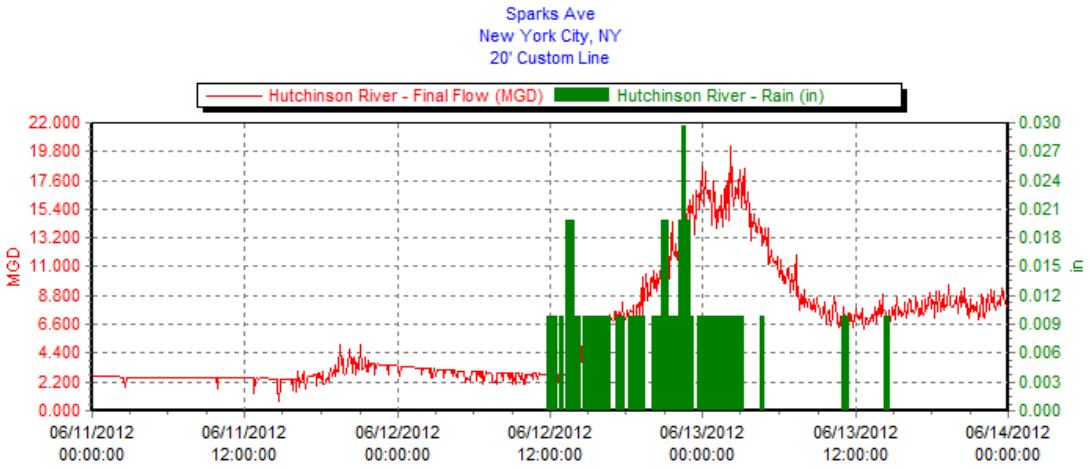


Figure 24: Hutchinson River Flows, June 11-14, 2012



For information on the flow meter accuracy and reliability, refer to the last paragraph of section 3.4

4. Data Validation

4.1. Method Followed

All Fecal Coliform tests were performed using the Standard Method 9222D – Fecal Coliform Membrane Filter Procedure.

All Enterococcus tests were performed using the EPA Method 1600 – Enterococci in Water by Membrane Filtration.

4.2. Holding Times

All samples were tested within eight hours , as required by the test protocols, except for two. One sample exceeded the transportation time of 6 hours, but was still tested within 8 hours and eleven samples were delivered to the lab within 6 hours but were tested between the 6 and 8 hour window.

4.3. Incubator Temperatures

Incubator temperatures were kept betweent 35 and 41 °C. Temperatures were controlled by an internal thermometer and remained stay constant as long as the incubator was turned on. There were no power outages during any incubation periods.

4.4. Media pH

All media batches were within the recommended pH range except for the following:

- Batch 7601: Media type MEI recommended pH range is 6.9 to 7.3. Recorded pH for this batch was 7.39.
- Batch 7504: Media type MFC recommended pH range is 7.2 to 7.6. Recorded pH for this batch was 7.61
- Batch 7948: Media type MEI recommended pH range is 6.9 to 7.3. No pH was recorded for this batch.

4.5. Density Calculations

The laboratory used the following rules for Calculating Membrane Filtration Test Analyzed at Multiple Dilutions:

1) If the counts for all dilutions are zero, then the reported result is the dilution corrected limit from the dilution that used the highest volume of sample.
Example: 10mls, 1ml and 0.1 ml of sample are filtered. None of the dilutions produced a countable colony. Use the 10ml volume reporting limit of < 10 col/100ml.

2) If the counts for all dilutions are greater than the upper counting limit, then the reported result is the upper counting limit value corrected for the dilution that used the lowest volume of sample.

Example: 10mls, 1ml and 0.1 ml of sample are filtered for Fecal MF. All of the dilutions produced more than 60 colonies per plate. Use the 0.1ml volume upper limit of >60000 col/100ml.

3) If only one of the dilutions produces a count in the method specified counting range, use only that count to calculate the result.

Example: 10mls, 1ml and 0.1 ml of sample are filtered for Fecal MF. The 10 ml portion has more than 60 colonies, the 1 ml portion has 22 colonies and the 0.1 ml portion has 4 colonies. Use only the 1 ml portion to calculate the result, it is the only count within the 20 to 60 colony counting range. The final result is 2200 col/100ml.

4) If two or more dilutions have colony counts below the countable range and none in the countable range, then a volume weighted result needs to be reported using those values from below the countable range. NOTE: A count of zero does need to be factored into the calculation if there is at least one other non zero value below the countable range.

Example: 10mls, 1ml and 0.1 ml of sample are filtered for Fecal MF. The 10 ml portion had greater than 60 colonies. The 1 ml portion had 18 colonies and the 0.1 ml portion had 0 colonies. The calculation is: 100x(the sum of the colonies counted on the plates)/(the sum of the volume of sample filtered from the plates used to calculate the

sum of the colonies counted). In this case 100x18/1.1=1636.36 rounded to 3 sig figs would be 1640 col/100ml.

5) If two or more dilutions have colony counts within the countable range, then a volume weighted result needs to be reported using those values. In this case, a count of zero will not be included in the calculation, only those counts from within the countable range can be used.

Example: 10mls, 1ml and 0.1 ml of sample are filtered for Fecal MF. The 10 ml filter has 59 colonies on it. the 1 ml filter has 20 colonies on it, and the 0.1 ml filter has 3 colonies on it. Only the 10ml and 1 ml plates are used to calculate the final result. 100x79/11=718.18 or 718 col/100ml.

Random calculations were checked to verify the accuracy of the results and all the calculations checked were accurate.

