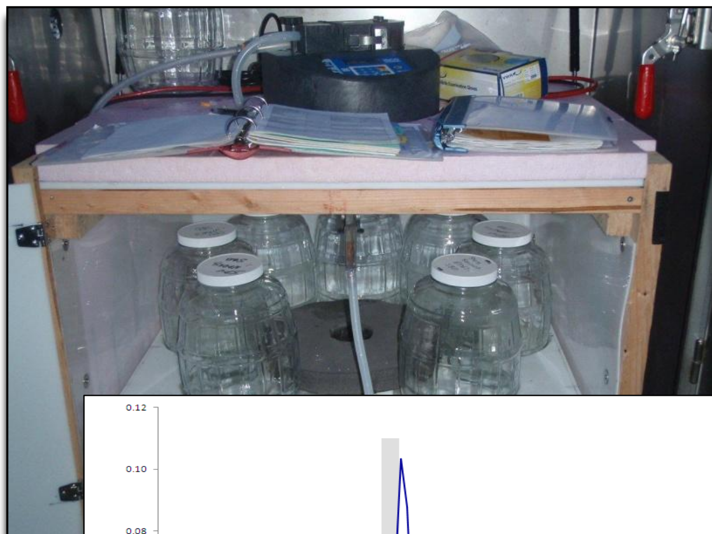
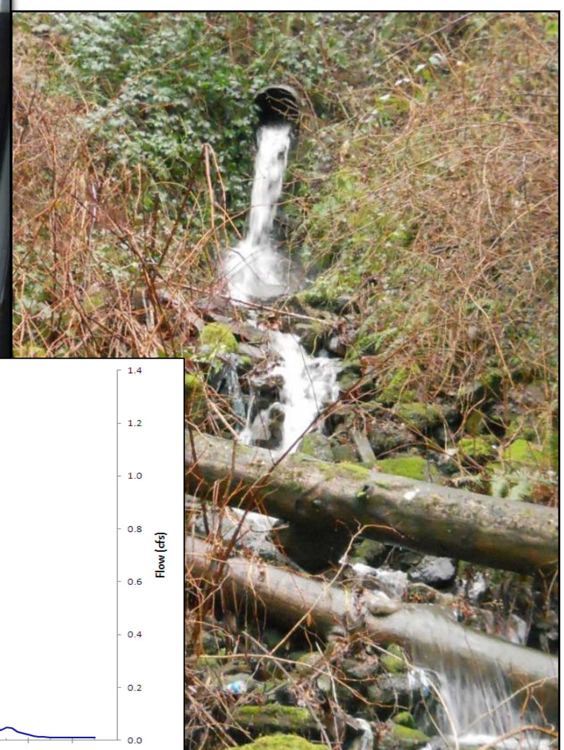
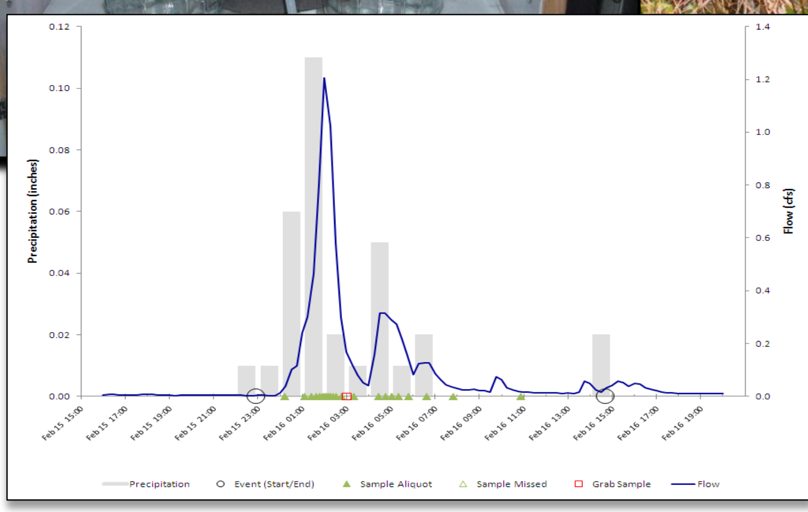
ATTACHMENT C

CITY OF SEATTLE
2010 NPDES PHASE I MUNICIPAL STORMWATER PERMIT STORMWATER MONITORING REPORT







Prepared by
Seattle Public Utilities

March 29, 2011

On Cover – (clockwise from right) Photo of Venema residential drainage basin (R1) stormwater outfall during a winter storm, hydrograph of a R1 sampled storm event and interior view of R1 modified automatic sampler.

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1 INTRODUCTION

1.1 Introduction

This document serves as the City of Seattle's (City) water year 2010 monitoring report as required by Special Conditions S8.H and S9 of the 2007 National Pollutant Discharge Elimination System (NPDES) Phase I Municipal Stormwater Permit (Permit). The Permit was effective on February 16, 2007 and modified on June 17, 2009 and September 1, 2010 by the Washington Department of Ecology (Ecology) under the NPDES and State Waste Discharge General Permits for discharges from Large and Medium Municipal Separate Storm Sewer Systems.

The City was required to fully implement the monitoring program as described in Special Condition 8 (S8) of the Permit on February 16, 2009. Special Condition S8.H of the Permit requires the City to provide a report annually on the monitoring that occurred during the previous water year (WY). A water year starts on October 1 and ends on September 30 of the following year. This report summarizes monitoring activities performed during the first complete water year stipulated in the 2007 Permit.

1.2 Background

The Permit requires three types of monitoring under section S8:

Stormwater Characterization (S8.D) – Stormwater characterization is monitoring which is intended to characterize stormwater runoff quantity and quality to allow analysis of loadings and changes in conditions over time and generalization across the Permittee's jurisdiction. Ecology stated in the Permit Fact Sheet that the purpose of requiring Permittees to engage in stormwater characterization monitoring is to gain knowledge of pollutant loads from areas within the municipality.

The City's implementation of this requirement consists of three in-pipe monitoring locations that are considered to be representative of the land uses that they are intended to characterize. The first monitoring location is located in North Seattle in the Venema neighborhood and represents a predominantly residential land use. The second monitoring location, located in Northeast Seattle, is located adjacent to the University of Washington and represents predominantly commercial land use. The third monitoring location is in South Seattle near the City's border with Tukwila and represents a predominantly industrial land use.

Program Effectiveness (S8.E) – The program effectiveness monitoring requires the City to select two specific aspects of the Stormwater Management Program to evaluate. One aspect to be evaluated is to determine the effectiveness of a targeted action. A second aspect to be evaluated is the effectiveness of achieving a targeted environmental outcome. This monitoring is intended to improve stormwater management efforts by providing a feedback loop to help determine if a stormwater management program element is meeting the desired environmental outcome.

The potential impact of urban stormwater runoff on the water quality of receiving waters is of great concern in the Seattle area. While new development may have a large number of options for providing water quality treatment through structural controls, existing developed areas have limited choices for retrofitting their stormwater systems. Thus, nonstructural measures, also known as source control, offer perhaps the greatest potential for improvement of water quality. Roads and other transportation related surfaces make up 26 percent of the land use within the City. Because of this, the City has chosen to evaluate the program effectiveness of street sweeping to meet this Permit.

The targeted action of street sweeping should result in improvements in stormwater quality and quality of sediments in stormwater discharges or both. To determine if this action is being achieved, analytical analysis of transportation land use sediment sources will be performed to increase our understanding of the distribution of contaminants in varying size fractions for each of the waste streams: street dirt, sweeper waste, and catch basin sediment.

The targeted outcome of street sweeping should reduce the discharge of certain pollutants below a targeted annual load amount. A mass balance model will be developed to predict a targeted annual load reduction for varying conditions, such as sweeping frequency, road surface condition and parking enforcement compliance. Existing data and a parking compliance survey will be used as a basis for the model.

BMP Effectiveness (S8.F) – The best management practice (BMP) effectiveness monitoring requires the City to monitor two types of structural stormwater controls required for use by project proponents in new development and re-development projects that trigger the Stormwater Code requirement for water quality treatment or flow control of stormwater. Ecology designed the Permit requirement to be full scale field monitoring to evaluate the effectiveness and operation and maintenance requirements of stormwater treatment and hydrologic management BMPs applied in Phase I jurisdictions.

The first treatment BMP monitored by the City is an "engineered" treatment BMP, the Catch Basin StormFilter™ (CBSF), manufactured by Contech® Construction Products Inc. The CBSF treatment BMP is frequently installed by the Seattle Department of Transportation (SDOT) to treat roadway stormwater runoff. The City is interested in monitoring the effectiveness of this BMP because the cartridge technology has received a basic treatment General Use Level Designation (GULD) by Ecology via testing within a vault, not as a catch basin retrofit device.

For the second treatment BMP, the City is partnering with Washington State University (WSU) to satisfy the Permit obligations for stormwater treatment BMP montitoring as allowed by special condition S3.B of the Permit. The City is participating in a WSU Low Impact Development (LID) research effort where WSU will be monitoring the pollution removal capacity of various bioretention soil mixes. The City has developed a Memorandum of Understanding (MOA) with WSU to obtain the monitoring results from four bioretention mesocosms at the WSU LID research facility to meet the S8.F.2 Permit monitoring requirements for a metals/phosphorus ("enhanced") treatment BMP. The MOA specifies that WSU will conduct water quality monitoring on four mesocosms, which are identical in size and all contain a 60/40 mix of aggregate/compost, which is the current soil mix for bioretention facilities specified in the City's Stormwater Code (SMC 22.800-22.808). Construction has been completed on the research facility and monitoring will begin in WY2011. Monitoring information will be provided to the City and included in the WY2011 Annual Report.

In addition to the two treatment BMPs, the Permit requires the City to monitor a flow reduction strategy that is in use or planned for installation within the city in a paired study or against a predicted outcome. To meet this requirement, the City has monitored one bioretention swale located in the High Point community in South West Seattle. Flow was monitored in the swale continuously for two years. The results of this work were summarized in the City's 2009 Annual Report submitted to Ecology on March 29, 2010.

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2 S8.D Stormwater Monitoring

2.1 Overview

As stated in the introduction, stormwater characterization monitoring is a requirement of the 2007 NPDES Phase I Municipal Stormwater Permit (Permit) Special Condition 8 (S8). Ecology designed the stormwater characterization monitoring requirements to characterize stormwater runoff quantity and quality to allow analysis of loadings and changes in conditions over time and generalization across the Permittees' jurisdiction.

The monitoring work as described in the Permit was performed by Seattle Public Utilities (SPU) or contractors under the direction of SPU in accordance with a draft Quality Assurance Project Plan (QAPP) dated February 10, 2008, and approved by Ecology on September 26, 2008. The final QAPP was submitted to Ecology on February 12, 2009. A brief summary of information provided in the approved QAPP is presented below.

WY2010 represents the first full year of stormwater characterization monitoring for the City and is a continuation of work that began in February 2009. The Permit required monitoring to begin on February 16, 2009 which was approximately five months after the beginning of WY2009. In addition, to monitoring performed during the prior year, the City was required to conduct first-flush toxicity tests during WY2010 at each of the three characterization monitoring locations. Toxicity testing is required during one year of the five year Permit cycle.

2.1.1 Monitoring Goals and Objectives

The goal of the stormwater characterization monitoring is to meet the requirements of Section S8.D of the Permit. Ecology's purpose for requiring the City to conduct stormwater characterization monitoring is to obtain knowledge of average event mean concentrations and pollutant loads from representative areas drained by municipal storm sewer systems. In addition, Ecology hopes that the information will be useful for determining whether the comprehensive stormwater management programs are making progress toward the goal of reducing the amount of pollutants discharged and protecting water quality.

2.2 Sampling Location Descriptions

The Permit requires each Permittee to select three monitoring sites within the municipal storm sewer system that represent the three types of land uses: residential, commercial and industrial. As required by the Permit, the City proposed, and received approval from Ecology in December

2007, for the three monitoring sites to meet these requirements. Details on the three monitoring sites are described below in Table 2.2 and presented visually in the Vicinity Map – Figure 2.2.

Table 2.2. Stormwater Characterization Basin Summary

Land Use Category	Station ID (Basin Name)	Storm Sewer System Type
Residential	R1 (Venema)	Separated, ditch & culvert system
Commercial	C1 (University District)	Partially separated
Industrial	I1 (Norfolk)	Partially separated

To determine locations for stormwater monitoring, the City's geographic information system (GIS) was used to display the stormwater infrastructure and identify possible catchments in the separated areas of the city that represent a discernible type of land use. Field visits were then conducted to evaluate hydrology (base flow, turbulent flow, tidal influence, etc.), the feasibility of monitoring (access, potential for vandalism, safety of monitoring personnel, equipment installation needs, etc.) and the suitability of the site for long-term monitoring.

Following the initial site selection, a walking survey of each basin was performed to confirm or correct the drainage area maps.

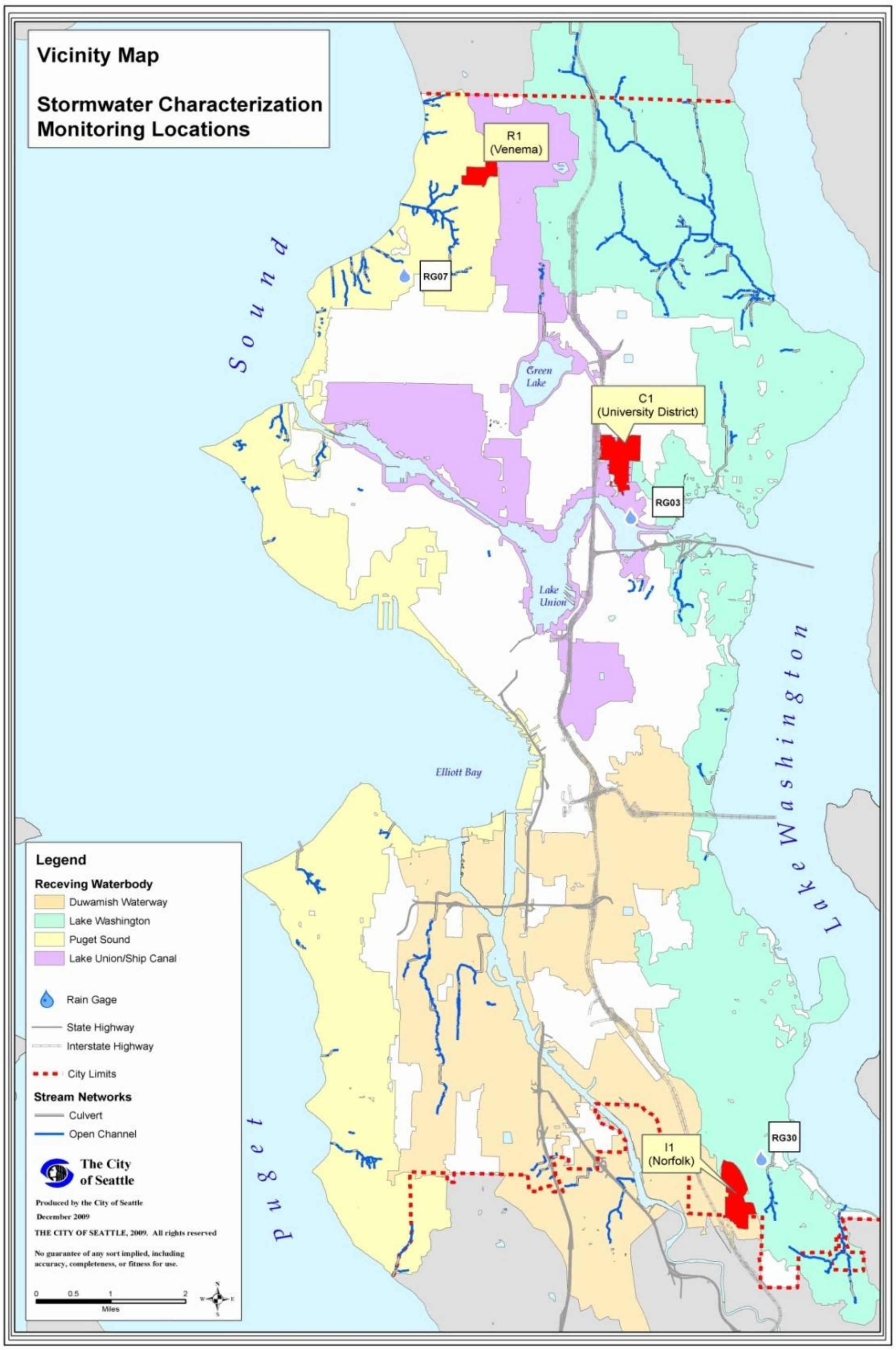
2.2.1 Basin Descriptions

Information about the basins monitored is summarized in Table 2.2.1 below.

Table 2.2.1. Stormwater Characterization Monitoring Location Summary

Represented Land Use	Residential	Commercial	Industrial
Basin	**R1 (Venema)**	**C1 (U- District)**	**I1 (Norfolk)**
Surface Area Distribution			
Total Area (acres)	85.3	181.0	164.2
Area Draining to MS4 Estimate (acres)	85.3	152.0	137.2
Area Draining to Combined System Estimate (acres)	0.0	29.0	27.0
Impervious Area Estimate (%) - for area draining to MS4	50.2	61.1	51.2
Land Use Distribution Estimate- for area draining to MS4			
Residential (%)	95	37	32
Industrial (%)	0	0	37
Commercial (%)	5	61	13
Open Space (%)	0	2	18
Hydrologic Information			
Rain Gauge	RG07	RG03	RG30
Receiving Water Body	Venema/Piper's Creek	Lake Union	Duwamish River

Figure 2.2. Vicinity Map – Stormwater Characterization Monitoring Locations



The Permit set the following goal for stormwater characterization monitoring locations: "ideally, to represent a particular land use, no less than 80 percent of the area served by the conveyance will be classified as having that land use." The City was unable to find basins that met this goal due to the ultra-urban mixed use nature of Seattle. The City selected basins that best represented the land use type in the City and had infrastructure suitable for installation of monitoring equipment. The information on land use percentages for each monitoring sampling location was provided to Ecology in the Permit required summary description of the monitoring program (S8.G.1.a) in October, 2007 and approved by Ecology in December, 2007.

SPU used the following method to determine the land use area for each stormwater characterization monitoring basin. Land use data is derived using GIS from the King County Parcel Database, which classifies each parcel into one of the eight general following categories: single family, multi-family, commercial, schools, other/NA, government/public facility, industrial, parks/open space, and vacant. Land that is not classified as a parcel is considered right-of-way.

The King County Parcel Database further groups land use is into four general categories: (1) residential which includes single family and multi-family and may include other/NA; (2) commercial which includes commercial, schools, government/public facility and may include other/NA; (3) industrial which includes industrial and may include vacant; and (4) open which includes parks/open space and may include vacant.

SPU used GIS to determine the percentage of each land use type that drains to the MS4. The impervious area for each land use category is estimated using citywide averages based on GIS analysis. For basins that are partially separated, the equivalent area draining to the MS4 is less than the total basin area because some stormwater in the basin is conveyed via the combined sewer system.

The three monitoring basins are briefly described below. A description of each related monitoring station is described in Section 2.2.2.

2.2.1.1 R1 (Venema)

The R1 basin represents a typical residential area in the separated portion of the City. This basin is located in the northwest portion of Seattle and discharges to Venema Creek which flows into

Piper's Creek and then Puget Sound. The basin is approximately 85.3 acres[1] in size with 95 percent residential land use. The basin's sewer system is 100 percent separated. The R1 basin is delineated on Figure 2.2.1.1.

2.2.1.2 C1 (University District)

The C1 basin is located in a partially separated portion of the northeast portion of Seattle and represents a mix of commercial uses such as the University of Washington and neighborhood businesses that serve the surrounding residential population. This basin is located north of Lake Union and east of I-5 and drains to Lake Union. The majority land use in the 181-acre basin is commercial which represents approximately 61 percent of the basin. The C1 basin is delineated on Figure 2.2.1.2.

2.2.1.3 I1 (Norfolk)

The I1 industrial basin is served by the partially separated stormwater system and contains business activities typical of industrial land uses in Seattle. It is one of the few industrial basins in Seattle that is not tidally influenced and therefore is considered the best industrial land use basin in the City for meeting the monitoring requirements even though the percent of industrial land use in this basin does not meet the Permit goal of ideally no less than 80 percent industrial land use. The I1 basin is located in southern Seattle adjacent and immediately north of the border between the City of Seattle and the City of Tukwila and drains under I-5 to the west into the Duwamish waterway. The 164.2-acre basin is 37 percent industrial, 32 percent residential, 13 percent commercial and 18 percent open space. The I1 basin is delineated on Figure 2.2.1.3.

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[1] In the final QAPP, the R1 basin size was listed as 157 acres. In early February 2009, some of the stormwater that previously drained through the monitoring station was diverted to outfalls north of the monitoring station by plugging several 4-way catch basins in the original basin. The catch basin plugging was performed for two reasons: 1) to limit flows to a storm pipe downstream of the monitoring station which requires repair; and 2) to allow a constant known area to drain to the monitoring station (4-way catch basins distribute flows in two directions with the flow distribution being dependent on flow intensity, gradients, and the structural condition of the catch basin so the rainfall to runoff ratio is variable). The catch basin plugging reduced the size of the area draining to the R1 monitoring station to 85.3 acres.

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Figure 2.2.1.1. Site Map – R1 (Venema)

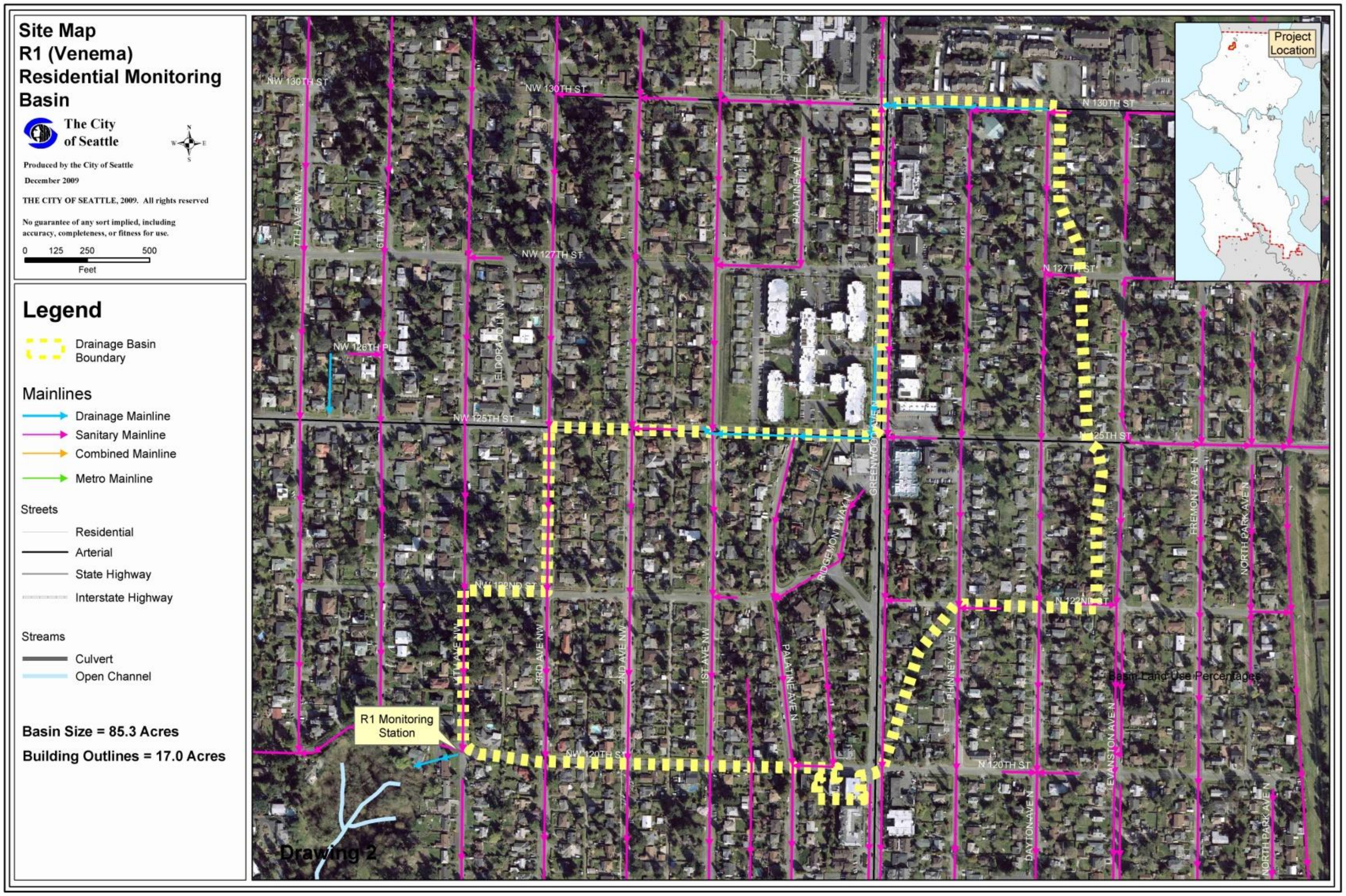

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Figure 2.2.1.2. Site Map – C1 (University District)

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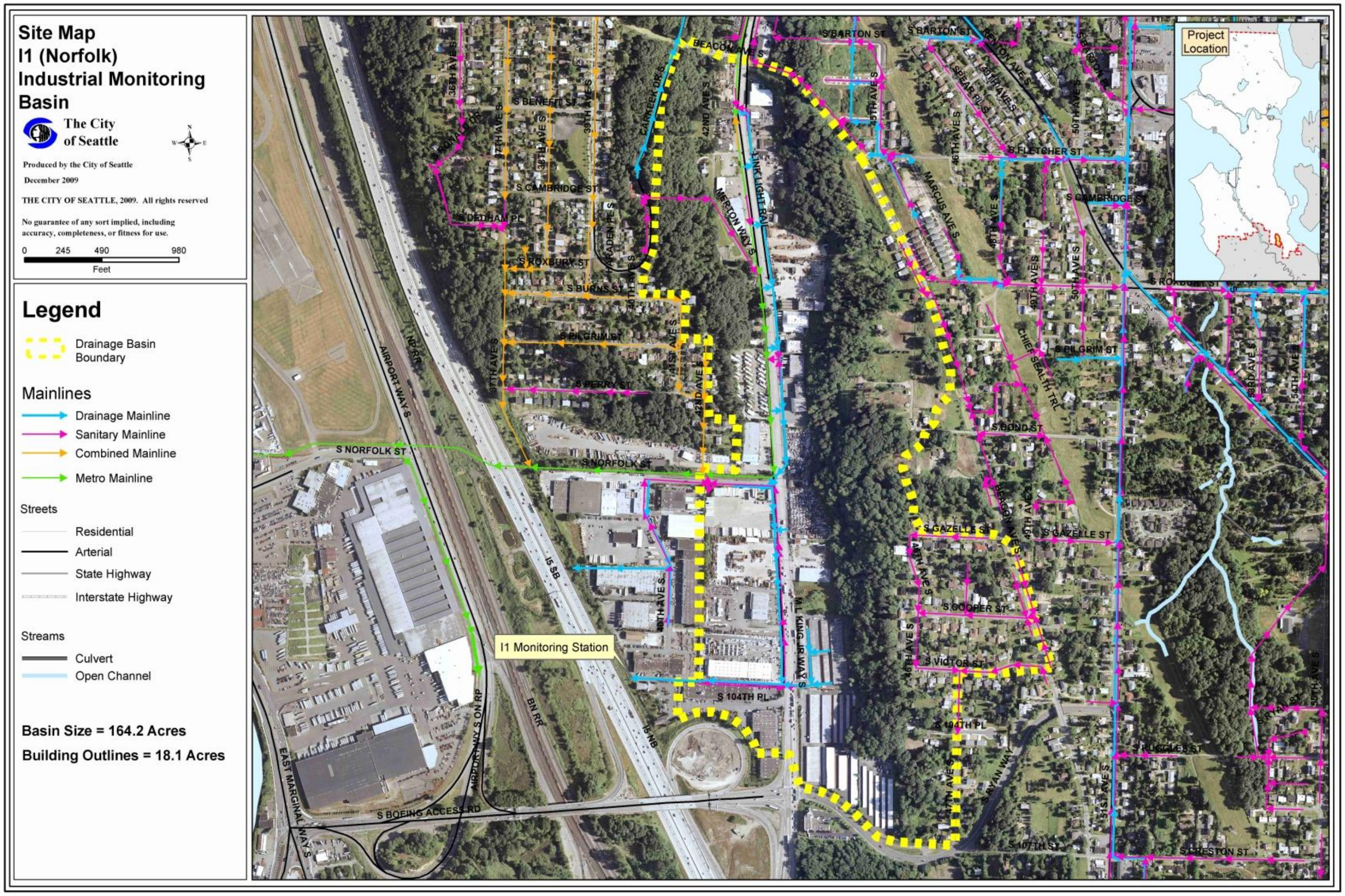
Figure 2.2.1.3. Site Map – I1 (Norfolk)



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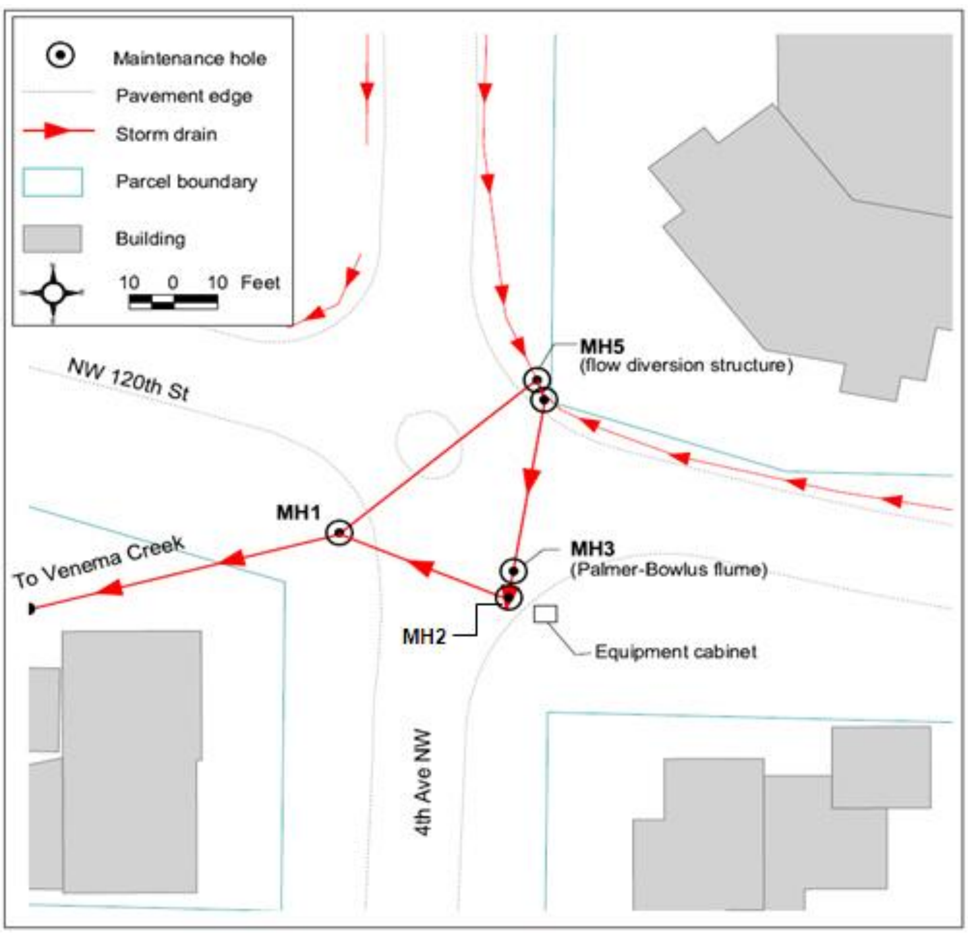
2.2.2 Monitoring Station Descriptions

Each of the three stormwater monitoring stations is configured with a flow monitor, automatic sampler, wireless telemetry and sediment traps. The specific monitor locations and equipment used at each site are detailed below with additional details being listed in the QAPP.

2.2.2.1 R1 (Venema)

The monitoring station R1 is composed of several maintenance holes, related storm drain piping, buried conduit and equipment enclosure at the intersection of NW 120th Street and 4th Avenue NW. The drainage system at this intersection was modified in June 2008 so that hydrologic conditions would be conducive to monitoring. Upgrades included adding a flow control weir (which acts as a diversion structure) and installing a 24-inch Palmer-Bowlus flume as a primary flow measurement device in a new section of storm drain piping with reduced slope (refer to Figure 2.2.2.1).

Figure 2.2.2.1a. R1 Monitoring Station Overview



All stormwater flows into Maintenance Hole (MH) 5. Most flows are directed to the 24-inch Palmer-Bowlus flume in MH3 and then flow back to the original storm pipe via MH2 and MH1. High flows, exceeding rates of 14.6 cubic feet second (cfs), overtop the sharp crested flow-control weir in MH5 and flow directly to MH1 via the original section of storm pipe.

The Palmer-Bowlus flume is a hydraulic structure of rectangular cross-section that constricts and reshapes the flow, developing a hydraulic head proportional to flow. These flumes consist of a converging section at the inlet, a throat and diverging section at the outlet.

Figure 2.2.2.1b. Photo of R1 Palmer-Bowlus Flume

Flow is monitored at two points at this monitoring location:

- The primary flow measurement point is a 24-inch Palmer-Bowlus flume installed in MH3. The water level in the flume is measured using a Campbell Scientific, Inc (CSI) CS408 pressure transducer (sensor).

- The secondary flow measurement point utilizes the weir in MH5. A portion of the higher flows overtop the weir, bypassing the flume in MH3. The water level behind the weir is measured using a CSI CS448 pressure transducer.

A CSI CR1000 data logger records level and flow at five minute intervals. The data logger calculates flow from the level data using flume and weir equations. The flow in the flume and the flow over the weir (if any) are summed into one overall flow rate for the residential site. The two pressure transducer cables are routed to MH3 and MH5, respectively, through buried conduits connecting the maintenance holes to the equipment cabinet.

Water quality samples are collected at a single location in MH2. A modified Isco 6712 sampler collects volume-proportional stormwater composite samples as controlled by the CR1000 data logger. The sampler is enabled by a change in water level in the flume, and the sampler pacing is based on the flow calculated from the flume. The data logger and Isco sampler are installed in the equipment cabinet and the sampler tubing is run to MH2 through buried conduit. The sample tubing and strainer are mounted in MH2 and collect water quality samples from the sump just below the invert of the outlet pipe.

Figure 2.2.2.1c. Photo of R1 Equipment Cabinet

Wireless telemetry provides remote communications with the CR1000 and both the data logger and sampler are powered by AC power.

Two sediment traps are installed in MH-2 with the mouths of the bottles located approximately 1-inch above the invert of the outlet pipe.

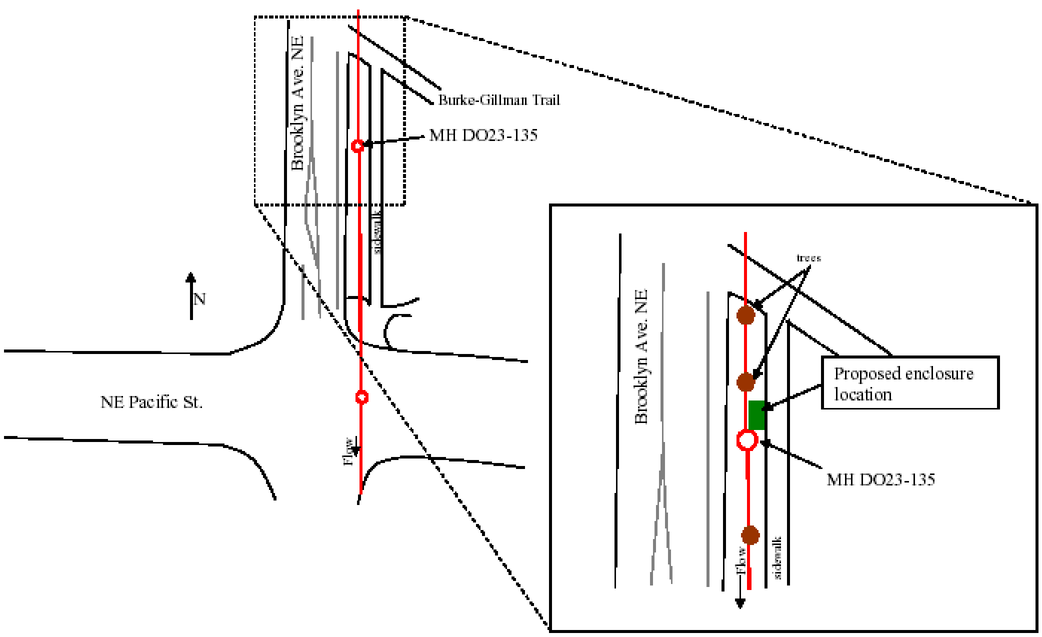
Figure 2.2.2.1d. Photo of R1 Sediment Traps

SPU rain gauge RG07 (45-S007) is used to represent rainfall in the R1 basin. RG07 is located at Whitman Middle School which is located near the corner of 15th Avenue NW and NW 92nd Street, roughly 1.5 miles southwest of the monitoring station.

2.2.2.2 C1 (University District)

Monitoring station C1 is accessed via MH D023-135 on the east side of Brooklyn Ave NE, which is situated on a relatively straight section of 36-inch diameter concrete reinforced pipe installed in 1972. The straightness of the pipe produces a relatively linear flow path through the maintenance hole. The pipe has a steep gradient with the upstream pipe slope at approximately 6.4 percent and the downstream pipe slope at approximately 7.6 percent.

Figure 2.2.2.2a. C1 Monitoring Station Overview



Flow is measured using an Isco 2150 area-velocity (AV) type meter. The AV sensor is mounted upstream of the MH, at the invert of the 36-inch concrete pipe using stainless steel mounting rings. Flow is calculated at five minute intervals based on measured level and velocity data and site-specific information (pipe size and pipe shape) using the continuity equation. This is the only stormwater characterization monitoring station where non-stormwater base flow is present.

A modified Isco 6712 sampler collects volume-proportional stormwater composite samples. The sampler's strainer is affixed to the AV sensor mounting ring, with the intake being positioned in the pipe invert just downstream of the sensor.

Figure 2.2.2.2b. Photograph of C1 Equipment Cabinet

Note – monitoring MH D023-135 visible behind cabinet under truck bumper.

Wireless telemetry provides remote communications to both the flow meter and sampler via a CSI CR1000 data logger. The CR1000 controls the collection of samples by pacing the autosampler.

The sampler, logger and modem are housed in an enclosure installed in the parking strip adjacent to MH D023-135.

Two sediment traps are installed downstream of the MH with the traps' housing mounted to the pipe's invert.

Figure 2.2.2.2c. Photograph of C1 Sediment Traps

SPU rain gauge RG03 (45-S003) is used to represent rainfall in the C1 basin. RG03 located on the roof of the Harris Hydraulics Laboratory on the University of Washington Campus near Lake Union. It is approximately 0.3 miles southeast of the monitoring site.

2.2.2.3 I1 (Norfolk)

The I1 monitoring station is located within a new pipe and flow diversion structure vault that was constructed as part of an upgrade to the drainage system in this basin. The former 36-inch storm drain pipe, which partially collapsed, was replaced during a construction project that was started in the winter of 2008/09 and finished in July 2009. The new storm drain is located between Martin Luther King Jr. Way and the Washington Department of Transportation (WSDOT) ditch located on the east side of Interstate 5. This pipeline runs along the south property boundary of the Papé Material Handling property (9892 40th Avenue South, Seattle, WA 98118) and parallels the boundary between the City of Seattle and the City of Tukwila.

The new pipe is a 64-inch, ductile-iron pipe (DIP). A 6-foot by 10-foot precast vault is installed at the downstream end of the new storm pipe. A high-flow outlet weir is installed at the downstream end of the vault with a crest elevation of 11.75 feet (NAVD88 datum). The purpose of the weir is to divert low flow to an oil control structure located under the Papé drive north of the new pipe. The weir, which discharges to the WSDOT ditch, also helps to dissipate flow energy of higher flows by spreading flow over the length of the weir. The following two figures present the I1 monitoring station layout in plan and side view, respectively.

Figure 2.2.2.3a. I1 Monitoring Station Overview

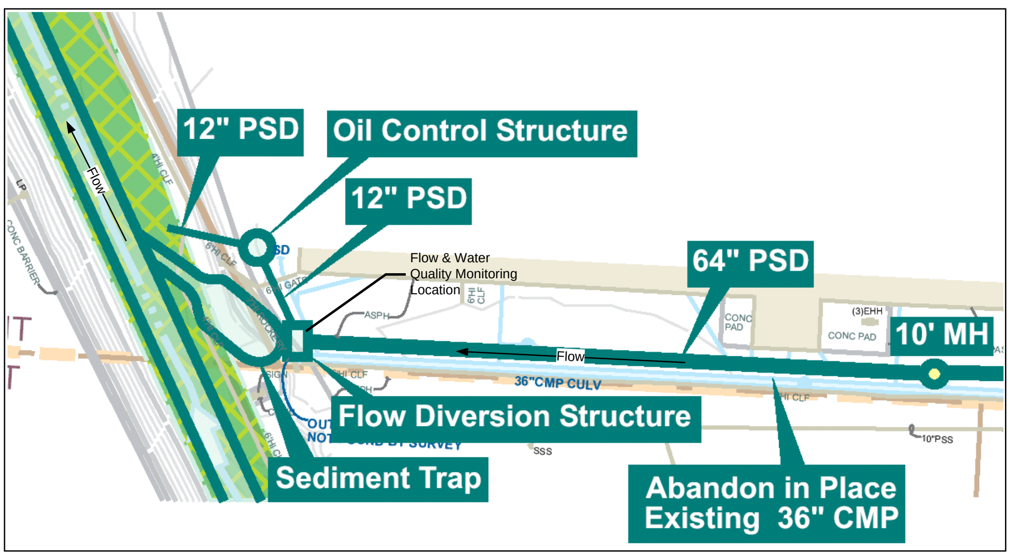
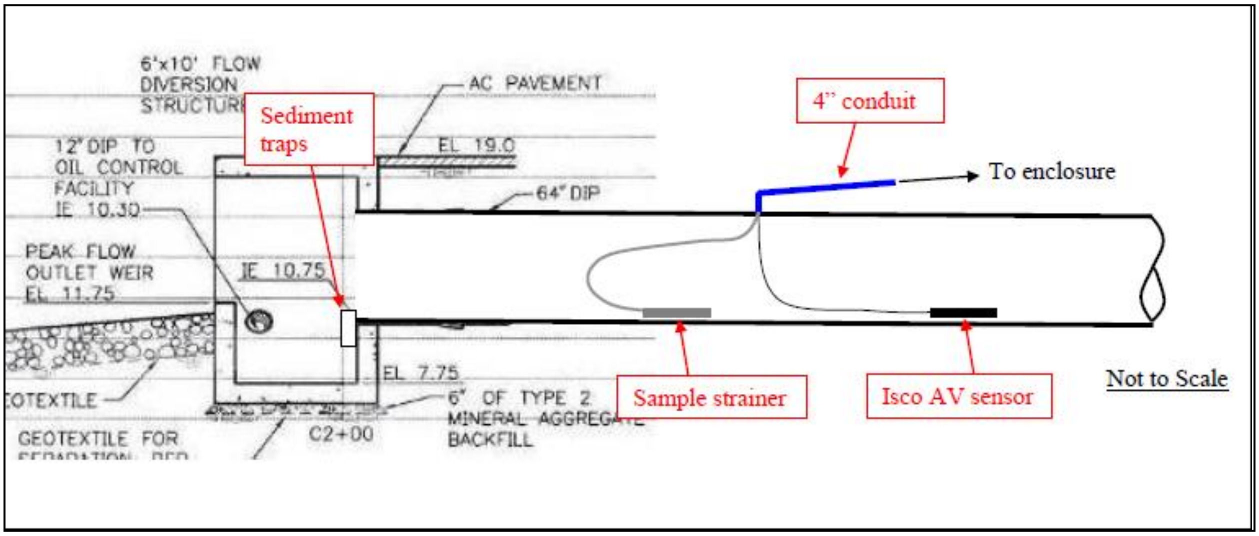


Figure 2.2.2.3b. I1 Station Cross Section View



Flow at the I1 station is measured using an Isco 2150 AV-type meter. The AV sensor is mounted upstream of the flow diversion vault, at the invert of the 64-inch DIP pipe using stainless steel mounting rings. Flow is calculated at five minute intervals based on measured level and velocity data and site-specific information (pipe size and pipe shape) using the continuity equation.

Figure 2.2.2.3c. Photograph of I1 Diversion Structure and Outfall

A modified Isco 6712 sampler collects volume-proportional stormwater composite samples. The sampler's strainer is affixed to the AV sensor mounting ring, with the intake being positioned in the pipe invert just downstream of the sensor.

Wireless telemetry provides remote communications to both the flow meter and sampler via a CSI CR1000 data logger. The CR1000 controls the collection of samples by pacing the autosampler.

The sampling equipment, logger and modem are housed in an enclosure installed in the Pape drive adjacent to the top of the diversion vault.

Figure 2.2.2.3d. Photograph of I1 Equipment Cabinet

Two sediment traps are installed in diversion structure vault with the mouths of the bottles located approximately 2-inches above the standing water level inside the structure.

Figure 2.2.2.3e. Photograph of I1 Sediment Traps

SPU rain gauge RG30 (45-S030) is used to represent rainfall in the I1 basin. RG30 is located on the roof of the Seattle Public Library at 9125 Rainier Ave. S. It is approximately miles 0.5 northeast of the monitoring site.

2.3 Sampling and Monitoring Procedures

Taylor Associates, Inc. (TAI), under contract with the City, performed all weather tracking, flow monitoring, stormwater sampling and sediment sampling activities.

2.3.1 Weather Tracking/Storm Criteria

Weather and rainfall data were continuously monitored using multiple forecasting, radar and satellite sources to target storms that meet the criteria for a qualifying event, listed in the table below.

Table 2.3.1. Qualifying Event Criteria

Criteria	Wet season	Dry season	Base Flow	Toxicity
Period	October 1 through April 30	May 1 through September 30	October 1 through September 30	August or September (ideally)
Rainfall volume	0.20" minimum, no fixed maximum	0.20" minimum, no fixed maximum	NA - none	No fixed minimum or maximum
Rainfall duration	No fixed minimum or maximum	No fixed minimum or maximum	NA	No fixed minimum or maximum
Antecedent dry period	≤ 0.02" rain in the previous 24 hours	≤ 0.02" rain in the previous 72 hours	≤ 0.02" rain in the previous 24 hours	One week
Storm capture coverage	75% (for storms longer than 24 hours, 75% of first 24 hours)	75% (for storms longer than 24 hours, 75% of first 24 hours)	100%/24 hrs	75% (for storms longer than 24 hours, 75% of first 24 hours)
Inter-event dry period	6 hours	6 hours	NA	NA

Notes-
NA – not applicable, no criteria

TAI made recommendations for storms to target for sampling with the final "go/no-go" decision made by the City's stormwater monitoring lead.

2.3.2 Precipitation Monitoring Procedures

SPU collects precipitation data from a network of 17 tipping bucket rain gages located throughout Seattle. Precipitation data are collected over one-minute intervals and transmitted via wireless telemetry to a centralized server. The rain gage network is operated and maintained under contract by ADS Environmental Services, Inc. (ADS).

Rain gage inspection and maintenance is performed on a quarterly basis. Maintenance includes: checking the levelness of the gage and re-leveling, if necessary; and cleaning of filter screens, drain holes and siphons. Gages are verified and calibrated annually by sending a known volume of water through the gage a minimum of two times, averaging the gage's measurement and comparing the average to the known volume. If the measurement is greater than +/- 2 percent of the actual volume, the gage is adjusted in the field until it reads within 2 percent or replaced with another gage, with the inaccurate gage sent back to the manufacturer for calibration.

All maintenance and calibration activities and any observed problems are recorded on a data sheet to be used to edit data raw rain data (discussed in Section 2.3.9.1).