4.6. Field Calibration

Field meters were calibrated in the field. DO was calibrated on a daily basis and Conductivity, and Turbidity on a weekly basis. Meters were also calibrated by the vendor before initial delivery on 4/27/12 and on 7/15/12. **Table 8, Table 9, and Table 10** (next pages) provide calibration records.

Calibration Record - G&H							
Daily Calibration for DO			Weekly Calibration				
Date	Calibrated by		Date	Conductivity	Turbidity	Re-Skin DO probe (only if necessary)	Calibrated by
5/22/2012	G. Caprario / W. Delnero		5/22/2012	X	X	NO	G. Caprario / W. Delnero
5/30/2012	G. Caprario / W. Delnero		5/30/2012	X	X	NO	G. Caprario / W. Delnero
5/31/2012	G. Caprario / W. Delnero		6/6/2012	X	X	NO	G. Caprario / W. Delnero
6/1/2012	G. Caprario / W. Delnero		6/11/2012	X	X	NO	G. Caprario / W. Delnero
6/6/2012	G. Caprario / W. Delnero		6/20/2012	X	X	NO	G. Caprario / K. Law
6/11/2012	G. Caprario / W. Delnero		6/26/2012	X	X	NO	G. Caprario / K. Law
6/13/2012	G. Caprario / K. Law		7/5/2012	X	X	NO	G. Caprario / K. Law
6/14/2012	W. Delnero / K. Law		7/11/2012	X (x2)	X (x2)	YES (x2)	G. Caprario / K. Law
6/15/2012	W. Delnero		7/16/2012	X	X	NO	G. Caprario / K. Law
6/20/2012	G. Caprario / K. Law (Morning)		7/23/2012	X	X	NO	G. Caprario / K. Law (Changed Batteries)
6/20/2012	G. Caprario / K. Law (Afternoon)		7/31/2012	X	X	NO	G. Caprario / K. Law
6/26/2012	G. Caprario / K. Law		8/21/2012	X	X	NO	G. Caprario
6/27/2012	G. Caprario / K. Law						
6/28/2012	G. Caprario						
7/5/2012	Calibrated by Vendor						
7/10/2012	G. Caprario / K. Law						
7/11/2012	G. Caprario / K. Law (3 times)						
7/16/2012	G. Caprario / K. Law						
7/17/2012	G. Caprario / K. Law						
7/18/2012	G. Caprario / K. Law						
7/23/2012	G. Caprario / K. Law						
7/31/2012	G. Caprario / K. Law						
8/21/2012	G. Caprario						

Table 8: Calibration Record, Greeley & Hansen

Calibration Record - Savin Crew One							
Daily Calibration for DO			Weekly Calibration				
Date	Calibrated by		Date	Conductivity	Turbidity	Re-Skin DO probe (only if necessary)	Calibrated by
5/29/2012	JAM		5/29/2012	X	X		JAM
5/30/2012	JAM		6/12/2012	X	X		JAM
5/31/2012	JAM		6/25/2012	X	X		JAM
6/1/2012	JAM		7/10/2012	X	X		JAM
6/12/2012	JAM		7/15/2012	X	X		JAM
6/13/2012	JAM		7/23/2012	X	X		JAM
6/14/2012	JAM		7/31/2012	X	X	X	JAM
6/15/2012	JAM		8/21/2012	X	X		JAM
6/25/2012	JAM		8/28/2012	X	X		JAM
6/26/2012	JAM		9/12/2012	X	X		JAM
6/27/2012	JAM		9/19/2012	X	X		JAM
6/28/2012	JAM						
7/10/2012	JAM						
7/15/2012	JAM						
7/16/2012	JAM						
7/17/2012	JAM						
7/18/2012	JAM						
7/23/2012	JAM						
7/26/2012	JAM						
7/27/2012	JAM						
7/28/2012	JAM						
7/29/2012	JAM						
7/30/2012	JAM						
7/31/2012	JAM						
8/21/2012	JAM						
8/28/2012	JAM						
8/29/2012	JAM						
8/30/2012	JAM						
9/12/2012	JAM						
9/18/2012	JAM						
9/19/2012	JAM						
9/20/2012	JAM						
9/21/2012	JAM						
9/25/2012	JAM						

Table 9: Calibration Record, Savin Crew No. 1

Calibration Record - Savin Crew Two							
Daily Calibration for DO			Weekly Calibration				
Date	Calibrated by		Date	Conductivity	Turbidity	Re-Skin DO probe (only if necessary)	Calibrated by
5/29/2012	JAM		5/29/2012	X	X		JAM
6/12/2012	JAM		6/12/2012	X	X		JAM
6/25/2012	JAM		6/25/2012	X	X		JAM
7/15/2012	JAM		7/15/2012	X	X		JAM
7/26/2012	JAM		7/26/2012	X	X		JAM
8/28/2012	JAM		8/28/2012	X	X		JAM
9/18/2012	JAM		9/18/2012	X	X		JAM

Table 10: Calibration Record, Savin Crew No. 2

4.7. Duplicates

Field and laboratory duplicates were tested; the results show that 63% of the Fecal Coliform results and 59% of the Enterococcus results fall within the 95% confidence interval for the test.

4.8. Flow Data

Flow readings were analyzed at the site for data quality and reliability of equipment. Equipment was modified as needed each week. In Flow Assessment's QA/QC process, data points were analyzed for data strength and reliability using the flow monitor's individual reading analysis of each data point and also statistically with the data as a whole. Readings from each site were analyzed for flow balance. Field notations were incorporated in the QA/QC process, and weekly corrections applied as found by the Flow Assessment field crew.