2.3.3 Flow Monitoring Procedures

Flow monitoring equipment type and configuration per each station are described in Section 2.2.2. Level, velocity (if applicable) and flow data are logged at five-minute intervals. Flow monitoring quality assurance/quality control procedures are discussed in Section 2.3.9.2.

2.3.4 Stormwater Grab Sampling Procedures

Grab samples were collected by lowering a decontaminated stainless steel bailer, utilizing a swing arm sampler mounted on a telescoping pole, into the flow stream and pouring the contents into analyte-specific bottles. Ideally, all grab samples were collected between the first and last volume-proportional composite sample aliquot at each site. However, if the rain/runoff ended before the field crew could be present to collect the grab sample; a makeup grab sample was collected for that event during another event that met the storm criteria.

2.3.5 Stormwater Composite Sampling Procedures

Volume-proportioned stormwater composite samples were collected using modified Isco 6712 automatic samplers (autosamplers). The samplers utilize a peristaltic pump to draw stormwater from a strainer (a perforated stainless steel sample head affixed to the end of the sampler tube) installed in the flow channel and distribute it to composite bottles in the sampler base. The samplers' bases and distribution arms were modified to allow the use of eight discrete 2.5-gallon [9.46 Liter (L)] glass bottles which increases the volume of stormwater that can be collected. This increases the chances of obtaining sufficient volume, which is essential especially for the toxicity event; increases flexibility if storm sizes change; and reduces staffing needed to visit stations to replace bottles as they fill during a sampling event.

Figure 2.3.5a. Photo of Modified Autosampler

The data loggers were programmed to trigger the samplers every time a specified volume (referred to as the "trigger volume") passes the monitoring location. Each trigger sent results in the collection of one stormwater aliquot deposited in the composite bottle. As each bottle is filled (after a discrete number of aliquots), the sampler's distributor arm advances to the next bottle. Bottles were removed and replaced as necessary over the course of the event.

Since stormwater samples, specifically stormwater solids concentrations and related contaminants, are readily biased without proper processing procedures; all composite samples were composited and split in the project analytical laboratory [Analytical Resources Inc. (ARI) in Tukwila, WA] using a combination of polytetrafluoroethylene (PTFE) cone splitters and 14L PTFE churn splitters for all events. The cone splitters were used to evenly split the original composite samples into subsamples that are theoretically equal in chemical quality and sediment concentration to any other subsample. One of the subsamples from the cone splitter was then poured into the churn splitter to split the sample into analyte-specific containers.

Figure 2.3.5b. Photo of Compositing Samples Using Cone Splitter

2.3.6 Toxicity Event Sampling Procedures

For the first flush toxicity event, samples were collected and processed in the same manner as routine stormwater composite samples discussed above. After splitting the samples at ARI, the majority of the sample was shipped to Nautilus Environmental (Nautilus) in Tacoma, WA for toxicity testing on rainbow trout gametes (*oncorhynchus mykiss*). The remaining stormwater, if sufficient quantity was collected, was analyzed at ARI for the same parameters as a routine stormwater event. For the annual toxicity event, the toxicity analysis was prioritized so if limited sample volume was collected, not all routine parameters were measured.

The toxicity testing procedure recommends that the hardness of the stormwater sample be modified in cases where the receiving water hardness exceeded the stormwater hardness by more than 20 percent. To determine the hardness of the receiving water, one surface water grab sample was collected, using the same procedures as the stormwater grab samples, from the receiving water body immediately downstream from each stormwater monitoring station's outfall during the toxicity event. Receiving water grab samples were submitted to Nautilus for hardness analysis.

2.3.7 Sediment Trap Samples

Two sediment traps were installed at each monitoring location by bolting the stainless steel trap mounting assembly directly to the pipe invert (C1), or wall of the catch basin or diversion structure (R1 and I1, respectively). One PTFE, 1L, wide-mouth sample bottle is placed in each mounting assembly and held in place by a retainer ring. When installed to the pipe invert (C1), the mouth of the bottle was approximately 9-inches above the invert. When the traps were installed in structures with standing water (R1 and I1), the mouths of the bottles were positioned 1-2 inches above the static water level.

Sediment traps were inspected on a monthly basis following installation, checking for damage, blockage or under- or over-accumulation. Inspections were adjusted to an as-needed basis when site characteristics were known. As bottles become partially full with sediment, there is a risk that new sediment will not be effectively captured by the trap. If sediment was observed to be over half full in any of the bottles, they were removed and replaced with new bottles. The removed bottles were archived in a secure refrigerator for processing with the newer bottles at the end of the water year.

Bottles were removed near the end of the water year and replaced with clean bottles for the following water year. The removed bottles, including any archived bottles, were delivered to ARI where laboratory staff separate the solids and water by centrifuging. The solids from all bottles collected at each location over the water year were composited in the laboratory to form one sample from each monitoring location and then transferred to analyte-specific containers for testing. The priority list in the Permit was used to determine which analytical tests to perform if insufficient sediment quantity is captured to run all tests.

2.3.8 Decontamination Procedures

All water quality sampling equipment and sediment trap bottles - which includes stainless steel beakers, sampler tubing/strainers, sample bottles, and churn/cone splitters - were decontaminated with the following procedure:

1. Wash in a solution of laboratory-grade, non-phosphate soap and tap (city) water.
2. Rinse in tap water.
3. Wash in a 10 percent nitric acid/deionized water solution.*
4. Rinse in deionized water.

5. Wash with 10% methanol/isopropyl alcohol
6. Final rinse in deionized water.

** Nitric wash omitted for stainless steel beakers*

Sampling equipment was decontaminated prior to every use with the exception of sampler tubing. Following the initial wash, sampler tubing was rinsed with deionized water immediately prior to each sampling event and will be replaced at the onset of each water year.

2.3.9 Sampling and Monitoring Quality Assurance/Quality Control (QA/QC) Procedures

2.3.9.1 Precipitation Monitoring QA/QC Procedures

All raw rainfall data was reviewed by ADS on a monthly basis. Data was reviewed for errors such as periods of no recorded rainfall when nearby rain gages record rain, excessive or unrealistic measured rainfall, periods of non-rain tips due to calibration or other activity and other indicators of inaccurate data. Field maintenance and calibration data sheets were reviewed to inform the data evaluation. Raw rainfall data were edited to remove erroneous or test tips which are recorded on a monthly edit log. Areas of missing data were either filled using transposed data from the nearest working gage or data is replaced with "*". All rain data were flagged with one of the four following qualifiers: 1) "*" - no data, 2) "R" – raw, unedited data, 3) "T" – data transposed from the nearest rain gage with validated data and 4) "V" – validated data (confirmed accurate or made accurate by deletion of erroneous data).

2.3.9.2 Flow Monitoring QA/QC Procedures

Routine flow monitor maintenance visits were performed on a monthly or as-needed based on remote real-time monitor checks or data reviews. Each maintenance visit included visual inspection and cleaning of the sensors, calibration checks and calibration of the level sensor, if necessary. If the actual and measured level values differ than more than 0.02 feet, the level sensor was calibrated. If level drift continued after correction, the level sensor was removed and replaced.

Level, flow and velocity data were downloaded on a weekly basis for maintenance purposes and on an as-needed basis around storm events. During each weekly data download, the data were inspected for any significant trends in reliability and/or accuracy (i.e., substantial level jump, spikes, flat-line data, or no data). If anomalies were observed, a maintenance team was sent to the monitoring site to test and troubleshoot any issues found.

After each routine monthly maintenance visit, a thorough review of the data was completed for the preceding period between maintenance visits. Because each maintenance visit included an actual measurement of the water level, level data were corrected for level drift if the difference between the actual and monitored level was greater than 0.02 ft. The adjusted level data were then used to recalculate the flow using sensed velocity data or the level-flow relationship at each site.

Both raw and edited/finalized flow data are stored in the City's time-series database. Only finalized data are used for calculations and presented in this report.

2.3.9.3 Field QC Sample Collection Procedures

During WY2010, numerous field QC samples were collected to evaluate the sampling operation and to quantify and document bias that can occur in the field. QC samples provide the ability to assess the quality of the data produced by field sampling and a means for quantifying sampling bias.

The following table lists the types of QC samples collected, description of how the QC samples were collected, the purpose and information provided by each sample and the number of samples collected during WY2010.

Table 2.3.9.3. QC Sample Summary

QC Sample Type	Code	Description	Purpose/Info Provided	Number Collected WY2010	Collected on
Field Duplicate Sample	FDS	Simultaneous sample collected at same location as Primary Environmental Sample (PES)	Quantify variability from field sampling activities Quantify variability from laboratory procedures	3	Stormwater grab samples
Field Split Sample	FSS	PES split by field staff	Quantify variability from laboratory procedures	3	Stormwater composite samples
Field Blank Sample	FBS	Blank water passed through decontaminated or new equipment in lab	Tests cleaning procedures or cleanliness of new, disposable equipment in a controlled environment	4	Composite and sed trap bottles and splitting equipment (churn and cone splitters)
Field Residual Blank	FRB	Blank water passed through equipment after sampling but without decontamination	Quantifies cross-contamination between samples and quantifies contamination from field sampling activities	4	Sampler tubing and stainless steel bailer
Trip Blank	TRB	Sample container filled with blank water by lab that accompanies sample bottles from lab to field and back	Identify sample handling and transport bias Quantify sample cross-contamination	25	Used to accompany NWTPH-G grab samples

The field duplicate samples were collected in the field by lowering two analyte-specific bottles into the stormwater channel and filling simultaneously. The field split samples were generated in the laboratory by field staff by filling two identical analyte-specific containers simultaneously from the churn splitter. Field duplicates and split samples were collected at frequency of approximately 10 percent of the stormwater samples collected.

Excluding the trip blanks, all other field blanks were made by field staff passing reagent grade deionized water over or through new or decontaminated sample equipment and capturing the blank water in analyte-specific bottles. The sampler tubing and stainless steel bailers were not fully decontaminated, but rinsed with deionized water (consistent with Ecology's *Standard Operating Procedure for Automatic Sampling for Stormwater Monitoring – ECY002*, dated September 16, 2009) prior to sample or blank collection. For the sediment trap bottles, the blank water was left in each bottle for at least 15 minutes prior to pouring into analyte-specific bottles. The trip blanks were generated by the primary environmental laboratory (ARI) by filling 40-milliter (mL) volatile organic analysis (VOA) vials with reagent grade deionized water. The trip blanks accompanied all sample bottles used for Northwest Total Petroleum Hydrocarbon – Gasoline range (NWTPH-G) analyses from the time the empty bottles left the laboratory until the filled bottles were relinquished to the laboratory.

2.3.9.4 Field Audits

During one sampling event, the SPU project manager audited the performance of the field sampling staff. Staff were observed prepping automatic sampling equipment prior to the event, collecting the grab sample during the event, retrieving the composite sample at the end of the event and processing the samples at the analytical laboratory. Any deficiencies observed were verbally conveyed for immediate correction and all sampling staff were informed of the corrective action procedures, if needed. If the deficiencies were significant, additional follow-up audits will be performed.

2.4 Analytical QA/QC Procedures, Methods and Reporting Limits

2.4.1 Analytical Data QA/QC Procedures

All laboratory data packages received included a hardcopy report and an electronic data deliverable (EDD). The laboratory case narratives were reviewed with each sample delivery group for quality control issues and corrective action taken. The data were evaluated for required method, reporting limit (RL), package completeness, holding time, blank contamination, accuracy and precision.

Each EDD was imported into a validation and review database, where deviations from the Measurement Quality Objectives (MQOs – in QAPP) were identified and associated samples were qualified accordingly. Qualification details are included in the QA/QC report in Appendix C.1.

2.4.2 Analytical Methods and Reporting Limits

Refer to Appendix C.1 for a list of analytical parameters, methods and reporting limits used for this project and a related discussion.

2.5 Pollutant Load Calculation Procedures

The primary goal of the stormwater characterization monitoring is to gain knowledge of stormwater pollutant loads from areas within the municipality. Specifically, the Permit requires that *"for each stormwater monitoring site calculate the Event Mean Concentrations (EMCs), total annual pollutant load, the seasonal pollutant load, for the wet and dry seasons based on the water year. The loading shall be expressed as pounds and pounds per acre, and must take into account the potential pollutant load from base flow."*

The EMC for each event is the analyte concentration reported by the laboratory as analyzed on the event's composite sample since each composite consists of multiple subsamples (aliquots) representing the runoff of the entire event. The basic concept of a pollutant load calculation is deceptively simple, but it is problematic to perform and requires several decisions to be made to resolve problems inherent in any load calculation. Due to these problems, most literature referred to this calculation as pollutant load estimation and many different methods can be employed to estimate the load using the same data set, resulting in a range of loads calculated from the same data. Below is a summary of load calculation methods to help explain why the City selected methods used in this report.

The total (also referred to as "gross") pollutant load, whether seasonal or annual, is the sum of base flow load (where present) and stormwater load. Since the end result of the calculation as specified in the Permit is to determine the stormwater load, the base flow contribution is essential "removed" (or subtracted) from the total load to derive the stormwater load. For the purposes of this analysis, base flow loading is defined as the annual mass of a chemical constituent from non-stormwater sources that passes a point in the stormwater sewer system. These non-stormwater flows can include groundwater and shallow subsurface stormwater flow, or surface flows such as irrigation or springs. A practical measure of the presence of base flow is to review the continuous flow record from each monitoring site to determine if flows do not return to zero during dry periods. Of the City's three monitoring sites, only the commercial site (C1) has base flow.

The total stormwater load is simply the mass or weight of a pollutant that passes a point in the stormwater sewer system (e.g., a monitoring station) over a specific amount of time. To calculate load, the mass concentration of a pollutant is multiplied by the total volume of water passing the monitoring location over a period (i.e., seasonally or annually). The total flow volume is calculated by aggregating the flow measured by the continuous flow monitoring equipment. Although flow is essentially measured continuously, the pollutant concentration is only measured several times over a period (e.g., 11 times annually from the 11 events sampled) so the concentrations for the majority of the periods when the stormwater is not measured must be estimated using one of several methods.

Of the five or more estimator methods commonly used for load estimation, SPU used two for this report which are discussed below: 1) the mean method; which is also referred to as "the Ecology method" since it is the method outlined in Ecology's Standard Operating Procedure (SOP) and 2) the volume-proportional method – which is the method outlined in the City's QAPP and thus will be referred to as the "QAPP method." The two methods used by SPU are summarized in the following sections.

In addition to selecting a method to estimate loads, a method of substituting values for non-detects must also be chosen. Methods for non-detect substitutions used by SPU are discussed below.

Lastly, the method to remove the base flow load from the total load that SPU used is discussed.

2.5.1 Ecology Method

The method described in Ecology's SOP – which is typically referred to as the mean concentration estimator method - simply averages all EMCs from storms sampled in the period to create one period mean EMC. The period mean EMC is multiplied by total flow volume during that period to calculate period load. This method assumes there is no correlation between stormwater volume and concentration so it weighs all EMCs equally and assumes the resulting mean concentration represents average concentration of stormwater discharged over a period. This method is detailed in the Ecology SOP ECY004 - *Standard Operating Procedure for Calculating Pollutant Loads for Stormwater Discharges*, dated September 16, 2009. This is the method used to calculate the base flow loads in this report since the base flow volume is relatively constant during dry weather sampling events so there is no relationship between measured concentration and volume.

2.5.2 QAPP Method

The method outlined in the City's stormwater characterization QAPP – the volume-weighted method - assumes there is a correlation between concentration and volume of flow. This estimator calculates a volume weighted concentration (VWC) representing the storms sampled in the period (dry season or wet season) and then multiplies the VWC times the storm volume over that period. The VWC is derived by dividing the sum of loads for each sampled event by the sum of flow volumes from each sampled event. The VWC of each period is multiplied by total flow volume during the period to calculate period load. Equations and stepwise procedures for this method are detailed in the City's QAPP. The City selected this method because our literature review indicated it was considered the best overall estimator for stormwater concentrations since it attained smaller biases when compared to other estimator methods. This is the method used in this report to estimate stormwater loads.

2.5.3 Non-Detect Substitution

Most types of environmental monitoring data, including stormwater data, contain analytical results reported as non-detect (ND) at or above the laboratory reporting limit (RL), rather than a specific numerical value. These non-detected values are statistically known as "left-censored" measurements because the actual concentrations are unknown and are assumed to fall within a range between 0 and the RL. Environmental data have been historically reported with inconsistent treatment of non-detects with many, both simple and complex, substitution methods used. Non-detect substitution is required when performing statistical analysis or loading calculations since an actual numerical value is required.

The City's QAPP states the following regarding non-detect substitutions: *In the event an estimated value below the reporting limit is not provided, the value will be estimated at half of the reporting limit.*

Since the QAPP was finalized, several discussions have occurred between the Phase I Permittees and Ecology regarding non-detect substitution with no formal agreement on the best method. With large data sets, complex statistical substitutions have been proven to yield less bias than simple substitutions but no complex substitutions work when sample numbers become small such as for this project where the maximum sample number for a wet season is 7-9 and the dry season is 2-4. For a consistent comparison with other Permittees, the City has elected to expand on the method stated in our QAPP and use three non-detect substitution methods for load. Each non-detect value will be substituted with 0.0, 0.5 and 1.0 times the RL for that analyte. The three different substitutions result in a range of loads for each analyte which we consider more accurate than a single load and demonstrate some of the error that is inherent in load estimation.

The range of loads estimated becomes larger as the ratio of non-detects to detected values increases.

If an analyte was non-detect across the entire period's data set, no load will be calculated for that analyte since the load would be based entirely on a theoretical presence of an analyte based on an arbitrary substitution.

2.5.4 Removal of Base Flow Load

Since the Permit requires that the load from stormwater-only is determined; any load from base flow, if present, must be subtracted from the stormwater load. Only the City's commercial monitoring site (C1) has base flow present. A total of four base flow events, two in the wet season and two in the dry season, were sampled during WY2010. The EMCs from each season's events were averaged to calculate a seasonal base flow concentration for each analyte. Each seasonal concentration was multiplied by the average base flow volume recorded for each of the stormwater events sampled during each season to calculate a seasonal base flow load (per the Ecology method). The base flow load was then subtracted from the total pollutant load (which is a combination of stormwater load and base flow load) to estimate the stormwater load.

2.6 Sampling Event Summary

This section presents a summary of events sampled during WY2010. This was the second year collecting stormwater samples under the 2007 Permit but the first complete water year and the first year which required the collection of first flush toxicity samples. WY2010 began on October 1, 2009 and ended on September 30, 2010. In general, the City was successful at collecting all routine storm, base flow, toxicity samples and sediment samples required by the Permit, with a minor number of the stormwater events being qualified based on total precipitation or antecedent criteria.

2.6.1 Precipitation Summary

The table below summarizes precipitation data for each of the three sampling locations for WY2010 based on a review of rain gage data.

Table 2.6.1. Total Precipitation – October 1, 2009 to September 30, 2010

Monitoring Station	R1	C1	I1
Rain Gage	RG07	RG03	RG30
Precipitation (inches)	47.04	47.04	47.65

2.6.2 Stormwater Sampling Summary

The stormwater monitoring frequency required by the Permit is "*sixty-seven percent of the forecasted qualifying storms which result in actual qualifying are required to be sampled, up to a maximum of eleven (11) storm events per water year. Qualifying storm event sampling must be distributed throughout the year, approximately reflecting the distribution of rainfall between wet and dry seasons (with a goal of 60-80% of the samples collected during the wet season and a goal of 20-40% of the sample collected in the dry season).*"

A minimum of 11 stormwater events, evenly distributed across the water year, were successfully sampled at all three stations. Nine samples were collected during the wet season and at least two samples were collected from each station during the dry season. The storm hydrologic data for each event, including precipitation, flow and sample information, is presented in Table 2.6.2. As noted on the table, all criteria for all events were met except for the following:

Antecedent Dry Period. The targeted 24-hr antecedent dry period of 0.02 inches or less was slightly exceeded for the following events: R1 – storm event (SE)[2]-10, C1 – SE-08, and I1 – SE-04 and SE-05. Every attempt was made to meet this criteria but it was decided to proceed with analyzing samples from events where the criteria was not perfectly met to ensure that a minimum of 11 events were captured as required by the Permit.

Storm Event Rainfall Volume. The targeted storm event rainfall volume of 0.20 inches was not achieved for the following two events: C1 – SE -12 and I1 – SE-11. The total rainfall for both these events was between 0.15 and 0.20 inches, which both occurred on September 15-16, 2011. After sampling nine events during the wet season, the City ceased sampling activities until entering the dry season to ensure that events were sampled during the dry season and representative annual coverage was achieved. The result of this action was to risk not capturing the total number of 11 annual events. Additional opportunities to make up these events did not occur prior to the start of the next water year on October 1, 2010.

Grab Sample Collection. Although there are no criteria that state that grab samples must be collected during the same period that a composite sample is collected at a monitoring site, every attempt was made to collect grab samples during composite sample collection time period. At site I1 for event SE-06 on 3/25/2010, the field crew was not able to make it back to the site before the rainfall and runoff ended to collect a manual grab sample. The grab sample

[2] Each sampled event at each station is labeled as either a storm event (SE) or base flow (BF) event. Event numbering began in WY2009 and will continue sequentially across subsequent water years.

representing this event was collected on 5/26/2010 during a separate event. All other grab samples were collected within the time period of the composite sample.

Annual and event specific flow, rainfall and aliquot information are graphically presented on hydrographs on Appendix C.2. Analytical results from stormwater samples are discussed in the *Sampling Results* section of this report.

2.6.3 Base Flow Sampling

Base flow is present at only one of the three monitoring stations – C1. To quantify the chemical concentration in the base flow for the purposes of removing the base flow load from the gross load, two wet season and two dry season base flow sampling events were sampled at C1. The base flow was sampled using the autosamplers to collect a time-proportional composite sample by collecting aliquots at 15 minute intervals over a 24-hour period when no rainfall occurred. Analytical results from base flow events are discussed in the *Sampling Results* section of this report.

Table 2.6.2. Stormwater Characterization Event Hydrologic Summary

Criteria	Goal	SE-01	SE-02	SE-03	SE-04	SE-05	SE-06	SE-07	SE-08	SE-09	SE-10	SE-11	SE-12	SE-13
Residential Zone														
Storm Event Start	NA	WY2009	WY2009	28-OCT-2009 20:10	05-NOV-2009 09:50	31-DEC-2009 12:25	07-JAN-2010 23:30	10-FEB-2010 11:50	15-FEB-2010 22:55	23-FEB-2010 12:50	11-MAR-2010 02:10	25-MAR-2010 05:00	31-AUG-2010 06:40	15-SEP-2010 14:45
Storm Event End	NA	WY2009	WY2009	29-OCT-2009 15:40	06-NOV-2009 04:05	01-JAN-2010 18:40	09-JAN-2010 11:20	12-FEB-2010 08:45	16-FEB-2010 14:40	24-FEB-2010 15:00	12-MAR-2010 17:00	26-MAR-2010 06:00	31-AUG-2010 21:50	16-SEP-2010 23:55
Storm Event Duration (hrs)	>1	WY2009	WY2009	19.5	18.3	30.3	35.8	44.9	15.8	26.2	38.8	25	15.2	33.2
24-hour Antecedent Rainfall (inches)(a)	<= 0.02(a)	WY2009	WY2009	0	0	0	0	0	0.01	0	0.06 J	0	NA	NA
72-hour Antecedent Rainfall (inches)(b)	<= 0.02(b)	WY2009	WY2009	NA	NA	NA	NA	NA	NA	NA	NA	NA	0	0
Storm Event Rainfall (inches)	>= 0.20	WY2009	WY2009	0.4	1.02	0.79	1.12	0.5	0.32	0.22	1.31	0.28	0.49	0.58
Storm Event Rainfall Max (in/hr)	NA	WY2009	WY2009	0.22	0.42	0.15	0.19	0.13	0.13	0.09	0.11	0.13	0.13	0.17
Storm Event Rainfall Mean (in/hr)	NA	WY2009	WY2009	0.009	0.019	0.010	0.017	0.009	0.006	0.007	0.009	0.006	0.004	0.013
Storm Event Baseflow Volume (cf)	NA	WY2009	WY2009	0	0	0	0	0	0	0	0	0	0	0
Storm Event Flow Max (cfs)	NA	WY2009	WY2009	2.20	14.24	1.67	1.93	2.22	1.37	0.44	1.24	3.13	0.36	2.63
Storm Event Flow Mean (cfs)	NA	WY2009	WY2009	0.05	0.21	0.05	0.15	0.08	0.06	0.03	0.06	0.03	0.01	0.06
Storm Event Flow Volume (cf)	NA	WY2009	WY2009	1983.82	15400	8552.89	26455	6426.03	6864.5	1367.55	29410	2197.71	3291.22	3156.2
Storm Event Composite Sample Aliquots	>= 10(c)	WY2009	WY2009	7	23	22	91	14	23	9	56	8	28	45
Storm Event Runoff Volume Sampled (%)	>= 75(d)	WY2009	WY2009	98	93.5	98.1	85	90.2	96.1	78.9	93.5	95.7	98.3	99.8
Commercial Zone														
Storm Event Start	NA	22-OCT-2009 23:30	14-DEC-2009 10:00	31-DEC-2009 12:20	07-JAN-2010 23:05	24-JAN-2010 12:50	10-FEB-2010 12:05	23-FEB-2010 13:55	11-MAR-2010 02:05	25-MAR-2010 04:45	22-AUG-2010 04:50	31-AUG-2010 06:55	15-SEP-2010 15:15	NS
Storm Event End	NA	23-OCT-2009 23:37	15-DEC-2009 10:35	02-JAN-2010 06:20	09-JAN-2010 08:30	25-JAN-2010 10:00	12-FEB-2010 08:25	24-FEB-2010 14:00	12-MAR-2010 12:00	26-MAR-2010 08:00	22-AUG-2010 14:20	31-AUG-2010 23:15	16-SEP-2010 07:00	NS
Storm Event Duration (hrs)	>1	24.1	24.6	42	33.4	21.2	44.3	24.1	33.9	27.3	9.5	16.3	15.8	NS
24-hour Antecedent Rainfall (inches)(a)	<= 0.02(a)	0	0	0	0	0.02	0	0	0.04 J	0	NA	NA	NA	NS
72-hour Antecedent Rainfall (inches)(b)	<= 0.02(b)	NA	NA	NA	NA	NA	NA	NA	NA	NA	0	0	0	NS
Storm Event Rainfall (inches)	>= 0.20	0.5	0.71	0.95	1.12	0.45	0.54	0.28	1	0.39	0.14 (f)	0.5	0.16 J	NS
Storm Event Rainfall Max (in/hr)	NA	0.25	0.16	0.11	0.17	0.13	0.16	0.11	0.1	0.12	0.07	0.15	0.28	NS
Storm Event Rainfall Mean (in/hr)	NA	0.012	0.009	0.010	0.016	0.003	0.012	0.007	0.007	0.007	0.001	0.003	0.015	NS
Storm Event Baseflow Volume (cf)	NA	13023	21240	39312	32481	16764	35112	21675	28083	20601	5130	14700	14175	NS
Storm Event Total Flow Max (cfs)	NA	20.80	18.35	27.24	39.74	24.60	13.58	8.70	14.17	57.25	2.21	13.58	75.42	NS

Criteria	Goal	SE-01	SE-02	SE-03	SE-04	SE-05	SE-06	SE-07	SE-08	SE-09	SE-10	SE-11	SE-12	SE-13
Storm Event Total Flow Mean (cfs)	NA	1.26	1.14	2.06	3.46	0.86	1.29	1.01	1.16	1.21	0.27	0.54	2.43	NS
Storm Event Flow Volume (cf)	NA	194770	220970	506520	739120	289150	180500	91718	434600	145040	16710	133950	52400	NS
Storm Event Composite Sample Aliquots	>= 10(c)	17	33	56	43	20	30	42	56	27	21	23	28	NS
Storm Event Runoff Volume Sampled (%)	>= 75(d)	98.4	86.9	100/71.5 (e)	99.7	98.8	96.4	89.5	82.4	99.3	84.4	97.9	97.3	NS
Industrial Zone														
Storm Event Start	NA	22-OCT-2009 17:45	14-DEC-2009 12:40	31-DEC-2009 12:05	24-JAN-2010 12:20	11-MAR-2010 01:30	25-MAR-2010 04:10	28-MAR-2010 04:00	01-APR-2010 16:05	26-APR-2010 16:30	31-AUG-2010 07:10	15-SEP-2010 15:00	NS	NS
Storm Event End	NA	23-OCT-2009 16:01	15-DEC-2009 03:45	02-JAN-2010 09:55	25-JAN-2010 05:15	12-MAR-2010 10:50	26-MAR-2010 03:35	29-MAR-2010 14:20	03-APR-2010 06:45	27-APR-2010 09:45	31-AUG-2010 12:50	15-SEP-2010 21:00	NS	NS
Storm Event Duration (hrs)	>1	22.3	15.1	45.8	16.9	33.3	23.4	34.3	38.7	17.3	5.7	6	NS	NS
24-hour Antecedent Rainfall (inches)(a)	<= 0.02(a)	0	0	0	0.03 J	0.04 J	0	0	0.01	0	NA	NA	NS	NS
72-hour Antecedent Rainfall (inches)(b)	<= 0.02(b)	NA	NA	NA	NA	NA	NA	NA	NA	NA	0	0	NS	NS
Storm Event Rainfall (inches)	>= 0.20	0.38	0.56	0.81	0.47	1.31	0.62	1.35	1.06	0.42	0.36	0.19 J	NS	NS
Storm Event Rainfall Max (in/hr)	NA	0.250	0.130	0.130	0.130	0.130	0.260	0.270	0.190	0.190	0.140	0.450	NS	NS
Storm Event Rainfall Mean (in/hr)	NA	0.011	0.010	0.011	0.004	0.009	0.009	0.015	0.012	0.006	0.003	0.016	NS	NS
Storm Event Baseflow Volume (cf)	NA	0	0	0	0	0	0	0	0	0	0	0	NS	NS
Storm Event Flow Max (cfs)	NA	15.76	4.46	5.39	3.85	8.24	10.09	12.47	10.86	7.07	2.68	17.20	NS	NS
Storm Event Flow Mean (cfs)	NA	0.33	0.13	0.40	0.12	0.34	0.27	0.59	0.54	0.17	0.05	0.39	NS	NS
Storm Event Flow Volume (cf)	NA	31963	23889	72990	54154	168400	48727	154400	154400	34022	19811	7070.37	NS	NS
Storm Event Composite Sample Aliquots	>= 10(c)	15	56	18	44	56	35	43	56	33	36	32	NS	NS
Storm Event Runoff Volume Sampled (%)	>= 75(d)	93.6	98.9	99.9	97.3	81.6	98.4	97.8	88.2	90.4	88.3	91.6	NS	NS

Notes:
NA - not applicable
j - did not meet storm criteria goal, conditional use only.
(a) - applies to wet season (Oct 1 to Apr 30)
(b) - applies to dry season (May 1 to Sept 30)
(c) - 10 aliquots is the goal but greater than 7 is acceptable
(d) - if storm exceeds 24 hours, required to sample 75% of the first 24 hours. Percent runoff sampled in first 24 hours displayed.
Unless otherwise noted, percent runoff sampled over entire storm shown.
(e) I1, SE-03 - 100% runoff sampled first 24 hrs, 71.5% over entire storm.
(f) C1 - 8/22/10 event was Toxicity event so no min. rainfall criteria applicable.
NS - Not sampled during WY2010
WY2009 - event sampled during prior water year.

2.6.4 Toxicity Sampling

The Permit required that the City "*shall test the seasonal first flush for toxicity*" beginning in August 2010. Methods and criteria for collecting stormwater for toxicity testing were the same as other dry season stormwater sampling events with two exceptions: 1) the antecedent dry period was listed as "*one-week*" and 2) no minimum rainfall volume was required.

The City successfully met the criteria and collected one sample for toxicity testing from each of the three sites during late August 2010. Specifically, toxicity samples were collected at C1 on August 22 and at R1 and C1 on August 31, 2010. Samples were split at ARI and the majority of the stormwater from the toxicity event was sent to Nautilus for testing using rainbow trout gametes according to procedures presented in by Environment Canada (1998) and modification from Canaria et al. (1999). The remaining water was analyzed by ARI for the routine stormwater parameters required by the Permit. During the C1 toxicity event, insufficient sample volume was available to run both the toxicity event and all the routine chemical parameters, so the toxicity testing was prioritized and not all routine chemical tests were performed. Results from the toxicity testing are discussed in the *Sampling Results* section of this report.

2.6.5 Sediment Sampling

The sediment trap bottles representing WY2010 were deployed on September 21, 2009 during the removal and replacement of the bottles from the previous water year. The traps were inspected monthly for debris or rapid accumulations of sediment. The only noteworthy observation was the rapid accumulation of trash (plastic bags, food wrappers, etc.) and organic debris on the traps in C1, which would often partially or completely cover the mouths of the bottles. Upon removal, the C1 bottles were observed to be smashed and dented by an object(s) in the flow but the structural integrity was not compromised. Debris was removed during every confined space entry made for flow monitoring maintenance, storm setup and routine sediment trap checks; but debris accumulation will likely be a long-term problem at this site even with increased site visits.

Bottles at R1 were observed to be approximately half full with sediment on April 1, 2010 so were removed, archived and replaced with new bottles during the visit. The removed bottles were archived in a secured refrigerator, and relinquished and combined with the second set of bottles (R1 only) to create one annual sediment composite for each site.

Bottles from all three locations were removed and replaced with new bottles on September 30, 2010. Insufficient sediment quantity was captured at site C1 for all the Permit sediment parameters. Tested parameters were prioritized according to Section S8.D.2.g.iii of the Permit and results are presented in the *Sampling Results* section of this report.

2.7 Sampling Results

The following section discusses results for samples collected during WY2010. All analytical work for the stormwater characterization project was performed by ARI or their subcontractors (Pacific Agricultural Lab and Am Test) except for the toxicity testing which was performed by Nautilus Environmental.

2.7.1 Stormwater Samples

The analytical results for all the stormwater events sampled are summarized in site specific tables on the following pages (refer to Tables 2.7.1a to c).

2.7.2 Base Flow Samples

The main purpose for the collection of base flow samples at C1 was to generate a seasonal average base flow concentration for each analyte to calculate a base flow load. The base flow load is then subtracted from the gross load to calculate the stormwater load for that site. Base flow analytical data from C1 is presented in Table 2.7.2.

2.7.3 Sediment Samples

The results of sediment trap samples collected from the three monitoring stations are summarized in Table 2.7.3.   Insufficient sediment quantity was captured at site C1 to analyze for all the Permit sediment parameters so parameters were prioritized according to Section S8.D.g.iii of the Permit.

Table 2.7.1a. Stormwater Analytical Summary – Residential Site (R1)

Analyte	Result Units	SE-03 R1 10/28/2009	SE-04 R1 11/05/2009	SE-05 R1 12/31/2009	SE-06 R1 01/07/2010	SE-07 R1 02/10/2010	SE-08 R1 02/15/2010	SE-09 R1 02/23/2010	SE-10 R1 03/11/2010	SE-11 R1 03/25/2010	SE-12 R1 08/31/2010	SE-13 R1 09/15/2010
Flow-proportional composite - automatic												
Nutrients												
Nitrate + Nitrite	mg-N/L	0.136 J	0.071 J	0.227	0.15 J	0.204 J	0.257	0.476	0.131 J	0.434	0.721	0.408
Nitrogen, Total Kjeldahl	mg-N/L	0.58	2.35	1.02	1	1.34	0.78	0.6	0.85	0.95	2.74	2.01
Phosphorus, Total	mg-P/L	0.104	0.632	0.178	0.226	0.27	0.136	0.052	0.15	0.122	0.39	0.258
Ortho-phosphate	mg-P/L	0.012	0.016	0.007	0.008	0.006	0.007	0.015	0.01	0.015	0.15	0.027
Semivolatile Organics												
bis(2-Ethylhexyl)phthalate	ug/L	1 UJ	1.6 U	6.6 J	1.9 U	2.2 U	2.2 U	1 U	3 U	8.5 J	1 U	1 U
Butylbenzylphthalate	ug/L	1 U	1 U	1 U	1 U	1 U	1 U	1 U	3 U	1 U	1 U	1 U
Diethylphthalate	ug/L	1 U	1 U	1 U	1 U	1 U	1 U	1 U	3 U	1 U	1 U	1 U
Dimethylphthalate	ug/L	1 U	1 U	1 U	1 U	1 U	1 U	1 U	3 U	1 U	1 U	1 U
Di-n-Butylphthalate	ug/L	1 U	1 U	1 U	1 U	1 U	1 U	1 U	3 U	1 U	1 U	1 U
Di-n-Octyl phthalate	ug/L	1 U	1 U	1 U	1 U	1 U	1 U	1 U	3 U	1 U	1 U	1 U
1-Methylnaphthalene	ug/L	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U	0.2 U	0.1 U	0.1 U
2-Methylnaphthalene	ug/L	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U	0.2 U	0.1 U	0.1 U
Acenaphthene	ug/L	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U	0.2 U	0.1 U	0.1 U
Acenaphthylene	ug/L	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U	0.2 U	0.1 U	0.1 U
Anthracene	ug/L	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U	0.2 U	0.1 U	0.1 U
Benzo(a)anthracene	ug/L	0.1 U	0.12	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U	0.2 U	0.1 U	0.1 U
Benzo(a)pyrene	ug/L	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U	0.2 U	0.1 U	0.1 U
Benzo(g,h,i)perylene	ug/L	0.1 U	0.17	0.1 U	0.1 U	0.11	0.1 U	0.1 U	0.1 U	0.2 U	0.1 U	0.1 U
Chlorpyrifos	ug/L	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U
Chrysene	ug/L	0.1 U	0.22	0.1 U	0.11	0.12	0.1 U	0.1 U	0.1 U	0.2 U	0.1 U	0.1 U
Diazinon	ug/L	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U
Dibenz(a,h)anthracene	ug/L	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U	0.2 U	0.1 U	0.1 U
Dibenzofuran	ug/L	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U	0.2 U	0.1 U	0.1 U
Dichlobenil	ug/L	0.15 UJ	0.33 J	0.6 U	0.15 U	0.12 UJ	0.12 UJ	0.12 U	0.12 U	0.12 UJ	0.026	0.024 U
Fluoranthene	ug/L	0.1 U	0.29	0.1 U	0.11	0.15	0.1 U	0.1 U	0.1 U	0.2 U	0.1 U	0.1 U
Fluorene	ug/L	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U	0.2 U	0.1 U	0.1 U
Indeno(1,2,3-cd)pyrene	ug/L	0.1 U	0.11	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U	0.2 U	0.1 U	0.1 U
Malathion	ug/L	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U
Naphthalene	ug/L	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U	0.2 U	0.1 U	0.1 U
Pentachlorophenol	ug/L	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	1 U	0.5 U	0.5 U
Phenanthrene	ug/L	0.1 U	0.11	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U	0.2 U	0.1 U	0.1 U
Prometon	ug/L	0.15 U	0.15 U	0.6 U	0.15 U	0.12 U	0.12 U	0.12 U	0.12 U	0.12 U	0.26	0.024

Analyte	Result Units	SE-03	SE-04	SE-05	SE-06	SE-07	SE-08	SE-09	SE-10	SE-11	SE-12	SE-13
		R1	R1	R1	R1	R1	R1	R1	R1	R1	R1	R1
		10/28/2009	11/05/2009	12/31/2009	01/07/2010	02/10/2010	02/15/2010	02/23/2010	03/11/2010	03/25/2010	08/31/2010	09/15/2010
Pyrene	ug/L	0.1 U	0.28	0.1	0.14	0.21	0.1 U	0.1 U	0.1 U	0.2 U	0.1 U	0.1 U
Metals												
Cadmium, Total	ug/L	0.2 U	0.4	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U	0.2
Cadmium, Dissolved	ug/L	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U
Copper, Total	ug/L	8	33.3	12.6	15.8	18.2	8.8	8	10.7	14.8	22.4	20.4
Copper, Dissolved	ug/L	4.2	4.3	3	1.8	3.5	2.4	6.7	2.3	8	16	7.9
Lead, Total	ug/L	7	56	16	22	24	11	3	13	10	17	30
Lead, Dissolved	ug/L	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	2	1 U
Zinc, Total	ug/L	26	114	42	53	63	53	30	42	42	49	58
Zinc, Dissolved	ug/L	9	10	11	11	11	26	21	11	16	26	12
Hardness	mg/L CaCO3	12	28	16	15	19	17	22	12	19	23	18
Miscellaneous Organics												
2,4-D	ug/L	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	2	1 U
MCPP	ug/L	250 U	250 U	250 U	250 U	250 U	250 U	250 U	250 U	250 U	250 U	250 U
Triclopyr	ug/L	0.08 U	0.08 U	0.08 U	0.08 U	0.08 U	0.08 U	0.08 U	0.08 U	0.08 UJ	0.08 U	0.08 UJ
Conventionals												
Conductivity	umho/cm	31.4	32.9	38.2	26.5	32.8	41.9	61.5	20.1	50.8	70.5	37.2
pH	std units	6.91	6.44	6.92	6.12	7.24	7.23	7.3	7.15	7.61	6.85	6.8
Solids, Total Suspended	mg/L	25.8	288	50.9	80.2	76.5	43.9	6.2	31.6	35.5	54 J	68.3
Turbidity	NTU	22	158	36	42	84	29	9.7	40	38	33	46
Chloride	mg/L	1.2	3.3	2.4	1.6	0.8	1.8	2.5	0.7	1.8	3.8	0.9
Biological Oxygen Demand	mg/L	3.9	12.3	2.9	3.2	4.3	2	2.7	1.8	4.1	8.6	8.4
Surfactants	mg/L	0.05 U	0.05 U	0.05 UJ	0.05 UJ	0.07	0.05 U	0.05 U	0.05 U	0.15	0.025 U	0.026 J
Grab - manual												
Petroleum Hydrocarbons												
Diesel Range Hydrocarbons	mg/L	0.37	0.26	0.33	0.3	0.31	0.25 U	0.44	0.25 U	0.61	0.49	0.3
Gasoline Range Hydrocarbons	mg/L	0.25 U	0.25 U	0.25 U	0.25 U	0.25 U	0.25 U	0.25 U	0.25 U	0.25 U	0.25 U	0.25 U
Bacteria												
Fecal Coliform	CFU/100 mL	640	1020	10600	528	43	512	184	19500	8	35300 J	3760

Notes:
U - Analyte was not detected above the reported result.
J- Analyte was positively identified. The reported result is an estimate.
UJ- Analyte was not detected above the reported estimate.

Table 2.7.1b. Stormwater Analytical Summary – Commercial Site (C1)

		SE-01	SE-02	SE-03	SE-04	SE-05	SE-06	SE-07	SE-08	SE-09	SE-10	SE-11	SE-12
		C1	C1	C1	C1	C1	C1	C1	C1	C1	C1	C1	C1
Analyte	Result Units	10/22/2009	12/14/2009	12/31/2009	01/07/2010	01/24/2010	02/10/2010	02/23/2010	03/11/2010	03/25/2010	08/22/2010	08/31/2010	09/15/2010
Flow-proportional composite - automatic													
Nutrients													
Nitrate + Nitrite	mg-N/L	0.225	0.259	0.304	0.283	0.387	0.562	0.706	0.211 J	0.671	NM	0.448	0.664
Nitrogen, Total Kjeldahl	mg-N/L	1.14	2.79	1.77	1.23	1.02	1.6	1.91	1.12	1.69	NM	2.71	2.62
Phosphorus, Total	mg-P/L	0.16	0.286	0.226	0.182	0.176	0.312	0.198	0.172	0.216	NM	0.428	0.314
Ortho-phosphate	mg-P/L	0.004 U	0.077	0.008	0.028	0.039	0.048	0.048	0.027	0.008	NM	0.128	0.067
Semivolatile Organics													
bis(2-Ethylhexyl)phthalate	ug/L	1.9 U	6.2 J	7.2 J	4.6 U	3.8 U	7 J	4.1 U	3.2 U	3.5 U	1 U	3.3 U	3.3 U
Butylbenzylphthalate	ug/L	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	2 U
Diethylphthalate	ug/L	1 U	3.7	1 U	1 U	1.1	1 U	1.3	1 U	1	1 U	1 U	2 U
Dimethylphthalate	ug/L	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	2 U
Di-n-Butylphthalate	ug/L	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	2 U
Di-n-Octyl phthalate	ug/L	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	2 U
1-Methylnaphthalene	ug/L	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U	0.2 U	0.1 U	0.1 U	0.1 U
2-Methylnaphthalene	ug/L	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U	0.2 U	0.1 U	0.1 U	0.1 U
Acenaphthene	ug/L	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U	0.2 U	0.1 U	0.1 U	0.1 U
Acenaphthylene	ug/L	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U	0.2 U	0.1 UJ	0.1 U	0.1 U
Anthracene	ug/L	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U	0.2 U	0.1 U	0.1 U	0.1 U
Benzo(a)anthracene	ug/L	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U	0.2 U	0.1 U	0.1 U	0.1 U
Benzo(a)pyrene	ug/L	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U	0.2 U	0.1 UJ	0.1 U	0.1 U
Benzo(g,h,i)perylene	ug/L	0.1 U	0.12	0.16	0.13	0.1	0.13	0.1 U	0.13	0.2 U	0.1 UJ	0.11	0.1 U
Chlorpyrifos	ug/L	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U
Chrysene	ug/L	0.1 U	0.13	0.15	0.17	0.12	0.16	0.1 U	0.1 U	0.2 U	0.1 U	0.1 U	0.1 U
Diazinon	ug/L	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U
Dibenz(a,h)anthracene	ug/L	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U	0.2 U	0.1 U	0.1 U	0.1 U
Dibenzofuran	ug/L	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U	0.2 U	0.1 U	0.1 U	0.1 U
Dichlobenil	ug/L	0.15 UJ	0.15 U	0.6 U	0.15 U	0.12 U	0.12 UJ	0.12 U	0.12 U	0.12 UJ	0.024 U	0.024 U	0.024 U
Fluoranthene	ug/L	0.1 U	0.19	0.2	0.21	0.17	0.22	0.1 U	0.13	0.2 U	0.1 U	0.14	0.1 U
Fluorene	ug/L	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U	0.2 U	0.1 U	0.1 U	0.1 U
Indeno(1,2,3-cd)pyrene	ug/L	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U	0.2 U	0.1 UJ	0.1 U	0.1 U
Malathion	ug/L	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U
Naphthalene	ug/L	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U	0.2 U	0.1 U	0.1 U	0.1 U
Pentachlorophenol	ug/L	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	1 U	0.5 U	0.5 U	0.5 U
Phenanthrene	ug/L	0.1 U	0.16	0.12	0.11	0.11	0.12	0.1 U	0.1 U	0.2 U	0.1 U	0.1 U	0.1 U
Prometon	ug/L	0.15 UJ	0.15 U	0.6 U	0.15 U	0.12 U	0.12 U	0.12 U	0.12 U	0.12 U	0.024 U	0.024 U	0.024 U
Pyrene	ug/L	0.1 U	0.24	0.26	0.23	0.21	0.32	0.11	0.16	0.2 U	0.1 U	0.1	0.1 U

		SE-01	SE-02	SE-03	SE-04	SE-05	SE-06	SE-07	SE-08	SE-09	SE-10	SE-11	SE-12
		C1	C1	C1	C1	C1	C1	C1	C1	C1	C1	C1	C1
Analyte	Result Units	10/22/2009	12/14/2009	12/31/2009	01/07/2010	01/24/2010	02/10/2010	02/23/2010	03/11/2010	03/25/2010	08/22/2010	08/31/2010	09/15/2010
Metals													
Cadmium, Total	ug/L	0.2 U	0.2 U	0.2	0.2 U	0.2 U	0.2	0.2 U	0.2 U	0.2	0.4	0.3	0.2
Cadmium, Dissolved	ug/L	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U
Copper, Total	ug/L	28.3	61.9	43.6	31.4	22.6	49	59.4	33.2	72.6	80.7	56.2	67.3
Copper, Dissolved	ug/L	15.6	19	12.4	7.4	9.2	17.3	25.9	10.7	28.9	47.3	22.6	32.5
Lead, Total	ug/L	6	19	19	15	10	18	8	12	12	9	19	11
Lead, Dissolved	ug/L	2	1	1 U	1 U	1 U	1 U	1	1 U	1	3	1	1
Mercury, Total	ug/L	0.02 U	0.02 U	0.0231	0.02 U	0.02 U	0.02 U	0.02 U	0.02 U	0.024	0.0256	0.0261	0.0483
Mercury, Dissolved	ug/L	0.02 U	0.02 U	0.02 U	0.02 U	0.02 U	0.02 U	0.02 U	0.02 U	0.02 U	0.02 U	0.02 U	0.02 U
Zinc, Total	ug/L	78	154	118	92	84	127	111	98	170	221	155	128
Zinc, Dissolved	ug/L	53	52	37	31	33	47	61	35	87	130	54	65
Hardness	mg/L CaCO3	27	30	27	21	34	43	48	25	41	69	35	47
Miscellaneous Organics													
2,4-D	ug/L	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U
MCPP	ug/L	250 U	250 U	250 U	250 U	250 U	250 U	250 U	250 U	250 U	250 U	250 U	250 U
Triclopyr	ug/L	0.08 UJ	0.08 U	0.08 U	0.08 U	0.08 U	0.08 U	0.08 U	0.08 U	0.08 UJ	0.08 U	0.08 U	0.08 UJ
Conventionals													
Conductivity	umho/cm	86.5	177	87.6	58.7	76.8	119	130	55.4	123	NM	96	124
pH	std units	6.99	7.05	6.88	6.65	6.9	7.34	7.29	7.32	7.35	NM	7.04	7.12
Solids, Total Suspended	mg/L	23.1	74	72	50	42.7	46.6	32.2	35.9	45.6	26.3	50.8 J	42.9
Turbidity	NTU	16.3	54	21	17.9	15.3	48	32	30	31	NM	34	20
Chloride	mg/L	3.6	31.4	8.8	3.2	3	6.2	8.1	2	6.5	8.9	3.8	4.7
Biological Oxygen Demand	mg/L	13	14.1	10.8	6.3	8.8	9.7	29.7	4.6	9.1	NM	16.3	25.1
Surfactants	mg/L	0.05 UJ	0.12	0.05 UJ	0.05 U	0.06	0.15	0.37	0.05 U	0.05 U	0.08	0.051	0.13
Grab - manual													
Petroleum Hydrocarbons													
Diesel Range Hydrocarbons	mg/L	0.98	2.4	1.2	0.75	1.3	1	0.99	0.53	0.91	NM	0.45	1
Gasoline Range Hydrocarbons	mg/L	0.25 U	0.25 U	0.25 U	0.25 U	0.25 U	0.25 U	0.25 U	0.25 U	0.25 U	NM	0.25 U	0.25 U
Bacteria													
Fecal Coliform	CFU/100 mL	4080	2760	1680	1000	1300	1020	2000	7180	1 U	NM	22700	22800

Notes:
U - Analyte was not detected above the reported result.
J- Analyte was positively identified. The reported result is an estimate.
UJ- Analyte was not detected above the reported estimate.
NM – Not measured due to insufficient sample volume. The 8/22/10 event was performed for toxicity testing which was prioritized over routine chemical analysis.

Table 2.7.1c. Stormwater Analytical Summary – Industrial Site (I1)

		SE-01	SE-02	SE-03	SE-04	SE-05	SE-06 (a)	SE-07	SE-08	SE-09	SE-10	SE-11
		I1	I1	I1	I1	I1	I1	I1	I1	I1	I1	I1
Analyte	Result Units	10/22/2009	12/14/2009	12/31/2009	01/24/2010	03/11/2010	03/25/2010	03/28/2010	04/01/2010	04/26/2010	08/31/2010	09/15/2010
Flow-proportional composite - automatic												
Nutrients												
Nitrate + Nitrite	mg-N/L	0.246	0.262	0.358	0.341	0.188 J	0.25	0.204 J	0.258	0.245	0.543	0.392
Nitrogen, Total Kjeldahl	mg-N/L	0.3 U	1.37	1.22	0.86	0.98	1.33	3	1.08	1.23	2.65	1.63
Phosphorus, Total	mg-P/L	0.366	0.336	0.334	0.2	0.246	0.122	0.972	0.254	0.106	0.232	0.21
Ortho-phosphate	mg-P/L	0.047	0.068	0.121	0.069	0.072	0.015	0.051	0.069	0.024	0.065	0.008
Semivolatile Organics												
bis(2-Ethylhexyl)phthalate	ug/L	1.7 U	3.6 U	3.7 U	1.6 U	2 U	2.6 U	5.3 J	1.4 U	2.2 U	3.4 U	4.4 U
Butylbenzylphthalate	ug/L	1 U	1 U	1 U	1 U	2 U	1 U	1 U	1 U	1 U	1 U	2 U
Diethylphthalate	ug/L	2.1	1 U	1 U	1 U	2 U	1.2	1 U	1 U	1 U	1 U	8.9
Dimethylphthalate	ug/L	1 U	1 U	1 U	1 U	2 U	1 U	1 U	1 U	1 U	1 U	2 U
Di-n-Butylphthalate	ug/L	1 U	1 U	1 U	1 U	2 U	1 U	1 U	1 U	1 U	1 U	2 U
Di-n-Octyl phthalate	ug/L	1 U	2.2	1.3	1 U	2 U	1 U	1 U	1 U	1 U	1 U	2.3
1-Methylnaphthalene	ug/L	0.1 U	0.1 U	0.1 U	0.17	0.1 U	0.1 U	0.2 U	0.1 U	0.1 U	0.1 U	0.1 U
2-Methylnaphthalene	ug/L	0.1 U	0.1 U	0.1 U	0.23	0.1 U	0.1 U	0.2 U	0.1 U	0.1 U	0.1 U	0.1 U
Acenaphthene	ug/L	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U	0.2 U	0.1 U	0.1 U	0.1 U	0.1 U
Acenaphthylene	ug/L	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U	0.2 U	0.1 U	0.1 U	0.1 U	0.1 U
Anthracene	ug/L	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U	0.2 U	0.1 U	0.1 U	0.1 U	0.1 U
Benzo(a)anthracene	ug/L	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U	0.3	0.1 U	0.1 U	0.1 U	0.1 U
Benzo(a)pyrene	ug/L	0.11	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U	0.36	0.1 U	0.1 U	0.1 U	0.1 U
Benzo(g,h,i)perylene	ug/L	0.11	0.12	0.1 U	0.1 U	0.1 U	0.12	0.36	0.1 U	0.1 U	0.1 U	0.1 U
Chlorpyrifos	ug/L	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U
Chrysene	ug/L	0.12	0.1	0.1 U	0.1 U	0.1 U	0.12	0.44	0.1 U	0.1 U	0.1 U	0.1 U
Diazinon	ug/L	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U
Dibenz(a,h)anthracene	ug/L	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U	0.2 U	0.1 U	0.1 U	0.1 U	0.1 U
Dibenzofuran	ug/L	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U	0.2 U	0.1 U	0.1 U	0.1 U	0.1 U
Dichlobenil	ug/L	0.15 UJ	0.15 U	0.6 U	0.12 U	0.12 U	0.12 UJ	0.12 UJ	0.12 U	0.12 U	0.024 U	0.024
Fluoranthene	ug/L	0.25	0.18	0.11	0.1 U	0.1 U	0.18	0.6	0.1 U	0.1 U	0.1 U	0.1 U
Fluorene	ug/L	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U	0.2 U	0.1 U	0.1 U	0.1 U	0.1 U
Indeno(1,2,3-cd)pyrene	ug/L	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U	0.1	0.28	0.1 U	0.1 U	0.1 U	0.1 U
Malathion	ug/L	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U
Naphthalene	ug/L	0.1 U	0.11	0.1 U	0.1 U	0.1 U	0.1 U	0.2 U	0.1 U	0.1 U	0.1 U	0.1 U
Pentachlorophenol	ug/L	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	1 U	0.5 U	0.5 U	0.5 U	0.5 U
Phenanthrene	ug/L	0.13	0.14	0.1 U	0.12	0.1 U	0.11	0.32	0.1 U	0.1 U	0.1 U	0.1 U
Prometon	ug/L	0.15 UJ	0.15 U	0.6 U	0.12 U	0.12 U	0.12 U	0.12 U	0.12 U	0.12 U	0.024 U	0.024 U

		SE-01	SE-02	SE-03	SE-04	SE-05	SE-06 (a)	SE-07	SE-08	SE-09	SE-10	SE-11
		I1	I1	I1	I1	I1	I1	I1	I1	I1	I1	I1
Analyte	Result Units	10/22/2009	12/14/2009	12/31/2009	01/24/2010	03/11/2010	03/25/2010	03/28/2010	04/01/2010	04/26/2010	08/31/2010	09/15/2010
Pyrene	ug/L	0.42	0.22	0.16	0.14	0.1 U	0.19	0.74	0.1	0.1 U	0.1 U	0.1
Metals												
Cadmium, Total	ug/L	0.3	0.2	0.2 U	0.2 U	0.2 U	0.2	0.6	0.2 U	0.2 U	0.3	0.2
Cadmium, Dissolved	ug/L	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U
Copper, Total	ug/L	38.2	25.4	18.1	11.4	13.3	24.6	64.3	15.6	13.4	34.9	25.7
Copper, Dissolved	ug/L	4.4	6.3	4.4	4.3	4.6	6.8	2	4.5	6.5	19.2	10.4
Lead, Total	ug/L	9	10	9	4	5	10	43	8	2	13	11
Lead, Dissolved	ug/L	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	2	1 U
Mercury, Total	ug/L	0.02 U	0.02 U	0.02 U	0.02 U	0.02 U	0.02 U	0.047	0.02 U	0.02 U	0.02 U	0.02 U
Mercury, Dissolved	ug/L	0.02 U	0.02 U	0.02 U	0.02 U	0.02 U	0.02 U	0.02 U	0.02 U	0.02 U	0.02 U	0.02 U
Zinc, Total	ug/L	135	160	131	82	117	145	420	117	103	208	187
Zinc, Dissolved	ug/L	20	43	47	47	57	52	12	46	74	125	79
Hardness	mg/L CaCO3	57	53	84	85	68	60	92	75	69	48	72
Miscellaneous Organics												
2,4-D	ug/L	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U
MCPP	ug/L	250 U	250 U	250 U	250 U	250 U	250 U	250 U	250 U	250 U	250 U	250 U
Triclopyr	ug/L	0.08 UJ	0.08 U	0.08 U	0.08 U	0.08 U	0.08 UJ	0.08 UJ	0.08 U	0.08 U	0.08 U	0.08 UJ
Conventionals												
Conductivity	umho/cm	96.8	142	194	169	141	143	146	170	167	117	171
pH	std units	7.43	7.39	7.26	7.18	7.47	7.25	7.49	7.32	7.21	7.24	7.28
Solids, Total Suspended	mg/L	106	120	69	37.7	43.4	74	398	73.1	16	50.2	48.5
Turbidity	NTU	140	91.5	31	31	40	58	200	21	16.9	44	31
Chloride	mg/L	1.8	13.8	6.3	3.5	2.6	2.8	2.8	5	3.1	2.2	3.4
Biological Oxygen Demand	mg/L	12.2	8.1	8	2.9	2.9	9.8	13.6	4.4	4.9	16.1	27.2
Surfactants	mg/L	0.05 UJ	0.05 U	0.05 U	0.05	0.05 U	0.15	0.05 U	0.05 U	0.23	0.11	0.23
Grab - manual												
Petroleum Hydrocarbons												
Diesel Range Hydrocarbons	mg/L	0.98	1.2	1	0.61	0.46	1.1 (a)	0.71	0.33	0.97	0.79	0.84
Gasoline Range Hydrocarbons	mg/L	0.37	0.25 U	0.25 U	0.25 U	0.25 U	0.25 (a) U	0.25 U	0.25 U	0.25 U	0.25 U	0.25 U
Bacteria												
Fecal Coliform	CFU/100 mL	820	440	680	372	720	3200 (a)	488	762	91900	1220	1800

Notes:
U - Analyte was not detected above the reported result.
J- Analyte was positively identified. The reported result is an estimate.
UJ- Analyte was not detected above the reported estimate.
(a) - Unable to collect grab samples during the composite event period. Grab samples collected during event on 5/25/10.

Table 2.7.2. Base Flow Analytical Summary – Commercial Site (C1)

		BF-01		BF-02		BF-03		BF-04	
		C1		C1		C1		C1	
Analyte	Result Units	02/18/2010		04/22/2010		07/20/2010		09/13/2010	
Time-proportional composite - automatic									
Nutrients									
Nitrate + Nitrite	mg-N/L	3		2.26		1.89		0.812	
Nitrogen, Total Kjeldahl	mg-N/L	0.67		1.03		1.27		0.68	
Phosphorus, Total	mg-P/L	0.156		0.118		0.254		0.18	
Ortho-phosphate	mg-P/L	0.105		0.062		0.112		0.118	
Semivolatile Organics									
bis(2-Ethylhexyl)phthalate	ug/L	1	U	1	U	1.2	U	1	U
Butylbenzylphthalate	ug/L	1	U	1	U	1	U	1	U
Diethylphthalate	ug/L	1	U	1	U	1	U	1	U
Dimethylphthalate	ug/L	1	U	1	U	1	U	1	U
Di-n-Butylphthalate	ug/L	1	U	1	U	1	U	1	U
Di-n-Octyl phthalate	ug/L	1	U	1	U	1	U	1	U
1-Methylnaphthalene	ug/L	0.1	U	0.1	U	0.1	U	0.1	U
2-Methylnaphthalene	ug/L	0.1	U	0.1	U	0.1	U	0.1	U
Acenaphthene	ug/L	0.1	U	0.1	U	0.1	U	0.1	U
Acenaphthylene	ug/L	0.1	U	0.1	U	0.1	U	0.1	U
Anthracene	ug/L	0.1	U	0.1	U	0.1	U	0.1	U
Benzo(a)anthracene	ug/L	0.1	U	0.1	U	0.1	U	0.1	U
Benzo(a)pyrene	ug/L	0.1	U	0.1	U	0.1	U	0.1	U
Benzo(g,h,i)perylene	ug/L	0.1	U	0.1	U	0.1	U	0.1	U
Chlorpyrifos	ug/L	0.2	U	0.2	U	0.2	U	0.2	U
Chrysene	ug/L	0.1	U	0.1	U	0.1	U	0.1	U
Diazinon	ug/L	0.2	U	0.2	U	0.2	U	0.2	U
Dibenz(a,h)anthracene	ug/L	0.1	U	0.1	U	0.1	U	0.1	U
Dibenzofuran	ug/L	0.1	U	0.1	U	0.1	U	0.1	U
Dichlobenil	ug/L	0.12	UJ	0.12	UJ	0.024	U	0.024	U
Fluoranthene	ug/L	0.1	U	0.1	U	0.1	U	0.1	U
Fluorene	ug/L	0.1	U	0.1	U	0.1	U	0.1	U
Indeno(1,2,3-cd)pyrene	ug/L	0.1	U	0.1	U	0.1	U	0.1	U
Malathion	ug/L	0.2	U	0.2	U	0.2	U	0.2	U
Naphthalene	ug/L	0.1	U	0.1	U	0.1	U	0.1	U
Pentachlorophenol	ug/L	0.5	U	0.5	U	0.5	U	0.5	U
Phenanthrene	ug/L	0.1	U	0.1	U	0.1	U	0.1	U

		BF-01		BF-02		BF-03		BF-04	
		C1		C1		C1		C1	
Analyte	Result Units	02/18/2010		04/22/2010		07/20/2010		09/13/2010	
Prometon	ug/L	0.12	U	0.12	U	0.024	U	0.024	U
Pyrene	ug/L	0.1	U	0.1	U	0.1	U	0.1	U
Metals									
Cadmium, Total	ug/L	1	U	0.2	U	0.5		0.2	U
Cadmium, Dissolved	ug/L	0.2	U	0.2	U	0.3		0.2	U
Copper, Total	ug/L	8.8		23		30.7		9.5	
Copper, Dissolved	ug/L	7.8		17.2		15		7.5	
Lead, Total	ug/L	5	U	2		6		1	
Lead, Dissolved	ug/L	1	U	1	U	1	U	1	U
Mercury, Total	ug/L	0.02	U	0.02	U	0.02	U	0.02	U
Mercury, Dissolved	ug/L	0.02	U	0.02	U	0.02	U	0.02	U
Zinc, Total	ug/L	35		67		103		26	
Zinc, Dissolved	ug/L	32		60		57		19	
Hardness	mg/L CaCO3	140		130		140		64	
Miscellaneous Organics									
2,4-D	ug/L	1	U	1	U	1	U	1	U
MCPP	ug/L	250	U	250	U	250	U	250	U
Triclopyr	ug/L	0.08	U	0.08	UJ	0.08	UJ	0.08	UJ
Conventionals									
Conductivity	umho/cm	343		340		337		176	
pH	std units	7.93		8.05		7.81		7.79	
Solids, Total Suspended	mg/L	2.6		10		15.9		2.2	
Turbidity	NTU	1		5.5		13.4		2.5	
Chloride	mg/L	13.9		14.7		11.8		7.2	
Biological Oxygen Demand	mg/L	1.3		1.4		2.5		1.1	U
Surfactants	mg/L	0.23		0.05	U	0.025	U	0.025	U
Grab - manual									
Petroleum Hydrocarbons									
Diesel Range Hydrocarbons	mg/L	0.25	U	0.25	U	0.2		0.1	U
Gas. Range Hydrocarbons	mg/L	0.25	U	0.25	U	0.25	U	0.25	U
Bacteria									
Fecal Coliform	CFU/100 mL	920		383		132		6	

Notes:
U - Analyte was not detected above the reported result.
J- Analyte was positively identified. The reported result is an estimate.
UJ- Analyte was not detected above the reported estimate.

Table 2.7.3. Sediment Analytical Summary (all sites)

Analyte	Result Units	C1 09/30/2010		I1 09/30/2010		R1 09/30/2010	
Semivolatile Organics							
Chlorpyrifos	ug/kg	240	U	240	U	240	U
2,4,5-Trichlorophenol	ug/kg	2000	U	1400	U	1100	U
Chrysene	ug/kg	1200		800		880	
2,4,6-Trichlorophenol	ug/kg	2000	U	1400	U	1100	U
Diazinon	ug/kg	240	U	240	U	240	U
2,4-Dichlorophenol	ug/kg	2000	U	1400	U	1100	U
Dibenz(a,h)anthracene	ug/kg	160	J	74	J	140	J
2,4-Dimethylphenol	ug/kg	410	J	280	J	230	UJ
Dibenzofuran	ug/kg	56	U	41	J	51	
2,4-Dinitrophenol	ug/kg	4100	UJ	2800	UJ	2300	UJ
Fluoranthene	ug/kg	2400		1600		2000	
2-Chlorophenol	ug/kg	410	U	280	U	230	U
Fluorene	ug/kg	110		81		70	
2-Methylphenol	ug/kg	410	U	280	U	230	U
Indeno(1,2,3-cd)pyrene	ug/kg	370		280		310	
2-Nitrophenol	ug/kg	410	U	280	U	230	U
Malathion	ug/kg	240	U	240	U	240	U
4,6-Dinitro-2-methylphenol	ug/kg	4100	UJ	2800	UJ	2300	UJ
Naphthalene	ug/kg	61		56	J	32	
Phenanthrene	ug/kg	1200		660		1000	
4-Chloro-3-methylphenol	ug/kg	2000	U	1400	U	1100	U
Pyrene	ug/kg	1800		1600		1400	
4-Methylphenol	ug/kg	410	UJ	280	UJ	5200	J
4-Nitrophenol	ug/kg	2000	U	1400	U	1100	U
bis(2-Ethylhexyl)phthalate	ug/kg	21000		15000		3400	
Butylbenzylphthalate	ug/kg	570		460		230	U
Diethylphthalate	ug/kg	410	U	280	U	230	U
Dimethylphthalate	ug/kg	410	U	280	UJ	230	U
Di-n-butylphthalate	ug/kg	410	U	280		230	U
Di-n-Octyl phthalate	ug/kg	410	U	280	U	230	U
Pentachlorophenol	ug/kg	2000	U	1400	U	1100	U
Phenol	ug/kg	410	U	280	U	830	
1-Methylnaphthalene	ug/kg	56	U	52	J	32	U
2-Methylnaphthalene	ug/kg	78		74		32	

		C1		I1		R1	
Analyte	Result Units	09/30/2010		09/30/2010		09/30/2010	
Acenaphthene	ug/kg	61		56	J	60	
Acenaphthylene	ug/kg	56	U	37	U	32	U
Anthracene	ug/kg	160		100		110	
Benzo(a)anthracene	ug/kg	640		420		540	
Benzo(a)pyrene	ug/kg	1100		710		680	
Benzo(g,h,i)perylene	ug/kg	470		380		300	
Pesticides and Aroclors							
Aroclor 1016	ug/kg	33	U	32	U	NR	
Aroclor 1242	ug/kg	33	U	32	U	NR	
Aroclor 1248	ug/kg	66	U	32	U	NR	
Aroclor 1254	ug/kg	140		65		NR	
Aroclor 1260	ug/kg	81		60		NR	
Aroclor 1221	ug/kg	33	U	32	U	NR	
Aroclor 1232	ug/kg	33	U	32	U	NR	
Metals							
Cadmium, Total	mg/kg	1.3		1.2		0.9	
Copper, Total	mg/kg	168		125		55	
Lead, Total	mg/kg	128		81		136	
Mercury, Total	mg/kg	0.14		0.14			
Zinc, Total	mg/kg	730		850		207	
Conventionals							
Solids, Total	%	38.9		41.2		45.9	
Total Organic Carbon	%	13		8.35		14.5	
Misc.							
Gravel	%	NM		13.2		13.1	
Very Coarse Sand	%	NM		7.1		15.5	
Coarse Sand	%	NM		6.5		18.4	
Fine Sand	%	NM		3.8		13.4	
Medium Sand	%	NM		4.8		19.6	
Very Fine Sand	%	NM		4.7		8.5	
Coarse Silt	%	NM		8.2	J	1.1	J
Medium Silt	%	NM		15.6	J	3.8	J
Fine Silt	%	NM		16.9		2.7	
Very Fine Silt	%	NM		10.2		2	
9-10 Phi Clay	%	NM		2.6		0.6	
8-9 Phi Clay	%	NM		4.2		1	

		C1	I1	R1
Analyte	Result Units	09/30/2010	09/30/2010	09/30/2010
>10 Phi Clay	%	NM	2.3	0.3
Total Fines	%	NM	59.9 J	11.5 J

Notes-

U - Analyte was not detected above the reported result.

J- Analyte was positively identified. The reported result is an estimate.

UJ- Analyte was not detected above the reported estimate.

NM - not measured. Insufficient sediment to perform analysis.

NR - not required to be analyzed.

The Permit allows that if insufficient sediment volume is available for grain size analysis per the Ecology sieve and pipette method (ASTM 1997) or PSEP 1986/2003 method, then the grain size can be characterized qualitatively. Following is the qualitative soil classification performed for sediment from monitoring station C1 by ARI per ASTM method D2488/D4427:

C1: ***"Peat with some Organic Sand*** **–** The sample consisted of about 60% organic material. Approximately 30% of the sample consisted of fibrous organic sand. The remaining 10% of the sample consisted of inorganic sand."

2.8 Stormwater Sample Statistics

Summary statistics for stormwater sample data from WY2010 for each of the three monitoring locations are displayed in Tables 2.8a-c. The substitution factor for non-detects is 0.5 the reporting limit.

2.9 Annual Load Estimation Results

As discussed previously, the City will estimate annual load using three non-detect substitution methods. Each non-detect value will be substituted with 0.0, 0.5 and 1.0 times the RL.

If an analyte contained no non-detectable results throughout the entire data set at each monitoring site, then the substitution factor is not applicable which means the estimated load will be the same using each of the three substitution methods. If an analyte was non-detect across the entire period's data set, no load will be calculated for that analyte since the load would be based entirely on a theoretical presence of an analyte based on an arbitrary substitution. Thus, the non-detect substitution only applies to analytes which contain a mix of detects and non-detects.

No load is estimated for fecal coliform, hardness, conductivity, pH or turbidity since these analytes are not reported as concentration per volume so these values cannot be converted into pounds per acre.

Table 2.8a. Summary Statistics – Residential Site (R1) Stormwater

Analyte	Units	n	# D	Min	Avg	Max	Std Dev	Var	5th Pctile	25th Pctile	Med	75th Pctile	95th Pctile
Petroleum Hydrocarbons													
TPH-D	mg/L	12	10	0.125	0.33	0.61	0.14	0.02	0.125	0.2825	0.305	0.388	0.544
TPH-G	mg/L	12	0	0.125	0.13	0.125	0.00	0.00	0.125	0.125	0.125	0.125	0.125
Motor Oil	mg/L	12	9	0.25	0.76	1.4	0.38	0.15	0.25	0.55	0.71	1.025	1.29
Bacteria													
Fecal Coliform	CFU/ 100 mL	12	12	8	898(a)	35300	1.08E+04	1.E+08	27.25	430	830	6325	26610
Nutrients													
Nitrate + Nitrite	mg-N/L	11	11	0.071	0.29	0.721	0.20	0.04	0.10	0.14	0.227	0.421	0.599
TKN	mg-N/L	11	11	0.58	1.29	2.74	0.74	0.55	0.59	0.815	1	1.675	2.545
Orthophosphate	mg-P/L	11	11	0.006	0.02	0.15	0.04	0.00	0.007	0.008	0.012	0.016	0.089
Phosphorus, Total	mg-P/L	11	11	0.052	0.23	0.632	0.16	0.03	0.078	0.129	0.178	0.264	0.511
Semivolatile Organics													
1-Methylnaphthalene	ug/L	11	0	0.05	0.05	0.1	0.02	0.00	0.05	0.05	0.05	0.05	0.075
2-Methylnaphthalene	ug/L	11	0	0.05	0.05	0.1	0.02	0.00	0.05	0.05	0.05	0.05	0.075
Acenaphthene	ug/L	11	0	0.05	0.05	0.1	0.02	0.00	0.05	0.05	0.05	0.05	0.075
Acenaphthylene	ug/L	11	0	0.05	0.05	0.1	0.02	0.00	0.05	0.05	0.05	0.05	0.075
Anthracene	ug/L	11	0	0.05	0.05	0.1	0.02	0.00	0.05	0.05	0.05	0.05	0.075
Benzo(a)anthracene	ug/L	11	1	0.05	0.06	0.12	0.02	0.00	0.05	0.05	0.05	0.05	0.11
Benzo(a)pyrene	ug/L	11	0	0.05	0.05	0.1	0.02	0.00	0.05	0.05	0.05	0.05	0.075
Benzo(g,h,i)perylene	ug/L	11	2	0.05	0.07	0.17	0.04	0.00	0.05	0.05	0.05	0.075	0.14
Butylbenzylphthalate	ug/L	11	0	0.5	0.59	1.5	0.30	0.09	0.5	0.5	0.5	0.5	1
Chlorpyrifos	ug/L	11	0	0.1	0.10	0.1	0.00	0.00	0.1	0.1	0.1	0.1	0.1
Chrysene	ug/L	11	3	0.05	0.08	0.22	0.05	0.00	0.05	0.05	0.05	0.105	0.17
Di-n-Butylphthalate	ug/L	11	0	0.5	0.59	1.5	0.30	0.09	0.5	0.5	0.5	0.5	1
Di-n-Octyl phthalate	ug/L	11	0	0.5	0.59	1.5	0.30	0.09	0.5	0.5	0.5	0.5	1
Diazinon	ug/L	11	0	0.1	0.10	0.1	0.00	0.00	0.1	0.1	0.1	0.1	0.1
Dibenz(a,h)anthracene	ug/L	11	0	0.05	0.05	0.1	0.02	0.00	0.05	0.05	0.05	0.05	0.075
Dibenzofuran	ug/L	11	0	0.05	0.05	0.1	0.02	0.00	0.05	0.05	0.05	0.05	0.075
Dichlobenil	ug/L	11	2	0.012	0.10	0.33	0.11	0.01	0.019	0.06	0.06	0.075	0.315
Diethylphthalate	ug/L	11	0	0.5	0.59	1.5	0.30	0.09	0.5	0.5	0.5	0.5	1
Dimethylphthalate	ug/L	11	0	0.5	0.59	1.5	0.30	0.09	0.5	0.5	0.5	0.5	1
Fluoranthene	ug/L	11	3	0.05	0.09	0.29	0.07	0.01	0.05	0.05	0.05	0.105	0.22
Fluorene	ug/L	11	0	0.05	0.05	0.1	0.02	0.00	0.05	0.05	0.05	0.05	0.075
Indeno(1,2,3-cd)pyrene	ug/L	11	1	0.05	0.06	0.11	0.02	0.00	0.05	0.05	0.05	0.05	0.105

Analyte	Units	n	# D	Min	Avg	Max	Std Dev	Var	5th Pctile	25th Pctile	Med	75th Pctile	95th Pctile
Malathion	ug/L	11	0	0.1	0.10	0.1	0.00	0.00	0.1	0.1	0.1	0.1	0.1
Naphthalene	ug/L	11	0	0.05	0.05	0.1	0.02	0.00	0.05	0.05	0.05	0.05	0.075
Pentachlorophenol	ug/L	11	0	0.25	0.27	0.5	0.08	0.01	0.25	0.25	0.25	0.25	0.375
Phenanthrene	ug/L	11	1	0.05	0.06	0.11	0.02	0.00	0.05	0.05	0.05	0.05	0.105
Prometon	ug/L	11	2	0.024	0.10	0.3	0.09	0.01	0.042	0.06	0.06	0.075	0.28
Pyrene	ug/L	11	4	0.05	0.10	0.28	0.08	0.01	0.05	0.05	0.05	0.12	0.245
bis(2-Ethylhexyl) phthalate	ug/L	11	2	0.5	2.05	8.5	2.77	7.68	0.5	0.5	0.95	1.3	7.55
Metals													
Cadmium, Dissolved	ug/L	11	0	0.1	0.10	0.1	0.00	0.00	0.1	0.1	0.1	0.1	0.1
Cadmium, Total	ug/L	11	2	0.1	0.14	0.4	0.09	0.01	0.1	0.1	0.1	0.1	0.3
Copper, Dissolved	ug/L	11	11	1.8	5.46	16	4.13	17.06	2.05	2.7	4.2	7.3	12
Copper, Total	ug/L	11	11	8	15.73	33.3	7.65	58.46	8	9.75	14.8	19.3	27.85
Hardness	mg/L CaCO3	11	11	12	18.27	28	4.78	22.82	12	15.5	18	20.5	25.5
Lead, Dissolved	ug/L	11	1	0.5	0.64	2	0.45	0.20	0.5	0.5	0.5	0.5	1.25
Lead, Total	ug/L	11	11	3	19.00	56	14.55	211.8	5	10.5	16	23	43
Zinc, Dissolved	ug/L	11	11	9	14.91	26	6.43	41.29	9.5	11	11	18.5	26
Zinc, Total	ug/L	11	11	26	52.00	114	23.39	547.20	28	42	49	55.5	88.5
Misc. Organics													
2,4-D	ug/L	11	1	0.5	0.64	2	0.45	0.20	0.5	0.5	0.5	0.5	1.25
MCPP	ug/L	11	0	125	125	125	0.00	0.00	125	125	125	125	125
Triclopyr	ug/L	11	0	0.04	0.04	0.04	0.00	0.00	0.04	0.04	0.04	0.04	0.04
Conventionals													
BOD	mg/L	11	11	1.8	4.93	12.3	3.35	11.24	1.9	2.8	3.9	6.35	10.45
Chloride	mg/L	11	11	0.7	1.89	3.8	1.02	1.04	0.75	1.05	1.8	2.45	3.55
Conductivity	umho/ cm	11	11	20.1	40.3	70.5	15.09	227.7	23.3	32.1	37.2	46.35	66
Solids, Total Suspended	mg/L	11	11	6.2	69.17	288	75.93	5766	16	33.55	50.9	72.4	184.1
Surfactants	mg/L	11	3	0.0125	0.04	0.15	0.04	0.00	0.019	0.025	0.025	0.0255	0.11
Turbidity	NTU	11	11	9.7	48.88	158	40.58	1646.4	15.85	31	38	44	121
pH	std units	11	11	6.12	NA	7.61	0.42	0.17	6.28	6.825	6.92	7.24	7.46

Notes: n – sample number, #D – number detected, min – minimum, avg – average, max – maximum, std dev – standard deviation, var – variance. pctile –percentile, med –median, (a) – geometric mean presented instead of average for bacteria data, NA – not applicable

Table 2.8b. Summary Statistics – Commercial Site (C1) Stormwater

Analyte	Units	n	# D	Min	Avg	Max	Std Dev	Var	5th Pctile	25th Pctile	Med	75th Pctile	95th Pctile
Petroleum Hydrocarbons													
TPH-D	mg/L	11	11	0.45	1.05	2.4	0.52	0.266	0.49	0.83	0.99	1.1	1.85
TPH-G	mg/L	11	0	0.125	0.13	0.125	0.00	0.000	0.13	0.125	0.125	0.125	0.125
Motor Oil	mg/L	11	11	0.73	2.64	5.8	1.39	1.943	1.07	1.7	2.5	3.35	4.6
Bacteria													
Fecal Coliform	CFU/ 100 mL	11	10	0.5	1608 (a)	22800	1.1E+ 04	7.E+07	500	1160	2000	5630	22750
Nutrients													
Nitrate + Nitrite	mg-N/L	11	11	0.211	0.43	0.71	0.19	0.037	0.22	0.271	0.39	0.613	0.69
TKN	mg-N/L	11	11	1.02	1.78	2.79	0.66	0.437	1.07	1.185	1.69	2.265	2.75
Orthophosphate	mg-P/L	11	10	0.002	0.04	0.13	0.04	0.001	0.01	0.018	0.039	0.058	0.10
Phosphorus, Total	mg-P/L	11	11	0.16	0.24	0.428	0.08	0.007	0.17	0.179	0.216	0.299	0.37
Semivolatile Organics													
1-Methylnaphthalene	ug/L	12	0	0.05	0.05	0.1	0.01	0.000	0.05	0.05	0.05	0.05	0.0725
2-Methylnaphthalene	ug/L	12	0	0.05	0.05	0.1	0.01	0.000	0.05	0.05	0.05	0.05	0.0725
Acenaphthene	ug/L	12	0	0.05	0.05	0.1	0.01	0.000	0.05	0.05	0.05	0.05	0.0725
Acenaphthylene	ug/L	12	0	0.05	0.05	0.1	0.01	0.000	0.05	0.05	0.05	0.05	0.0725
Anthracene	ug/L	12	0	0.05	0.05	0.1	0.01	0.000	0.05	0.05	0.05	0.05	0.0725
Benzo(a)anthracene	ug/L	12	0	0.05	0.05	0.1	0.01	0.000	0.05	0.05	0.05	0.05	0.0725
Benzo(a)pyrene	ug/L	12	0	0.05	0.05	0.1	0.01	0.000	0.05	0.05	0.05	0.05	0.0725
Benzo(g,h,i)perylene	ug/L	12	7	0.05	0.10	0.16	0.04	0.002	0.05	0.05	0.11	0.13	0.1435
Butylbenzylphthalate	ug/L	12	0	0.5	0.54	1	0.14	0.021	0.5	0.5	0.5	0.5	0.725
Chlorpyrifos	ug/L	12	0	0.1	0.10	0.1	0.00	0.000	0.1	0.1	0.1	0.1	0.1
Chrysene	ug/L	12	5	0.05	0.09	0.17	0.05	0.002	0.05	0.05	0.075	0.135	0.1645
Di-n-Butylphthalate	ug/L	12	0	0.5	0.54	1	0.14	0.021	0.5	0.5	0.5	0.5	0.725
Di-n-Octyl phthalate	ug/L	12	0	0.5	0.54	1	0.14	0.021	0.5	0.5	0.5	0.5	0.725
Diazinon	ug/L	12	0	0.1	0.10	0.1	0.00	0.000	0.1	0.1	0.1	0.1	0.1
Dibenz(a,h)anthracene	ug/L	12	0	0.05	0.05	0.1	0.01	0.000	0.05	0.05	0.05	0.05	0.0725
Dibenzofuran	ug/L	12	0	0.05	0.05	0.1	0.01	0.000	0.05	0.05	0.05	0.05	0.0725
Dichlobenil	ug/L	12	0	0.012	0.07	0.3	0.08	0.006	0.012	0.048	0.06	0.075	0.1763
Diethylphthalate	ug/L	12	4	0.5	0.97	3.7	0.91	0.830	0.5	0.5	0.5	1.025	2.38
Dimethylphthalate	ug/L	12	0	0.5	0.54	1	0.14	0.021	0.5	0.5	0.5	0.5	0.725
Fluoranthene	ug/L	12	7	0.05	0.13	0.22	0.07	0.005	0.05	0.05	0.135	0.193	0.2145
Fluorene	ug/L	12	0	0.05	0.05	0.1	0.01	0.000	0.05	0.05	0.05	0.05	0.0725
Indeno(1,2,3-cd)pyrene	ug/L	12	0	0.05	0.05	0.1	0.01	0.000	0.05	0.05	0.05	0.05	0.0725

Analyte	Units	n	# D	Min	Avg	Max	Std Dev	Var	5th Pctile	25th Pctile	Med	75th Pctile	95th Pctile
Malathion	ug/L	12	0	0.1	0.10	0.1	0.00	0.000	0.1	0.1	0.1	0.1	0.1
Naphthalene	ug/L	12	0	0.05	0.05	0.1	0.01	0.000	0.05	0.05	0.05	0.05	0.0725
Pentachlorophenol	ug/L	12	0	0.25	0.27	0.5	0.07	0.005	0.25	0.25	0.25	0.25	0.3625
Phenanthrene	ug/L	12	5	0.05	0.09	0.16	0.04	0.002	0.05	0.05	0.075	0.113	0.138
Prometon	ug/L	12	0	0.012	0.07	0.3	0.08	0.006	0.012	0.048	0.06	0.075	0.1763
Pyrene	ug/L	12	8	0.05	0.16	0.32	0.09	0.009	0.05	0.088	0.135	0.233	0.287
bis(2-Ethylhexyl) phthalate	ug/L	12	4	0.5	3.05	7.2	2.40	5.773	0.75	1.64	1.9	4.4	7.09
Metals													
Cadmium, Dissolved	ug/L	12	0	0.1	0.10	0.1	0.00	0.000	0.1	0.1	0.1	0.1	0.1
Cadmium, Total	ug/L	12	6	0.1	0.18	0.4	0.10	0.009	0.1	0.1	0.15	0.2	0.345
Copper, Dissolved	ug/L	12	12	7.4	20.73	47.3	11.53	133.0	8.39	11.975	18.15	26.65	39.16
Copper, Total	ug/L	12	12	22.6	50.52	80.7	18.85	355.4	25.8	32.75	52.6	63.25	76.245
Hardness	mg/L CaCO3	12	12	21	37.25	69	13.34	178.0	23.2	27	34.5	44	57.45
Lead, Dissolved	ug/L	12	7	0.5	1.04	3	0.75	0.566	0.5	0.5	1	1	2.45
Lead, Total	ug/L	12	12	6	13.17	19	4.69	21.97	7.1	9.75	12	18.25	19
Mercury, Dissolved	ug/L	12	0	0.01	0.01	0.01	0.00	0.000	0.01	0.01	0.01	0.01	0.01
Mercury, Total	ug/L	12	5	0.010	0.02	0.048	0.01	0.000	0.01	0.01	0.01	0.024	0.0361
Zinc, Dissolved	ug/L	12	12	31	57.08	130	27.95	781.4	32.1	36.5	52.5	62	106.35
Zinc, Total	ug/L	12	12	78	128.0	221	41.39	1712.7	81.3	96.5	122.5	154.3	192.95
Misc. Organics													
2,4-D	ug/L	12	0	0.5	0.50	0.5	0.00	0.000	0.5	0.5	0.5	0.5	0.5
MCPP	ug/L	12	0	125	125	125	0.00	0.000	125	125	125	125	125
Triclopyr	ug/L	12	0	0.04	0.04	0.04	0.00	0.000	0.04	0.04	0.04	0.04	0.04
Conventionals													
BOD	mg/L	11	11	4.6	13.41	29.7	7.74	60.0	5.45	8.95	10.8	15.2	27.4
Chloride	mg/L	12	12	2	7.52	31.4	7.88	62.1	2.55	3.5	5.45	8.275	19.025
Conductivity	umho / cm	11	11	55.4	103.1	177	35.74	1277.5	57.2	81.65	96	123.5	153.5
Solids, Total Suspended	mg/L	12	12	23.1	45.18	74	15.72	247.0	24.9	34.98	44.25	50.2	72.9
Surfactants	mg/L	12	7	0.025	0.09	0.37	0.10	0.010	0.03	0.025	0.056	0.1225	0.249
Turbidity	NTU	11	11	15.3	29.05	54	12.82	164.2	15.8	18.95	30	33	51
pH	std units	11	11	6.65	NA	7.35	0.23	0.051	6.77	6.945	7.05	7.305	7.345

Notes: n – sample number, # D– number detected, min – minimum, avg – average, max – maximum, std dev – standard deviation, var – variance. pctile –percentile, med – median, (a) – geometric mean presented instead of average for bacteria data, NA – not applicable

Table 2.8c. Summary Statistics – Industrial Site (I1) Stormwater

Analyte	Units	n	# D	Min	Avg	Max	Std Dev	Var	5th Pctile	25th Pctile	Med	75th Pctile	95th Pctile
Petroleum Hydrocarbons													
TPH-D	mg/L	11	11	0.33	0.75	1.2	0.28	0.077	0.37	0.535	0.79	0.975	1.1
TPH-G	mg/L	11	1	0.125	0.15	0.37	0.07	0.005	0.125	0.125	0.125	0.125	0.2475
Motor Oil	mg/L	11	11	0.98	1.79	3.3	0.86	0.740	1.04	1.1	1.4	2.25	3.25
Bacteria													
Fecal Coliform	CFU/ 100 mL	11	11	372	1285 (a)	91900	1.08 E+04	8.E+08	406	584	762	1510	47550
Nutrients													
Nitrate + Nitrite	mg-N/L	11	11	0.19	0.30	0.543	0.10	0.011	0.196	0.246	0.258	0.349	0.468
TKN	mg-N/L	11	10	0.15	1.41	3	0.80	0.637	0.505	1.03	1.23	1.5	2.825
Orthophosphate	mg-P/L	11	11	0.01	0.06	0.121	0.03	0.001	0.012	0.036	0.065	0.069	0.097
Phosphorus, Total	mg-P/L	11	11	0.11	0.31	0.972	0.24	0.055	0.114	0.205	0.246	0.335	0.669
Semivolatile Organics													
1-Methylnaphthalene	ug/L	11	1	0.05	0.07	0.17	0.04	0.001	0.05	0.05	0.05	0.05	0.135
2-Methylnaphthalene	ug/L	11	1	0.05	0.07	0.23	0.05	0.003	0.05	0.05	0.05	0.05	0.165
Acenaphthene	ug/L	11	0	0.05	0.05	0.1	0.02	0.000	0.05	0.05	0.05	0.05	0.075
Acenaphthylene	ug/L	11	0	0.05	0.05	0.1	0.02	0.000	0.05	0.05	0.05	0.05	0.075
Anthracene	ug/L	11	0	0.05	0.05	0.1	0.02	0.000	0.05	0.05	0.05	0.05	0.075
Benzo(a)anthracene	ug/L	11	1	0.05	0.07	0.3	0.08	0.006	0.05	0.05	0.05	0.05	0.175
Benzo(a)pyrene	ug/L	11	2	0.05	0.08	0.36	0.09	0.009	0.05	0.05	0.05	0.05	0.235
Benzo(g,h,i)perylene	ug/L	11	4	0.05	0.10	0.36	0.09	0.009	0.05	0.05	0.05	0.115	0.24
Butylbenzylphthalate	ug/L	11	0	0.5	0.59	1	0.20	0.041	0.5	0.5	0.5	0.5	1
Chlorpyrifos	ug/L	11	0	0.1	0.10	0.1	0.00	0.000	0.1	0.1	0.1	0.1	0.1
Chrysene	ug/L	11	4	0.05	0.10	0.44	0.12	0.013	0.05	0.05	0.05	0.11	0.28
Di-n-Butylphthalate	ug/L	11	0	0.5	0.59	1	0.20	0.041	0.5	0.5	0.5	0.5	1
Di-n-Octyl phthalate	ug/L	11	3	0.5	0.94	2.3	0.70	0.493	0.5	0.5	0.5	1.15	2.25
Diazinon	ug/L	11	0	0.1	0.10	0.1	0.00	0.000	0.1	0.1	0.1	0.1	0.1
Dibenz(a,h)anthracen	ug/L	11	0	0.05	0.05	0.1	0.02	0.000	0.05	0.05	0.05	0.05	0.075
Dibenzofuran	ug/L	11	0	0.05	0.05	0.1	0.02	0.000	0.05	0.05	0.05	0.05	0.075
Dichlobenil	ug/L	11	1	0.02	0.08	0.3	0.08	0.006	0.018	0.06	0.06	0.0675	0.1875
Diethylphthalate	ug/L	11	3	0.5	1.52	8.9	2.50	6.246	0.5	0.5	0.5	1.1	5.5
Dimethylphthalate	ug/L	11	0	0.5	0.59	1	0.20	0.041	0.5	0.5	0.5	0.5	1
Fluoranthene	ug/L	11	5	0.05	0.15	0.6	0.17	0.028	0.05	0.05	0.05	0.18	0.425
Fluorene	ug/L	11	0	0.05	0.05	0.1	0.02	0.000	0.05	0.05	0.05	0.05	0.075
Indeno(1,2,3-cd)pyrene	ug/L	11	2	0.05	0.08	0.28	0.07	0.005	0.05	0.05	0.05	0.05	0.19
Malathion	ug/L	11	0	0.1	0.10	0.1	0.00	0.000	0.1	0.1	0.1	0.1	0.1

Analyte	Units	n	# D	Min	Avg	Max	Std Dev	Var	5th Pctile	25th Pctile	Med	75th Pctile	95th Pctile
Naphthalene	ug/L	11	1	0.05	0.06	0.11	0.02	0.001	0.05	0.05	0.05	0.05	0.105
Pentachlorophenol	ug/L	11	0	0.25	0.27	0.5	0.08	0.006	0.25	0.25	0.25	0.25	0.375
Phenanthrene	ug/L	11	5	0.05	0.10	0.32	0.08	0.007	0.05	0.05	0.05	0.125	0.23
Prometon	ug/L	11	0	0.012	0.08	0.3	0.08	0.006	0.012	0.06	0.06	0.0675	0.1875
Pyrene	ug/L	11	8	0.05	0.20	0.74	0.21	0.043	0.05	0.075	0.14	0.205	0.58
bis(2-Ethylhexyl) phthalate	ug/L	11	1	0.7	1.69	5.3	1.30	1.678	0.75	0.925	1.3	1.825	3.75
Metals													
Cadmium, Dissolved	ug/L	11	0	0.1	0.10	0.1	0.00	0.000	0.1	0.1	0.1	0.1	0.1
Cadmium, Total	ug/L	11	6	0.1	0.21	0.6	0.15	0.023	0.1	0.1	0.2	0.25	0.45
Copper, Dissolved	ug/L	11	11	2	6.67	19.2	4.67	21.8	3.15	4.4	4.6	6.65	14.8
Copper, Total	ug/L	11	11	11.4	25.9	64.3	15.5	240.1	12.35	14.5	24.6	30.3	51.25
Hardness	mg/L CaCO3	11	11	48	69.4	92	14.1	197.7	50.5	58.5	69	79.5	88.5
Lead, Dissolved	ug/L	11	1	0.5	0.64	2	0.45	0.205	0.5	0.5	0.5	0.5	1.25
Lead, Total	ug/L	11	11	2	11.3	43	11.0	121.2	3	6.5	9	10.5	28
Mercury, Dissolved	ug/L	11	0	0.01	0.01	0.01	0.00	0.000	0.01	0.01	0.01	0.01	0.01
Mercury, Total	ug/L	11	1	0.01	0.01	0.047	0.01	0.000	0.01	0.01	0.01	0.01	0.029
Zinc, Dissolved	ug/L	11	11	12	54.7	125	30.5	927.6	16	44.5	47	65.5	102
Zinc, Total	ug/L	11	11	82	164	420	92.3	8517.1	92.5	117	135	173.5	314
Misc. Organics													
2,4-D	ug/L	11	0	0.5	0.50	0.5	0.00	0.000	0.5	0.5	0.5	0.5	0.5
MCPP	ug/L	11	0	125	125	125	0.00	0.000	125	125	125	125	125
Triclopyr	ug/L	11	0	0.04	0.04	0.04	0.00	0.000	0.04	0.04	0.04	0.04	0.04
Conventionals													
BOD	mg/L	11	11	2.9	10.0	27.2	7.19	51.7	2.9	4.65	8.1	12.9	21.65
Chloride	mg/L	11	11	1.8	4.30	13.8	3.40	11.6	2	2.7	3.1	4.25	10.05
Conductivity	umho/cm	11	11	96.8	150	194	27.5	755.2	106.9	141.5	146	169.5	182.5
Solids, Total Suspended	mg/L	11	11	16	94.2	398	105	11050.0	26.85	45.95	69	90	259
Surfactants	mg/L	11	5	0.03	0.08	0.23	0.08	0.007	0.025	0.025	0.025	0.13	0.23
Turbidity	NTU	11	11	16.9	64.0	200	57.8	3337.5	18.95	31	40	74.75	170
pH	std units	11	11	7.18	NA	7.49	0.11	0.012	7.195	7.245	7.28	7.41	7.48

Notes: n – sample number, # D– number detected, min – minimum, avg – average, max – maximum, std dev – standard deviation, var – variance. pctile –percentile, med – median, (a) – geometric mean presented instead of average for bacteria data, NA – not applicable

No load is estimated for fecal coliform, hardness, conductivity, pH or turbidity since these analytes are not reported as concentration per volume so these values cannot be converted into pounds per acre.

The area used for the load calculation for each basin is the area of that basin draining to the municipal separated storm sewer system (MS4) and does not include acreage draining to the combined sewer system.

2.9.1 Residential Site (R1) Load Estimation

The following analytes were not detected in any stormwater from any events at R1 so no load was calculated:

Gasoline Range Hydrocarbons
1-Methylnaphthalene
2-Methylnaphthalene
Acenaphthene
Acenaphthylene
Anthracene
Benzo(a)pyrene
Butylbenzylphthalate
Chlorpyrifos
Di-n-Butylphthalate
Di-n-Octyl phthalate
Diazinon
Dibenz(a,h)anthracene
Dibenzofuran
Diethylphthalate
Dimethylphthalate
Fluorene
Malathion
Naphthalene
Pentachlorophenol
Cadmium, Dissolved
MCPP
Triclopyr

Sormwater loads for detected parameters are presented in Table 2.8.1. No base flow is present at this site.

2.9.2 Commercial Site (C1) Load Estimation

The following analytes were not detected in any stormwater from any events at C1 so no load was calculated:

Gasoline Range Hydrocarbons
1-Methylnaphthalene
2-Methylnaphthalene
Acenaphthene
Acenaphthylene
Anthracene
Benzo(a)anthracene
Benzo(a)pyrene
Butylbenzylphthalate
Chlorpyrifos
Di-n-Butylphthalate
Di-n-Octyl phthalate
Diazinon
Dibenz(a,h)anthracene
Dibenzofuran
Dichlobenil
Dimethylphthalate
Fluorene
Indeno(1,2,3-cd)pyrene
Malathion
Naphthalene
Pentachlorophenol
Prometon
Cadmium, Dissolved
Mercury, Dissolved
2,4-D
MCPP
Triclopyr

Sormwater loads for detected parameters are presented in Table 2.8.2a., which displays loads with the base flow load removed.

The following analytes were not detected in any base flow samples at C1 so no base flow load was calculated:

Gasoline Range Hydrocarbons	Di-n-Butylphthalate	Naphthalene
1-Methylnaphthalene	Di-n-Octyl phthalate	Pentachlorophenol
2-Methylnaphthalene	Diazinon	Phenanthrene
Acenaphthene	Dibenz(a,h)anthracene	Prometon
Acenaphthylene	Dibenzofuran	Pyrene
Anthracene	Dichlobenil	bis(2-Ethylhexyl)phthalate
Benzo(a)anthracene	Diethylphthalate	Lead, Dissolved
Benzo(a)pyrene	Dimethylphthalate	Mercury, Dissolved
Benzo(g,h,i)perylene	Fluoranthene	Mercury, Total
Butylbenzylphthalate	Fluorene	2,4-D
Chlorpyrifos	Indeno(1,2,3-cd)pyrene	MCPP
Chrysene	Malathion	Triclopyr

Base flow loads for C1 are presented in Table 2.8.2b.

Note – for analytes detected in some or all of the stormwater samples from C1 but not detected in some or all of base flow samples, the stormwater loads can decrease as the non-detect substitution factor increases since more base flow load will be removed from the gross load as the non-detect replacement value becomes higher.

2.9.3 Industrial Site (I1) Load Estimation

The following analytes were not detected in any stormwater from any events at I1 so no load was calculated:

Acenaphthene	Dibenz(a,h)anthracene	Cadmium, Dissolved
Acenaphthylene	Dibenzofuran	Mercury, Dissolved
Anthracene	Dimethylphthalate	2,4-D
Butylbenzylphthalate	Fluorene	MCPP
Chlorpyrifos	Malathion	Triclopyr
Di-n-Butylphthalate	Pentachlorophenol	
Diazinon	Prometon	

Stormwater loads for detected parameters are presented in Table 2.8.3. No base flow is present at this site.

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Table 2.9.1. Load Estimation – Residential Site (R1) Stormwater

Analyte Name	Wet Period Storm Load (LB)	Wet Period Storm Load by Area* (LB/acre)	Dry Period Storm Load (LB)	Dry Period Storm Load by Area* (LB/acre)	Annual Storm Load (LB)	Annual Storm Load by Area* (LB/acre)	Wet Period Storm Load (LB)	Wet Period Storm Load by Area* (LB/acre)	Dry Period Storm Load (LB)	Dry Period Storm Load by Area* (LB/acre)	Annual Storm Load (LB)	Annual Storm Load by Area* (LB/acre)	Wet Period Storm Load (LB)	Wet Period Storm Load by Area* (LB/acre)	Dry Period Storm Load (LB)	Dry Period Storm Load by Area* (LB/acre)	Annual Storm Load (LB)	Annual Storm Load by Area* (LB/acre)
Substitution Factor for Non-Detects	**0.0 x Reporting Limit**						**0.5 x Reporting Limit**						**1.0 x Reporting Limit**					
Petroleum Hydrocarbons																		
Diesel Range Hydrocarbons	10.93	0.13	2.04	0.02	12.97	0.15	13.48	0.16	2.04	0.02	15.52	0.18	16.04	0.19	2.04	0.02	18.08	0.21
Gasoline Range Hydrocarbons	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Nutrients																		
Nitrate + Nitrite	8.89	0.10	2.92	0.03	11.81	0.14	8.89	0.10	2.92	0.03	11.81	0.14	8.89	0.10	2.92	0.03	11.81	0.14
Nitrogen, Total Kjeldahl	64.36	0.75	12.25	0.14	76.60	0.90	64.36	0.75	12.25	0.14	76.60	0.90	64.36	0.75	12.25	0.14	76.60	0.90
Orthophosphate	0.55	0.01	0.46	0.01	1.01	0.01	0.55	0.01	0.46	0.01	1.01	0.01	0.55	0.01	0.46	0.01	1.01	0.01
Phosphorus, Total	13.99	0.16	1.67	0.02	15.66	0.18	13.99	0.16	1.67	0.02	15.66	0.18	13.99	0.16	1.67	0.02	15.66	0.18
Semivolatile Organics																		
1-Methylnaphthalene	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
2-Methylnaphthalene	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Acenaphthene	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Acenaphthylene	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Anthracene	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Benzo(a)anthracene	0.00104	0.00001	0.00000	0.00000	0.00104	0.00001	0.00344	0.00004	0.00026	0.00000	0.00370	0.00004	0.00585	0.00007	0.00051	0.00001	0.00636	0.00007
Benzo(a)pyrene	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Benzo(g,h,i)perylene	0.00187	0.00002	0.00000	0.00000	0.00187	0.00002	0.00409	0.00005	0.00026	0.00000	0.00435	0.00005	0.00632	0.00007	0.00051	0.00001	0.00683	0.00008
Butylbenzylphthalate	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Chlorpyrifos	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Chrysene	0.00398	0.00005	0.00000	0.00000	0.00398	0.00005	0.00546	0.00006	0.00026	0.00000	0.00571	0.00007	0.00694	0.00008	0.00051	0.00001	0.00745	0.00009
Di-n-Butylphthalate	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Di-n-Octyl phthalate	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Diazinon	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Dibenz(a,h)anthracene	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Dibenzofuran	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Dichlobenil	0.00286	0.00003	0.00007	0.00000	0.00293	0.00003	0.00706	0.00008	0.00010	0.00000	0.00716	0.00008	0.01127	0.00013	0.00013	0.00000	0.01140	0.00013
Diethylphthalate	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Dimethylphthalate	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Fluoranthene	0.00469	0.00006	0.00000	0.00000	0.00469	0.00006	0.00617	0.00007	0.00026	0.00000	0.00643	0.00008	0.00765	0.00009	0.00051	0.00001	0.00816	0.00010
Fluorene	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND

Analyte Name	Wet Period Storm Load (LB)	Wet Period Storm Load by Area* (LB/acre)	Dry Period Storm Load (LB)	Dry Period Storm Load by Area* (LB/acre)	Annual Storm Load (LB)	Annual Storm Load by Area* (LB/acre)	Wet Period Storm Load (LB)	Wet Period Storm Load by Area* (LB/acre)	Dry Period Storm Load (LB)	Dry Period Storm Load by Area* (LB/acre)	Annual Storm Load (LB)	Annual Storm Load by Area* (LB/acre)	Wet Period Storm Load (LB)	Wet Period Storm Load by Area* (LB/acre)	Dry Period Storm Load (LB)	Dry Period Storm Load by Area* (LB/acre)	Annual Storm Load (LB)	Annual Storm Load by Area* (LB/acre)
Substitution Factor for Non-Detects	**0.0 x Reporting Limit**						**0.5 x Reporting Limit**						**1.0 x Reporting Limit**					
Indeno(1,2,3-cd)pyrene	0.00095	0.00001	0.00000	0.00000	0.00095	0.00001	0.00336	0.00004	0.00026	0.00000	0.00361	0.00004	0.00576	0.00007	0.00051	0.00001	0.00627	0.00007
Malathion	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Naphthalene	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Pentachlorophenol	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Phenanthrene	0.00095	0.00001	0.00000	0.00000	0.00095	0.00001	0.00336	0.00004	0.00026	0.00000	0.00361	0.00004	0.00576	0.00007	0.00051	0.00001	0.00627	0.00007
Prometon	0.00000	0.00000	0.00074	0.00001	0.00074	0.00001	0.00486	0.00006	0.00074	0.00001	0.00560	0.00007	0.00971	0.00011	0.00074	0.00001	0.01045	0.00012
Pyrene	0.00575	0.00007	0.00000	0.00000	0.00575	0.00007	0.00699	0.00008	0.00026	0.00000	0.00724	0.00008	0.00823	0.00010	0.00051	0.00001	0.00874	0.00010
bis(2-Ethylhexyl)phthalate	0.04227	0.00050	0.00000	0.00000	0.04227	0.00050	0.09734	0.00114	0.00257	0.00003	0.09991	0.00117	0.15237	0.00179	0.00514	0.00006	0.15751	0.00185
Metals																		
Cadmium, Dissolved	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Cadmium, Total	0.00347	0.00004	0.00050	0.00001	0.00397	0.00005	0.00815	0.00010	0.00077	0.00001	0.00892	0.00010	0.01284	0.00015	0.00103	0.00001	0.01386	0.00016
Copper, Dissolved	0.15820	0.00185	0.06186	0.00073	0.22006	0.00258	0.15820	0.00185	0.06186	0.00073	0.22006	0.00258	0.15820	0.00185	0.06186	0.00073	0.22006	0.00258
Copper, Total	0.89451	0.01049	0.11009	0.00129	1.00460	0.01178	0.89451	0.01049	0.11009	0.00129	1.00460	0.01178	0.89451	0.01049	0.11009	0.00129	1.00460	0.01178
Lead, Dissolved	0.00000	0.00000	0.00525	0.00006	0.00525	0.00006	0.02775	0.00033	0.00651	0.00008	0.03426	0.00040	0.05550	0.00065	0.00776	0.00009	0.06327	0.00074
Lead, Total	1.25660	0.01473	0.12010	0.00141	1.37670	0.01614	1.25660	0.01473	0.12010	0.00141	1.37670	0.01614	1.25660	0.01473	0.12010	0.00141	1.37670	0.01614
Zinc, Dissolved	0.67151	0.00787	0.09842	0.00115	0.76993	0.00903	0.67151	0.00787	0.09842	0.00115	0.76993	0.00903	0.67151	0.00787	0.09842	0.00115	0.76993	0.00903
Zinc, Total	3.21040	0.03764	0.27453	0.00322	3.48493	0.04086	3.21040	0.03764	0.27453	0.00322	3.48493	0.04086	3.21040	0.03764	0.27453	0.00322	3.48493	0.04086
Miscellaneous Organics																		
2,4-D	ND	ND	0.00525	0.00006	0.00525	0.00006	ND	ND	0.00651	0.00008	0.03426	0.00040	ND	ND	0.00776	0.00009	0.06327	0.00074
MCPP	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Triclopyr	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Conventionals																		
Biological Oxygen Demand	232.71	2.73	43.70	0.51	276.41	3.24	232.71	2.73	43.70	0.51	276.41	3.24	232.71	2.73	43.70	0.51	276.41	3.24
Chloride	90.88	1.07	12.24	0.14	103.11	1.21	90.88	1.07	12.24	0.14	103.11	1.21	90.88	1.07	12.24	0.14	103.11	1.21
Solids, Total Suspended	4980.50	58.39	313.55	3.68	5294.05	62.06	4980.50	58.39	313.55	3.68	5294.05	62.06	4980.50	58.39	313.55	3.68	5294.05	62.06
Surfactants	0.44	0.01	0.07	0.00	0.50	0.01	1.70	0.02	0.10	0.00	1.80	0.02	2.97	0.03	0.13	0.00	3.10	0.04

Notes-
Loads estimated by QAPP method.
ND – Not detected. Analyte not detected in any samples from period so no load calculated.
* - Area used for load calculation is basin area draining to MS4, not total basin area.

Table 2.9.2. Load Estimation – Commercial Site (C1) Stormwater (with Base Flow Removed)

Analyte Name	Wet Period Storm Load (LB)	Wet Period Storm Load by Area* (LB/acre)	Dry Period Storm Load (LB)	Dry Period Storm Load by Area* (LB/acre)	Annual Storm Load (LB)	Annual Storm Load by Area* (LB/acre)	Wet Period Storm Load (LB)	Wet Period Storm Load by Area* (LB/acre)	Dry Period Storm Load (LB)	Dry Period Storm Load by Area* (LB/acre)	Annual Storm Load (LB)	Annual Storm Load by Area* (LB/acre)	Wet Period Storm Load (LB)	Wet Period Storm Load by Area* (LB/acre)	Dry Period Storm Load (LB)	Dry Period Storm Load by Area* (LB/acre)	Annual Storm Load (LB)	Annual Storm Load by Area* (LB/acre)
Substitution Factor for Non-Detects	**0.0 x Reporting Limit**						**0.5 x Reporting Limit**						**1.0 x Reporting Limit**					
Petroleum Hydrocarbons																		
Diesel Range Hydrocarbons	1110.30	7.30	150.85	0.99	1261.15	8.30	1099.30	7.23	149.86	0.99	1249.16	8.22	1088.40	7.16	148.86	0.98	1237.26	8.14
Gasoline Range Hydrocarbons	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Nutrients																		
Nitrate + Nitrite	126.96	0.84	76.66	0.50	203.62	1.34	126.96	0.84	76.66	0.50	203.62	1.34	126.96	0.84	76.66	0.50	203.62	1.34
Nitrogen, Total Kjeldahl	1512.40	9.95	648.62	4.27	2161.02	14.22	1512.40	9.95	648.62	4.27	2161.02	14.22	1512.40	9.95	648.62	4.27	2161.02	14.22
Orthophosphate	23.00	0.15	23.82	0.16	46.82	0.31	23.15	0.15	23.82	0.16	46.97	0.31	23.30	0.15	23.82	0.16	47.12	0.31
Phosphorus, Total	208.61	1.37	92.76	0.61	301.37	1.98	208.61	1.37	92.76	0.61	301.37	1.98	208.61	1.37	92.76	0.61	301.37	1.98
Semivolatile Organics																		
1-Methylnaphthalene	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
2-Methylnaphthalene	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Acenaphthene	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Acenaphthylene	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Anthracene	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Benzo(a)anthracene	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Benzo(a)pyrene	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Benzo(g,h,i)perylene	0.11995	0.00079	0.01886	0.00012	0.13881	0.00091	0.12664	0.00083	0.02111	0.00014	0.14775	0.00097	0.13332	0.00088	0.02335	0.00015	0.15667	0.00103
Butylbenzylphthalate	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Chlorpyrifos	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Chrysene	0.11283	0.00074	0.00000	0.00000	0.11283	0.00074	0.12785	0.00084	0.01082	0.00007	0.13867	0.00091	0.14288	0.00094	0.02164	0.00014	0.16452	0.00108
Di-n-Butylphthalate	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Di-n-Octyl phthalate	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Diazinon	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Dibenz(a,h)anthracene	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Dibenzofuran	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Dichlobenil	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Diethylphthalate	0.53726	0.00353	0.00000	0.00000	0.53726	0.00353	0.88788	0.00584	0.14171	0.00093	1.02959	0.00677	1.23850	0.00815	0.28344	0.00186	1.52194	0.01001
Dimethylphthalate	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Fluoranthene	0.17035	0.00112	0.02400	0.00016	0.19435	0.00128	0.17704	0.00116	0.02624	0.00017	0.20328	0.00134	0.18372	0.00121	0.02849	0.00019	0.21221	0.00140
Fluorene	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND

Analyte Name	Wet Period Storm Load (LB)	Wet Period Storm Load by Area* (LB/acre)	Dry Period Storm Load (LB)	Dry Period Storm Load by Area* (LB/acre)	Annual Storm Load (LB)	Annual Storm Load by Area* (LB/acre)	Wet Period Storm Load (LB)	Wet Period Storm Load by Area* (LB/acre)	Dry Period Storm Load (LB)	Dry Period Storm Load by Area* (LB/acre)	Annual Storm Load (LB)	Annual Storm Load by Area* (LB/acre)	Wet Period Storm Load (LB)	Wet Period Storm Load by Area* (LB/acre)	Dry Period Storm Load (LB)	Dry Period Storm Load by Area* (LB/acre)	Annual Storm Load (LB)	Annual Storm Load by Area* (LB/acre)
Substitution Factor for Non-Detects	**0.0 x Reporting Limit**						**0.5 x Reporting Limit**						**1.0 x Reporting Limit**					
Indeno(1,2,3-cd)pyrene	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Malathion	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Naphthalene	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Pentachlorophenol	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Phenanthrene	0.08861	0.00058	0.00000	0.00000	0.08861	0.00058	0.10363	0.00068	0.01082	0.00007	0.11445	0.00075	0.11866	0.00078	0.02164	0.00014	0.14030	0.00092
Prometon	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Pyrene	0.21217	0.00140	0.01714	0.00011	0.22931	0.00151	0.21709	0.00143	0.01939	0.00013	0.23648	0.00156	0.22202	0.00146	0.02164	0.00014	0.24366	0.00160
bis(2-Ethylhexyl)phthalate	2.83210	0.01863	0.00000	0.00000	2.83210	0.01863	3.94810	0.02597	0.38034	0.00250	4.32844	0.02848	5.06410	0.03332	0.76068	0.00500	5.82478	0.03832
Metals																		
Cadmium, Dissolved	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Cadmium, Total	0.06387	0.00042	0.06251	0.00041	0.12639	0.00083	0.11321	0.00074	0.06034	0.00040	0.17355	0.00114	0.16255	0.00107	0.05816	0.00038	0.22071	0.00145
Copper, Dissolved	12.71800	0.08367	6.57660	0.04327	19.29460	0.12694	12.71800	0.08367	6.57660	0.04327	19.29460	0.12694	12.71800	0.08367	6.57660	0.04327	19.29460	0.12694
Copper, Total	40.92600	0.26925	15.00100	0.09869	55.92700	0.36794	40.92600	0.26925	15.00100	0.09869	55.92700	0.36794	40.92600	0.26925	15.00100	0.09869	55.92700	0.36794
Lead, Dissolved	0.32519	0.00214	0.30265	0.00199	0.62784	0.00413	0.69392	0.00457	0.28089	0.00185	0.97481	0.00641	1.06260	0.00699	0.25913	0.00170	1.32173	0.00870
Lead, Total	15.22700	0.10018	4.03430	0.02654	19.26130	0.12672	15.11800	0.09946	4.03430	0.02654	19.15230	0.12600	15.00800	0.09874	4.03430	0.02654	19.04230	0.12528
Mercury, Dissolved	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Mercury, Total	0.00583	0.00004	0.00826	0.00005	0.01409	0.00009	0.01321	0.00009	0.00783	0.00005	0.02103	0.00014	0.02059	0.00014	0.00739	0.00005	0.02798	0.00018
Zinc, Dissolved	40.07600	0.26366	14.74400	0.09700	54.82000	0.36066	40.07600	0.26366	14.74400	0.09700	54.82000	0.36066	40.07600	0.26366	14.74400	0.09700	54.82000	0.36066
Zinc, Total	111.30000	0.73224	37.06800	0.24387	148.36800	0.97611	111.30000	0.73224	37.06800	0.24387	148.36800	0.97611	111.30000	0.73224	37.06800	0.24387	148.36800	0.97611
Miscellaneous Organics																		
2,4-D	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
MCPP	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Triclopyr	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Conventionals																		
Biological Oxygen Demand	9903.70	65.16	4757.50	31.30	14661.20	96.46	9903.70	65.16	4746.60	31.23	14650.30	96.38	9903.70	65.16	4735.70	31.16	14639.40	96.31
Chloride	6040.50	39.74	743.63	4.89	6784.13	44.63	6040.50	39.74	743.63	4.89	6784.13	44.63	6040.50	39.74	743.63	4.89	6784.13	44.63
Solids, Total Suspended	53258.00	350.38	11755.00	77.34	65013.00	427.72	53258.00	350.38	11755.00	77.34	65013.00	427.72	53258.00	350.38	11755.00	77.34	65013.00	427.72
Surfactants	30.17	0.20	19.18	0.13	49.35	0.32	48.46	0.32	18.63	0.12	67.09	0.44	66.75	0.44	18.09	0.12	84.83	0.56

Notes-
Loads estimated by QAPP method.
ND – Not detected. Analyte not detected in any samples from period so no load calculated.
* - Area used for load calculation is basin area draining to MS4, not total basin area.

Table 2.9.2b. Load Estimation – Commercial Site (C1) Base Flow

Analyte Name	Wet Period Baseflow Load (LB)	Wet Period Baseflow Load by Area* (LB/acre)	Dry Period Baseflow Load (LB)	Dry Period Baseflow Load by Area* (LB/acre)	Annual Period Baseflow Load (LB)	Annual Period Baseflow Load by Area* (LB/acre)	Wet Period Baseflow Load (LB)	Wet Period Baseflow Load by Area* (LB/acre)	Dry Period Baseflow Load (LB)	Dry Period Baseflow Load by Area* (LB/acre)	Annual Period Baseflow Load (LB)	Annual Period Baseflow Load by Area* (LB/acre)	Wet Period Baseflow Load (LB)	Wet Period Baseflow Load by Area* (LB/acre)	Dry Period Baseflow Load (LB)	Dry Period Baseflow Load by Area* (LB/acre)	Annual Period Baseflow Load (LB)	Annual Period Baseflow Load by Area* (LB/acre)
Substitution Factor for Non-Detects	**0.0 x Reporting Limit**						**0.5 x Reporting Limit**						**1.0 x Reporting Limit**					
Diesel Range Hydrocarbons	ND	ND	17.87	0.12	17.87	0.12	ND	ND	22.34	0.15	22.34	0.15	ND	ND	26.82	0.18	26.82	0.18
Gasoline Range Hydrocarbons	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Nutrients																		
Nitrate + Nitrite	684.98	4.51	241.47	1.59	926.45	6.10	684.98	4.51	241.47	1.59	926.45	6.10	684.98	4.51	241.47	1.59	926.45	6.10
Nitrogen, Total Kjeldahl	221.35	1.46	174.27	1.15	395.62	2.60	221.35	1.46	174.27	1.15	395.62	2.60	221.35	1.46	174.27	1.15	395.62	2.60
Orthophosphate	21.74	0.14	20.56	0.14	42.30	0.28	21.74	0.14	20.56	0.14	42.30	0.28	21.74	0.14	20.56	0.14	42.30	0.28
Phosphorus, Total	35.67	0.23	38.79	0.26	74.46	0.49	35.67	0.23	38.79	0.26	74.46	0.49	35.67	0.23	38.79	0.26	74.46	0.49
Semivolatile Organics																		
1-Methylnaphthalene	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
2-Methylnaphthalene	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Acenaphthene	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Acenaphthylene	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Anthracene	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Benzo(a)anthracene	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Benzo(a)pyrene	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Benzo(g,h,i)perylene	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Butylbenzylphthalate	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Chlorpyrifos	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Chrysene	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Di-n-Butylphthalate	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Di-n-Octyl phthalate	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Diazinon	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Dibenz(a,h)anthracene	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Dibenzofuran	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Dichlobenil	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Diethylphthalate	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Dimethylphthalate	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Fluoranthene	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Fluorene	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Indeno(1,2,3-cd)pyrene	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND

Analyte Name	Wet Period Baseflow Load (LB)	Wet Period Baseflow Load by Area* (LB/acre)	Dry Period Baseflow Load (LB)	Dry Period Baseflow Load by Area* (LB/acre)	Annual Period Baseflow Load (LB)	Annual Period Baseflow Load by Area* (LB/acre)	Wet Period Baseflow Load (LB)	Wet Period Baseflow Load by Area* (LB/acre)	Dry Period Baseflow Load (LB)	Dry Period Baseflow Load by Area* (LB/acre)	Annual Period Baseflow Load (LB)	Annual Period Baseflow Load by Area* (LB/acre)	Wet Period Baseflow Load (LB)	Wet Period Baseflow Load by Area* (LB/acre)	Dry Period Baseflow Load (LB)	Dry Period Baseflow Load by Area* (LB/acre)	Annual Period Baseflow Load (LB)	Annual Period Baseflow Load by Area* (LB/acre)
Substitution Factor for Non-Detects	**0.0 x Reporting Limit**						**0.5 x Reporting Limit**						**1.0 x Reporting Limit**					
Malathion	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Naphthalene	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Pentachlorophenol	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Phenanthrene	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Prometon	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Pyrene	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
bis(2-Ethylhexyl)phthalate	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Metals																		
Cadmium, Dissolved	ND	ND	0.02682	0.00018	0.02682	0.00018	ND	ND	0.03575	0.00024	0.03575	0.00024	ND	ND	0.04468	0.00029	0.04468	0.00029
Cadmium, Total	ND	ND	0.04468	0.00029	0.04468	0.00029	ND	ND	0.05361	0.00035	0.05361	0.00035	ND	ND	0.06257	0.00041	0.06257	0.00041
Copper, Dissolved	3.25480	0.02141	2.01080	0.01323	5.26560	0.03464	3.25480	0.02141	2.01080	0.01323	5.26560	0.03464	3.25480	0.02141	2.01080	0.01323	5.26560	0.03464
Copper, Total	4.14110	0.02724	3.59210	0.02363	7.73320	0.05088	4.14110	0.02724	3.59210	0.02363	7.73320	0.05088	4.14110	0.02724	3.59210	0.02363	7.73320	0.05088
Lead, Dissolved	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Lead, Total	0.26039	0.00171	0.62568	0.00412	0.88607	0.00583	0.58606	0.00386	0.62568	0.00412	1.21174	0.00797	0.91154	0.00600	0.62568	0.00412	1.53722	0.01011
Mercury, Dissolved	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Mercury, Total	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Zinc, Dissolved	11.97700	0.07880	6.79230	0.04469	18.76930	0.12348	11.97700	0.07880	6.79230	0.04469	18.76930	0.12348	11.97700	0.07880	6.79230	0.04469	18.76930	0.12348
Zinc, Total	13.28100	0.08738	11.52800	0.07584	24.80900	0.16322	13.28100	0.08738	11.52800	0.07584	24.80900	0.16322	13.28100	0.08738	11.52800	0.07584	24.80900	0.16322
Miscellaneous Organics																		
2,4-D	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
MCPP	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Triclopyr	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Conventionals																		
Biological Oxygen Demand	351.70	2.31	223.41	1.47	575.11	3.78	351.70	2.31	272.68	1.79	624.38	4.11	351.70	2.31	321.73	2.12	673.43	4.43
Chloride	3723.90	24.50	1698.00	11.17	5421.90	35.67	3723.90	24.50	1698.00	11.17	5421.90	35.67	3723.90	24.50	1698.00	11.17	5421.90	35.67
Solids, Total Suspended	1640.50	10.79	1617.60	10.64	3258.10	21.43	1640.50	10.79	1617.60	10.64	3258.10	21.43	1640.50	10.79	1617.60	10.64	3258.10	21.43
Surfactants	29.95	0.20	ND	ND	29.95	0.20	33.20	0.22	ND	ND	33.20	0.22	36.45	0.24	ND	ND	36.45	0.24

Notes-
Loads estimated by Ecology method.
ND – Not detected. Analyte not detected in any samples from period so no load calculated.
* - Area used for load calculation is basin area draining to MS4, not total basin area.

Table 2.9.3. Load Estimation – Industrial Site (I1) Stormwater

Analyte Name	Wet Period Storm Load (LB)	Wet Period Storm Load by Area* (LB/acre)	Dry Period Storm Load (LB)	Dry Period Storm Load by Area* (LB/acre)	Annual Storm Load (LB)	Annual Storm Load by Area* (LB/acre)	Wet Period Storm Load (LB)	Wet Period Storm Load by Area* (LB/acre)	Dry Period Storm Load (LB)	Dry Period Storm Load by Area* (LB/acre)	Annual Storm Load (LB)	Annual Storm Load by Area* (LB/acre)	Wet Period Storm Load (LB)	Wet Period Storm Load by Area* (LB/acre)	Dry Period Storm Load (LB)	Dry Period Storm Load by Area* (LB/acre)	Annual Storm Load (LB)	Annual Storm Load by Area* (LB/acre)
Substitution Factor for Non-Detects	**0.0 x Reporting Limit**						**0.5 x Reporting Limit**						**1.0 x Reporting Limit**					
Petroleum Hydrocarbons																		
Diesel Range Hydrocarbons	161.64	1.18	22.49	0.16	184.13	1.34	161.64	1.18	22.49	0.16	184.13	1.34	161.64	1.18	22.49	0.16	184.13	1.34
Gasoline Range Hydrocarbons	4.37	0.03	ND	ND	4.37	0.03	34.99	0.26	ND	ND	39.40	0.29	65.60	0.48	ND	ND	74.43	0.54
Nutrients																		
Nitrate + Nitrite	62.98	0.46	17.77	0.13	80.74	0.59	62.98	0.46	17.77	0.13	80.74	0.59	62.98	0.46	17.77	0.13	80.74	0.59
Nitrogen, Total Kjeldahl	369.75	2.69	84.08	0.61	453.83	3.31	371.41	2.71	84.08	0.61	455.49	3.32	373.07	2.72	84.08	0.61	457.15	3.33
Orthophosphate	16.55	0.12	1.77	0.01	18.32	0.13	16.55	0.12	1.77	0.01	18.32	0.13	16.55	0.12	1.77	0.01	18.32	0.13
Phosphorus, Total	102.02	0.74	7.99	0.06	110.01	0.80	102.02	0.74	7.99	0.06	110.01	0.80	102.02	0.74	7.99	0.06	110.01	0.80
Semivolatile Organics																		
1-Methylnaphthalene	0.00318	0.00002	0.00000	0.00000	0.00318	0.00002	0.01775	0.00013	0.00177	0.00001	0.01952	0.00014	0.03232	0.00024	0.00353	0.00003	0.03585	0.00026
2-Methylnaphthalene	0.00430	0.00003	0.00000	0.00000	0.00430	0.00003	0.01887	0.00014	0.00177	0.00001	0.02064	0.00015	0.03344	0.00024	0.00353	0.00003	0.03697	0.00027
Acenaphthene	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Acenaphthylene	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Anthracene	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Benzo(a)anthracene	0.01601	0.00012	0.00000	0.00000	0.01601	0.00012	0.02618	0.00019	0.00177	0.00001	0.02794	0.00020	0.03634	0.00026	0.00353	0.00003	0.03987	0.00029
Benzo(a)pyrene	0.02042	0.00015	0.00000	0.00000	0.02042	0.00015	0.03004	0.00022	0.00177	0.00001	0.03181	0.00023	0.03966	0.00029	0.00353	0.00003	0.04319	0.00031
Benzo(g,h,i)perylene	0.02343	0.00017	0.00000	0.00000	0.02343	0.00017	0.03180	0.00023	0.00177	0.00001	0.03356	0.00024	0.04016	0.00029	0.00353	0.00003	0.04369	0.00032
Butylbenzylphthalate	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Chlorpyrifos	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Chrysene	0.02765	0.00020	0.00000	0.00000	0.02765	0.00020	0.03601	0.00026	0.00177	0.00001	0.03778	0.00028	0.04438	0.00032	0.00353	0.00003	0.04791	0.00035
Di-n-Butylphthalate	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Di-n-Octyl phthalate	0.05096	0.00037	0.02136	0.00016	0.07232	0.00053	0.19170	0.00140	0.03436	0.00025	0.22606	0.00165	0.33245	0.00242	0.04737	0.00035	0.37982	0.00277
Diazinon	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Dibenz(a,h)anthracene	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Dibenzofuran	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Dichlobenil	0.00000	0.00000	0.00022	0.00000	0.00022	0.00000	0.02175	0.00016	0.00054	0.00000	0.02228	0.00016	0.04349	0.00032	0.00085	0.00001	0.04434	0.00032
Diethylphthalate	0.04339	0.00032	0.08265	0.00060	0.12604	0.00092	0.18692	0.00136	0.09566	0.00070	0.28258	0.00206	0.33047	0.00241	0.10867	0.00079	0.43914	0.00320
Dimethylphthalate	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Fluoranthene	0.04207	0.00031	0.00000	0.00000	0.04207	0.00031	0.04917	0.00036	0.00177	0.00001	0.05094	0.00037	0.05627	0.00041	0.00353	0.00003	0.05980	0.00044
Fluorene	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND

Analyte Name	Wet Period Storm Load (LB)	Wet Period Storm Load by Area* (LB/acre)	Dry Period Storm Load (LB)	Dry Period Storm Load by Area* (LB/acre)	Annual Storm Load (LB)	Annual Storm Load by Area* (LB/acre)	Wet Period Storm Load (LB)	Wet Period Storm Load by Area* (LB/acre)	Dry Period Storm Load (LB)	Dry Period Storm Load by Area* (LB/acre)	Annual Storm Load (LB)	Annual Storm Load by Area* (LB/acre)	Wet Period Storm Load (LB)	Wet Period Storm Load by Area* (LB/acre)	Dry Period Storm Load (LB)	Dry Period Storm Load by Area* (LB/acre)	Annual Storm Load (LB)	Annual Storm Load by Area* (LB/acre)
Substitution Factor for Non-Detects	**0.0 x Reporting Limit**						**0.5 x Reporting Limit**						**1.0 x Reporting Limit**					
Indeno(1,2,3-cd)pyrene	0.01662	0.00012	0.00000	0.00000	0.01662	0.00012	0.02595	0.00019	0.00177	0.00001	0.02771	0.00020	0.03528	0.00026	0.00353	0.00003	0.03881	0.00028
Malathion	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Naphthalene	0.00091	0.00001	0.00000	0.00000	0.00091	0.00001	0.01600	0.00012	0.00177	0.00001	0.01777	0.00013	0.03109	0.00023	0.00353	0.00003	0.03462	0.00025
Pentachlorophenol	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Phenanthrene	0.02376	0.00017	0.00000	0.00000	0.02376	0.00017	0.03119	0.00023	0.00177	0.00001	0.03295	0.00024	0.03862	0.00028	0.00353	0.00003	0.04215	0.00031
Prometon	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Pyrene	0.06113	0.00045	0.00093	0.00001	0.06206	0.00045	0.06463	0.00047	0.00223	0.00002	0.06686	0.00049	0.06813	0.00050	0.00353	0.00003	0.07166	0.00052
bis(2-Ethylhexyl)phthalate	0.28282	0.00206	0.00000	0.00000	0.28282	0.00206	0.49910	0.00364	0.06468	0.00047	0.56378	0.00411	0.71535	0.00521	0.12933	0.00094	0.84468	0.00616
Metals																		
Cadmium, Dissolved	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Cadmium, Total	0.04035	0.00029	0.00966	0.00007	0.05001	0.00036	0.05707	0.00042	0.00966	0.00007	0.06674	0.00049	0.07380	0.00054	0.00966	0.00007	0.08347	0.00061
Copper, Dissolved	1.09760	0.00800	0.59610	0.00434	1.69370	0.01234	1.09760	0.00800	0.59610	0.00434	1.69370	0.01234	1.09760	0.00800	0.59610	0.00434	1.69370	0.01234
Copper, Total	6.91070	0.05037	1.14670	0.00836	8.05740	0.05873	6.91070	0.05037	1.14670	0.00836	8.05740	0.05873	6.91070	0.05037	1.14670	0.00836	8.05740	0.05873
Lead, Dissolved	0.00000	0.00000	0.05204	0.00038	0.05204	0.00038	0.12837	0.00094	0.05669	0.00041	0.18506	0.00135	0.25674	0.00187	0.06133	0.00045	0.31807	0.00232
Lead, Total	3.68800	0.02688	0.44047	0.00321	4.12847	0.03009	3.68800	0.02688	0.44047	0.00321	4.12847	0.03009	3.68800	0.02688	0.44047	0.00321	4.12847	0.03009
Mercury, Dissolved	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Mercury, Total	0.00251	0.00002	0.00000	0.00000	0.00251	0.00002	0.00454	0.00003	0.00035	0.00000	0.00489	0.00004	0.00658	0.00005	0.00071	0.00001	0.00728	0.00005
Zinc, Dissolved	10.79900	0.07871	3.98580	0.02905	14.78480	0.10776	10.79900	0.07871	3.98580	0.02905	14.78480	0.10776	10.79900	0.07871	3.98580	0.02905	14.78480	0.10776
Zinc, Total	46.76900	0.34088	7.14920	0.05211	53.91820	0.39299	46.76900	0.34088	7.14920	0.05211	53.91820	0.39299	46.76900	0.34088	7.14920	0.05211	53.91820	0.39299
Miscellaneous Organics																		
2,4-D	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
MCPP	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Triclopyr	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Conventionals																		
Biological Oxygen Demand	1809.60	13.19	671.50	4.89	2481.10	18.08	1809.60	13.19	671.50	4.89	2481.10	18.08	1809.60	13.19	671.50	4.89	2481.10	18.08
Chloride	1009.30	7.36	88.82	0.65	1098.12	8.00	1009.30	7.36	88.82	0.65	1098.12	8.00	1009.30	7.36	88.82	0.65	1098.12	8.00
Solids, Total Suspended	33705.00	245.66	1756.50	12.80	35461.50	258.46	33705.00	245.66	1756.50	12.80	35461.50	258.46	33705.00	245.66	1756.50	12.80	35461.50	258.46
Surfactants	6.17	0.04	5.00	0.04	11.16	0.08	11.40	0.08	5.00	0.04	16.40	0.12	16.64	0.12	5.00	0.04	21.64	0.16

Notes:
Loads estimated by QAPP method.
ND - Not detected. Analyte not detected in any samples from period so no load calculated. * - Area used for load calculation is basin area draining to MS4, not total basin area.

2.10 Toxicity Testing Results

Details of chemical parameters measured in the stormwater delivered to the toxicity laboratory are detailed in the following table. All data in this section were analyzed and reported by Nautilus Environmental, LLC.

Table 2.10a. Toxicity Samples Analytical Summary

	C1	R1	I1
Sample collection date and time	8/22/2010 1050	8/31/2010 1741	8/31/2010 1152
Receipt date and time	8/23/2010 1205	9/1/2010 1455	9/1/2010 1455
Receipt temp (°C)	4	0.8	1
Dissolved oxygen (mg/L)	11	11	12.1
pH	7.11	6.15	6.98
Conductivity (µS/cm)	147	46	74
Hardness (mg/L $CaCO_3$)	68	24	52
Alkalinity (mg/L $CaCO_3$)	60	16	40
Total chlorine (mg/L)	<0.03	<0.03	<0.03
Total ammonia (mg/L)	3.5	<1.0	<1.0

Receiving water body hardness data for grab samples collected during the toxicity test sample collection period are summarized in the following table.

Table 2.10b. Receiving Water Body Hardness Summary

Sample ID	C1 RWB	R1 RWB	I1 RWB
Associated stormwater sample ID	C1	R1	I1
Sample collection date and time	8/22/2010 1035	8/31/2010 1015	8/31/2010 1115
Receipt date and time	8/23/2010 1205	9/1/2010 1455	9/1/2010 1455
Hardness (mg/L $CaCO_3$)	40	76	384

Hardness modification of samples was conducted when receiving water hardness differed from stormwater sample hardness by more than 20 percent by the addition of salts.

No significant toxicity was observed in tests from any of the three samples. The no observed effects concentration (NOEC) was 100 percent sample for all samples, and the 50 percent effective concentration (EC_{50}) was greater than 100 percent for all samples. There was no significant difference in survival or development between dilution water controls and hardness-adjusted controls. Results of the toxicity tests are summarized on the following table.

Table 2.10c. Toxicity Tests Results

	Sample ID	C1	R1	I1
Survival	No Observed Effect Concentration (%)	100	100	100
	Lowest Observed Effect Concentration (%)	>100	>100	>100
	EC_{50}[a] (%)	>100	>100	>100
	EC_{25}[b] (%)	>100	>100	>100
	Mean control	97.5	99.2	99.2
	(95% C.I.)	(95.6-99.4)	(98.5-99.8)	(98.5-99.8)
	Mean 100% sample (95% C.I.)	75	98.3	98.3
		(61.7-88.3)	(97.6-99.1)	(97.1-99.6)
Development	No Observed Effect Concentration (%)	100	100	100
	Lowest Observed Effect Concentration (%)	>100	>100	>100
	EC_{50}[a] (%)	>100	>100	>100
	EC_{25}[b] (%)	85.9	>100	>100
	Mean control	87.4	87.4	85.8
	(95% C.I.)	(81.3-93.5)	(83.0-91.9)	(81.7-89.9)
	Mean 100% sample (95% C.I.)	58.2	88.9	89.2
		(39.8-76.6)	(86.5-91.4)	(84.7-93.6)

Notes:
C.I. – confidence interval
(a) – Effective concentration for 50% of test organisms
(b) - Effective concentration for 25% of test organisms

Nautilus documented the results of the testing in a report dated September 20, 2010 (on file) and via electronic results. Toxicity data electronic results were sent to Randall Marshall, Ecology's Whole Effluent Toxicity (WET) Testing Coordinator, within two weeks of sample collection. Mr. Marshall reviewed and validated the results of the toxicity tests. All tests were found to be acceptable, and all stormwater tested was considered non-toxic to the rainbow trout gametes. No follow-up actions or additional testing are required, and toxicity testing is concluded for this Permit cycle. Copies of the Ecology validation (Comprehensive Environmental Toxicity Information System Evaluation Reports) are included in Appendix C.3.

2.11 QA/QC Results

Refer to Appendix C.1 for the full QA/QC report.

2.12 Discussion of Results and Follow-up Actions

Permit-required analyses were successfully completed on 38 water samples and three sediment samples during WY2010.

Stormwater chemistry data were screened as it was received from the analytical laboratory looking for outliers or anomalies. One major outlier was observed which led to corrective action being performed.

The fecal coliform grab sample collected at I1 on April 26, 2010 had a concentration of 91,900 colony forming units (CFU)/100mL. Up to this time, the previous fecal coliform results were all below 1,000 CFU/100mL including the sample collected immediately prior on April 1, 2010. Due to the high bacteria concentration, SPU's Spill Response team was asked to investigate the I1 basin for bacteria sources. The SPU Spill Response team performed an investigation that consisted of sampling, dye testing and business inspections; which resulted in determining that a newly constructed wash pad at a business located at 9801 Martin Luther King Jr. Way S. was improperly connected to the storm drain rather than the sanitary sewer. The business was using the wash pad for washing their bus fleet in addition to emptying the fleet's septic holding tanks. On June 11, 2010, SPU informed Ecology of the illicit connection which was reported under the Environmental Report Tracking System (ERTS), report number 620490.

It was determined that the illicit connection was the result of upgrades made to the site in January 2010, when the wash pad was built. The contractor constructed the wash pad and mistakenly connected it to the storm drainage system. The business was ordered to stop using this wash pad until the illicit connection was fixed. The business turned the water off to the wash pad to prevent it from being used and rented an onsite containment tank into which all wastewater from the site was diverted. The connection was fixed on June 16, 2010 and confirmed by an additional dye test.

2.13 SWMP Activities

The City's Stormwater Management Program (SWMP) Activities are described in Attachment A of the 2010 NPDES Annual Report. The City applies all of the activities in the SWMP throughout the areas of the City that are served by the MS4, which includes the R1, C1 and I1 monitoring station drainage basins.

2.14 Summary of Stormwater Characterization Monitoring

The City was successful in meeting Permit sampling goals in Section S8.D for WY2010 which was the first complete year of stormwater characterization monitoring performed under the 2007 Permit. The required number of routine stormwater events and toxicity events were captured. Stormwater from all three land use monitoring stations were considered to be non-toxic based on the results of the annual toxicity test. Complete and continuous flow and rain data were collected for all sites. As a result of this monitoring work, an illicit sanitary connection in the industrial land use basin was discovered and corrected.

2.15 Acknowledgements

Stormwater sampling is very challenging environmental monitoring work due to, among other factors: the difficulties of forecasting weather and targeting storms; operating and maintaining automatic sampling equipment continuously within a drainage system; working in traffic and confined spaces at irregular hours in inclement weather, etc. Data in reports such as this are presented in a matter-of-fact style which typically does not acknowledge that sampling and laboratory personnel are constantly required to rearrange their work and personal schedules to prioritize capturing stormwater samples. For example, staff may not know if they will need to work on New Year's Eve, New Year's Day or both, until the last minute; as actually occurred during this water year. Once samples are collected, laboratory personnel must be available to process and preserve samples to meet holding times, and then analyze and manage large amounts of samples and data. The Permit's requirements were very ambitious regarding the large number of samples required using restrictive storm event and sample criteria. The success in meeting the Permit sampling goals during WY2010 was due to the hard work of many dedicated scientists who collaborated very effectively on this project.

The City of Seattle would like to acknowledge the dedication of the following staff:

Taylor Associates Inc. – field sampling staff
Bryan Berkompas (current project manager)
Kurt Marx (WY2010 project manager)

Amy Miller	Jon Berg	Curtis Nickerson
Peter Heltzel	Brad Kwasnowski	Heidi Wachter
James Packman	Dave Metallo	Carla Milesi
Joe Hamman	Suzanne Smith	Bill Taylor
Dan O'Brien		

Analytical Resources, Inc – primary project analytical laboratory
Mark Harris (project manager) and staff

Nautilus Environmental, LLC – toxicity laboratory
Cat Curran (project manager) and staff

Seattle Public Utilities
Doug Hutchinson (project manager, report author)
Amy Minichillo, Lea Beard (data validators)

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3 S8.E Stormwater Management Program Effectiveness

3.1 Requirements

The program effectiveness monitoring requirement is for the City to select two specific aspects of the Stormwater Management Program to evaluate. One aspect to be evaluated is to determine the effectiveness of a targeted action. A second aspect to be evaluated is the effectiveness of achieving a targeted environmental outcome. This monitoring is intended to improve stormwater management efforts by providing a feedback loop to help determine if a stormwater management program element is meeting the desired environmental outcome.

3.2 Purpose, Design and Methods

The program effectiveness monitoring evaluates aspects of the stormwater management program; the effectiveness of a specific action and the effectiveness of achieving a targeted environmental outcome. The City proposes to address stormwater related problems associated with sediments by conducting a street sweeping study to determine if this BMP action helps to achieve the desired outcome of a reduced sediment load.

The Ecology fact sheet for the 2007 NPDES Phase I Permit states:

> In both the "actions" and "outcomes" categories, permittees are required to select an issue for study that has significance for them.
>
> The "specific action" monitoring is aimed at having the permittees establish a feedback loop for a specific component or part of a component. The intent is to do sufficient investigation to determine if a specific action is making an effective contribution to achieving the overall stormwater program and Permit goals. Examples could include: improvements in stormwater quality or quality of sediments in stormwater discharges; reduction in frequency of high flows; reduction in frequency of spills.
>
> The "targeted outcome" monitoring is intended to establish a feedback loop concerning the effectiveness of a subset or the entire stormwater program in achieving a specific environmental outcome. Examples of an outcome include: reopening an area to commercial shellfish harvesting; preventing recontamination of receiving water sediments; reducing discharge of certain pollutants by a targeted percentage, below a certain concentration, or below a targeted annual load amount; re-establishment of a sustaining native fish population.

The effect of urban stormwater runoff on the water quality of receiving waters is of great concern in the Seattle area. While new development may have a large number of options for providing water quality treatment through structural controls, existing developed areas have limited choices for retrofitting their stormwater systems. Thus, nonstructural measures for improving the quality of runoff have become increasingly important. One of the nonstructural measures that may be readily used throughout the city is street sweeping.

In 2006 and 2007, Seattle conducted a Street Sweeping Pilot Study in two residential areas and one industrial area to evaluate whether street sweeping with regenerative air sweepers can significantly reduce the mass of pollutants discharged to area receiving water bodies while reducing the frequency of catch basin cleaning by removing sediment/debris from the street before it is transported in stormwater runoff. The study was conducted in two residential areas and one industrial area using a paired basin approach (i.e., a swept and unswept basin in each area). The quantity and quality of street dirt, sweeper waste, and catch basin sediment were measured and evaluated. Conclusions from the study include:

- Sweeping streets every other week was effective in reducing the amount of sediment and pollutants that enters the storm drain system and the amount of dirt present on the streets.
- Sweeping streets every other week did not reduce the amount of sediment that accumulated in catch basins, which indicates that sweeping may not reduce the frequency that catch basins would need to be cleaned. However, because of the short time frame of the pilot study and the difficulty in accurately measuring sediment depth in the catch basins, there is still considerable uncertainty about the effect of sweeping on catch basin cleaning frequency.
- Street sweeping has the potential to be a cost-effective strategy for removing sediment and pollutants from the roadways of Seattle. Sweeping streets every other week is likely to be more cost-effective than annual catch basin cleaning or structural controls.

The *Seattle Street Sweeping Pilot Study – Monitoring Report* is available online at: http://www.seattle.gov/util/Services/Drainage_&_Sewer/Keep_Water_Safe_&_Clean/Street_Sweep_Project/QuestionsAnswers/

3.2.1 Targeted Action

A targeted action results in improvements in stormwater quality or quality of sediments in stormwater discharges. Additional analytical analysis of the street dirt, sweeper waste, and catch basin sediment collected during the Seattle Street Sweeping Pilot Study will be performed to increase our understanding of the distribution of contaminants in varying size fractions in street dirt, sweeper waste, and catch basin sediments. Refer to Table 3.2.1 for more information on this program effectiveness monitoring of a targeted action.

Table 3.2.1. Program Effectiveness Monitoring Proposal 1a – Effectiveness of a Targeted Action.

Project	**Seattle Street Sweeping Pilot**
Significance	The application of street sweeping in highly built out urban area has the potential to be an effective non-structural BMP which addresses potentially toxic transport-derived contaminants.
Hypothesis to be tested	Regenerative air sweepers are effective at removing contaminants in the silt, clay, and/or dissolved sized fraction.
Parameters to be measured	Archived, frozen samples of street dirt, street sweeper waste, and catch basin sediment will be analyzed to determine the distribution of selected contaminants in sand, silt, and clay size fractions – or other fractions as appropriate to answer the question.
Management actions	If yes, consider employing street sweeping on streets drained by MS4. If no, use street sweeping where feasible.
Temporal Scale	Permit cycle
Feasibility Issues	There may not be adequate sample. The archived samples have been frozen - holding times may be an issue. Frozen samples may not sieve satisfactorily.

3.2.2 Targeted Outcome

A targeted outcome reduces discharge of certain pollutants below a targeted annual load amount. A mass balance model will be developed to predict a targeted annual load reduction for varying conditions, such as sweeping frequency, road surface condition, and parking enforcement compliance (Table 3.2.). Existing data and a parking compliance survey will be used as a basis for the model.

Table 3.2.2. Program Effectiveness Monitoring Proposal 1b – Effectiveness of a Targeted Outcome.

Project	**Seattle Street Sweeping Pilot**
Significance	The application of street sweeping in highly built out urban area has the potential to be an effective non-structural BMP which addresses potential toxic transport-derived contaminants. Street sweeping effectiveness can generally be attributed to the sweeper's efficiency and the sediment deposition rate. A model that describes this relationship will allow prioritizing and optimizing a street sweeping program with the intent of providing the highest value.
Hypothesis to be tested	Street sweeping effectiveness can be described by a model which accounts for (1) sweeping efficiency, a function of the sweeper frequency, utilization, and availability, and (2) sediment deposition rate, a function of pollutant build up and wash off.

Parameters to be measured and modeled	• Sweeper efficiency
	  ○ Planned frequency with which the streets were swept.
	  ○ Utilization due to holidays, equipment breakdowns, communication failures.
	  ○ Availability due to incomplete sweeping of streets from no parking violators.
	• Pollutant build up (Total Suspended Solids (TSS) loading)
	  ○ National land use data will be used to estimate TSS runoff concentrations.
	  ○ WWHM3 will be used to estimate average annual runoff volumes.

Project	Seattle Street Sweeping Pilot
	○ Average annual pollutant load will be determined from above. • Pollutant wash off ○ Pavement roughness and street slopes will be measured to account for removal efficiencies affected by pavement conditions. ○ Precipitation intensity and frequency will be analyzed to account for "wash off" between sweepings.
Management actions	If yes, design a street sweeping program to optimize the sweeping efficiency using a mass balance model as a tool.
Temporal Scale	Permit cycle
Feasibility Issues	There may be inadequate data to calibrate the model.

3.3 Implementation Status

As indicated previously, the City has completed the report for the Street Sweeping Pilot Study. This report - the *Seattle Street Sweeping Pilot Study – Monitoring Report* - is available online at: http://www.seattle.gov/util/Services/Drainage_&_Sewer/Keep_Water_Safe_&_Clean/Street_Sweep_Project/QuestionsAnswers/

The additional physical and chemical analysis of the street dirt, sweeper waste and catch basin sediment from the Street Sweeping Pilot Study has been completed. The results and conclusions from these additional analyses will be included in a future Annual Report.

4 S8.F Stormwater Treatment and Hydrologic Management BMP Evaluation

4.1 Overview

The Permit requires full scale field monitoring to evaluate the effectiveness and operation and maintenance requirements of stormwater treatment and hydrologic management best management practice (BMPs) applied in Permittee's jurisdiction. Specifically, the Permit requires that each Phase I Permittee select two treatment types that are standard technologies in their stormwater manuals, for detailed performance monitoring. Two BMPs per each BMP treatment type are required to be monitored. In addition, one hydrologic management (or "flow reduction") BMP is required to be monitored.

4.1.1 Treatment BMP Number One Overview

One of the two selected treatment types that the City is monitoring is a proprietary or "engineered" treatment BMP - the Catch Basin StormFilter™ (CBSF), manufactured by Contech® Construction Products Inc. (Contech). The CBSF is a frequently installed BMP by the Seattle Department of Transportation (SDOT) to treat roadway stormwater runoff. The City is interested in monitoring the effectiveness of this BMP because the cartridge technology has received a basic treatment General Use Level Designation (GULD) by Ecology based on testing within a vault ("StormFilter®"), not a catch basin device.

The CBSF monitoring work was performed in general accordance with the draft QAPP submitted to Ecology on February 10, 2008 and approved by Ecology on September 26, 2008. The final QAPP was submitted to Ecology on February 12, 2009. A summary of information provided in the QAPP and data from the WY2010 monitoring work are presented beginning in Section 4.2.

4.1.2 Treatment BMP Number Two Overview

The second BMP project that the City proposed to monitor consisted of two bioretention swales located in the High Point redevelopment project of West Seattle. The final QAPP for the High Point bioretention swales project was submitted to Ecology on February 12, 2009. The City began implementation of monitoring the bioretention swales prior to February 2009, with the intent to collect the first water quality samples with the start of the partial water year on February 16, 2009. However, factors such as the complexity of this monitoring project coupled with concerns over the numerous assumptions and models required to make performance estimates, and the lack of transferability of findings from the project, resulted in the City changing its approach to the second BMP.

The City was still interested in evaluating the performance of bioretention systems and soils and pursued an opportunity to partner with the Washington State University (WSU) Puyallup Research and Extension Center to have WSU conduct BMP evaluation monitoring on the City's behalf by using Special Condition S8.B.1 of the Permit. WSU, with the City of Puyallup, is constructing a Low Impact Development (LID) research center at the WSU Puyallup Research and Extension Center. The LID center will contain many full-scale BMPs including bioretention cells, water gardens and porous pavements.

The City will use monitoring and results from four bioretention cells, referred to as mesocosms, to meet Special Condition S8.F.2.b for monitoring a metals/phosphorus treatment BMP. The four mesocosms are identical (essentially one primary and three replicates) and all contain a 60/40 mix of aggregate/compost. The mix and configuration of the mesocosms is similar to the City's bioretention design standard. Stormwater will flow into each mesocosm and the water quality samples and flow data will be collected at the influent and effluent of each mesocosm to calculate pollutant reduction.

The City notified Ecology of its plan to replace the High Point BMP project with the WSU collaboration verbally and followed with a letter dated September 15, 2009. Ecology gave the City approval to proceed with this plan. The City signed a Memorandum of Agreement (MOA) with WSU on November 12, 2009. The WSU mesocosm final QAPP was completed in September 2010 and Ecology approved the QAPP in a letter dated October 27, 2010. Construction of the research facility was completed in the fall of 2010, and the monitoring will begin in the late winter of 2011.

A brief summary of information provided in the QAPP and the results of the WY2010 work on this project are presented below.

4.1.3 Hydrologic Management BMP Overview

The Permit requires the city to monitor a flow reduction strategy that is in use in the City or planned for installation within the City in a paired study or against a predicted outcome. To meet this requirement, the City has monitored one bioretention swale located in the High Point community in West Seattle. Flow was monitored in the swale continuously for two years and reported in the WY2009 report.

4.2 Catch Basin StormFilter™ Monitoring (Treatment BMP One)

4.2.1 Catch Basin StormFilter™ Description

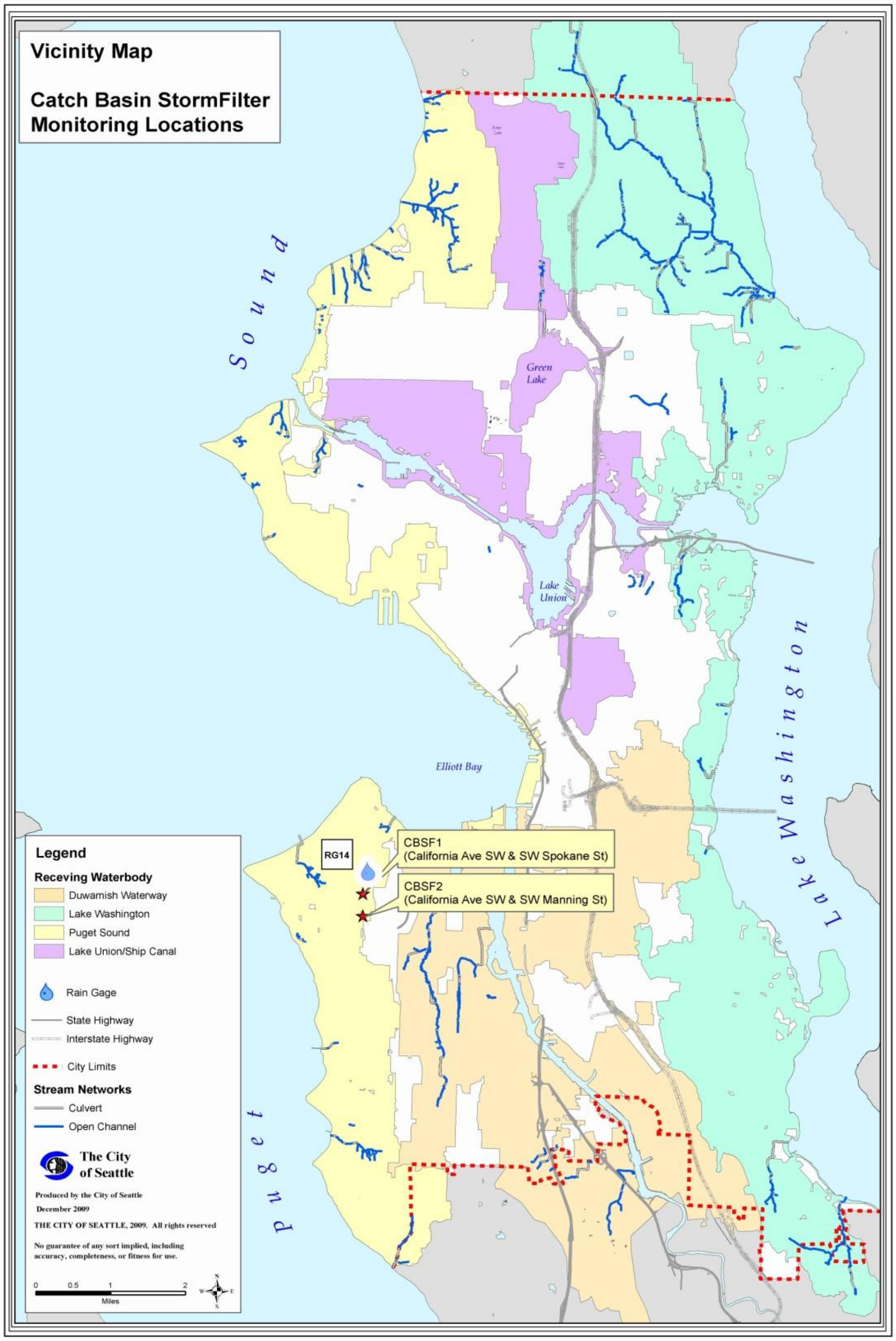
The Contech® Catch Basin StormFilter™ (CBSF) is a passive, flow-through stormwater filtration system. It is engineered to replace a standard catch basin and consists of a steel vault that houses replacement cartridges that can be filled with a variety of filtration media.

In April 2007, numerous CBSFs were installed along California Avenue SW in West Seattle as part of roadway improvements. Two of the units were selected for monitoring to partially satisfy section S8.F of the Permit. The first unit, referred to as CBSF1, is located on the southeast corner of California Avenue SW and SW Spokane Street. The second unit, referred to as CBSF2, is located on the southeast corner of California Avenue SW and SW Manning Street. Refer to Figure 4.2.1a – Vicinity Map, and Figures 4.2.1b and c – Site Maps.

These units, which are model CBSF4, are constructed of steel and each contains up to four cartridges. Each cartridge is designed to treat a maximum of 7.5 gallons per minute of influent stormwater; consequently, each unit can treat a maximum of 30 gallons per minute (0.065 cubic feet per second). The CBSF units are installed flush with the finished grade and stormwater enters the units through grated inlets. They are applicable for small drainage areas from roadways and parking lots, and retrofit applications.

The CBSF units are designed with the following primary components: influent sump, scum baffle, two filter cartridge chambers containing two StormFilter™ cartridges each, internal bypass weir, and an effluent/bypass chamber (see Figure 4.2.1d – Design Details). Stormwater initially enters the influent sump where some treatment may occur via settling of heavier particles. It then passes under the scum baffle, leaving floatable pollutants behind in the influent sump. Next, the stormwater may be routed into one of two cartridge chambers for treatment via the StormFilters™ cartridges. Alternatively, if the treatment capacity of the StormFilters™ cartridges has been exceeded or the storm flow exceeds the design flow, the stormwater can bypass the cartridge chambers entirely by spilling over an internal bypass weir. Filtered effluent from the StormFilters™ cartridges and bypassed stormwater enter the effluent chamber and are subsequently discharged out of the unit and into the storm drain system via an 8-inch outlet pipe.

Figure 4.2.1a. Vicinity Map – CBSF Monitoring Locations



City of Seattle

Figure 4.2.1b. Site Map – CBSF1

Figure 4.2.1c. Site Map – CBSF2

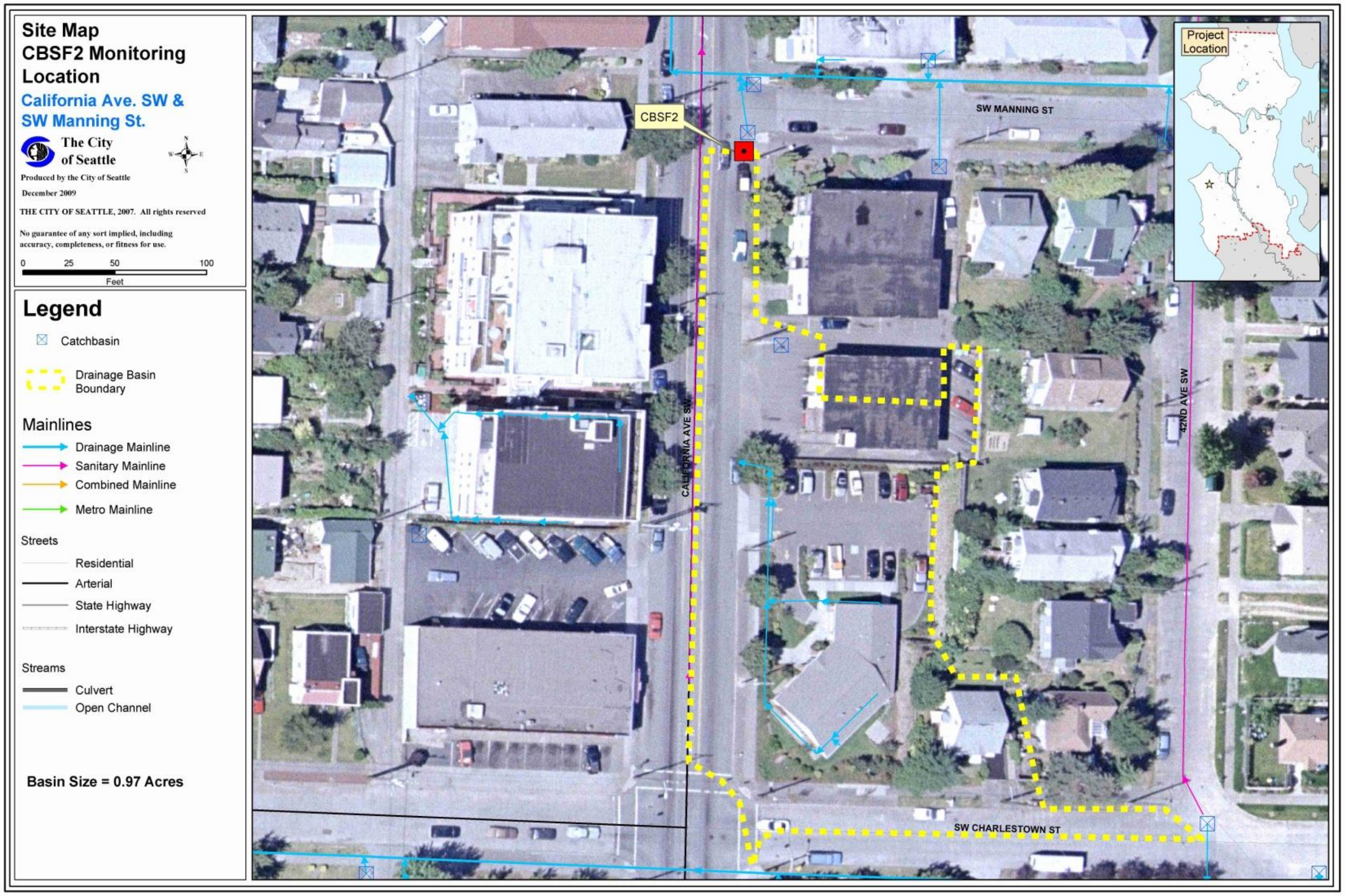
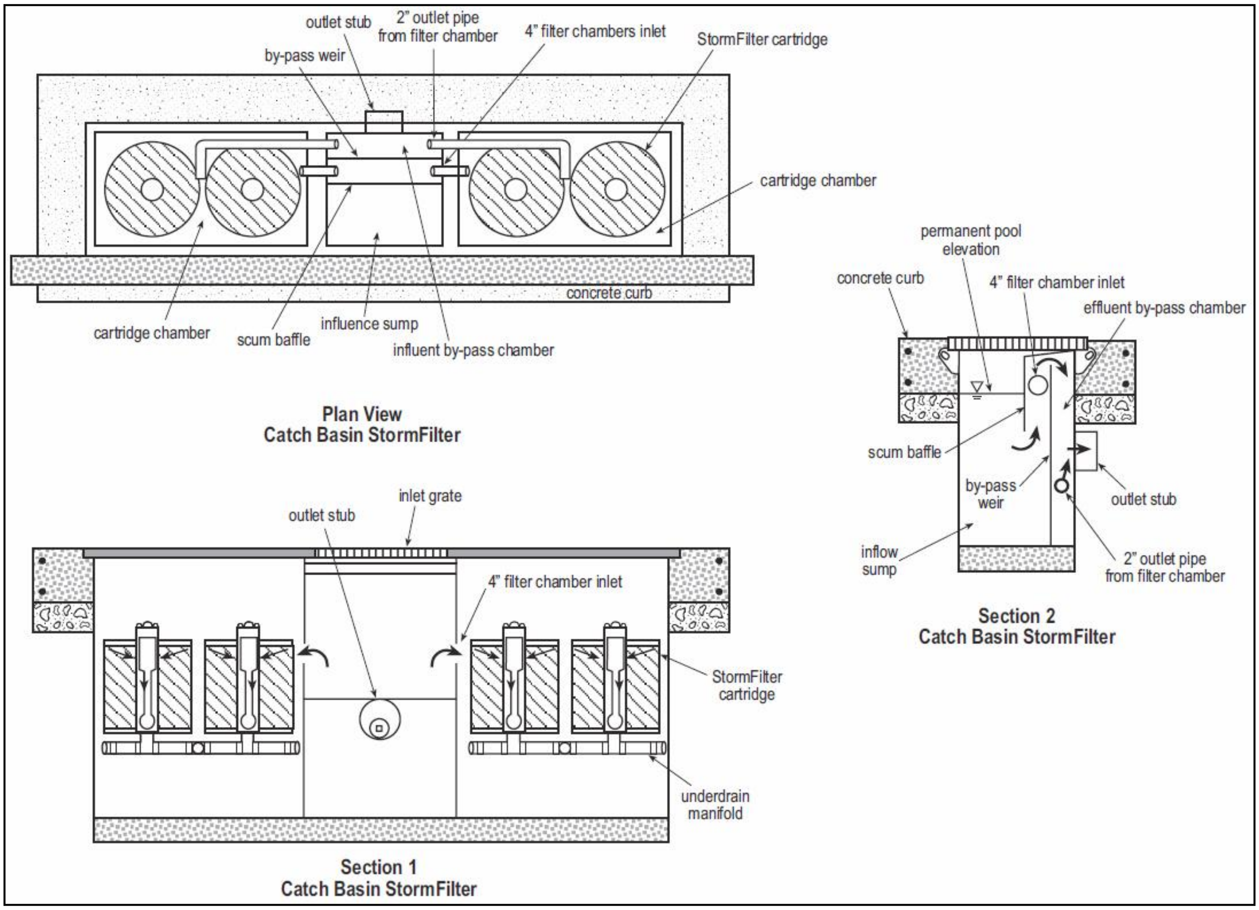


Figure 4.2.1d. CBSF Design Detail



The CBSF units were sized using the Western Washington Hydrology Model Version 3 (WWHM3), an Ecology-approved continuous runoff model. The units were sized assuming an online, or flow-through facility, based on the manufacturer's recommendation and the definition provided in the Stormwater Management Manual for Western Washington (Ecology 2005), Section 4.5 Hydraulic Structures, 5.1 Flow Splitter Designs:

"*Many water quality (WQ) facilities can be designed as flow-through or on-line systems with flows above the WQ design flow or volume simply passing through the facility at lower pollutant removal efficiency. However, it is sometimes desirable to restrict flows to WQ treatment facilities and bypass the remaining higher flows around them through offline facilities. This can be accomplished by splitting flows in excess of the WQ design flow upstream of the facility and diverting higher flows to a bypass pipe or channel.*"

Because the CBSF is fitted with an internal bypass weir, all stormwater that enters the unit receives some treatment via settling and floatation in the influent sump. For influent storm flows at or below the design flow rate, stormwater flows from the sump enter the filter cartridges for treatment and then are discharged to the municipal separated storm sewer system (MS4). Flows bypass the cartridge when they either exceed the design flow rate or the cartridge capacity has been exhausted.

Figure 4.2.1e. Photo of CBSF1 with Covers Removed

The cartridges tested in this study are zeolite-perlite-granular activated carbon (ZPG) cartridges. Each cartridge contains a total of approximately 2.6 cubic feet (CF) of media. The ZPG cartridge consists of an outer layer of perlite that is approximately 1.3 CF in volume and an inner layer, consisting of a mixture of 90 percent zeolite and 10 percent granular activated carbon, which is approximately 1.3 CF in volume. The cartridge is covered by a plastic hood.
The ZPG cartridges are manufactured to meet the specifications described in Ecology's General Use Level Designation (GULD) for Basic Treatment issued January 2005 and updated December 2007.

The manufacturer refers to the filtration process as "siphon-activated filtration" due to processes occurring within the filter. Refer to Figure 4.2.1e for a schematic of the filter cartridge. Stormwater enters each cartridge from the outside and passes through the ZPG media flowing horizontally to the center. As the water rises within the filter, air below the hood is purged via a one-way check valve in the top of the cartridge. A float in the center of each cartridge restricts the stormwater from leaving the cartridge by sealing the exit to the under-drain, causing the stormwater to wet the media evenly and equalizing flow through the media. When stormwater in the filter chamber reaches approximately the top of the float valve, the float lifts and filtered stormwater is allowed to exit the cartridge via the under-drain. This causes the check valve to close which initiates a siphon which draws the stormwater through the filter. When the inflow decreases at the end of the storm, the water level falls below the top of the float and the float falls and reseals the exit to the under-drain.

Figure 4.2.1f. Filter Cartridge Details

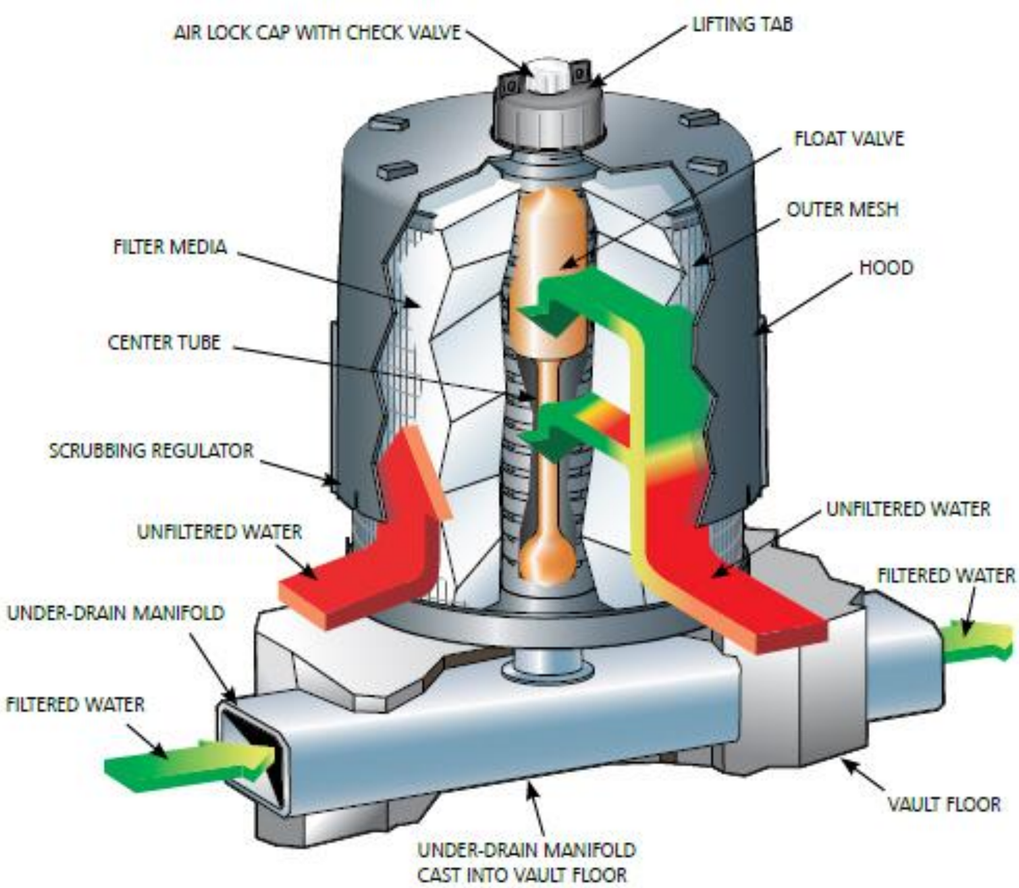


Image from Contech, CPI (http://www.contech-cpi.com)

To meet the conditions of the General Use Level Designation (Ecology 2007a) and prepare the units for monitoring, the following tasks were performed prior to monitoring in February 2009:

- The units were cleaned of sediment and cartridges removed,
- The media was converted from perlite to zeolite-perlite-granular activated carbon (ZPG),
- The individual cartridge flow rate was reduced from 15 gpm to 7.5 gpm by modifying the orifice-control disc placed at the base of the cartridge, and the CBSF1 unit was adapted to accommodate the expected flow rate (discussed below).

Because the CBSF1 basin would not produce enough flow to reach the design flow rate of 0.065 cfs for the four cartridge system, two of the four cartridges were isolated during the monitoring period. This was accomplished by installing plugs in both the 4-inch inlet orifice to the filtration chamber and the 2-inch outlet orifice from the filtration chamber in the northern of the two cartridge chambers. No adaptation was necessary for CBSF2 since the expected flow rate was close to the water quality design flow rate for the entire unit with both filter chambers online[3].

On September 23, 2009 (near the end of WY2009), both units were cleaned of all sediment and all spent cartridges were replaced with recharged cartridges by SPU Field Operations overseen by a Contech representative. Although this was performed earlier than the recommend annual maintenance, it corresponded with annual sediment sampling scheduled for the end of each water year.

4.2.2 Catch Basin StormFilter Monitoring Locations

The two monitored CBSF are located in basins dominated by commercial land use. The drainage basins for CBSF1 and CBSF2 measure approximately 0.18 acres and 0.97 acres, respectively. Most of the basins' area is impervious with the California Ave. SW road surface representing almost all of the CBSF1 drainage basin and approximately 25 percent of the CBSF2 drainage basin. The portion of California Ave. SW where the units are located is swept by regenerative air sweet sweepers approximately every two weeks.

To evaluate the effectiveness of the CBSFs, volume-proportional stormwater composite samples were collected from the influent and treated effluent of each unit. The treatment performance of each unit was evaluated based on comparisons of concentrations measured at these stations (i.e., CBSF1-In versus CBSF1-Out, and CBSF2-In versus CBSF2-Out) to calculate percent removals for each unit.

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[3] Since the final QAPP was submitted, the catchment size for the CBSF2 basin was increased from 0.23 to 0.97 acres due to additional area/runoff from SW Charlestown Street in the block east of California Ave SW which was not included in the original estimate.

Sediment volumes were measured and sediment samples were collected annually, at the end of each water year, from the influent, filter chamber and effluent chambers of each unit.

4.2.2.1 Flow and Water Quality Sampling Equipment

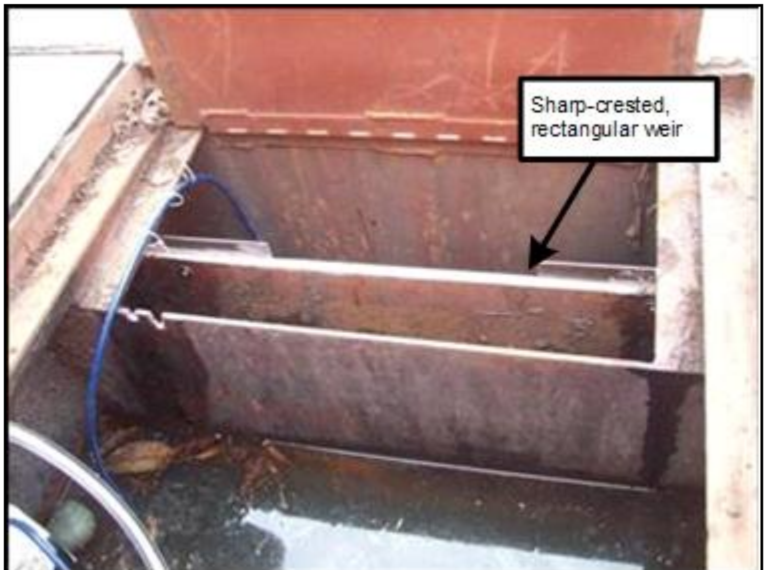
At each CBSF unit, flow was monitored at two locations: 1) in the 8-inch outlet pipe where it discharges into the downstream catch basin (stations identified as: CBSF1-FM and CBSF2-FM), and 2) at the bypass weir within the CBSF units (CBSF1-BP, CBSF2-BP) – refer to Figures 4.2.2.1a and 4.2.2.1b. The CBSF1-FM and CBSF2-FM stations measured a combination of treated effluent and bypassed flow while the CBSF1-BP and CBSF2-BP stations measured bypass flow alone. Since the units have a low hydraulic residence time and do not infiltrate water, the effluent flow is considered to represent both the flow entering and leaving the unit.

Accurate flow monitoring in propriety BMPs is a challenging task since the units are compact and not designed for flow monitoring. To facilitate flow monitoring, a Thel-Mar volumetric weirs were installed in each downstream outlet pipe and the existing, internal bypass weirs were modified into sharp-crested, rectangular weirs. The weirs are primary measurement devices which constrict and reshape the flow, developing a hydraulic head proportional to flow relationship. Each weir was associated with a stilling well and an Instrumentation Northwest PS9805 (0-1 psig) submerged pressure sensor for measuring water depth on the upstream face of the weirs. The presence of the monitoring weirs does not affect the flow dynamics of the units except that the addition of sharp-crested weir at the bypass weir may act to slightly reduce the occurrence of bypass by slightly raising the elevation of the bypass weir.

Figure 4.2.2.1a. Photo of Thel-Mar Weir in Downstream Outlet Pipe of CBSF2

Data from the pressure sensors were recorded on a 5-minute time interval by Campbell Scientific Inc. (CSI) CR1000 data loggers (one data logger for each unit). The data loggers were programmed with standard weir equations to convert recorded water level data to discharge in cubic feet per second. The data loggers were also programmed to control automatic samplers and send alarms based on user-defined conditions. The monitoring equipment layout is discussed below and shown in plan view and side view on Figures 4.2.2.1c and d, respectively.

Figure 4.2.2.1b. Photo of Bypass Weir in CBSF2



Isco 6712 automatic samplers (autosamplers) were configured to collect volume-proportional influent and effluent stormwater composite samples from each CBSF unit. Polyethylene tubing (3/8-inch internal diameter) was routed from the point of sample collection back to the autosamplers. Influent samples (designated CBSF1-In and CBSF2-In) were collected where the untreated roadway runoff enters each unit. Plastic trays were installed directly below the inlet grate to intercept runoff before it mixed with water in the influent sump. The influent sample line intake was placed in the tray. Effluent samples (designated CBSF1-Out and CBSF2-Out) were collected in the manifold beneath the filter cartridges, by inserting the sample tubing approximately 12-inches up the 2-inch outlet orifice from the filtration chamber. This configuration enabled sampling only treated effluent, as opposed to a mix of treated and untreated effluent in the effluent/bypass chamber. Because both filtration chambers were active in CBSF2, the effluent sampler tubing was alternated between each chamber's outlet pipes from event to event. This was done in order to account for any variability in treatment between the filtration chambers.

Figure 4.2.2.1c. CBSF1 Schematic Monitoring Details for (plan view and side view)

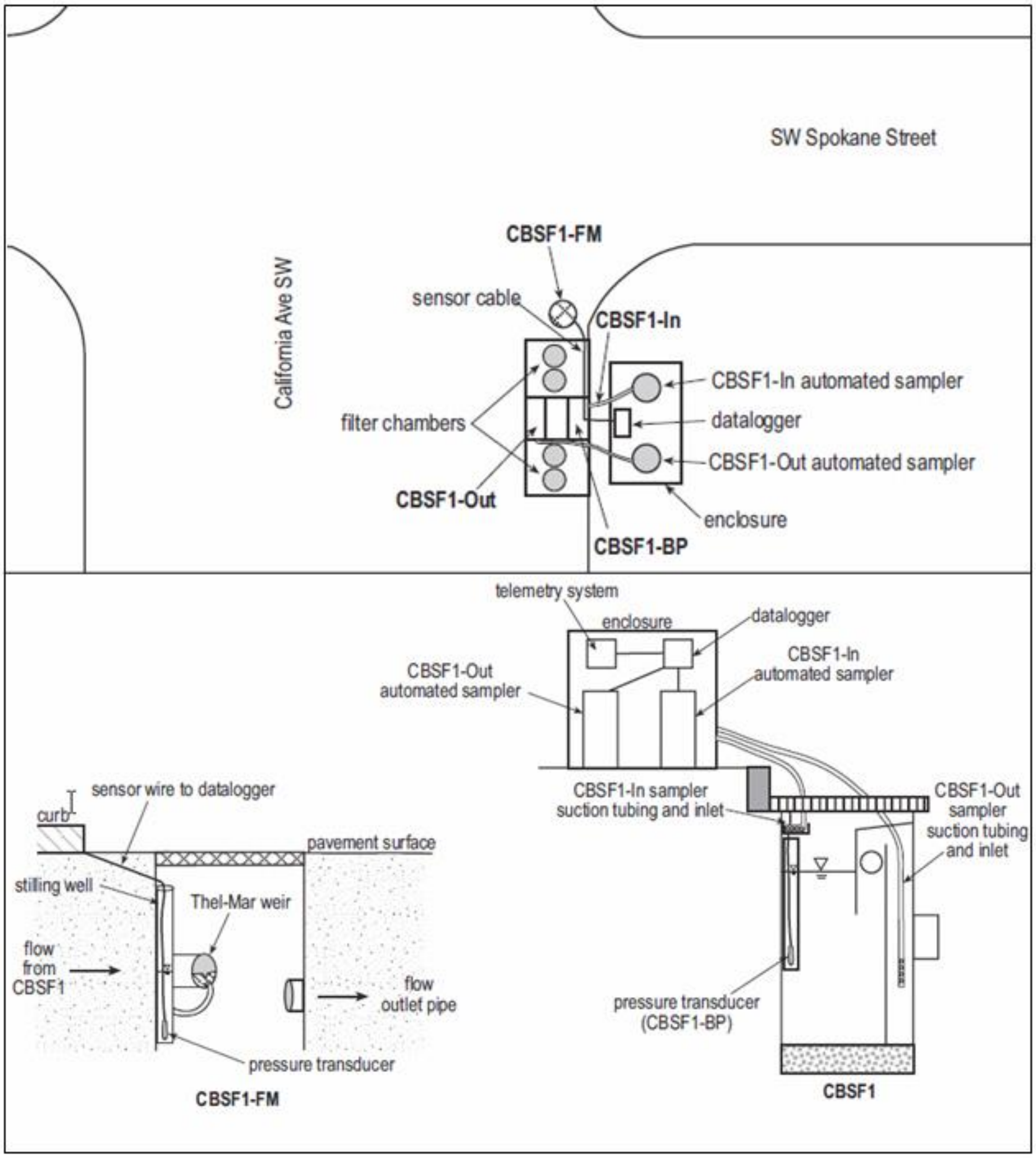
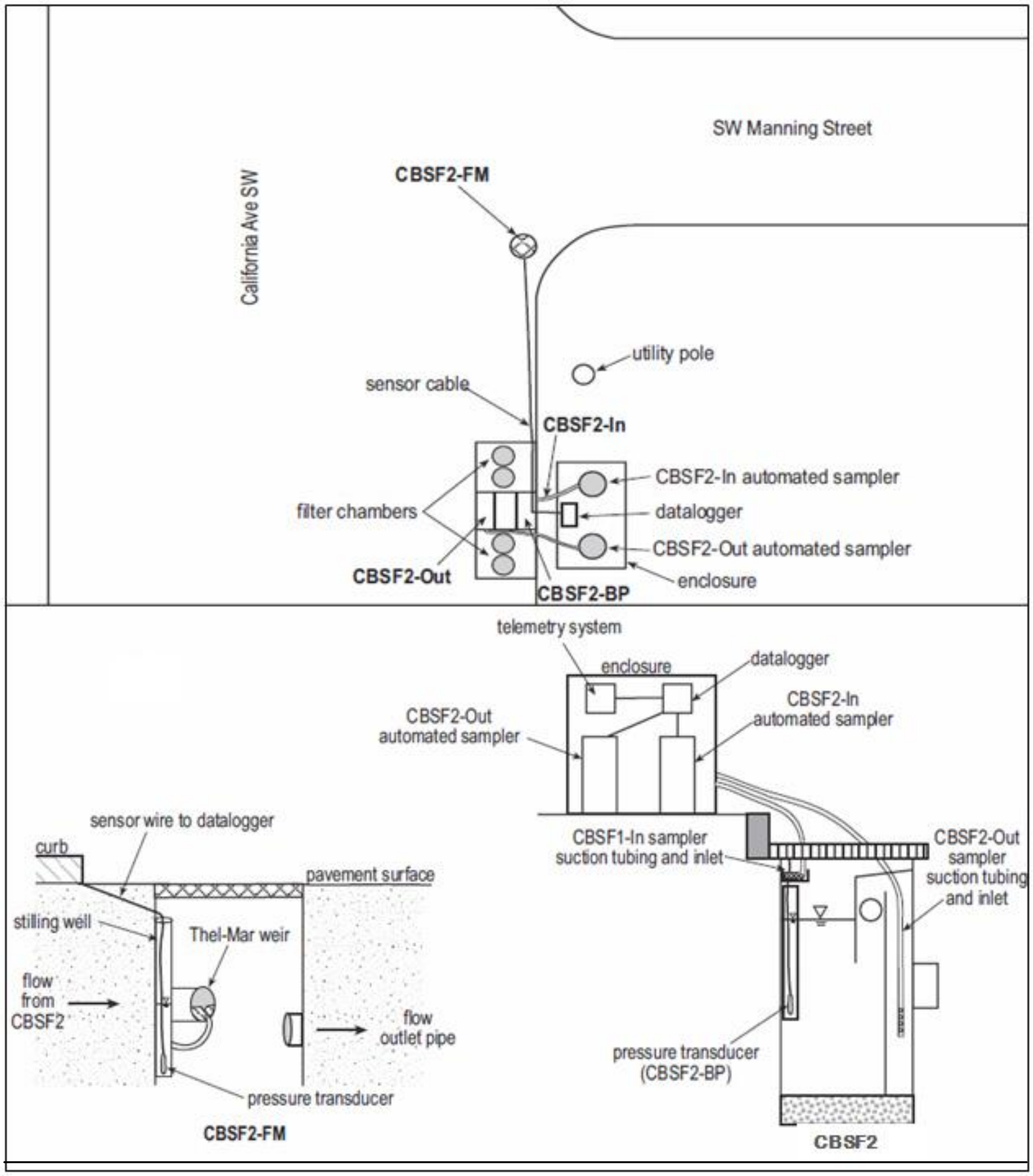


Figure 4.2.2.1d. CBSF2 Schematic Monitoring Details (plan view and side view)



The data logger and autosamplers are housed in an enclosure on the sidewalk immediately adjacent to each unit, and the sample tubing and sensor cables are run in conduits to each sampling/monitoring location. Wireless telemetry provides remote communications with the CR1000. A combination of batteries and solar panels power the loggers and samplers.
SPU rain gauge RG14 (06-689) is used to represent rainfall for both CBSF sites. RG14 is located at Lafayette Elementary School which is located at the corner of California Avenue SW and SW Admiral Way, approximately 0.5 miles north of the CBSF units (see Figure 4.2.1a).

Figure 4.2.2.1e. Photo of Samplers in Equipment Cabinet

Figure 4.2.2.1f. Inlet Chamber showing Sample Tubing

4.2.2.2 Sediment Monitoring Locations

Sediment accumulation and sediment quality were monitored in each chamber of the two CBSF units to quantify the mass and chemical characteristics of particulates retained in each unit at the following locations:

Influent chamber (Stations CBSF1-Sed1 and CBSF2-Sed1)
Filter chamber (Stations CBSF1-Sed2 and CBSF2-Sed2)
Effluent chamber (Stations CBSF1-Sed3 and CBSF2-Sed3).

4.3 Sampling and Monitoring Procedures

SPU staff performed all weather tracking, flow monitoring, stormwater sampling, and sediment monitoring/sampling activities during WY2010.

4.3.1 Weather Tracking/Storm Criteria

Weather and rainfall data were continuously monitored using multiple forecasting, radar and satellite sources to target storms that are anticipated to meet the criteria for a qualifying event, listed in the following table.

Table 4.3.1. Qualifying Event Criteria

Criteria	Requirements
Target storm depth	A minimum of 0.15 inches of precipitation over a 24-hour period
Rainfall duration	Target storms must have a duration of at least one hour
Antecedent dry period	A period of at least 6 hours preceding the event with less than 0.04 inches of precipitation.
Storm capture coverage	75% (for storms longer than 24 hours, 75% of first 24 hours)
End of storm	A continuous 6-hour period with less than 0.04 inches of precipitation.

4.3.2 Precipitation Monitoring Procedures

SPU collects precipitation data from a network of 17 tipping bucket rain gages located throughout the City of Seattle. Precipitation data are aggregated over one-minute intervals and transmitted via wireless telemetry to a centralized server. The rain gage network is operated and maintained under contract by ADS Environmental Services, Inc. (ADS).

Rain gage inspection and maintenance is performed on a quarterly basis. Maintenance includes: checking the levelness of the gage and re-leveling, if necessary; and cleaning of filter screens, drain holes and siphons. Gages are verified and calibrated annually by sending a known volume of water through the gage a minimum of two times, averaging the gage's measurement and comparing the average to the known volume. If the measurement is greater than +/- 2 percent of the actual volume the gage is adjusted in the field until it reads within 2 percent or replaced with another gage, and the inaccurate gage is sent back to the manufacturer for calibration.

All maintenance and calibration activities and any observed problems are recorded on a data sheet for documentation and quality assurance purposes..

4.3.3 Flow Monitoring Procedures

Flow monitoring equipment type and configuration at each station are described in Section 4.2.2.1. Level and flow data were logged at five-minute intervals. Flow monitoring quality assurance/quality control procedures are discussed in Section 4.3.7.1.

4.3.4 Water Quality Sampling Procedures

Volume-proportioned stormwater composite samples were collected using Isco 6712 autosamplers. The samplers utilize a peristaltic pump to draw stormwater from the strainer installed at the sampling location and distribute it to one 20 liter (L) polyethylene ("poly") composite bottle in the sampler base.

The data loggers were programmed to trigger the influent and effluent samplers every time a specified volume (referred to as the "trigger volume") was measured at the outlet flow monitoring station of each CBSF, creating a volume-proportional composite. Each CBSF has one data logger which triggered the influent and effluent samplers simultaneously. Each trigger sent resulted in each sampler collecting one stormwater aliquot which was deposited into the 20L composite bottle in the sampler's base. Each aliquot measured 200mL so the composite bottles could receive 100 aliquots before filling. Bottles were removed and replaced as necessary through the course of the sampled storm events.

Since stormwater samples, especially stormwater solids concentrations and related contaminants, are easily biased without proper processing procedures; all composite samples were composited and split in SPU's Water Quality Laboratory (WQL) using large, custom-made polyethylene churn splitters.

4.3.5 Sediment Monitoring and Sampling Procedures

Sediment accumulation was measured in each chamber of the two CBSFs to quantify the mass that was deposited over the water year. Sediment accumulation was monitored on a quarterly basis using a custom-made tool consisting of graduated rods and plates that rest on the sediment surface. Sediment was sampled for chemical analysis annually at the end of the water year.

During the annual sediment sampling event, overlying water was removed using a City vactor truck and the sediment depth was measured using an engineer's tape measure. Sediment depth was measured at five locations (four corners and the center) in each chamber, and the depths were averaged to determine the average sediment depth per chamber.

One sediment composite sample was collected from each chamber. Since both filter chambers are active in CBSF2, one composite was generated from sediments collected from both chambers. Sediment from at least five locations in each chamber was collected using a stainless steel spoon. The sediment from each chamber was placed in a stainless steel bowl and homogenized by mixing and turning with the spoon. Any foreign debris (e.g., cigarette butts, trash, and inorganic debris greater than 2 centimeters) was removed. Remaining sediment was transferred into analyte-specific bottles.

Following sediment monitoring and sampling, all accumulated sediment was removed and the units were maintained per the manufacturer's instructions.

4.3.6 Decontamination Procedures

All water quality and sediment sampling equipment - which includes sampler tubing, sample bottles, churn splitters, and stainless steel spoons and bowls - were decontaminated with the following procedure:

1. Wash in a solution of laboratory-grade, non-phosphate soap and tap (city) water.
2. Rinse in tap water.
3. Wash in a 10 percent nitric acid/deionized water solution.*
4. Rinse in deionized water.
5. Final rinse in deionized water.

** Nitric wash omitted for stainless steel equipment*

4.3.7 Sampling and Monitoring QA/QC Procedures

4.3.7.1 Precipitation Monitoring QA/QC Procedures

All raw rainfall data were reviewed by ADS on a monthly basis. Data were reviewed for errors such as periods of no recorded rainfall when nearby rain gages recorded rain, excessive or unrealistic measured rainfall, periods of non-rain tips due to calibration or other activity, and other indicators of inaccurate data. Maintenance and calibration data sheets were reviewed to inform the data evaluation. Raw rainfall data were edited to remove erroneous or test tips which were recorded on a monthly edit log. Areas of missing data were either filled using transposed data from the nearest working gage or data was replaced with "*". All rain data were flagged with one of the four following qualifiers: 1) "*" - no data, 2) "R" – raw, unedited data, 3) "T" – data transposed from the nearest rain gage with validated data, and 4) "V" – validated data (confirmed accurate or made accurate by deletion of erroneous data).

4.3.7.2 Flow Monitoring QA/QC Procedures

Level and flow data were automatically downloaded on a daily basis. On a monthly basis, the data were inspected for any significant trends in reliability and/or accuracy (i.e., substantial level jump, spikes, flat-line data, or no data). If anomalies were observed, a field crew was deployed to troubleshoot and calibrate the sensors.

Routine maintenance visits were performed on a monthly basis, prior to every storm event, or as needed based on remote real-time checks or data reviews. During these visits, sensors were adjusted to exact level based on manual measurements for the bypass sensors, or by topping off the Thel-Mar weirs and zeroing the transducers for the outlet sensors. As part of the calibration tracking procedure, level values before and after calibration were recorded. If the before and after values differed by than more than 0.02 feet, the data were corrected for the level drift. The difference between these values was also tracked over time to assess long-term drift which triggers sensor replacement.

Raw level data and rain data were transferred into an Isco Flowlink® database for review and editing. Level data were edited using proportional, fixed offset and constant value correction tools based on before and after values recorded during each maintenance visit, and corresponding rain data. Finalized level data were converted to flow rates using a manufacturer-provided lookup table for the Thel-Mar weir (outlet) stations and a standard 1-foot rectangular weir with end contraction equation for the bypass stations. Only edited/finalized data were used for calculations and presented in this report.

4.3.7.3 Field QC Sample Collection Procedures

During WY2010, numerous field QC samples were collected to evaluate the sampling operation and to quantify and document bias that can occur in the field. QC samples provide the ability to assess the quality of the data produced by field sampling and provide a means for quantifying sampling bias.

The following table lists the types of QC samples collected, description of how the QC samples were collected, the purpose and information provided by each sample and the number of samples collected during WY2010.

Table 4.3.7.3. CBSF QC Sample Summary

QC Sample Type	Code	Description	Purpose/Info Provided	Number Collected WY2010	Collected on
Field Split Sample	FSS	Primary Environmental Sample (PES) split by field staff	Quantify variability from laboratory procedures	5	Stormwater composite samples
Field Blank Sample	FBS	Blank water passed through decontaminated sampling equipment in the field	Tests cleaning procedures and quantifies contamination from field sampling activities	4	Autosampler tubing
Field Duplicate Sample	FDS	Simultaneous sample collected at same location as PES	Quantify variability from field sampling activities Quantify variability from laboratory procedures	1	Sediment samples

The field split samples were generated in the laboratory by filling two identical analyte-specific containers simultaneously from the churn splitter. Field stormwater split samples were collected at frequency of 12.5 percent of the stormwater samples collected.

The tubing blanks were made by field staff passing reagent grade deionized water through decontaminated sample sampler and pump tubing and capturing the blank water in analyte-specific bottles.

The sediment field duplicate samples were collected by field staff simultaneously filling analyte-specific containers from the homogenized sediment sample. Field duplicate sediment samples were collected at frequency of 16.7 percent of the sediment samples collected.

4.4 Analytical QA/QC Procedures, Methods and Reporting Limits

4.4.1 Analytical QA/QC Procedures

All laboratory data packages received included a hardcopy report and an electronic data deliverable (EDD). The laboratory case narratives were reviewed with each sample delivery group for quality control issues and corrective action taken. The data were evaluated for required method, reporting limit (RL), package completeness, holding time, blank contamination, accuracy and precision.

Each EDD was imported into a validation and review database, where deviations from the Measurement Quality Objectives (MQOs – in QAPP) were identified and associated samples were qualified accordingly. Qualification details are included in Appendix C.4.

4.4.2 Analytical Methods and Reporting Limits

Refer to Appendix C.4 for analytical parameters, methods and reporting limits used for this project and related discussion.

4.5 Sampling Event Summary

This section presents a summary of events sampled during WY2010. This was the first full water year of stormwater sampling at the two CBSF sites. During WY2009, two events were sampled at each CBSF unit, designated SE-01 and SE-02, for a total of four sample influent/effluent sample pairs. Event numbering was continued sequentially from the previous water year so the first events collected during WY2010 are designated SE-03.

4.5.1 Stormwater Samples

Ten storm events, designated Storm Event (SE)-03 though SE-12, were successfully sampled at each of the two monitored CBSF locations during WY2010. These events qualified for all rainfall and sampling criteria. One event at CBSF1 from February 10-11, 2010 was sampled and submitted to the laboratory but later discarded because it failed to meet the 75% storm capture requirement, so data from this event are not included in this report. All remaining events meet all required storm and sampling criteria without exception, so no qualification of the event criteria is required.

The hydrologic data for each WY2010 event, including precipitation, flow and sample information, are presented in Table 4.5.1. Event specific flow, rainfall and aliquot information are graphically presented in site- and event-specific hydrographs presented in Appendix C.5

4.5.2 Sediment Sampling

Annual sediment accumulation monitoring and sampling was performed on September 28, 2010. Approximately one year earlier on September 23, 2009, both CBSFs were maintained which included cleaning all sediment and replacing the filter cartridges. Thus, the sediment monitoring and sampling documented in this report is representative of one year of accumulation.

Sediment depth was measured in all chambers. Sufficient quantities of sediment were present in all three chambers of both CBSFs to submit samples for analysis.

4.6 Sampling Results

The following section discusses the results of the Catch Basin Stormfilter BMP samples collected during WY2010. Since the two monitored units are structurally identical, data from both units will be pooled to evaluate performance. With a total of four paired samples collected in WY2009 and an additional 20 paired samples collected during the current water years, the total sample number for the evaluation by the end of the WY2010 was 24.

4.6.1 Water Quality Samples – Summary Data

The results of the ten events sampled are summarized in Tables 4.6.1a and b, with results for all parameters shown including qualifiers. For summary purposes, all influent data from both sites are summarized on the first table and all effluent data from both sites is summarized on the second table. Later in the report, monitoring results are presented with statistical information and performance efficiencies calculated. All water chemistry analysis was performed by SPU's Water Quality Laboratory with the exception of Particle Size Distribution, which was analyzed by Analytical Resources, Inc (ARI) in Tukwila, Washington.

4.6.1.1 Particle Size Distribution Results

Ecology's guidance for "Evaluation of the Emerging Stormwater Technologies" (hereafter referred to as "TAPE" for Technology Assessment Protocol – Ecology) states that treatment technologies must be capable of removing TSS across size fraction ranges typically found in urban runoff and that field data from Pacific Northwest studies show that most total suspended solid (TSS) particles are silt-sized particles. Table 4.6.1.1 summarizes particle size distribution data measured during WY2010.

Table 4.6.1.1. Particle Size Distribution Summary Data

Particle Size (microns)	Wentworth Scale Name	Influent Distribution (% of total)	Effluent Distribution (% of total)	Mass Percent Reduction
> 500	Coarse sand and greater	47.3%	1.9%	99.2%
500 to 250	Medium sand	8.3%	1.6%	96.0%
250 to 125	Fine Sand	1.7%	1.5%	81.7%
125 to 62.5	Very fine sand	3.5%	6.2%	63.3%
62.5 to 3.9	Silt	20.0%	46.0%	52.1%
3.9 to 1	Clay	11.0%	24.1%	54.6%
< 1	Colloids	8.2%	18.7%	52.2%

For influent samples, the largest percentages of particles measured are classified as coarser than medium sand with the silt-sized particles representing the second largest fraction by percent. Technically, TSS particles do not include particle sizes greater than 500 microns so the largest TSS-sized fractions measured on the influent samples are in the silt-size range. The CBSFs consistently treated all ranges of particle sizes ranging from mass reductions (based on average mass in each range) of 99 percent for the coarsest fraction to 52 percent for the finest fraction.

Table 4.5.1. CBSF Event Hydrologic Data

Analyte Name	Goal	SE-03	SE-04	SE-05	SE-06	SE-07	SE-08	SE-09	SE-10	SE-11	SE-12
CBSF1											
Storm Event Start	NA	21-OCT-2009 05:00	25-OCT-2009 07:40	05-NOV-2009 10:00	14-DEC-2009 09:00	11-MAR-2010 01:30	25-MAR-2010 04:00	02-APR-2010 05:00	19-MAY-2010 14:00	01-JUN-2010 22:00	08-JUN-2010 21:00
Storm Event End	NA	21-OCT-2009 13:45	26-OCT-2009 13:05	06-NOV-2009 12:00	15-DEC-2009 03:00	11-MAR-2010 13:30	26-MAR-2010 10:00	02-APR-2010 13:30	20-MAY-2010 03:00	02-JUN-2010 11:30	09-JUN-2010 12:30
Storm Event Duration (hrs)	>1	8.8	29.4	26	18	12	30	8.5	13	13.5	15.5
6-hr Antecedent Rainfall (in)	<= 0.04	0	0.01	0	0	0	0	0	0	0.01	0
24-hr Antecedent Rainfall (in)	NA	0	0.01	0	0	0.05	0	0.01	0	0.01	0
Event Rainfall (inches)	>= 0.15	0.19	0.95	0.94	0.41	0.3	0.5	0.49	0.4	0.27	0.45
Event Rainfall Max (in/hr)	NA	0.07	0.23	0.21	0.12	0.11	0.11	0.12	0.75	0.11	0.11
Event Rainfall Mean (in/hr)	NA	0.004	0.010	0.018	0.008	0.009	0.006	0.008	0.01	0.007	0.005
Event Runoff Flow Max (cfs)	NA	0.005	0.165	0.10	0.023	0.02	0.12	0.02	0.36	0.02	0.05
Event Runoff Flow Mean (cfs)	NA	0.0002	0.0017	0.002	0.0005	0.001	0.002	0.0008	0.002	0.0006	0.0004
Event Runoff Flow Volume (cf)	NA	30.19	714.3	304.0	87.0	94.4	190.2	173.0	175.7	84.5	114.9
Event Bypass Max (cfs)	NA	0	0.13	0.08	0.03	0.02	0.09	0.02	0.37	0.02	0.05
Event Bypass Mean (cfs)	NA	0	0.0009	0.001	0.0005	0.0009	0.001	0.0007	0.002	0.0006	0.0008
Storm Event Bypass Volume (cf)	NA	0	408.4	73.0	113.6	46.0	106.5	150.5	160.4	63.4	146.5
No. Composite Sample Aliquots	>= 10	14	140	25	16	23	147	73	78	16	24
Event Flow Volume Sampled (%)	>= 75	87.8	99.3	97.2	92.6	97.5	99.8	99.8	99.2	94.5	95.7
CBSF2											
Storm Event Start	NA	25-OCT-2009 14:00	05-NOV-2009 10:00	14-DEC-2009 09:00	16-DEC-2009 09:00	04-FEB-2010 21:00	10-FEB-2010 11:00	11-MAR-2010 01:30	25-MAR-2010 04:00	19-MAY-2010 14:00	01-JUN-2010 22:00
Storm Event End	NA	26-OCT-2009 14:30	06-NOV-2009 12:00	15-DEC-2009 03:00	17-DEC-2009 02:00	05-FEB-2010 12:00	11-FEB-2010 13:00	11-MAR-2010 13:30	26-MAR-2010 03:00	20-MAY-2010 05:00	02-JUN-2010 11:30
Storm Event Duration (hrs)	>1	24.5	26	18	17	15	26	12	23	15	13.5
6-hr Antecedent Rainfall (in)	<= 0.04	0	0	0	0.02	0	0	0	0	0	0.01
24-hr Antecedent Rainfall (in)	NA	0.01	0	0	0.31	0.04	0	0.05	0	0	0.01
Event Rainfall (inches)	>= 0.15	0.95	0.94	0.41	0.41	0.16	0.23	0.3	0.5	0.4	0.27
Event Rainfall Max (in/hr)	NA	0.23	0.21	0.12	0.12	0.14	0.11	0.11	0.11	0.75	0.11
Event Rainfall Mean (in/hr)	NA	0.01	0.02	0.008	0.009	0.006	0.01	0.009	0.006	0.01	0.007
Event Runoff Flow Max (cfs)	NA	0.15	0.16	0.17	0.17	0.14	0.20	0.09	0.15	0.45	0.07
Event Runoff Flow Mean (cfs)	NA	0.004	0.006	0.01	0.01	0.002	0.007	0.005	0.003	0.006	0.002
Event Runoff Flow Volume (cf)	NA	1148.6	796.5	1856.8	1199.5	178.2	202.3	319.4	723.2	554.9	287.4
Event Bypass Max (cfs)	NA	0.09	0.09	0.06	0.06	0.1	0.08	0.03	0.10	2.1	0.04
Event Bypass Mean (cfs)	NA	0.0005	0.0002	0.0004	0.0004	0.0005	0.001	0.0005	0.002	0.007	0.0004
Storm Event Bypass Volume (cf)	NA	171.9	0	108.2	21.3	0	2.9	0.02	220.6	340.4	36.0
No. Composite Sample Aliquots	>= 10	51	25	100	76	27	29	14	141	50	15
Event Flow Volume Sampled (%)	>= 75	97.2	93.3	86.9	99	97.9	96.8	89.1	99.6	98.6	97.1

Notes – Data are preliminary and may be revised when finalizing study in WY2011.
NA – not applicable.

Table 4.6.1a. Analytical Summary –CBSF Influent Stormwater Samples (both sites)

Analyte	Result Units	SE-03	SE-03	SE-04	SE-04	SE-05	SE-05	SE-06	SE-06	SE-07	SE-08	SE-07	SE-09	SE-08	SE-10	SE-09	SE-10	SE-11	SE-11	SE-12	SE-12
		CBSF1-IN	CBSF2-IN	CBSF1-IN	CBSF2-IN	CBSF1-IN	CBSF2-IN	CBSF1-IN	CBSF2-IN	CBSF2-IN	CBSF2-IN	CBSF1-IN	CBSF2-IN	CBSF1-IN	CBSF2-IN	CBSF1-IN	CBSF1-IN	CBSF2-IN	CBSF1-IN	CBSF2-IN	CBSF1-IN
		10/21/09	10/25/09	10/25/09	11/05/09	11/05/09	12/14/09	12/14/09	12/16/09	02/04/10	02/10/10	03/11/10	03/11/10	03/25/10	03/25/10	04/02/10	05/19/10	05/19/10	06/01/10	06/01/10	06/08/10
Nutrients																					
Phosphorus, Total	mg-P/L	0.232	0.103 J	0.105	0.125	0.193	0.117 J	0.211	0.073 J	0.016 J	0.087 J	0.129 J	0.079 J	0.17	0.098	0.067	0.268 J	0.111 J	0.079 J	0.044 J	0.027 J
Orthophosphate	mg-P/L	0.097 J	0.038 J	0.040 J	0.032 J	0.077 J	0.043 J	0.033 J	0.012 J	0.0086	0.014	0.019	0.014	0.026	0.022	0.014	0.100 J	0.037 J	0.006 J	0.006 J	0.007 J
Metals																					
Copper, Total	ug/L	19.7	7.24	10.7	9.1	14.2	19.1	29.1	11.6	6.33	14.9	22.6	10.3	30.3	20.5	13.5	37.9	33.7	11	13.1	20.5
Copper, Dissolved	ug/L	10.4	2.75	3.53	3.66	6.19	7.04	4.59	3.12	2.88	4.57	7.46	4.48	8.78	4.88	5.16	14.7	7.41	7.47	4.84	6.92
Zinc, Total	ug/L	81.2	36.9	53.6	47.1	74.2	91.9	135	48.7	36.5	80.8	68.2	52	136	121	61	180	184	53.3	70	99.9
Zinc, Dissolved	ug/L	34.1 J	15.7 J	18.8 J	18.5 J	32.3 J	27.1 J	18.5 J	17.2 J	13.8 J	20.7 J	26.7 J	19.5 J	29.6 J	22.2 J	22.2 J	51.5 J	29.4 J	38.7 J	23.3 J	38.2 J
Conventionals																					
pH	std units	7.32	6.99	6.98	7.09	7.07	7 J	6.75 J	7.23	7.4	7.37	7.2	7.12	7.03	7.06	6.95	6.72	6.88	7.32 J	7.16 J	6.8
Solids, Total Suspended	mg/L	92.5 J	34.8	93.5	29.3 J	54.5 J	61 J	105 J	39.5	5.95 J	52.2 J	29.5	25.6	154 J	119	38.6	221	360	30.4	44	96.3
Hardness	mg/L CaCO3	21.8	9.66	10.3	16.1	19.1	14.6	8.46	11.4	14.1	17.7	15.4	13.1	17.9	13.5	8.37	37.1	21.7	16.6	14.7	18.7
Misc.																					
Sediment Conc. > 500 um	mg/L	69.61 J	13.99 J	43.27 J	0.34 J	7.92 J	20.45 J	105 J	9.19 J	6.73 J	23.19 J	3.51 J	25.89 J	91.85 J	123.3 J	3.29 J	186.5 J	107.4 J	6.95 J	53.64 J	46.18 J
Sediment Conc. 500 to 250 um	mg/L	4.66 J	9.22 J	6.36 J	0.45 J	5.1 J	4.61 J	12.77 J	1.84 J	1.35 J	4.3 J	0.36 J	4.49 J	13.41 J	24.48 J	1.88 J	9.77 J	30.99 J	0.7 J	10.92 J	18.67 J
Sediment Conc. 250 to 125 um	mg/L	0.01 UJ	0.01 UJ	0.01 UJ	0.01 UJ	0.01 UJ	0.01 UJ	0.01 UJ	0.01 UJ	0.01 UJ	0.01 UJ	0.01 UJ	0.01 UJ	0.09 J	0.01 UJ	0.01 UJ	8.33 J	18.9 J	3.97 J	2.4 J	0.62 J
Sediment Conc. 125 to 62.5 um	mg/L	0.01 UJ	0.01 UJ	0.01 UJ	0.01 J	0.01 UJ	0.01 UJ	0.01 UJ	0.01 UJ	0.01 UJ	0.01 UJ	0.01 UJ	0.01 UJ	14.38 J	0.01 UJ	0.01 UJ	15.01 J	25.9 J	8.05 J	3.53 J	3.35 J
Sediment Conc. 62.5 to 3.9 um	mg/L	12.31 J	25.18 J	28.08 J	21.53 J	30.06 J	0.03 J	19.52 UJ	0.01 UJ	0.01 J	24.93 J	14.43 J	0.01 UJ	52.05 J	23.67 J	0.01 UJ	50.05 J	53.81 J	21.63 J	8.15 J	14.76 J
Sediment Conc. 3.9 to 1 um	mg/L	24.49 J	5.25 J	4.32 J	4.54 J	4.72 J	27.81 J	6.19 J	44.1 J	6.42 J	6.89 J	10.36 J	8.53 J	7.64 J	29.43 J	11.56 J	6.46 J	5.05 J	3.67 J	1.01 J	2.34 J
Sediment Conc. < 1 um	mg/L	10.2 J	1.58 J	1.61 J	1.95 J	1.22 J	16.19 J	2.29 J	55.9 J	9.51 J	3.89 J	5.37 J	12.53 J	4.85 J	14.71 J	15.14 J	2.66 J	2.54 J	0.79 J	0.46 J	0.01 J

Notes:
U - Analyte was not detected above the reported result.
J- Analyte was positively identified. The reported result is an estimate.
UJ- Analyte was not detected above the reported estimate.

Table 4.6.1b. Analytical Summary – CBSF Effluent Stormwater Samples (both sites)

		SE-03	SE-03	SE-04	SE-04	SE-05	SE-05	SE-06	SE-06	SE-07	SE-08	SE-07	SE-09	SE-08	SE-10	SE-09	SE-10	SE-11	SE-11	SE-12	SE-12
		CBSF1-OUT	CBSF2-OUT	CBSF1-OUT	CBSF2-OUT	CBSF1-OUT	CBSF2-OUT	CBSF1-OUT	CBSF2-OUT	CBSF2-OUT	CBSF2-OUT	CBSF1-OUT	CBSF2-OUT	CBSF1-OUT	CBSF2-OUT	CBSF1-OUT	CBSF1-OUT	CBSF2-OUT	CBSF1-OUT	CBSF2-OUT	CBSF1-OUT
Analyte	Result Units	10/21/09	10/25/09	10/25/09	11/05/09	11/05/09	12/14/09	12/14/09	12/16/09	02/04/10	02/10/10	03/11/10	03/11/10	03/25/10	03/25/10	04/02/10	05/19/10	05/19/10	06/01/10	06/01/10	06/08/10
Nutrients																					
Phosphorus, Total	mg-P/L	0.218	0.045 J	0.109	0.114	0.212	0.112 J	0.109	0.069 J	0.018 J	0.064 J	0.087 J	0.049 J	0.0782	0.075	0.066	0.134 J	0.077 J	0.042 J	0.0398 J	0.058
Orthophosphate	mg-P/L	0.054 J	0.024 J	0.033 J	0.038 J	0.085 J	0.022 J	0.032 J	0.011 J	0.009	0.011	0.015	0.016	0.0336	0.019	0.019	0.029 J	0.021 J	0.016 J	0.0023 J	0.027 J
Metals																					
Copper, Total	ug/L	15.1	3.95	6.88	7.72	11.3	13.5	17.3	8.29	5.23	10.9	11.3	8.68	15.9	12	8.53	19.4	25.9	8.41	8.98	11.3
Copper, Dissolved	ug/L	10.2	2.26	2.21	5.13	6.01	6.65	6.54	3.72	3.34	5.46	7.34	5.71	10.4	6.88	5.79	11.8	11.3	5.48	4.97	7.79
Zinc, Total	ug/L	55.8	17.5	30.2	38.2	49.4	54.5	63.1	38.2	28.6	52.9	43.1	35.6	56.3	53.4	37.8	96.2	91.2	42.6	43	62.1
Zinc, Dissolved	ug/L	31.9 J	12 J	15.2 J	29.6 J	22.9 J	29.6 J	21.5 J	19.6 J	21.3 J	28.5 J	28.7 J	22.4 J	40.2	29.1 J	28.8 J	76.2 J	53.8 J	35.2 J	26.7 J	54.7 J
Conventionals																					
pH	std units	7.34	6.97	7.02	7.09	7.07	6.85 J	7.07 J	7.11	7.3	7.36	7.05	7.12	6.72	7.01	6.71	6.44	6.7	6.86 J	7.2 J	6.54
Solids, Total Suspended	mg/L	26.5 J	11.6	20.9	14.3 J	24.4 J	22.2 J	31.8 J	9.76	19.6 J	20 J	9.55	11.5	6.11	16.3	7.22	19.1	30.6	15.7	17.2	11 J
Hardness	mg/L CaCO3	29.5	7.6	12.4	17.1	22.8	19.2	11.4	11.4	16.7	21.6	19.2	13.8	23.5	13.2	15	40.9	19.7	20.9	13.4	23.9
Misc.																					
Sediment Conc. > 500 um	mg/L	0.01 UJ	0.01 UJ	0.11 J	0.34 J	0.34 J	0.11 J	0.01 UJ	0.01 UJ	0.12 J	0.01 UJ	0.01 UJ	0.01 UJ	0.01 UJ	2.33 J	0.11 J	0.85 J	2.6 J	0.21 J	0.34 J	0.34 J
Sediment Conc. 500 to 250 um	mg/L	0.01 UJ	0.01 UJ	0.01 UJ	0.45 J	1.49 J	0.01 UJ	0.01 UJ	0.01 UJ	1.17 J	0.34 J	0.01 UJ	0.5 J	0.01 UJ	0.01 UJ	0.01 J	0.73 J	0.34 J	0.11 J	1.01 J	0.34 J
Sediment Conc. 250 to 125 um	mg/L	0.01 UJ	0.01 UJ	0.01 UJ	0.01 UJ	0.01 UJ	0.01 UJ	0.01 UJ	0.01 UJ	0.01 UJ	0.01 UJ	0.01 UJ	0.01 UJ	0.01 UJ	0.01 UJ	0.01 J	1.76 J	2.55 J	1.28 J	0.43 J	0.15 J
Sediment Conc. 125 to 62.5 um	mg/L	0.01 UJ	0.01 UJ	0.01 UJ	0.01 UJ	0.01 UJ	0.01 UJ	0.01 UJ	0.01 UJ	0.01 UJ	0.01 UJ	0.01 UJ	0.01 UJ	0.01 UJ	0.01 UJ	0.01 J	6.5 J	7.01 J	4.07 J	1.34 J	6.72 J
Sediment Conc. 62.5 to 3.9 um	mg/L	4.6 J	15.06 J	17.2 J	21.53 J	49.14 J	0.01 UJ	1.62 J	0.01 UJ	0.01 UJ	15.52 J	0.01 UJ	0.01 UJ	0.01 UJ	0.01 UJ	0.01 J	16.78 J	15.05 J	8.75 J	3.08 J	23.14 J
Sediment Conc. 3.9 to 1 um	mg/L	33.65 J	3.88 J	3.5 J	4.54 J	7.8 J	1.75 J	1.69 J	5.18 J	3.92 J	4.68 J	3.83 J	1.01 J	4.49 J	7.23 J	2.97 J	2.09 J	1.32 J	1.77 J	0.35 J	4.52 J
Sediment Conc. < 1 um	mg/L	15.04 J	1.07 J	1.3 J	1.95 J	3.07 J	2.25 J	0.7 J	6.82 J	7.37 J	2.78 J	6.63 J	1.65 J	8.19 J	10.58 J	5.1 J	0.86 J	0.95 J	0.54 J	0.18 J	1.01 J

Notes:
U - Analyte was not detected above the reported result.
J- Analyte was positively identified. The reported result is an estimate.
UJ- Analyte was not detected above the reported estimate.

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4.6.2 Sediment Monitoring and Sampling

Sediment depth was monitored to determine average depth in each chamber of the CBSFs. The average depth was converted to volume and mass using the unit dimensions and density data calculated by ARI. Sediment sample chemical and geotechnical analysis was performed by ARI.

4.6.2.1 Sediment Accumulation Monitoring

The results of the sediment accumulation monitoring are presented in Table 4.6.2.1. The sediment accumulation period for both units was from September 23, 2009 to September 28, 2010 (370 days).

Table 4.6.2.1. CBSF Sediment Accumulation Data

Location (chamber)	ID	Average Sediment Depth (ft)	Sediment Volume (CF)	Wet Density (lbs/CF)	Dry Density (lbs/CF)	Wet Sediment Mass (kg)	Dry Sediment Mass (kg)	Total Wet Sed Mass per Unit (kg)	Total Dry Sed Mass per Unit (kg)
CBSF1-Influent	CBSF1-Sed1	0.75	3.03	68.1	12.8	93.8	17.6	102.1	19.1
CBSF1-Filter	CBSF1-Sed2	0.03	0.24	68.8	11.7	7.5	1.3		
CBSF1-Effluent	CBSF1-Sed3	0.03	0.03	69.8	15.7	0.8	0.2		
CBSF2-Influent	CBSF2-Sed1	1.25	5.05	73.5	22.6	168.7	51.9	225.9	65.8
CBSF2-Filter	CBSF2-Sed2	0.11	1.65	68.8	14.9	51.6	11.2		
CBSF2-Effluent	CBSF2-Sed3	0.14	0.14	87	41.8	5.5	2.7		

The annual sediment accumulation amounts indicate that the default annual maintenance cycle is sufficient since sediment depths in the filter chambers were below the manufacturer’s 2-inch (0.16 foot) trigger level for maintenance. The annual accumulated sediment depth measured on top of the cartridges ranged from 0-0.25 inches which was also below the 0.5-inch maintenance trigger level.

The sediment accumulation monitoring measured most, but not all, all of the sediment captured by the units over the accumulation period. The unmeasured portion was captured by the filter cartridges. Due to difficulties quantifying the mass or volume retained in the cartridges, which is considered negligible compared to solids settled in the chambers, the sediment retained in the cartridges was not quantified.

4.6.2.2 Sediment Sampling

The results of sediment samples collected from the two locations are summarized in Table 4.6.2.2. The fines portion (clay to coarse silt) of the grain size analysis was not performed on several samples (noted with "NM" in the table) because the sample did not contain the required 5 grams of fines in the pipette portion of the analysis.

Table 4.6.2.2. Analytical Summary - CBSF Sediment Data

		CBSF1 Chamber						CBSF2 Chamber					
		Influent		Filter		Outlet		Influent		Chamber		Outlet	
		CBSF1-SED1		CBSF1-SED2		CBSF1-SED3		CBSF2-SED1		CBSF2-SED2		CBSF2-SED3	
Analyte	Units	09/28/10		09/28/10		09/28/10		09/28/10		09/28/10		09/28/10	
Petroleum Hydrocarbons													
Gasoline Range Hydrocarbons	mg/kg	160		110	J	39	UJ	54	J	59	J	11	UJ
Diesel Range Hydrocarbons	mg/kg	300		650		240		360		510		240	
Motor Oil	mg/kg	2400		4500		2000		2100		3300		1700	
Nutrients													
Phosphorus, Total	mg/kg	931		1940		452		249		717		332	
Metals													
Cadmium, Total	mg/kg	1	U	1		1.5		0.7		1.5		0.8	
Copper, Total	mg/kg	78		135		128		51		163		57	
Lead, Total	mg/kg	67		120		133		58		127		64	
Zinc, Total	mg/kg	340		570		570		230		560		205	
Conventionals													
Solids, Total	%	16.3	J	22.1	J	26.7	J	45.3	J	32.2	J	55.6	J
Solids, Total Volatile	%	57.42	J	48.29	J	40.83	J	19.82	J	30.01	J	11.13	J
Grain Size													
Gravel	%	41.9		29		19.3		25.9		17.6		7.6	
Very Coarse Sand	%	17.8		17.2		14.5		14.2		16		11.9	
Coarse Sand	%	10.6		12.4		12.4		17.9		17.7		21.5	
Fine Sand	%	4.6		6.2		8.7		11.6		9.1		11.8	
Medium Sand	%	7.4		9.8		12		20.3		16.5		26.7	
Very Fine Sand	%	2.2		3.4		4.4		3.8		4.8		9.9	

		CBSF1 Chamber			CBSF2 Chamber		
		Influent	Filter	Outlet	Influent	Chamber	Outlet
		CBSF1-SED1	CBSF1-SED2	CBSF1-SED3	CBSF2-SED1	CBSF2-SED2	CBSF2-SED3
Analyte	Units	09/28/10	09/28/10	09/28/10	09/28/10	09/28/10	09/28/10
Coarse Silt	%	NM	NM	4.3	NM	3	1.5
Medium Silt	%	NM	NM	15.3	NM	5.3	3
Fine Silt	%	NM	NM	4.8	NM	4.1	1.7
Very Fine Silt	%	NM	NM	2.1	NM	2.6	1.5
9-10 Phi Clay	%	NM	NM	0.3	NM	0.9	0.9
8-9 Phi Clay	%	NM	NM	0.5	NM	1.2	0.8
>10 Phi Clay	%	NM	NM	1.3	NM	1.3	1.1
Total Fines	%	15.6	21.9	28.7	6.3	18.3	10.5

Notes:
U - Analyte was not detected above the reported result.
J- Analyte was positively identified. The reported result is an estimate.
UJ- Analyte was not detected above the reported estimate.
NM - Not measured. Insufficient fines to perform analysis.

4.7 Performance Evaluation

The following sections discuss procedures that will be used to evaluate the water quality and hydrologic performance of the CBSFs to date. This evaluation started in WY2009 so this performance evaluation will consider water quality data collected from both WY2009 and WY2010. Since both CBSFs are identical, data from the two monitored CBSFs will be pooled to evaluate the performance of both CBSFs collectively.

4.7.1 Water Quality Performance Evaluation

The statistical goals for the BMP monitoring project are summarized in section S8.F.4 of the Permit which states that Permittees must use appropriate sections of the TAPE guidance manual for "*preparing, implementing, and reporting on the results of the BMP evaluation program*." Statistical goals are used to determine when sufficient samples have been collected and sampling activities can be ended with a minimum of 12 and a maximum number of 35 samples being required. TAPE has specified treatment performance goals that vendors of BMPs are to meet to achieve certification for their product; however, Ecology representatives verbally explained to the City that they did not intend Phase I Permittees to evaluate BMPs to meet the same performance goals. The City had questions how to perform the statistical analysis outlined in

TAPE without using the treatment performance goals and requested a meeting with Ecology to discuss the issue.

The City met with Ecology to clarify the goals and now understands that the following considerations apply when determining the number of sampling events that are required to meet the monitoring conditions of the Permit:

- Permittees shall collect a minimum of 12 qualifying samples. Each sample must meet the storm and sampling criteria specified in TAPE.
- After this minimum number of qualifying samples has been collected, an appropriate paired statistical test may be used to determine if influent concentrations are significantly different from effluent concentrations for each parameter. If the test indicates there is a significant difference at 95% confidence and 80% power for a given parameter, no further sampling for that parameter is required.
- If the test indicates there is no significant difference between the influent and effluent concentrations for a given parameter, then the Permittee should continue to sample until a significant difference is observed or the Permittee collects samples from up to 35 events.

The City has collected the minimum sample number and conducted the appropriate statistical tests to evaluate the sample results. The following section details the statistical procedures used for this evaluation.

4.7.1.1 Treatment Efficiency Calculation Procedures

Statistical analyses were performed to assess significance of differences in pollutant concentrations between the influent and effluent data across individual storm events. It is important to note that this evaluation considers the efficiency of treated stormwater only and does not consider the overall BMP efficiency by factoring in bypassed or untreated flows. This is consistent with the manufacturer's 2004 Technical Evaluation Engineering Report (TEER) submittal for GULD approval and conversations with Ecology representatives who felt treatment efficiencies should be evaluated for treated flows, and bypass quantities should be evaluated separately as a unit sizing issue.

The specific null hypothesis (Ho) and alternative hypothesis (Ha) for the treatment efficiency analyses are as follows:

Ho: Effluent pollutant concentrations are equal to or higher than influent concentrations.

Ha: Effluent concentrations are lower than influent concentrations.

Pollutant removal efficiencies for parameters of concern were calculated for all storm samples using the Individual Storm Reduction in Pollutant Concentration method (TAPE Method #1). The change (in percent) in pollutant concentration during each individual storm (ΔC) was calculated as:

$$\Delta C = 100 \times \frac{\left(C_{in} - C_{eff}\right)}{C_{in}}$$

Where:

Cin = volume-proportional influent concentration (also known as the Event Mean Concentration or EMC), and

Ceff = volume-proportional effluent concentration (EMC).

Since the CBSFs do not infiltrate any flow (i.e., flow in equals flow out) calculating removal efficiencies using loads (concentration times volume) would result in the same percent change as using only concentration since the volume would be the same for each influent and effluent pair. Thus, pollutant removal efficiencies using loads were not calculated.

To aggregate treatment performance over the study, efficiencies were also calculated using a modification of Method 2 from TAPE. The modification aggregates concentration instead of load since the volume is the same at the influent and effluent sites. The aggregate reduction (in percent) in analyte concentration for all storms (ΔC_{agg}) was calculated as:

$$\Delta C_{agg} = 100 \times \frac{\left(\sum_{i=1}^{n} \left(C_{i,in}\right) - \sum_{i=1}^{n} \left(C_{i,eff}\right)\right)}{\sum_{i=1}^{n} \left(C_{i,in}\right)}$$

Where:

$C_{i,in}$ = volume-proportional influent concentration for storm *i*,

$C_{i,eff}$ = volume-proportional effluent concentration, and

n = number of sampled events.

Since the parameters TSS, dissolved copper, dissolved zinc and orthophosphate are specifically addressed in the TAPE guidance, these analyte's influent concentrations were screened using the following TAPE influent concentration criteria.

- TSS - >100 mg/L for percent removal analysis, <100 mg/L should achieve effluent goal of 20 mg/L
- Dissolved copper – 0.003 to 0.02 mg/L
- Dissolved zinc – 0.02 to 0.3 mg/L
- Total phosphorus 0.1 to 0.5 mg/L

Performance efficiencies typically increase as influent concentrations increase. Conversely, as influent concentrations decrease, efficiencies also tend to decrease. There is no agreement about what is considered an “irreducible concentration” (a concentration which is too low to expect a BMP to be able to further reduce) but at lower influents concentrations, BMP removal efficiencies may become zero or even negative.

In addition to using Method 2 to determine aggregate concentration reductions, a bootstrap estimate of the percent reduction was also calculated. Mean percent removal values and 95 percent confidence intervals about the mean were estimated using a bootstrapping approach (Helsel and Hirsch 2002) based on the influent and effluent concentrations. Bootstrapping offers a distribution-free method for estimates of confidence intervals of a measure of central tendency (in this case, the average percent removal). The generality of bootstrapped confidence intervals means they are well-suited to non-normally distributed data and/or datasets not numerous enough for a powerful test of normality.

To perform the bootstrapping approach, the influent and effluent concentrations for each valid event were sampled randomly with replacement until new synthetic influent and effluent datasets of equivalent size were generated. The mean influent and effluent concentrations were then calculated on the synthetic datasets and the process was repeated until 10,001 estimates of the mean influent and effluent concentrations were generated. The percent reduction was then calculated for each pair. After sorting the resultant 10,001 percent reduction values, the 250th and 9,750th elements constitute the bootstrapped 95 percent confidence interval of the mean, while the reported bootstrapped mean was the 5,000th ranked value. The lower 95 percent confidence interval establishes a threshold over which there is 95 percent assurance that the true population mean lies.

Subsequent to bootstrapping, the influent and effluent data were tested for normality in order to determine which data were suitable for parametric versus nonparametric hypothesis testing. A Shapiro-Wilk W test was used to determine normality. The Shapiro-Wilk W test is the preferred test of normality because of its good power properties as compared to a wide range of alternative tests (Shapiro, Wilk and Chen, 1968). The test results indicated that only the total copper data exhibited both influent and effluent concentrations that were normally distributed. Consequently, a one-tailed Student's T-test (a hypothesis test for normally distributed data) was applied to the total copper data, while a one-tailed Wilcoxon signed-rank test (a nonparametric analog to the T-test) (Helsel and Hirsch 2002) was applied to the remainder of the data set.

Lastly, a power test was conducted to determine if the hypothesis tests exhibited sufficient power (at least 80 percent) to be deemed valid by Ecology. The power of a statistical test is the probability that the test will reject a false null hypothesis. An online calculator recommended by Ecology (http://www.dssresearch.com/toolkit/spcalc/power_a2.asp) was used for this analysis.

4.7.1.2 Treatment Efficient Results

When the TAPE influent concentration criteria are applied to the 24 qualifying paired sample sets collected to date for the four TAPE parameters, there are 23, 14, 20 and 13 qualifying samples for total suspended solids, total phosphorus, dissolved copper and dissolved zinc, respectively. For the non-TAPE parameters, 24 paired samples have been collected to date. Therefore, the minimum number of samples (12) has been collected for all parameters.

Since no significant differences can be observed with confidence for some of the required parameters, additional samples (up to a total of 35) will need to be collected in order to meet the statistical goals. This study will need to continue into WY2011 to collect the additional samples.

Since additional data will be collected for *all* parameters in WY2011, including parameters that met the statistical goals with existing samples; no performance evaluation results will be presented in this report since the results are interim and may change with the additional WY2011 data. In the WY2011 annual report, a complete performance analysis of all data collected for this project will be presented.

4.7.2 Hydrologic Performance Evaluation

As discussed above, this performance evaluation will continue into WY2011 to meet the Permit's statistical goals for the water quality data. Since the current results are considered preliminary and are expected to change with the collection of additional data, the complete hydrologic performance evaluation for the project will be presented in the WY2011 annual report.

4.8 Quality Assurance/Quality Control Report

See Appendix C.4 for the complete QA/QC report.

4.9 Interim CBSF Performance Evaluation Conclusions

Water quality and hydrologic monitoring has been performed on two Catch Basin StormFilter (CBSF) units beginning in February 2009 and continuing through the entire 2010 water year. By the end of WY2010, a total of 24 qualifying storm events have been sampled across both units. Based on the 24 events, the Permit's statistical goals were not met for all required parameters. Thus, sampling will continue into WY2011 until the maximum number of samples (35) is obtained.

Since this study is ongoing, no interim performance data for water quality or flow will be present in this report. Final results evaluating all project data will be documented in the WY2011 annual report.

4.10 Acknowledgements

The following staff were responsible for the success of this project in WY2010:

Seattle Public Utilities – project management, field staff and analysis
Doug Hutchinson (project manager, field lead, report author)
Rex Davis, Adam Bailey (field technicians)
Amy Minichillo, Lea Beard (data validators)

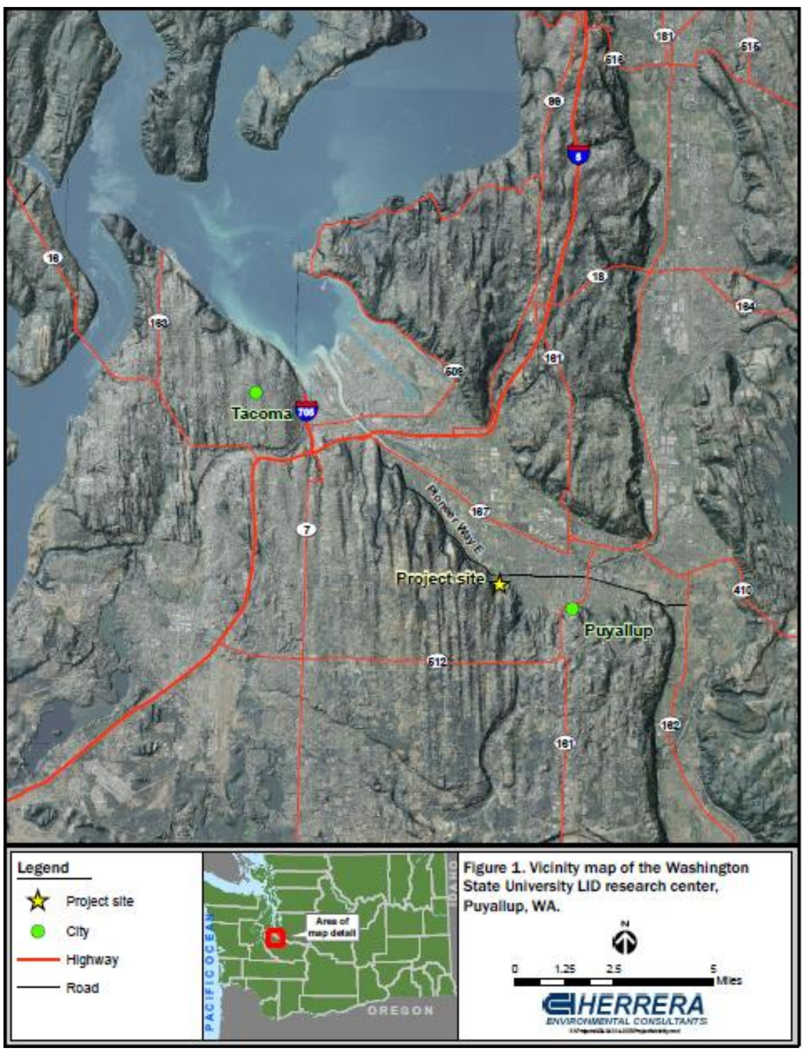
Water Quality Laboratory (SPU) – primary environmental laboratory
Jim Dunn (project manager) and staff

Analytical Resources, Inc – secondary analytical laboratory (particle size distribution)
Mark Harris (project manager) and staff

4.11 WSU Mesocosm Monitoring (Treatment BMP Two)

The City and Washington State University (WSU) have partnered to study bioretention stormwater facilities as the second treatment BMP that the City will monitor to meet Permit requirements. During WY2010, this partnership produced a QAPP for the mesocosm monitoring portion of the new LID research center which is located at WSU's Puyallup campus (see Figure 4.10). The QAPP was prepared by Herrera Environmental Consultants on the behalf of WSU and the City. Due to the experimental nature of the research center and the complexities of the monitoring plan, drafting the QAPP took longer than expected and required much dialogue between Ecology, WSU and the City. A final QAPP was submitted to Ecology in September 2010. The following summarizes the monitoring plan detailed in the QAPP.

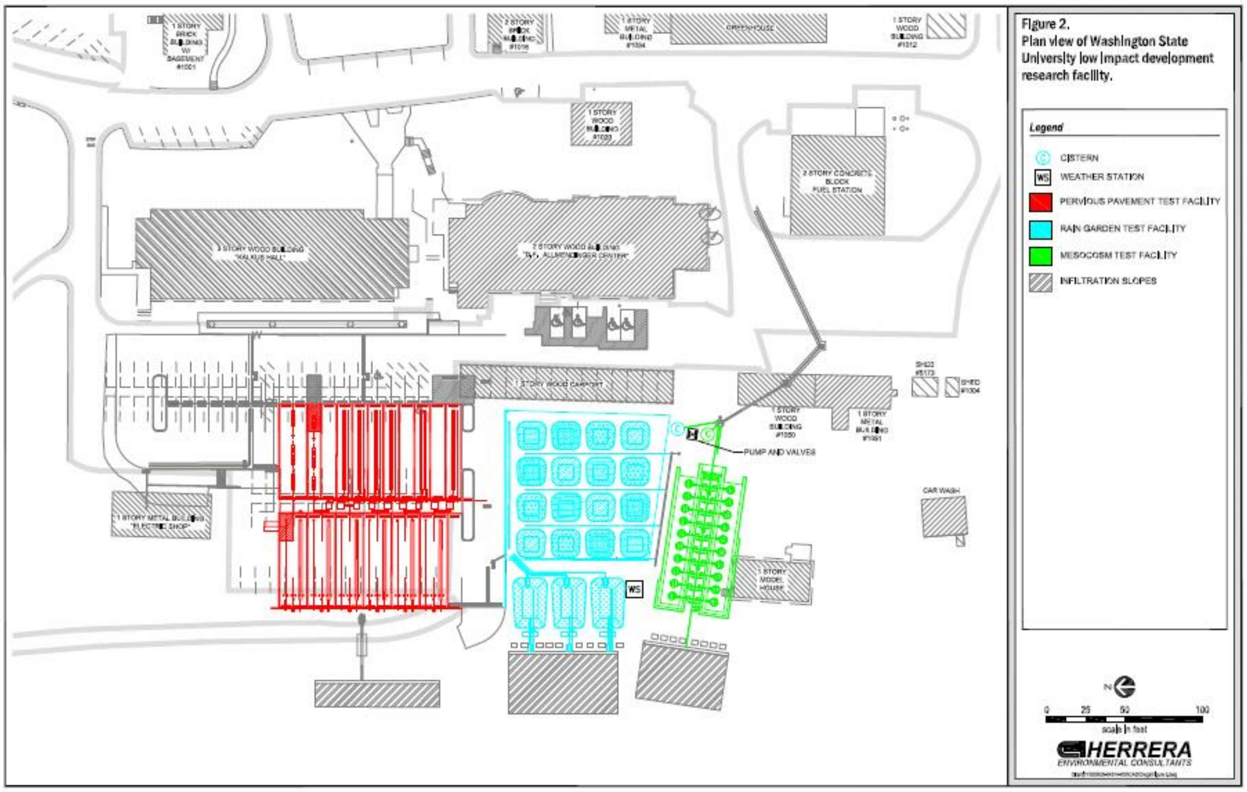
Figure 4.11. Vicinty Map – WSU LID Research Center



4.11.1 WSU Mesocosm Monitoring Design Summary

The LID research center contains many full-scale, structural stormwater BMPs including bioretention cells, water gardens and porous pavements. Figure 4.10.1a displays the plan view of the entire LID research center, which includes the mesocosms (shown in green) along with other LID elements not studied by the City.

Figure 4.11.1a. Site Map – WSU LID Research Center



The City will analyze data from a subset (four) of the twenty bioretention cells, referred to as mesocosms, to evaluate bioretention soils as metals/phosphorus treatment BMPs. The four mesocosms of the City's study are identical (essentially one primary and three replicates) and all contain a soil mixture of 60 percent aggregate and 40 percent compost. The mix, configuration and sizing of the mesocosms are similar to the bioretention design standard in the City's stormwater code. The monitoring plan for this subset of mesocosms will conform to requirements identified in the Permit and be very similar to those used for Treatment BMP Number One.

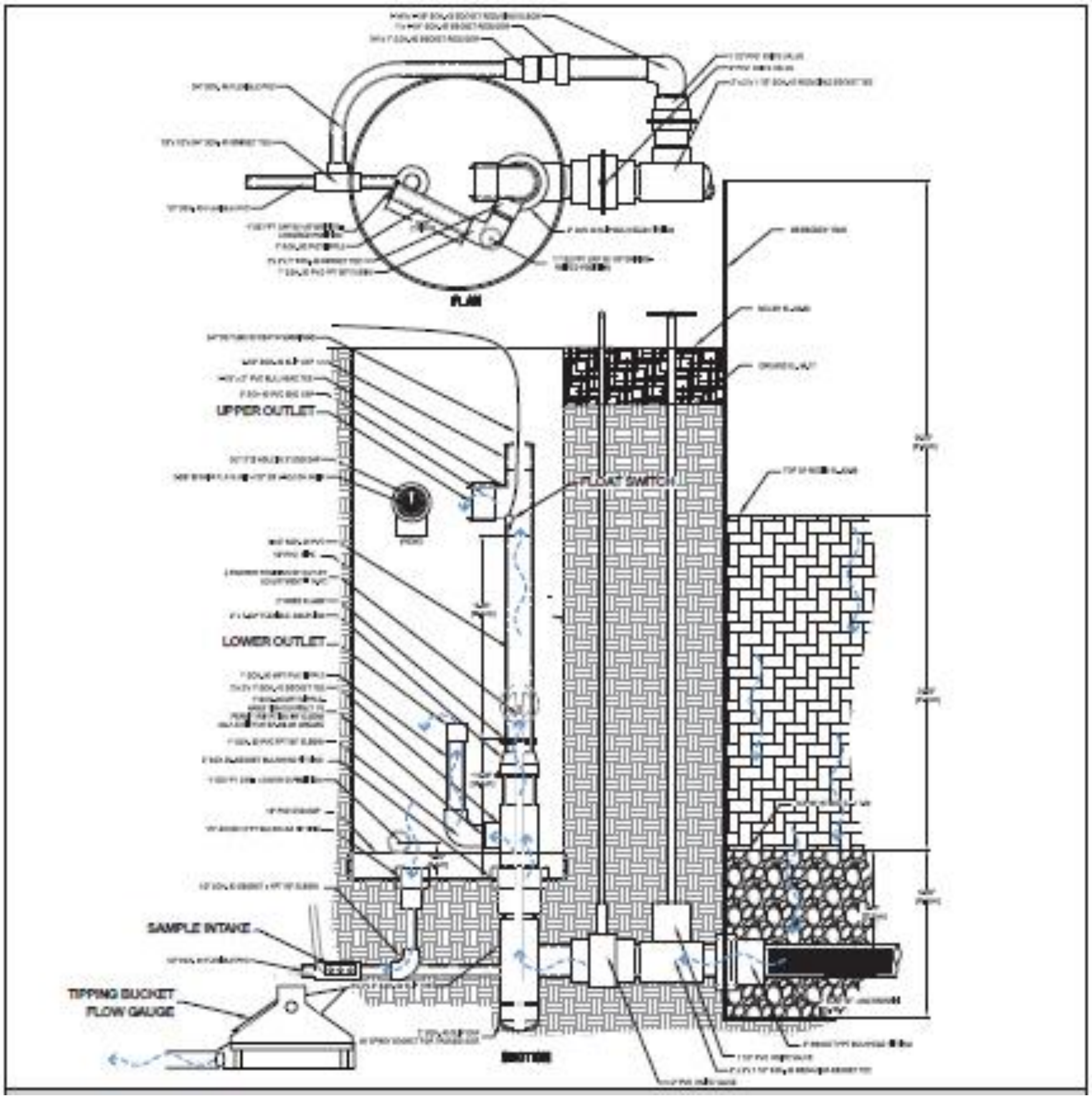
Runoff from an 18,021 square foot (SF) drainage area will be routed via gravity flow to all 20 mesocosms and one influent monitoring station. The runoff will be routed to an 11,370 liter (L) (3,000 gallon) cistern for storage and delivery to the mesocosms. Stormwater from the cistern will be routed via gravity flow to the mesocosms to assess treatment performance during natural storms. Weir boxes constructed at the water surface elevation inside the cistern will distribute flows evenly to each mesocosm, with one distribution line bypassing the mesocosms and terminating at a separate Influent Monitoring Station. Influent flows and chemistry for all the mesocosms will be generalized based on representative data that are collected at this station.

Eductors (jet pump ejectors) installed inside the cistern will be activated during sampled storm events to keep particulate bound pollutants from settling out in the cistern prior to reaching the mesocosms. This will minimize any pretreatment that might occur in the cistern that would bias the results from the mesocosm monitoring. If settling of solids does occur within the cistern (essentially performing pretreatment), the result will be to lower the influent concentration of stormwater distributed to all the mesocosms and the Influent Monitoring Station. The influent versus effluent comparison will not be compromised by the effect of pretreatment, but the calculated performance efficiency of the mesocosms may be more conservative compared to using “untreated” or higher concentration influent stormwater.

Each mesocosm is constructed with a 152.4 centimeter (cm) (60 inches) diameter by 132 cm (52 inches) deep media tank to hold the bioretention soil mix. The bottom of each media tank is filled with coarse sand to a depth of 30.5 cm (12 inches) thick. Next, 61 cm (24 inches) of the bioretention soil mix was placed over the sand layer and hand packed before water is introduced to the system. A slotted underdrain pipe within the sand layer serves as the drain for the mesocosm. Flow enters the tanks through a manifold constructed of plastic piping perforated with drilled holes that distributes water across the surface of the bioretention soil mix. The following figure shows a cross-section and plan view of a typical mesocosm with related components.

Each mesocosm has a surface area of 19.63 SF. Given flows from the impervious drainage area will be distributed equally to the 20 mesocosms and the Influent Monitoring Station, the ratio of contributing basin area to surface area for the mesocosm is 2.3 percent ([19.63 SF × 21]/18,021 SF = 0.023 = 2.3 percent). For reference, SPU sizing criteria for water quality treatment using bioretention require the bottom area of the treatment system to represent 2.6 percent of the contributing area for 6 inches of ponding, and 2.0 percent of the contributing area for 12 inches of ponding. Pursuant to SPU design criteria, the maximum ponding depth for bioretention cells is 12 inches and in high density right-of-way applications the ponding depth shall be no greater than 6 inches. In general, these data indicate the mesocosms are appropriately sized for assessing the performance of systems that were constructed to meet SPU's sizing criteria for water quality treatment (larger sizing is required for facilities used for flow control).

Figure 4.10.1b. Mesocosm Cross-Section and Plan View



Stormwater inflows and outflows to the four mesocosms monitored by WSU for fulfillment of the City's Permit requirements will be measured continuously. Although the mesocosms are sized for water quality only, the flow data will then be analyzed to evaluate the flow reduction effects of the bioretention soil mix, including its effects on reducing and/or delaying flow peaks, volume and duration. In conjunction with the water quality monitoring described below, these data will also facilitate event-based pollutant loading analyses for characterizing water quality treatment performance.

Volume-proportional composite effluent samples will be collected from each mesocosm and used to characterize effluent chemistry. Similarly, one volume-proportional composite sample will be collected from the Influent Monitoring Station and used to generalize influent chemistry across all the mesocosms.

Storm criteria, analytical parameters, sample numbers and data and analysis goals will all be the same as used for the Catch Basin StormFilter BMP (Treatment BMP Number One) monitoring documented previously in this report.

Construction of the facility was completed following the end of WY2010 and monitoring is scheduled to begin in the first quarter of 2011. Initial monitoring results will be included in the WY2011 annual report but statistical goals will likely not be met until the second full year of monitoring scheduled for WY2012.

4.12 Hydrologic Management BMP Monitoring

SPU completed the hydrologic management BMP assessment during WY2009. For a discussion of this work, refer to the WY2009 Annual Report.

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Appendix C.1: Stormwater Characterization - Quality Assurance/Quality Control Report

City of Seattle

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This Quality Assurance/Quality Control (QA/QC) report documents results of the QA/QC review of time series and analytical data generated for the Stormwater Characterization project. The following discussion will include QA/QC practices and results for flow monitoring, laboratory analytical testing, and field sample analysis. The discussion will conclude with a table of all sample results qualified by the validation process.

Flow Monitoring QA/QC Results

Flow data were reviewed and edited according to the procedures outline in Section 2.3.9.2. The following is a summary of any inconsistencies noted during data review.

R1: The pressure transducer started showing level drift through the spring and summer months (March –August). The transducer was calibrated and the level drift was documented during each monthly maintenance visit and the level and flow data were corrected for drift when they were reviewed. The average drift was -0.03 ft over a month (published accuracy for the sensor is 0.012 ft) with a maximum drift of -0.06 ft which led to the sensor being replaced on August 11, 2010. The drift was edited from the final flow data.

I1: Anomalous rhythmic spikes in level and flow were observed in the data from July 19, 2010 through the end of the water year. The spikes typically occurred during periods with zero flow and were likely caused by inconsistent communication between the flow monitor and data logger (which are made by different manufacturers) and were not representative of actual flow conditions. These spikes were removed from the final flow data.

The site often experiences a backwater condition due to the pipe's low elevation difference with the Duwamish River which result in the velocity to be below the optimum accuracy for the Doppler velocity sensor [velocities greater than one foot per second (fps) are optimum]. This is primarily a concern during small or low intensity events where velocity and flow may be unreported. Therefore, the confidence in the velocity and flow data is lower for small events than for the larger events where higher flow velocities occur.

C1: The pipe at C1 has a slope of 7 percent which results in very high velocities, often exceeding 10 fps (velocities above 10 fps are considered less than optimum). These conditions often can produce a turbulent "rooster tail" over the submerged area/velocity sensor during low to medium flow rates which makes level measurement extremely difficult. A low flow dam was installed immediately downstream of the sensor which backs water up over the sensor to mitigate the rooster tail effect. However, the Doppler velocity sensor is obtaining measurements just upstream of the backwater zone so velocity measurements are largely unaffected by the check dam. Level measurements occur within the backwater zone. The combination of the backwater level readings and unaffected velocity readings leads to a general overestimation of the flow rate under base flow conditions. As the flow increases the check dam's influence is reduced and the flow measurement accuracy is increased.

Debris is commonly found in the in pipe and there have been numerous occurrences of debris becoming entangled in or around the area/velocity sensor and the sediment traps located downstream. This debris is removed immediately upon discovery but may result in short periods of low accuracy flow data as the debris obstructs the submerged sensor.

Analytical QA/QC Results

This analytical data quality QA/QC report addresses analytical data collected for the Stormwater Characterization project (S8.D) during WY2010.

All laboratory data packages included a hardcopy report and an electronic data deliverable (EDD). The laboratory case narratives were reviewed for quality control issues and corrective action taken for each sample delivery group. The data were evaluated for required methods, holding times, reporting limits, accuracy, precision and blank contamination.

Each EDD was imported into a review template where deviations from the measurement quality objectives (MQOs) were identified and associated samples were qualified accordingly. The following describes the details of this review.

Analytical Methods and Reporting Limits

The following table is used to describe the methods and reporting limits used by the laboratory. Reporting limits represents the minimum concentration of an analyte in a specific matrix that can be identified and quantified above the method detection limit and within specified limits of precision and bias during routine analytical operating conditions. Reporting limits can vary by individual samples, particularly for sediments where the quantity and dilution analyzed affect the minimum detectable value.

Stormwater Characterization Water Sample Analytes, Methods and Reporting Limits

Analyte Group	Analyte	Reporting Limit	Units	Lab Method
Bacteria	Fecal Coliform	2	CFU/ 100 mL	SM9222D [c]
Conventionals	BOD	2	mg/L	SM5210B [a]
	Conductivity	1	umhos/cm	EPA120.1
	Hardness	0.33	mg/L CaCO3	SM2340B [a]
	pH	0.01	std units	SM4500H
	TSS	1	mg/L	SM2540B [a]
	Surfactants	0.025	mg/L	SM5540C
	Turbidity	0.05	NTU	EPA180.1
Metals	Cadmium - Dissolved	0.2 [h]	ug/L	EPA200.8
	Cadmium - Total	0.2	ug/L	EPA200.8

Analyte Group	Analyte	Reporting Limit	Units	Lab Method
	Copper - Dissolved	0.5	ug/L	EPA200.8
	Copper - Total	0.5	ug/L	EPA200.8
	Lead - Dissolved	1 [h]	ug/L	EPA200.8
	Lead - Total	1 [h]	ug/L	EPA200.8
	Mercury - Dissolved	20	ng/L	SW7470A
	Mercury - Total	20	ng/L	SW7470A
	Zinc - Dissolved	4	ug/L	EPA200.8
	Zinc - Total	4	ug/L	EPA200.8
Nutrients	Chloride	0.1	mg/L	EPA300.0
	Chloride	1	mg/L	EPA325.2 [b]
	Nitrate + Nitrite	0.01	mg-N/L	EPA353.2
	Nitrogen, Total Kjeldahl	0.3	mg-N/L	EPA351.2 [d]
	Ortho-phosphate	0.004	mg-P/L	SM4500-PE [a]
	Phosphorus, Total	0.002	mg-P/L	SM4500-PE [a]
SVOC	2,4-D	1	ug/L	SW8151A
	Diazinon	0.12	ug/L	SW8270DSIM
	Dichlobenil [g]	0.024	ug/L	SW8270DSIM
	Dichlobenil [g]	0.15	ug/L	SW8270D [i]
	Malathion [g]	0.15	ug/L	SW8270DSIM
	MCPP	250 [f]	ug/L	SW8151A
	Prometon [g]	0.024	ug/L	SW8270DSIM
	Prometon [g]	0.15	ug/L	SW8270D [i]
	Triclopyr [g]	0.08	ug/L	EPA8321B [e]
	Chlorpyrifos	0.15	ug/L	SW8270DSIM
	Dibenzofuran	0.1	ug/L	SW8270DSIM
	PAHs	0.1	ug/L	SW8270DSIM
	Phthalates	1	ug/L	SW8270D
	Pentachlorophenol	0.5	ug/L	SW8270DSIM
TPH	Diesel Range	0.1	mg/L	NWTPH-DX
	Gasoline Range	0.25	mg/L	NWTPH-GX
	Motor Oil	0.2	mg/L	NWTPH-DX

a. During the QA/QC review, it was determined that the contract lab (ARI) analyzed samples using currently approved analytical methods but reported some of the methods using older method names/numbers. In discussions with Stewart M. Lombard, Lab Accreditation Unit Supervisor, Department of Ecology, it was confirmed that the chemistries and analytical techniques used are identical between the analytical methods performed and the analytical methods reported for the parameters listed.

Comparison of Methods Performed to Methods Reported

Analyte	Analytical Method Performed	Lab Reported Method	Analytical Technique
BOD	SM5210-B	EPA405.1	Potentiometric
Hardness	SM2340-B	SW6010B	ICP-calculation
TSS	SM2540-D	EPA160.2	Gravimetric
Orthophosphate	SM4500-P E	EPA365.2	Colorimetric
Phosphorous, Total	SM4500-P E	EPA365.2	Colorimetric

b. For the chloride analysis, the EPA Method 325.2 (colorimetric) was erroneously performed on some samples. This error was corrected, and subsequent analyses were performed by Ion Chromatography (Method 300.0). Method 300.0 is equivalent to SM4110-B.

c. Fecal coliform analysis was performed using the membrane filtration technique (SM9222D). The method listed in the QAPP was multiple tube fermentation (SM9221E). As of January 2011, the laboratory as been directed to analyze a 0.1 mL, 1.0 mL, 10.0 mL and 50mL aliquot in order to detect potential interferences.

d. During the review, it was also discovered that ARI performed the TKN analysis using the potentiometric method (EPA351.4). The method listed in the QAPP is the colorimetric method (EPA351.2). ARI discovered this error and has since started to use the correct method.

e. For trichlopyr analysis, Pacific Agricultural Labs (subcontracted by ARI) could only achieve the required, lower reporting limit using method EPA8321B. The City elected to use this method, which was not originally listed in SPU's QAPP, to achieve the lower reporting limit.

f. For MCPP analysis, the laboratory was unable to meet the permit specified reporting limit. Corrective action is being taken, and beginning in water year 2011 the samples are being sent to a different laboratory for analysis.

g. During 2011 some question has arisen regarding the accreditation of the laboratory that reported these analytes. Corrective action is being determined with the aid of Ecology and the laboratory. More information will be available in the annual report for water year 2011.

h. The reporting limits listed are not currently approved by Ecology. Corrective action has been initiated and steps are being taken to work with the laboratory to evaluate options.

i. For analysis of samples taken on 10/23/2009 for dichlobenil and prometon the laboratory mistakenly performed analysis by method SW8270D rather than by SW8270DSIM as specified by the QAPP. Corrective action was taken, and all other analyses for these parameters were performed by method SW8270DSIM.

Stormwater Characterization Sediment Sample Analytes, Methods and Reporting Limits Used

Analyte Group	Analyte	Reporting Limit	Units	Lab Method
Conventionals	Solids, Total	0.01	%	EPA160.3
	Grain Size	0.1	%	PSEP-PS
	Solids, Total Volatile	0.01	%	EPA160.4
	Total Organic Carbon	0.02	%	PLUMB81TC
Petroleum Hydrocarbons	Diesel Range	5	mg/Kg	NWTPH-DX
	Motor Oil	10	mg/Kg	NWTPH-DX
	Gasoline Range	0.1	mg/Kg	NWTPH-GX
Metals	Cadmium	0.2	mg/kg	EPA200.8
	Copper	0.5	mg/kg	EPA200.8
	Lead	1	mg/kg	EPA200.8
	Mercury	0.02	mg/kg	SW7471A
	Zinc	4	mg/kg	EPA200.8

Analyte Group	Analyte	Reporting Limit	Units	Lab Method
PCB	Aroclors	32	ug/kg	SW8082
Pesticides	Chlorpyrifos	10	ug/kg	SW8270DSIM
	Diazinon	10	ug/kg	SW8270DSIM
	Malathion	10	ug/kg	SW8270DSIM
SVOC	PAHs	5	ug/kg	SW8270DSIM
	Pentachlorophenol	100	ug/kg	SW8270D
	Phenols	20-200	ug/kg	SW8270D
	Phthalates	20	ug/kg	SW8270D

Data Qualifier Definitions

Data qualifiers were applied to sample chemistry data based on the results of validation. Three data qualifier codes were used; U, J and UJ.

One result value per sample per analyte is reported. In instances where the laboratory performed dilutions or re-analyses, the most acceptable result with the lowest detection limit is reported.

Qualifier	Definition
U	Analyte was analyzed for, but not detected above reported result.
J	Reported result is an estimated quantity.
UJ	Analyte was analyzed for, but not detected above reported estimate.

Laboratory QA/QC Results

Holding Time

All sample results were assessed for holding time compliance per 40 Code for Federal Regulations (CFR) part 136. Holding times were met for all results except as listed below. Surfactants were analyzed by a laboratory which was subcontracted by the primary analytical laboratory. In some instances, difficulties arose in transferring samples between labs, resulting in hold time exceedances. Analytical results obtained outside of holding time have been qualified as estimated (J). Qualification based on holding time is only applied to the specific results listed below.

Holding Time Exceedances for Water Samples

Sample ID	Sample Date	Analyte	Reason
I1	10/23/09 15:59	Surfactants	Analyzed past holding by 3 days
C1	10/23/09 22:45	Surfactants	Analyzed past holding by 3 days
C1	1/1/10 14:56	Surfactants	Analyzed past holding by 1 day
R1	1/1/10 17:01	Surfactants	Analyzed past holding by 1 day
R1	1/8/10 22:03	Surfactants	Analyzed past holding by 1 day

Sample ID	Sample Date	Analyte	Reason
R1	9/16/10 23:23	Surfactants	Analyzed past holding by 1 day

Blanks

Laboratory method blanks were generated and analyzed by the laboratories in association with primary environmental samples. The following table lists the qualification actions resulting from the blank results.

Blank Validation Criteria

Blank	Sample	Action
Blank > RL	Sample < RL	Qualify sample result as non-detect (U) at the Reporting Limit. No note needed.
	RL < Sample < Blank	Qualify sample result as non-detect (U) at the reported concentration. Note in report.
	Blank < Sample < 10x Blank	Qualify sample result as estimated (J). Note in report.
	10x Blank < Sample	No qualification needed. Note in report.
Blank < (-RL)	Sample < RL	Qualify sample result as estimated non-detect (UJ) at Reporting Limit. Note in report.
	RL < Sample < 10x Blank	Qualify sample result as estimated (J). Note in report.
	10x Blank < Sample	No qualification needed. Note in report.
(-RL) < Blank < RL	Sample < RL	Qualify sample result as non-detect (U) at Reporting Limit. No note needed.
	RL < Sample	No qualification needed. No note needed.

The following table illustrates the application of qualifiers to sample results based on the blank QC sample type.

Association of Blank QC Qualifiers to Results

QC Type	Associated Results
Method Blank	All results in prep batch
Filter Blank	All results from same SDG
Trip Blank	All results from same SDG
Tubing Blank/Bottle Blank/Splitter Blank/Bailer Blank	All composite results from project water year
Grab Sampler Equipment Blank	All grab results from project water year

Blank Results Discussion

All method blank results were within control limits with the exception of those listed below.

Bis(2-ethylhexyl)phthalate is classified as a common laboratory contaminant. Due to the ubiquitous nature of this chemical in many plastic products, laboratories struggle to eliminate its presence in blanks and limit sample cross contamination. No corrective action is recommended for the bis(2-ethylhexyl)phthalate contamination. Associated sample results have been qualified accordingly.

Field and equipment blanks were collected and analyzed in addition to laboratory method blanks. The results of these additional blanks can be found in the Field QC Sample results section.

Method Blank Exceedances for Water Samples

Analyte	Reported Result	Units	Action
bis(2-Ethylhexyl)phthalate	7.6	ug/L	Results above RL and < 7.6 qualified U
bis(2-Ethylhexyl)phthalate	1.2	ug/L	Results above RL and < 1.2 qualified U
Dibenz(a,h)anthracene	0.12	ug/L	No Action - Associated samples < RL

Accuracy

Accuracy is the degree of agreement between an observed value and an accepted reference value. Accuracy was demonstrated by analysis of matrix spikes (MS), laboratory control samples (LCS), reference materials (RM) and surrogate compounds (SUR). Laboratory control limits were used when provided. The following table lists the qualification actions resulting from the accuracy analysis.

Accuracy Validation Criteria

%R*	Sample	Action
%R < LowLimit	Sample ≤ RL	Qualify sample result as estimated non-detect (UJ). Note in report.
	RL < Sample	Qualify sample result as estimated (J). Note in Report.
	Parent† > 4x spike added	No qualification needed. Note in report.
UppLimit < %R	Sample ≤ RL	No qualification needed. Note in report.
	RL < Sample	Qualify sample result as estimated (J). Note in Report.
	Parent > 4x spike added	No qualification needed. Note in report.

† Parent - The sample from which an aliquot is used to make the spiked QC sample.
* %R - The percent recovery of the spiked compound and is calculated as:

The following table illustrates the application of qualifiers to sample results based on the accuracy of QC sample types.

Association of Accuracy QC

QC Type	Associated Results
LCS/LCSD/RM	All results in prep batch
MS/MSD	All results in prep batch
Surrogate	Results for associated analyte in current sample only

Accuracy QC Results Discussion

All accuracy QC results were within control limits except as noted below. Sample results associated with QC exceedances have been qualified as appropriate.

Accuracy Exceedances for Water Samples

Analyte	Type	Analysis Date	Out	Action
2-Methylnaphthalene	LCS	11/6/09 12:46	High	Associated samples Non-Detect. No action taken.
Acenaphthene	LCS	2/2/10 12:16	High	Associated samples Non-Detect. No action taken.
Acenaphthylene	LCS	1/18/10 16:19	High	Associated samples Non-Detect. No action taken.
Benzo(a)pyrene	LCS	11/6/09 15:22	High	Associated samples Non-Detect. No action taken.
Benzo(g,h,i)perylene	LCS	11/6/09 15:22	High	Associated samples Non-Detect. No action taken.
Benzofluoranthenes,	LCS	11/6/09 15:22	High	Associated samples Non-Detect. No action taken.
bis(2-	LCSD	11/5/09 19:48	High	LCS in control. No action taken.
Butylbenzylphthalate	LCSD	11/5/09 19:48	High	Associated samples Non-Detect. No action taken.
Dibenz(a,h)anthracene	LCS	11/6/09 15:22	High	Associated samples Non-Detect. No action taken.
Dibenzofuran	LCS	11/17/09	High	Associated samples Non-Detect. No action taken.
Dibenzofuran	LCS	2/2/10 12:16	High	Associated samples Non-Detect. No action taken.
Dibenzofuran	LCS	4/7/10 12:03	High	Associated samples Non-Detect. No action taken.
Dibenzofuran	LCSD	4/7/10 12:24	High	Associated samples Non-Detect. No action taken.
Dibenzofuran	LCS	4/7/10 14:50	High	Associated samples Non-Detect. No action taken.
Dibenzofuran	LCS	4/7/10 12:03	High	Associated samples Non-Detect. No action taken.
Dibenzofuran	LCSD	4/7/10 12:24	High	Associated samples Non-Detect. No action taken.
Di-n-Butylphthalate	LCSD	11/5/09 19:48	High	Associated samples Non-Detect. No action taken.
Indeno(1,2,3-cd)pyrene	LCS	11/6/09 15:22	High	Associated samples Non-Detect. No action taken.

Accuracy Exceedances for Sediment Samples

Analyte	Type	Analysis Date	Out	Action
4-Methylphenol	MS	10/19/10 19:10	High	Associated samples > RL qualified J
4-Methylphenol	MSD	10/19/10 19:44	High	Associated samples > RL qualified J
2-Methylnaphthalene	MS	10/14/10 0:53	High	MSD in control. No action taken.
Pyrene	MSD	10/14/10 1:18	High	MS in control. No action taken.
2,4-Dinitrophenol	MS	10/19/10 19:10	Low	Associated samples qualified UJ

Analyte	Type	Analysis Date	Out	Action
2,4-Dinitrophenol	MSD	10/19/10 19:44	Low	Associated samples qualified UJ
4,6-Dinitro-2-Methylphenol	MS	10/19/10 19:10	Low	Associated samples qualified UJ
4,6-Dinitro-2-Methylphenol	MSD	10/19/10 19:44	Low	Associated samples qualified UJ

Precision

Precision is the degree observed reproducibility of measurement results. Precision was demonstrated by analysis of laboratory sample duplicates (LD), field sample duplicates (FD), laboratory control sample duplicates (LCSD) and matrix spike duplicates (MSD). The following table lists the qualification actions resulting from the precision analysis.

Precision Validation Criteria

<table>
<tr><th rowspan="2">Matrix</th><th colspan="2">Original & Duplicate</th><th rowspan="2">Associated Sample</th><th rowspan="2">Action</th></tr>
<tr><th>Criteria 1</th><th>Criteria 2</th></tr>
<tr><td rowspan="3">AQ</td><td rowspan="6">Both Original and Dup Results < 5x RL</td><td rowspan="2">|original - duplicate| > RL</td><td>Result < RL</td><td>Qualify sample results as estimated non-detect (UJ). Note in report.</td></tr>
<tr><td>Result > RL</td><td>Qualify sample results as estimated (J). Note in report.</td></tr>
<tr><td>|original - duplicate|≤ RL</td><td>All</td><td>No qualification needed. No note needed.</td></tr>
<tr><td rowspan="3">SED</td><td rowspan="2">|original - duplicate| > 2x RL</td><td>Result < RL</td><td>Qualify sample results as estimated non-detect (UJ). Note in report.</td></tr>
<tr><td>Result > RL</td><td>Qualify sample results as estimated non-detect (UJ). Note in report.</td></tr>
<tr><td>|original - duplicate|≤ 2x RL</td><td>All</td><td>No qualification needed. No note needed.</td></tr>
<tr><td rowspan="3">AQ</td><td rowspan="6">Either Original or Dup Results > 5x RL</td><td rowspan="2">RPD[†] > 20[*]%</td><td>Result < RL</td><td>Qualify sample results as estimated non-detect (UJ). Note in report.</td></tr>
<tr><td>Result > RL</td><td>Qualify sample results as estimated (J). Note in report.</td></tr>
<tr><td>RPD ≤ 20[*]%</td><td>All</td><td>No qualification needed. No note needed.</td></tr>
<tr><td rowspan="3">SED</td><td rowspan="2">RPD > 35%</td><td>Result < RL</td><td>Qualify sample results as estimated non-detect (UJ). Note in report.</td></tr>
<tr><td>Result > RL</td><td>Qualify sample results as estimated (J). Note in report.</td></tr>
<tr><td>RPD ≤ 35%</td><td>All</td><td>No qualification needed. No note needed.</td></tr>
</table>

† RPD – Relative Percent Difference between the original and the duplicate, calculated as follows:

*An RPD control limit of 25% was used when assessing field duplicate water samples.

The following table illustrates the application of qualifiers to sample results based on the precision QC sample types.

Association of Precision QC

QC Type	Associated Results
Lab Dup	All results in prep batch
LCSD	All results in prep batch
MSD	All results in prep batch
Field Dup/ Field Split	Parent sample results only*

*In cases where the laboratory was deficient in providing laboratory precision QC, Field precision QC was used to evaluate all results in each prep batch.

Precision QC Results for Laboratory Duplicates

All laboratory precision QC results were within control parameters except as noted below. Associated sample results have been qualified accordingly.

Analyte	Type	Result	Units	RL	RPD (|Δ|)	Action
Acenaphthylene	LCSD	1.6	ug/L	0.1	28	Associated samples qualified (J/UJ)
Benzo(a)pyrene	LCSD	1.09	ug/L	0.1	54.2	Associated samples qualified (J/UJ)
Benzo(g,h,i)perylene	LCSD	1.74	ug/L	0.1	38.5	Associated samples qualified (J/UJ)
bis(2-Ethylhexyl)phthalate	LCSD	29.3	ug/L	1	48.8	Associated samples qualified (J/UJ)
bis(2-Ethylhexyl)phthalate	LCSD	56	ug/L	1	75.5	Associated samples qualified (J/UJ)
Dichlobenil	LCSD	0.84	ug/L	0.15	(0.32)	Associated samples qualified (J/UJ)
Dichlobenil	LCSD	1.1	ug/L	0.1	34	Associated samples qualified (J/UJ)
Dichlobenil	LCSD	0.41	ug/L	0.12	(0.14)	Associated samples qualified (J/UJ)
Dichlobenil	LCSD	0.66	ug/L	0.12	(0.21)	Associated samples qualified (J/UJ)
Dichlobenil	LCSD	0.51	ug/L	0.12	(0.41)	Associated samples qualified (J/UJ)
Dichlobenil	LCSD	0.77	ug/L	0.12	25	Associated samples qualified (J/UJ)
Indeno(1,2,3-cd)pyrene	LCSD	1.96	ug/L	0.1	35.3	Associated samples qualified (J/UJ)
Triclopyr	LCSD	0.79	ug/L	0.08	42	Associated samples qualified (J/UJ)
Triclopyr	LCSD	0.59	ug/L	0.08	(0.24)	Associated samples qualified (J/UJ)
Triclopyr	LCSD	0.65	ug/L	0.08	24	Associated samples qualified (J/UJ)

Analyte	Type	Result	Units	RL	RPD (|Δ|)	Action
Triclopyr	LCSD	0.43	ug/L	0.08	29	Associated samples qualified (J/UJ)

Laboratory Precision Exceedances for Sediment Samples

Analyte	Type	Result	Units	RL	RPD (|Δ|)	Action
2,4-Dimethylphenol	MSD	348	ug/kg	230	(545)[1]	Associated samples qualified J/UJ.
Coarse Silt [2]	DUP	2.6	%	0.1	81.1	Associated samples qualified J/UJ.
Coarse Silt [2]	DUP	4.3	%	0.1	119	Associated samples qualified J/UJ.
Dibenz(a,h)anthracene	MSD	229	ug/kg	37	(77)	Associated samples qualified J/UJ.
Medium Silt [2]	DUP	5.7	%	0.1	40	Associated samples qualified J/UJ.
Total Fines [2]	DUP	17.2	%	0.1	39.7	Associated samples qualified J/UJ.

[1]The precision outlier for 2,4-Dimethylphenol is likely the result of a spiking error by a laboratory technician.

[2]Particle size precision outliers are likely the result of poor homogeneity in the samples.

RPD – Relative percent difference

|Δ| - Absolute difference

Field duplicates were collected and analyzed in addition to laboratory duplicates. The results of these additional blanks can be found in the Field QC Sample results section.

Laboratory Reporting Observations

Some qualification of data was done based on observations of laboratory reporting.

Incomplete Lab QC

In one analysis, the laboratory did not report method QC. This analysis run is from the first sampling event of the 2010 water year. Corrective action was taken by contacting the laboratory and clarifying the need for laboratory QC results to be included in the report. No further action was needed.

Incomplete Lab QC for Water Samples

Analyte	Sample ID	Sample Date	Reason
Dichlobenil	C1	10/23/09 22:45	No Lab QC Provided
Dichlobenil	I1	10/23/09 15:59	No Lab QC Provided
Prometon	C1	10/23/09 22:45	No Lab QC Provided
Prometon	I1	10/23/09 15:59	No Lab QC Provided
Triclopyr	C1	10/23/09 22:45	No Lab QC Provided
Triclopyr	I1	10/23/09 15:59	No Lab QC Provided

For methods EPA200.8, EPA405.1, EPA6010B, and SW8151A; the laboratory did not routinely report sufficient laboratory duplicate (LD) or matrix spike/matrix spike duplicate (MS/MSD) analysis on samples. In these cases, laboratory control samples/ laboratory control sample duplicates (LCS/LCSD) and field duplicates (FD) were used to demonstrate precision. No field duplicate precision exceedances were observed for these methods and no qualification was necessary. Corrective action has been taken, and from now on the laboratory and sampling group will take care to insure a larger percentage of our samples are processed for precision QC.

Benzofluoranthenes

During 2010, Analytical Resources, Inc. (ARI) altered their reporting procedure for the SW8270D SIM method with regards to the analytes benzo(b)fluoranthene, benzo(j)fluoranthene and benzo(k)fluoranthene. Prior to May 2010, ARI reported benzo(b)fluoranthene and benzo(k)fluoranthene separately. ARI did not explicitly report benzo(j)fluoranthene, due to poor resolution.

ARI's new policy is to report "total benzofluoranthenes" as the result of integrating across the combined elution ranges of benzo(b)fluoranthene, benzo(k)fluoranthene and benzo(j)fluoranthene.

To maintain compatibility throughout the data set for water year 2010, benzo(b)fluoranthene and benzo(k)fluoranthene results from prior to May 2010 have been manually combined as "Total Benzofluoranthenes". No further action was required.

Field QC Sample Results

Field Blank QC

Water Sampling Equipment Blanks

To test the cleanliness of all the sampling and processing equipment that contacts the sampled stormwater, a blank was taken of following equipment:

- Stainless Steel Bailer – used to collect grab samples
- 2.5 Gallon Glass Bottle – composite bottle used in auto samplers
- Cone and Churn Splitters – used to process samples
- Sampler Tubing – used to pump samples from channel to composite bottle

Results of water sampling equipment blank samples are summarized in the following table. Equipment blanks were analyzed for all applicable analytes (i.e., composite sampling equipment analyzed for composite sample analytes and grab sample equipment analyze for grab sample analytes).

Field Blank results were non detect for all analytes except nitrate-nitrite and bis(2-ethylhexyl)phthalate.

Nitrate-nitrite was present in all blanks sampled, with concentrations ranging from 0.011 to 0.022 mg-N/L. Stormwater sample results ranged from 0.071 to 3.0 mg-N/L. Although the blank results are only slightly above the 0.01 mg-N/L reporting limit and could be considered “trace amounts,” the highest blank results exceed 10 percent of the lowest stormwater sample concentration, which is the action level to flag the sample results. Sampling staff investigated their procedures for sources of nitrates. After eliminating probable sources of nitrate-nitrites, the analytical laboratory was asked to investigate their equipment for sources of nitrate-nitrites. In January 2011, the laboratory isolated the nitrate contamination to be coming from the gloves their staff use when decontaminating sample bottles. The corrective action is for laboratory technician that washes sample bottles remove his/her gloves prior to the final rinsing steps. No further corrective action was needed.

Bis(2-ethylhexyl)phthalate was detected in two of the five field blanks samples with concentrations of 2.1 and 4.8 ug/L, compared to the reporting limit of 1.0 ug/L. Seven of the 38 stormwater samples collected in WY2010 had detectable amounts of bis(2-ethylhexyl)phthalate, with the maximum detected concentration being 8.5 ug/L. Four of 29 laboratory method blanks had detectable concentrations of this chemical with lab blank results ranging from 1.2 to 8.6 ug/L. Bis(2-ethylhexyl)phthalate is commonly attributed to laboratory contamination and the above blank data strongly suggest the laboratory is the source of the bis(2-ethylhexyl)phthalate for this project. Due to the ubiquitous nature of this chemical in many plastic products, laboratories struggle to eliminate its presence in blanks and limit sample cross contamination. No corrective action is recommended for the bis(2-ethylhexyl)phthalate contamination.

Individual result qualifiers due to the blank detections are listed in the table of all qualified results at the end of this appendix and are displayed on the *Analytical Summary Tables* in the body of the report.

Stormwater Characterization Water Sampling Equipment Blank Data

Analyte	Reporting Limit	Units	Bailer Blank 2/9/2010		2.5 Gal Glass Bottle Blank 2/10/2010		Splitter Blanks 2/10/2010		I1 Tubing Blank 2/9/2010		C1 Tubing Blank 2/9/2010		R1 Tubing Blank 2/9/2010	
Cadmium, Dissolved	0.2	ug/L	NM		0.2	U	0.2	U	0.2	U	0.2	U	0.2	U
Cadmium, Total	0.2	ug/L	NM		0.2	U	0.2	U	0.2	U	0.2	U	0.2	U
Copper, Dissolved	0.5	ug/L	NM		0.5	U	0.5	U	0.5	U	0.5	U	0.5	U
Copper, Total	0.5	ug/L	NM		0.5	U	0.5	U	0.5	U	0.5	U	0.5	U

Analyte	Reporting Limit	Units	Bailer Blank 2/9/2010		2.5 Gal Glass Bottle Blank 2/10/2010		Splitter Blanks 2/10/2010		I1 Tubing Blank 2/9/2010		C1 Tubing Blank 2/9/2010		R1 Tubing Blank 2/9/2010	
Lead, Dissolved	1	ug/L	NM		1	U	1	U	1	U	1	U	1	U
Lead, Total	1	ug/L	NM		1	U	1	U	1	U	1	U	1	U
Zinc, Dissolved	4	ug/L	NM		4	U	4	U	4	U	4	U	4	U
Zinc, Total	4	ug/L	NM		4	U	4	U	4	U	4	U	4	U
Nitrogen, Total Kjeldahl	0.3	mg-N/L	NM		0.3	U	0.3	U	0.3	U	0.3	U	0.3	U
Nitrate + Nitrite	0.01	mg-N/L	NM		**0.011**		**0.013**		**0.022**		**0.011**		**0.012**	
Ortho-phosphate	0.004	mg-P/L	NM		0.004	U	0.004	U	0.004	U	0.004	U	0.004	U
Phosphorus, Total	0.008	mg-P/L	NM		0.008	U	0.008	U	0.008	U	0.008	U	0.008	U
Diesel Range Hydrocarbons	0.25	mg/L	0.25	U	NM		NM		NM		NM		NM	
Motor Oil	0.5	mg/L	0.5	U	NM		NM		NM		NM		NM	
Gasoline Range Hydrocarbons	0.25	mg/L	0.25	U	NM		NM		NM		NM		NM	
Fecal Coliform	1	CFU/100 mL	1	U	NM		NM		NM		NM		NM	
bis(2-Ethylhexyl)phthalate	1	ug/L	NM		1	U	1	U	**2.1**		1	U	**4.8**	
Butylbenzylphthalate	1	ug/L	NM		1	U	1	U	1	U	1	U	1	U
Diethylphthalate	1	ug/L	NM		1	U	1	U	1	U	1	U	1	U
Dimethylphthalate	1	ug/L	NM		1	U	1	U	1	U	1	U	1	U
Di-n-Butylphthalate	1	ug/L	NM		1	U	1	U	1	U	1	U	1	U
Di-n-Octyl phthalate	1	ug/L	NM		1	U	1	U	1	U	1	U	1	U
1-Methylnaphthalene	0.1	ug/L	NM		0.1	U	0.1	U	0.1	U	0.1	U	0.1	U
2-Methylnaphthalene	0.1	ug/L	NM		0.1	U	0.1	U	0.1	U	0.1	U	0.1	U
Acenaphthene	0.1	ug/L	NM		0.1	U	0.1	U	0.1	U	0.1	U	0.1	U
Acenaphthylene	0.1	ug/L	NM		0.1	U	0.1	U	0.1	U	0.1	U	0.1	U
Anthracene	0.1	ug/L	NM		0.1	U	0.1	U	0.1	U	0.1	U	0.1	U
Benzo(a)anthracene	0.1	ug/L	NM		0.1	U	0.1	U	0.1	U	0.1	U	0.1	U
Benzo(a)pyrene	0.1	ug/L	NM		0.1	U	0.1	U	0.1	U	0.1	U	0.1	U

Analyte	Reporting Limit	Units	Bailer Blank 2/9/2010		2.5 Gal Glass Bottle Blank 2/10/2010		Splitter Blanks 2/10/2010		I1 Tubing Blank 2/9/2010		C1 Tubing Blank 2/9/2010		R1 Tubing Blank 2/9/2010	
Benzo(g,h,i)perylene	0.1	ug/L	NM		0.1	U	0.1	U	0.1	U	0.1	U	0.1	U
Chrysene	0.1	ug/L	NM		0.1	U	0.1	U	0.1	U	0.1	U	0.1	U
Dibenz(a,h)anthracene	0.1	ug/L	NM		0.1	U	0.1	U	0.1	U	0.1	U	0.1	U
Dibenzofuran	0.1	ug/L	NM		0.1	U	0.1	U	0.1	U	0.1	U	0.1	U
Fluoranthene	0.1	ug/L	NM		0.1	U	0.1	U	0.1	U	0.1	U	0.1	U
Fluorene	0.1	ug/L	NM		0.1	U	0.1	U	0.1	U	0.1	U	0.1	U
Indeno(1,2,3-cd)pyrene	0.1	ug/L	NM		0.1	U	0.1	U	0.1	U	0.1	U	0.1	U
Naphthalene	0.1	ug/L	NM		0.1	U	0.1	U	0.1	U	0.1	U	0.1	U
Pentachlorophenol	0.5	ug/L	NM		0.5	U	0.5	U	0.5	U	0.5	U	0.5	U
Phenanthrene	0.1	ug/L	NM		0.1	U	0.1	U	0.1	U	0.1	U	0.1	U
Pyrene	0.1	ug/L	NM		0.1	U	0.1	U	0.1	U	0.1	U	0.1	U
Total Benzofluoranthenes	0.1	ug/L	NM		0.1	U	0.1	U	0.1	U	0.1	U	0.1	U

Notes-

U - Analyte was not detected above the reported result.

NM – Not measured.

Sediment Sampling Equipment Blanks

Two blanks were collected on the PTFE, 1L wide mouth sediment traps bottles in WY2010. One blank was collected from bottles previously used by SPU and then decontaminated before use on this project, and another blank collected on new, unused bottles purchased pre-cleaned from the manufacturer. The blank water was tested for all the analytes required for sediment samples, but using analytical methods for water. No analytes were detected in either of the two sediment trap blank samples, and no further action was required. Sediment trap blank results are presented in the table below.

Stormwater Characterization Sediment Sampling Equipment Blank Data

Analyte	Reporting Limits	Units	Sed Trap Bottle Blank (Used, decontaminated) 3/5/2010 10:55		Sed Trap Bottle Blank (New, unused) 3/5/2010 11:00	
Cadmium	0.2	ug/L	0.2	U	0.2	U

Analyte	Reporting Limits	Units	Sed Trap Bottle Blank (Used, decontaminated) 3/5/2010 10:55		Sed Trap Bottle Blank (New, unused) 3/5/2010 11:00	
Copper	0.5	ug/L	0.5	U	0.5	U
Lead	1	ug/L	1	U	1	U
Zinc	4	ug/L	4	U	4	U
Mercury	0.1	ug/L	0.1	U	0.1	U
Aroclor 1016	1	ug/L	1	U	1	U
Aroclor 1221	1	ug/L	1	U	1	U
Aroclor 1232	1	ug/L	1	U	1	U
Aroclor 1242	1	ug/L	1	U	1	U
Aroclor 1248	1	ug/L	1	U	1	U
Aroclor 1254	1	ug/L	1	U	1	U
Aroclor 1260	1	ug/L	1	U	1	U
2,4,5-Trichlorophenol	5	ug/L	5	U	5	U
2,4,6-Trichlorophenol	5	ug/L	5	U	5	U
2,4-Dichlorophenol	5	ug/L	5	U	5	U
2,4-Dimethylphenol	1	ug/L	1	U	1	U
2,4-Dinitrophenol	10	ug/L	10	U	10	U
2-Chlorophenol	1	ug/L	1	U	1	U
2-Methylphenol	1	ug/L	1	U	1	U
2-Nitrophenol	5	ug/L	5	U	5	U
4,6-Dinitro-2-Methylphenol	10	ug/L	10	U	10	U
4-Chloro-3-methylphenol	5	ug/L	5	U	5	U
4-Methylphenol	1	ug/L	1	U	1	U
4-Nitrophenol	5	ug/L	5	U	5	U
bis(2-Ethylhexyl)phthalate	1	ug/L	1	U	1	U
Butylbenzylphthalate	1	ug/L	1	U	1	U
Diethylphthalate	1	ug/L	1	U	1	U
Dimethylphthalate	1	ug/L	1	U	1	U
Di-n-Butylphthalate	1	ug/L	1	U	1	U
Di-n-Octyl phthalate	1	ug/L	1	U	1	U

Analyte	Reporting Limits	Units	Sed Trap Bottle Blank (Used, decontaminated) 3/5/2010 10:55		Sed Trap Bottle Blank (New, unused) 3/5/2010 11:00	
Phenol	1	ug/L	1	U	1	U
1-Methylnaphthalene	0.1	ug/L	0.1	U	0.1	U
2-Methylnaphthalene	0.1	ug/L	0.1	U	0.1	U
Acenaphthene	0.1	ug/L	0.1	U	0.1	U
Acenaphthylene	0.1	ug/L	0.1	U	0.1	U
Anthracene	0.1	ug/L	0.1	U	0.1	U
Benzo(a)anthracene	0.1	ug/L	0.1	U	0.1	U
Benzo(a)pyrene	0.1	ug/L	0.1	U	0.1	U
Benzo(g,h,i)perylene	0.1	ug/L	0.1	U	0.1	U
Chlorpyrifos	0.2	ug/L	0.2	U	0.2	U
Chrysene	0.1	ug/L	0.1	U	0.1	U
Diazinon	0.2	ug/L	0.2	U	0.2	U
Dibenz(a,h)anthracene	0.1	ug/L	0.1	U	0.1	U
Dibenzofuran	0.1	ug/L	0.1	U	0.1	U
Fluoranthene	0.1	ug/L	0.1	U	0.1	U
Fluorene	0.1	ug/L	0.1	U	0.1	U
Indeno(1,2,3-cd)pyrene	0.1	ug/L	0.1	U	0.1	U
Malathion	0.2	ug/L	0.2	U	0.2	U
Naphthalene	0.1	ug/L	0.1	U	0.1	U
Pentachlorophenol	0.5	ug/L	0.5	U	0.5	U
Phenanthrene	0.1	ug/L	0.1	U	0.1	U
Pyrene	0.1	ug/L	0.1	U	0.1	U
Total Benzofluoranthenes	0.1	ug/L	0.1	U	0.1	U

Notes-

U - Analyte was not detected above the reported result.

Field Duplicate Samples

During WY2010, three duplicate grab samples and three composite split samples were analyzed.

The only grab duplicate sample analyte that exceeded control limits (25 percent) was for fecal coliform. Due to the nature of this test (i.e., an analyst counting colony forming units), the precision for this method decreases as concentrations increase. In addition, since grab samples are collected individually and bacteria concentrations can change from second to second in a flowing medium, it can prove very difficult to meet the 25 percent control limit between a primary grab and duplicate sample. Due to this inherent problem, associated sample results are flagged accordingly but no corrective actions are recommended.

Only one of three composite split samples slightly exceeded the control limit (RPD of 25.3 versus the limit of 25 percent) for total suspended solids (TSS). It is very difficult for TSS split results to remain below the 25 percent control limit due to settling that occurs while processing stormwater solids. Even when using cone and churn splitting equipment, as was used during this project, further settling can occur when the laboratory analyst subsamples from sample containers while performing the TSS analysis. Due to these reasons, there is general agreement that Suspended Solids Concentration (SSC) is a more representative test when evaluating stormwater and stormwater BMPs. Associated sample results have been qualified accordingly, and no further action was required.

Two of three surfactant samples also exceeded the control limits. Associated sample results have been qualified. No further action taken.

Duplicate sample results are summarized in the tables below. Tables list the original lab qualifier adjacent to the corresponding sample result. The sample results qualifier, which is based on rules listed in above, is listed after the RPD or absolute difference.

Insufficient quantities of sediment were captured at each site to allow for sediment duplicate samples to be generated.

Stormwater Characterization Water Sample Grab Duplicate Data

Analyte	Report Limit	Units	I1 Grab – 3/11/2010						I1 Grab - 8/31/2010						R1 Grab – 8/31/2010					
			I1 Parent		I1 Dup		RPD or (|Δ|)	Qualifiers Applied	I1 Parent		I1 Dup		RPD or (|Δ|)	Qualifier Applied	R1 Parent 8/31/2010		R1 Dup 8/31/2010		RPD or (|Δ|)	Qualifier Applied
Diesel Range Hydrocarbons	0.25	mg/L	0.46		0.39		(0.07)		0.79		0.89		(0.1)		0.49		0.47		(0.02)	
Gasoline Range Hydrocarbons	0.25	mg/L	0.25	U	0.25	U	0		0.25	U	0.25	U	0		0.25	U	0.25	U	0	
Fecal Coliform	1	CFU/100 mL	720		660		8.7		1220		960		23.9		35300		10900		**106**	**J/UJ**

Stormwater Characterization Water Sample Composite Split Data

Analyte	Report Limit	Units	C1 Composite – 8/31/2010						I1 Composite – 3/12/2010						R1 Composite – 9/16/2010					
			C1 Parent		C1 Split		RPD or (|Δ|)	Qualifier Applied	I1 Parent		I1 Split		RPD or (|Δ|)	Qualifiers Applied	R1 Parent		R1 Split		RPD or (|Δ|)	Qualifier Applied
Conductivity	1	umhos /cm	96		94		2.1		141		141		0		37.2		39.2		5.24	
pH	0.01	std units	7.04		7.02		(0.02)		7.47		7.57		(0.1)		6.8		6.77		(0.03)	
Solids, Total Suspended	1	mg/L	50.8		65.6		**25.4**	**J/UJ**	43.4		45.7		5.16		68.3		63.4		7.44	
Turbidity	0.05	NTU	34		31		9.23		40		38		5.13		46		48		4.26	
Cadmium, Dissolved	0.2	ug/L	0.2	U	0.2	U	0		0.2	U	0.2	U	0		0.2	U	0.2	U	0	
Cadmium, Total	0.2	ug/L	0.3		0.3		0		0.2	U	0.2	U	0		0.2	U	0.2	U	0	
Copper, Total	0.5	ug/L	22.6		23.7		4.75		4.6		4.5		2.2		7.9		8.4		6.13	
Copper, Dissolved	0.5	ug/L	56.2		53.3		5.3		13.3		13.6		2.23		20.4		20.2		1	
Lead, Total	1	ug/L	1	U	2		(1)		1	U	1	U	0		1	U	1	U	0	
Lead, Dissolved	1	ug/L	19		17		11.1		5		5		0		30		29		3.39	
Zinc, Total	4	ug/L	54		57		5.4		57		55		3.57		12		12		0	

Analyte	Report Limit	Units	C1 Composite – 8/31/2010 C1 Parent	C1 Split	RPD or (|Δ|)	Qualifier Applied	I1 Composite – 3/12/2010 I1 Parent	I1 Split	RPD or (|Δ|)	Qualifiers Applied	R1 Composite – 9/16/2010 R1 Parent	R1 Split	RPD or (|Δ|)	Qualifier Applied
Zinc, Dissolved	4	ug/L	155	139	10.9		117	117	0		58	55	5.31	
Chloride	0.1	mg/L	3.8	3.8	0		2.6	2.6	0		0.9	0.9	0	
Nitrogen, Total Kjeldahl	0.3	mg-N/L	2.71	2.59	4.53		0.98	1.23	(0.25)		2.01	2.18	8.11	
Nitrate + Nitrite	0.01	mg-N/L	0.448	0.451	0.667		0.188 J	0.225	17.9		0.408	0.408	0	
Ortho-Phosphate	0.004	mg-P/L	0.128	0.128	0		0.072	0.07	(0.002)		0.027	0.028	3.64	
Phosphorus, Total	0.008	mg-P/L	0.428	0.442	3.22		0.246	0.238	3.31		0.258	0.244	5.58	
Biological Oxygen Demand	1	mg/L	16.3	16.3	0		2.9	3.6	(0.7)		8.4	8.8	4.65	
Triclopyr	0.08	ug/L	0.08 U	0.08 U	0		0.08 U	0.08 U	0		0.08 U	0.08 U	0	
Surfactants	0.025	mg/L	0.051	0.025 U	**(0.026)**	**J/UJ**	0.05 U	0.05	0		0.026	0.053	**(0.027)**	**J/UJ**
Hardness	0.33	mg/L CaCO3	35	33	5.88		68	68	0		18	17	5.71	
Mercury, Dissolved	20	ng/L	20 U	20 U	0		20 U	20 U	0		NM	NM U	NA	
Mercury, Total	20	ng/L	26.1	26.8	(0.7)		20 U	20 U	0		NM	NM	NA	
2,4-D	1	ug/L	1 U	1 U	0		1 U	1 U	0		1 U	1 U	0	
MCPP	250	ug/L	250 U	250 U	0		250 U	250 U	0		250 U	250 U	0	
bis(2-Ethylhexyl)phthalate	1	ug/L	3.3 B	2.8 B	(0.5)		1.4	1.3	(0.1)		1 U	1 U	0	
Butylbenzylphthalate	1	ug/L	1 U	1 U	0		1 U	1 U	0		1 U	1 U	0	
Diethylphthalate	1	ug/L	1 U	1 U	0		1 U	1 U	0		1 U	1 U	0	
Dimethylphthalate	1	ug/L	1 U	1 U	0		1 U	1 U	0		1 U	1 U	0	
Di-n-Butylphthalate	1	ug/L	1 U	1 U	0		1 U	1 U	0		1 U	1 U	0	

			C1 Composite – 8/31/2010				I1 Composite – 3/12/2010				R1 Composite – 9/16/2010			
Analyte	Report Limit	Units	C1 Parent	C1 Split	RPD or (|Δ|)	Qualifier Applied	I1 Parent	I1 Split	RPD or (|Δ|)	Qualifiers Applied	R1 Parent	R1 Split	RPD or (|Δ|)	Qualifier Applied
Di-n-Octyl phthalate	1	ug/L	1 U	1 U	0		1 U	1 U	0		1 U	1 U	0	
1-Methylnaphthalene	0.1	ug/L	0.1 U	0.1 U	0		0.1 U	0.1 U	0		0.1 U	0.1 U	0	
2-Methylnaphthalene	0.1	ug/L	0.1 U	0.1 U	0		0.1 U	0.1 U	0		0.1 U	0.1 U	0	
Acenaphthene	0.1	ug/L	0.1 U	0.1 U	0		0.1 U	0.1 U	0		0.1 U	0.1 U	0	
Acenaphthylene	0.1	ug/L	0.1 U	0.1 U	0		0.1 U	0.1 U	0		0.1 U	0.1 U	0	
Anthracene	0.1	ug/L	0.1 U	0.1 U	0		0.1 U	0.1 U	0		0.1 U	0.1 U	0	
Benzo(a)anthracene	0.1	ug/L	0.1 U	0.1 U	0		0.1 U	0.1 U	0		0.1 U	0.1 U	0	
Benzo(a)pyrene	0.1	ug/L	0.1 U	0.1 U	0		0.1 U	0.1 U	0		0.1 U	0.1 U	0	
Benzo(g,h,i)perylene	0.1	ug/L	0.11	0.1 U	(0.1)		0.1 U	0.1 U	0		0.1 U	0.1 U	0	
Benzofluoranthenes, Total	0.1	ug/L	0.1 U	0.1 U	0		0.1 U	0.1 U	0		0.1 U	0.1 U	0	
Chlorpyrifos	0.2	ug/L	0.2 U	0.2 U	0		0.2 U	0.2 U	0		0.2 U	0.2 U	0	
Chrysene	0.1	ug/L	0.1 U	0.1 U	0		0.1 U	0.1 U	0		0.1 U	0.1 U	0	
Diazinon	0.2	ug/L	0.2 U	0.2 U	0		0.2 U	0.2 U	0		0.2 U	0.2 U	0	
Dibenz(a,h)anthracene	0.1	ug/L	0.1 U	0.1 U	0		0.1 U	0.1 U	0		0.1 U	0.1 U	0	
Dibenzofuran	0.1	ug/L	0.1 U	0.1 U	0		0.1 U	0.1 U	0		0.1 U	0.1 U	0	
Dichlobenil	0.1	ug/L	0.024 U	0.024 U	0		0.12	0.12	0		0.024	0.024	0	
Fluoranthene	0.1	ug/L	0.14	0.16	(0.02)		0.1 U	0.11	(0.01)		0.1 U	0.1 U	0	
Fluorene	0.1	ug/L	0.1 U	0.1 U	0		0.1 U	0.1 U	0		0.1 U	0.1 U	0	
Indeno(1,2,3-cd)pyrene	0.1	ug/L	0.1 U	0.1 U	0		0.1 U	0.1 U	0		0.1 U	0.1 U	0	

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			C1 Composite – 8/31/2010					I1 Composite – 3/12/2010					R1 Composite – 9/16/2010					
Analyte	Report Limit	Units	C1 Parent		C1 Split		RPD or (|Δ|)	Qualifier Applied	I1 Parent		I1 Split		RPD or (|Δ|)	Qualifiers Applied	R1 Parent		R1 Split		RPD or (|Δ|)	Qualifier Applied
Malathion	0.2	ug/L	0.2	U	0.2	U	0		0.2	U	0.2	U	0		0.2	U	0.2	U	0	
Naphthalene	0.1	ug/L	0.1	U	0.12		(0.02)		0.1	U	0.1	U	0		0.1	U	0.1	U	0	
Pentachlorophenol	0.5	ug/L	0.5	U	0.5	U	0		0.5	U	0.5	U	0		0.5	U	0.5	U	0	
Phenanthrene	0.1	ug/L	0.1	U	0.1	U	0		0.1	U	0.1	U	0		0.1	U	0.1	U	0	
Prometon	0.1	ug/L	0.024	U	0.024	U	0		0.12		0.12		0		0.024		0.024		0	
Pyrene	0.1	ug/L	0.1	U	0.15		(0.05)		0.1	U	0.13		(0.03)		0.1	U	0.1	U	0	

Notes:

U - Analyte was not detected above the reported result.

J- Analyte was positively identified. The reported result is an estimate.

UJ- Analyte was not detected above the reported estimate.

RPD – Relative percent difference, |Δ| - Absolute difference

Field Audit Results

On July 20 and 21, 2010, field staff were observed setting up, retrieving and processing samples from site C1 during a base flow sampling event. All work was performed using good sampling techniques and with excellent additional to detail. Sample processing procedures were excellent. No deficiencies were observed and no corrective actions are required.

All Qualified Results by Analyte

The following tables list by analyte all results qualified in the validation process discussed in the previous sections.

All Qualified Results for Water Samples

Analyte	Sample ID	Sample Date	Result	Units	Qualifier	Reason
Acenaphthylene	C1	8/22/10 10:50	0.1	ug/L	UJ	LCS/LCSD Precision Exceedance
Benzo(a)pyrene	C1	8/22/10 10:50	0.1	ug/L	UJ	LCS/LCSD Precision Exceedance
Benzo(g,h,i)perylene	C1	8/22/10 10:50	0.1	ug/L	UJ	LCS/LCSD Precision Exceedance
bis(2-Ethylhexyl)phthalate	I1	10/23/09 15:59	1.7	ug/L	U	Field Blank Contamination
bis(2-Ethylhexyl)phthalate	C1	10/23/09 22:45	1.9	ug/L	U	Field Blank Contamination
bis(2-Ethylhexyl)phthalate	R1	10/29/09 11:22	1	ug/L	UJ	Precision QC Exceedance, Field Blank Contamination
bis(2-Ethylhexyl)phthalate	R1	11/6/09 1:29	1.6	ug/L	U	Field Blank Contamination
bis(2-Ethylhexyl)phthalate	I1	12/14/09 23:44	3.6	ug/L	U	Field Blank Contamination
bis(2-Ethylhexyl)phthalate	C1	12/15/09 8:26	6.2	ug/L	J	Field Blank Contamination
bis(2-Ethylhexyl)phthalate	C1	1/1/10 14:56	7.2	ug/L	J	Field Blank Contamination
bis(2-Ethylhexyl)phthalate	R1	1/1/10 17:01	6.6	ug/L	J	Field Blank Contamination
bis(2-Ethylhexyl)phthalate	I1	1/2/10 9:02	3.7	ug/L	U	Field Blank Contamination
bis(2-	R1	1/8/10 22:03	1.9	ug/L	U	Field Blank

Analyte	Sample ID	Sample Date	Result	Units	Qualifier	Reason
Ethylhexyl)phthalate						Contamination
bis(2-Ethylhexyl)phthalate	C1	1/9/10 8:00	4.6	ug/L	U	Field Blank Contamination
bis(2-Ethylhexyl)phthalate	I1	1/25/10 4:06	1.6	ug/L	U	Field Blank Contamination
bis(2-Ethylhexyl)phthalate	C1	1/25/10 8:30	3.8	ug/L	U	Field Blank Contamination
bis(2-Ethylhexyl)phthalate	R1	2/12/10 0:36	2.2	ug/L	U	Field Blank Contamination
bis(2-Ethylhexyl)phthalate	C1	2/12/10 4:00	7	ug/L	J	Field Blank Contamination
bis(2-Ethylhexyl)phthalate	R1	2/16/10 10:51	2.2	ug/L	U	Field Blank Contamination
bis(2-Ethylhexyl)phthalate	C1	2/19/10 8:51	1	ug/L	U	Field Blank Contamination
bis(2-Ethylhexyl)phthalate	R1	2/24/10 9:53	1	ug/L	U	Field Blank Contamination
bis(2-Ethylhexyl)phthalate	C1	2/24/10 11:11	4.1	ug/L	U	Field Blank Contamination
bis(2-Ethylhexyl)phthalate	C1	3/12/10 5:38	3.2	ug/L	U	Field Blank Contamination
bis(2-Ethylhexyl)phthalate	I1	3/12/10 7:29	2	ug/L	U	Field Blank Contamination
bis(2-Ethylhexyl)phthalate	R1	3/12/10 7:39	3	ug/L	U	Field Blank Contamination
bis(2-Ethylhexyl)phthalate	I1	3/25/10 22:27	2.6	ug/L	U	Field Blank Contamination
bis(2-Ethylhexyl)phthalate	R1	3/26/10 3:38	8.5	ug/L	J	Field Blank Contamination
bis(2-Ethylhexyl)phthalate	C1	3/26/10 7:26	3.5	ug/L	U	Field Blank Contamination
bis(2-Ethylhexyl)phthalate	I1	3/29/10 10:56	5.3	ug/L	J	Field Blank Contamination
bis(2-Ethylhexyl)phthalate	I1	4/3/10 1:07	1.4	ug/L	U	Field Blank Contamination
bis(2-Ethylhexyl)phthalate	C1	4/23/10 12:22	1	ug/L	U	Field Blank Contamination

bis(2-Ethylhexyl)phthalate	I1	4/27/10 5:16	2.2	ug/L	U	Field Blank Contamination
bis(2-Ethylhexyl)phthalate	C1	7/21/10 10:05	1.2	ug/L	U	Method Blank > RL, Field Blank Contamination
bis(2-Ethylhexyl)phthalate	C1	8/22/10 10:50	1	ug/L	U	Field Blank Contamination
bis(2-Ethylhexyl)phthalate	I1	8/31/10 11:52	3.4	ug/L	U	Method Blank > RL, Field Blank Contamination
bis(2-Ethylhexyl)phthalate	R1	8/31/10 17:41	1	ug/L	U	Method Blank > RL, Field Blank Contamination
bis(2-Ethylhexyl)phthalate	C1	8/31/10 21:49	3.3	ug/L	U	Method Blank > RL, Field Blank Contamination
bis(2-Ethylhexyl)phthalate	C1	9/14/10 12:21	1	ug/L	U	Field Blank Contamination
bis(2-Ethylhexyl)phthalate	I1	9/15/10 19:52	4.4	ug/L	U	Field Blank Contamination
bis(2-Ethylhexyl)phthalate	C1	9/16/10 6:23	3.3	ug/L	U	Field Blank Contamination
bis(2-Ethylhexyl)phthalate	R1	9/16/10 23:23	1	ug/L	U	Field Blank Contamination
Dichlobenil	I1	10/23/09 15:59	0.15	ug/L	UJ	No Lab QC Provided
Dichlobenil	C1	10/23/09 22:45	0.15	ug/L	UJ	No Lab QC Provided
Dichlobenil	R1	10/29/09 11:22	0.15	ug/L	UJ	Precision QC Exceedance
Dichlobenil	R1	11/6/09 1:29	0.33	ug/L	J	Precision QC Exceedance
Dichlobenil	R1	2/12/10 0:36	0.12	ug/L	UJ	Precision QC Exceedance
Dichlobenil	C1	2/12/10 4:00	0.12	ug/L	UJ	Precision QC Exceedance
Dichlobenil	R1	2/16/10 10:51	0.12	ug/L	UJ	Precision QC Exceedance
Dichlobenil	C1	2/19/10 8:51	0.12	ug/L	UJ	Precision QC Exceedance
Dichlobenil	I1	3/25/10 22:27	0.12	ug/L	UJ	Precision QC Exceedance

Dichlobenil	R1	3/26/10 3:38	0.12	ug/L	UJ	Precision QC Exceedance
Dichlobenil	C1	3/26/10 7:26	0.12	ug/L	UJ	Precision QC Exceedance
Dichlobenil	I1	3/29/10 10:56	0.12	ug/L	UJ	Precision QC Exceedance
Dichlobenil	C1	4/23/10 12:22	0.12	ug/L	UJ	Precision QC Exceedance
Fecal Coliform	R1	8/31/10 9:25	35300	CFU/100 mL	J	Precision QC Exceedance
Indeno(1,2,3-cd)pyrene	C1	8/22/10 10:50	0.1	ug/L	UJ	Precision QC Exceedance
Nitrate + Nitrite	R1	10/29/09 11:22	0.136	mg-N/L	J	Field Blank Contamination
Nitrate + Nitrite	R1	11/6/09 1:29	0.071	mg-N/L	J	Field Blank Contamination
Nitrate + Nitrite	R1	1/8/10 22:03	0.15	mg-N/L	J	Field Blank Contamination
Nitrate + Nitrite	R1	2/12/10 0:36	0.204	mg-N/L	J	Field Blank Contamination
Nitrate + Nitrite	C1	3/12/10 5:38	0.211	mg-N/L	J	Field Blank Contamination
Nitrate + Nitrite	I1	3/12/10 7:29	0.188	mg-N/L	J	Field Blank Contamination
Nitrate + Nitrite	R1	3/12/10 7:39	0.131	mg-N/L	J	Field Blank Contamination
Nitrate + Nitrite	I1	3/29/10 10:56	0.204	mg-N/L	J	Field Blank Contamination
Prometon	I1	10/23/09 15:59	0.15	ug/L	UJ	No Lab QC Provided
Prometon	C1	10/23/09 22:45	0.15	ug/L	UJ	No Lab QC Provided
Solids, Total Suspended	R1	8/31/10 17:41	54	mg/L	J	Field Dup Precision Exceedance
Solids, Total Suspended	C1	8/31/10 21:49	50.8	mg/L	J	Field Dup Precision Exceedance
Surfactants	I1	10/23/09 15:59	0.05	mg/L	UJ	Exceeded Hold Time
Surfactants	C1	10/23/09 22:45	0.05	mg/L	UJ	Exceeded Hold Time
Surfactants	C1	1/1/10 14:56	0.05	mg/L	UJ	Exceeded Hold Time
Surfactants	R1	1/1/10 17:01	0.05	mg/L	UJ	Exceeded Hold Time

Surfactants	R1	1/8/10 22:03	0.05	mg/L	UJ	Exceeds Hold Time
Surfactants	R1	9/16/10 23:23	0.026	mg/L	J	Exceeded Hold Time, Field Dup Precision Exceedance
Triclopyr	I1	10/23/09 15:59	0.08	ug/L	UJ	No Lab QC Provided
Triclopyr	C1	10/23/09 22:45	0.08	ug/L	UJ	No Lab QC Provided
Triclopyr	I1	3/25/10 22:27	0.08	ug/L	UJ	LCS/LCSD Precision Exceedance
Triclopyr	R1	3/26/10 3:38	0.08	ug/L	UJ	LCS/LCSD Precision Exceedance
Triclopyr	C1	3/26/10 7:26	0.08	ug/L	UJ	LCS/LCSD Precision Exceedance
Triclopyr	I1	3/29/10 10:56	0.08	ug/L	UJ	LCS/LCSD Precision Exceedance
Triclopyr	C1	4/23/10 12:22	0.08	ug/L	UJ	Precision QC Exceedance
Triclopyr	C1	7/21/10 10:05	0.08	ug/L	UJ	Precision QC Exceedance
Triclopyr	C1	9/14/10 12:21	0.08	ug/L	UJ	Precision QC Exceedance
Triclopyr	I1	9/15/10 19:52	0.08	ug/L	UJ	Precision QC Exceedance
Triclopyr	C1	9/16/10 6:23	0.08	ug/L	UJ	Precision QC Exceedance
Triclopyr	R1	9/16/10 23:23	0.08	ug/L	UJ	Precision QC Exceedance

All Qualified Results for Sediment Samples

Analyte	Sample ID	Sample Date	Result	Units	Qualifier	Reason
1-Methylnaphthalene	I1	9/30/10 12:10	52	ug/kg	J	Qualified by Lab
2,4-Dimethylphenol	C1	9/30/10 11:30	410	ug/kg	UJ	MS/MSD Precision
2,4-Dimethylphenol	I1	9/30/10 12:10	280	ug/kg	UJ	MS/MSD Precision
2,4-Dimethylphenol	R1	9/30/10 10:37	230	ug/kg	UJ	MS/MSD Precision
2,4-Dinitrophenol	C1	9/30/10 11:30	4100	ug/kg	UJ	MS / MSD Recovery Low
2,4-Dinitrophenol	I1	9/30/10 12:10	2800	ug/kg	UJ	MS / MSD Recovery Low
2,4-Dinitrophenol	R1	9/30/10 10:37	2300	ug/kg	UJ	MS / MSD Recovery Low
4,6-Dinitro-2-	C1	9/30/10 11:30	4100	ug/kg	UJ	MS / MSD Recovery Low

Analyte	Sample ID	Sample Date	Result	Units	Qualifier	Reason
Methylphenol						
4,6-Dinitro-2-Methylphenol	I1	9/30/10 12:10	2800	ug/kg	UJ	MS / MSD Recovery Low
4,6-Dinitro-2-Methylphenol	R1	9/30/10 10:37	2300	ug/kg	UJ	MS / MSD Recovery Low
4-Methylphenol	C1	9/30/10 11:30	410	ug/kg	UJ	Result <RL, Qualified Estimated by Lab
4-Methylphenol	I1	9/30/10 12:10	280	ug/kg	UJ	Result <RL, Qualified Estimated by Lab
4-Methylphenol	R1	9/30/10 10:37	5200	ug/kg	J	MS/MSD Recovery High
Acenaphthene	I1	9/30/10 12:10	56	ug/kg	J	Qualified by Lab
Aroclor 1248	C1	9/30/10 11:30	66	ug/kg	U	Qualified Non-Detect by Lab
Coarse Silt	I1	9/30/10 12:10	8.2	%	J	Lab Dup Exceedance
Coarse Silt	R1	9/30/10 10:37	1.1	%	J	Lab Dup Exceedance
Dibenz(a,h)anthracene	C1	9/30/10 11:30	160	ug/kg	J	MS/MSD Precision
Dibenz(a,h)anthracene	I1	9/30/10 12:10	74	ug/kg	J	MS/MSD Precision
Dibenz(a,h)anthracene	R1	9/30/10 10:37	140	ug/kg	J	MS/MSD Precision
Dibenzofuran	I1	9/30/10 12:10	41	ug/kg	J	Qualified by Lab
Dimethylphthalate	I1	9/30/10 12:10	280	ug/kg	J	Qualified by Lab
Medium Silt	I1	9/30/10 12:10	15.6	%	J	Lab Dup Exceedance
Medium Silt	R1	9/30/10 10:37	3.8	%	J	Lab Dup Exceedance
Naphthalene	I1	9/30/10 12:10	56	ug/kg	J	Qualified by Lab
Total Fines	I1	9/30/10 12:10	59.9	%	J	Lab Dup Exceedance
Total Fines	R1	9/30/10 10:37	11.5	%	J	Lab Dup Exceedance

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Appendix C.2: Stormwater Characterization - Annual, Storm And Base Flow Event Hydrographs

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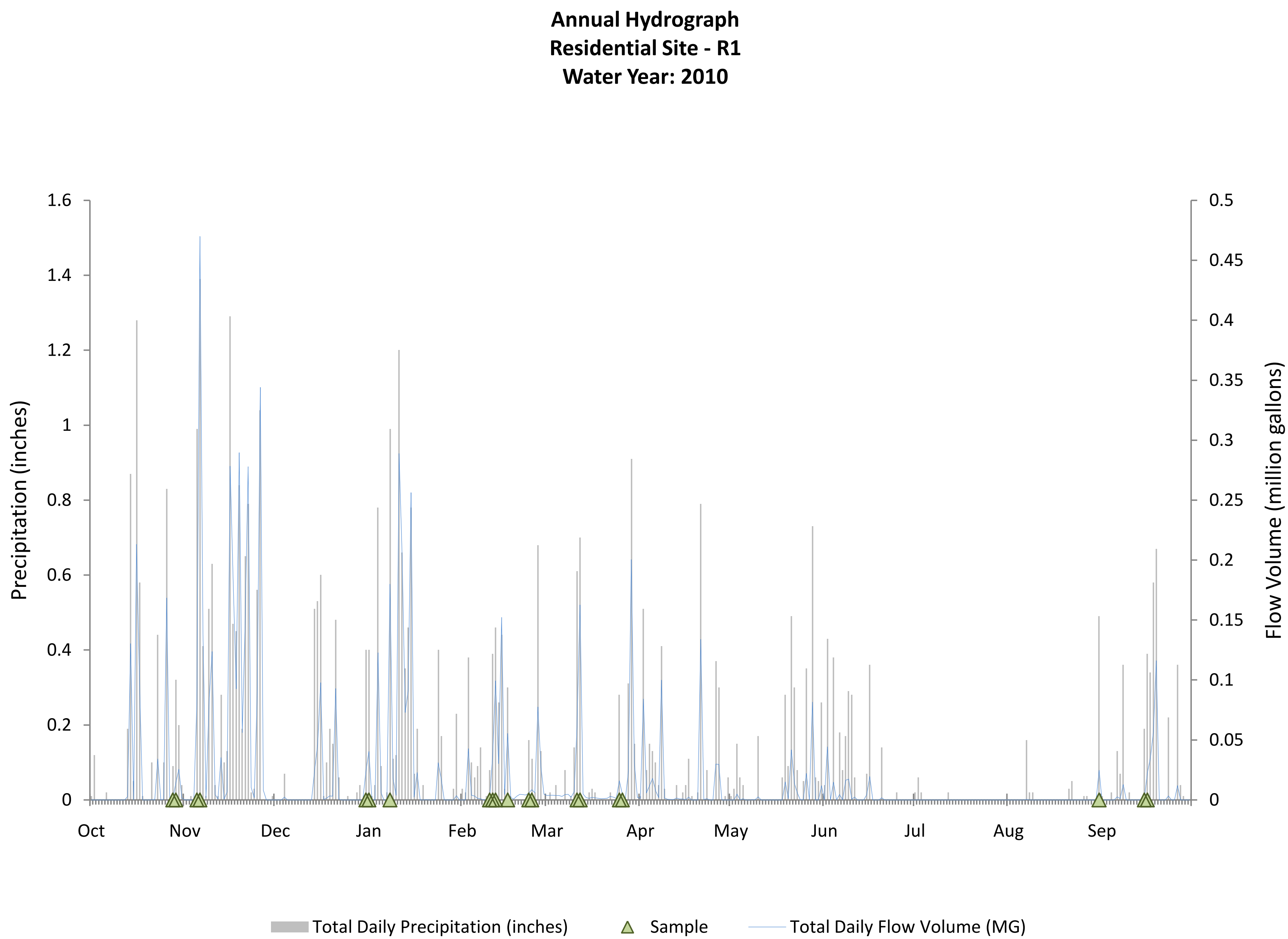
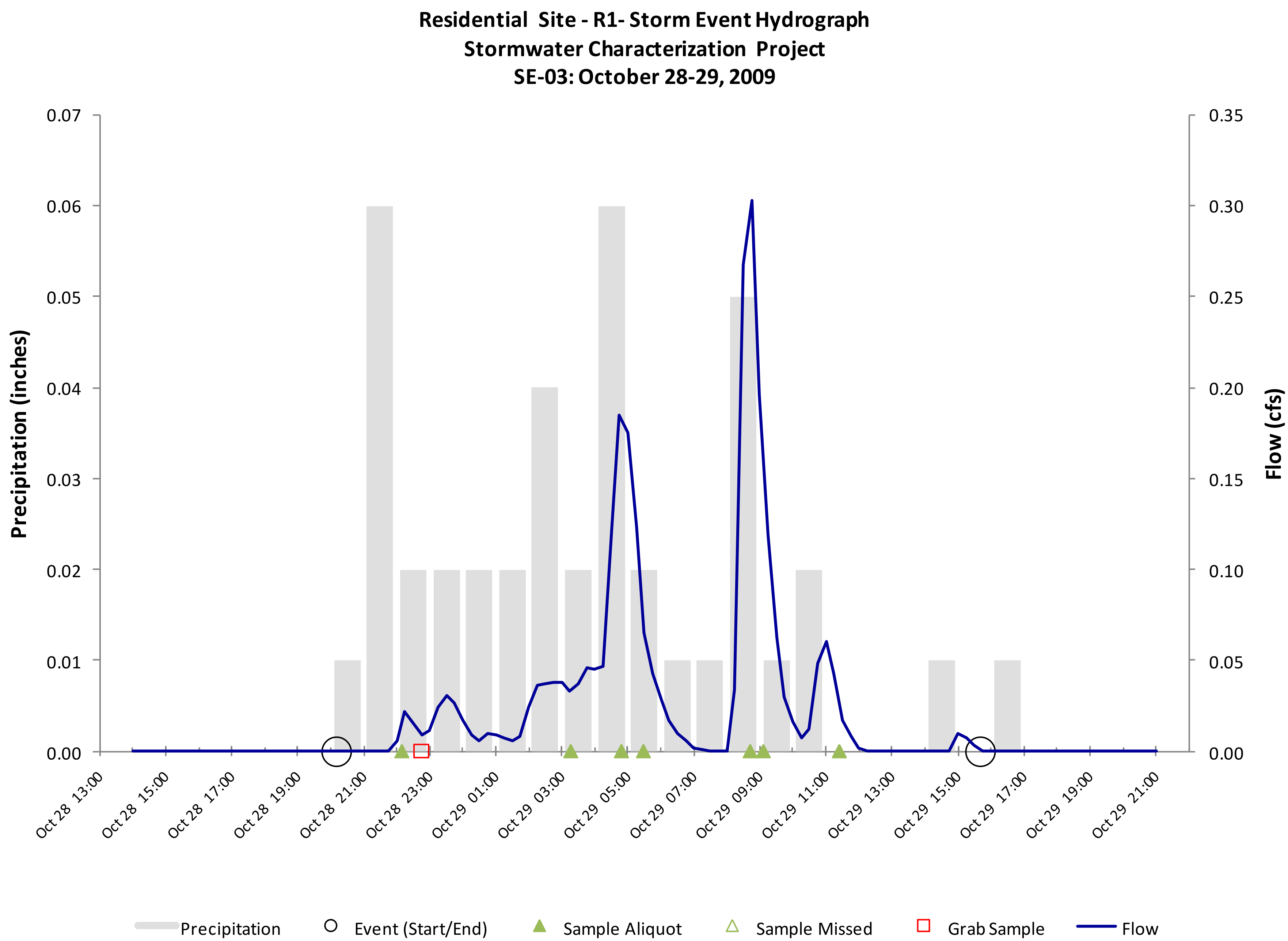
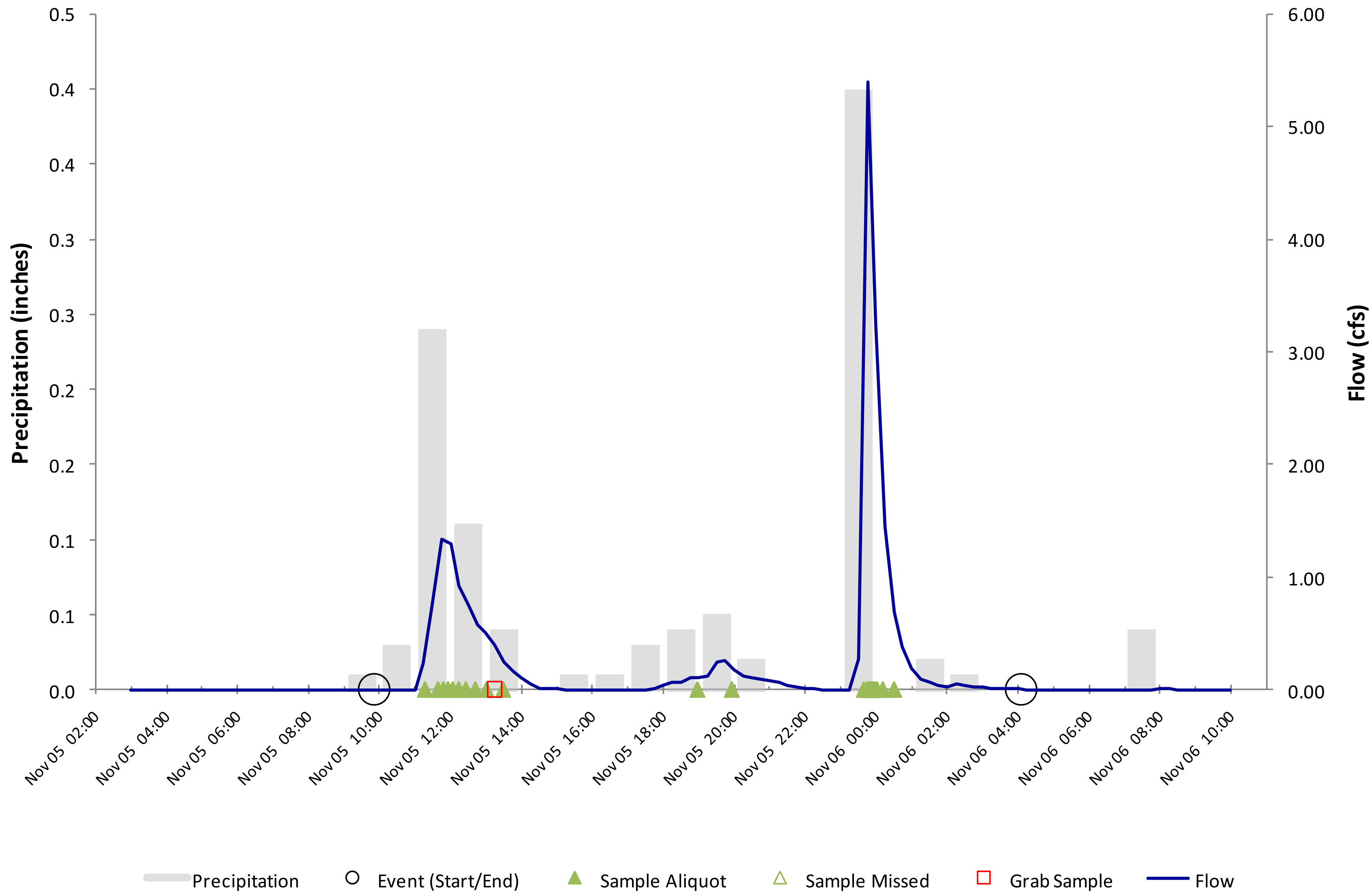
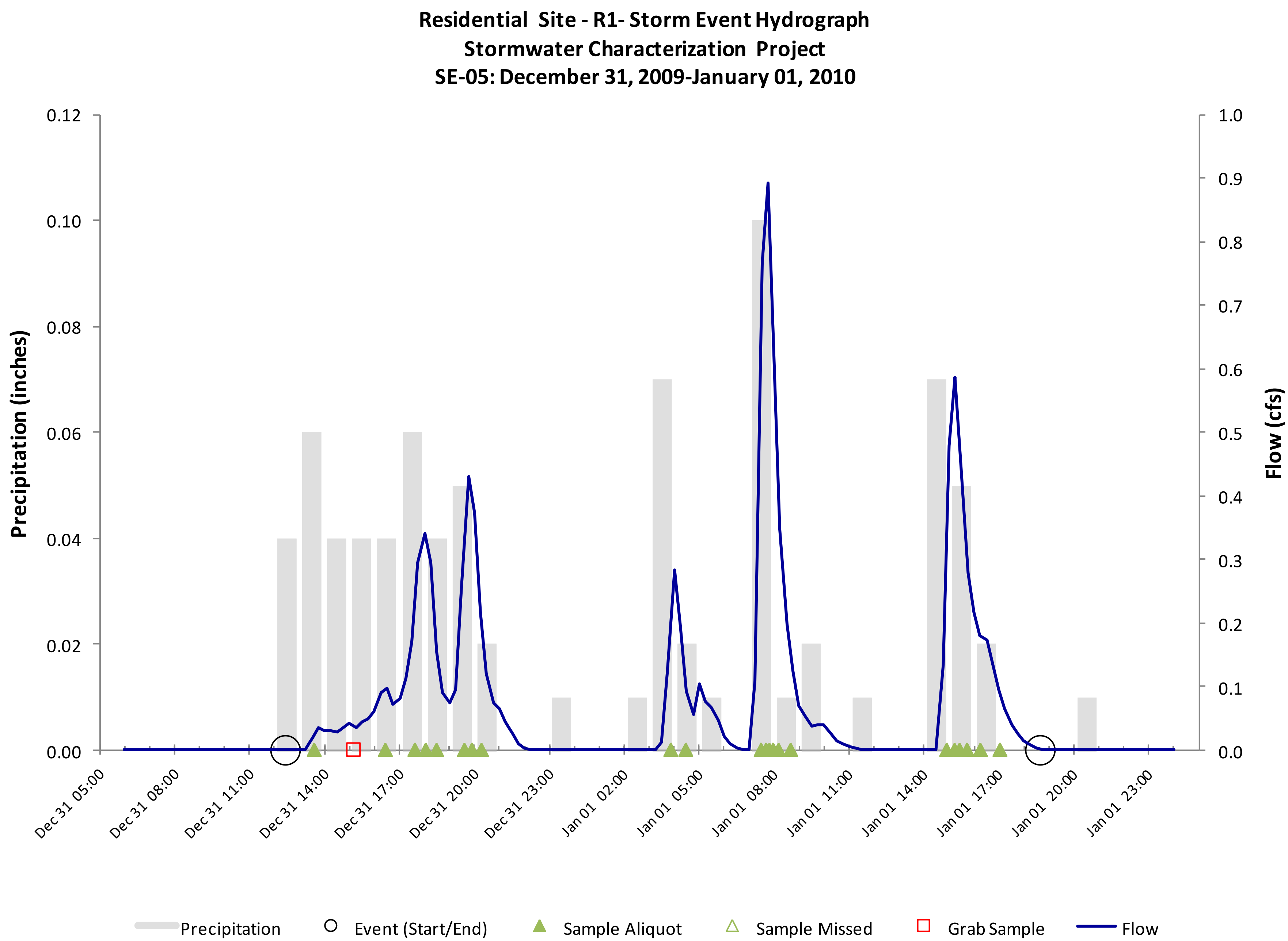

Annual Hydrograph
Residential Site - R1
Water Year: 2010
Precipitation (inches)
Flow Volume (million gallons)
1.6
1.4
1.2
1
0.8
0.6
0.4
0.2
0
0.5
0.45
0.4
0.35
0.3
0.25
0.2
0.15
0.1
0.05
0
Oct
Nov
Dec
Jan
Feb
Mar
Apr
May
Jun
Jul
Aug
Sep
Total Daily Precipitation (inches)
Sample
Total Daily Flow Volume (MG)

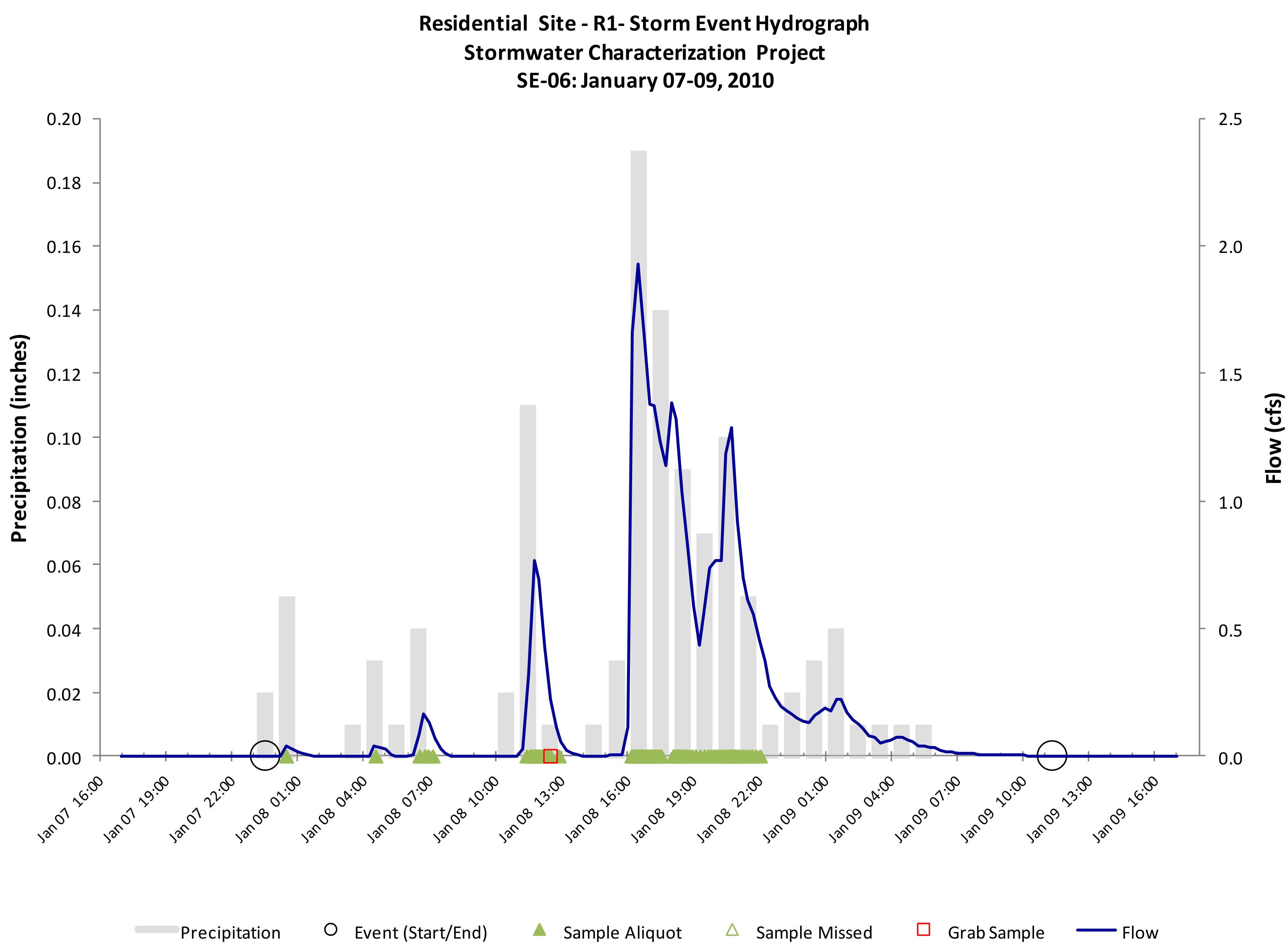

Residential Site - R1- Storm Event Hydrograph
Stormwater Characterization Project
SE-03: October 28-29, 2009
Precipitation (inches)
Flow (cfs)
0.07
0.06
0.05
0.04
0.03
0.02
0.01
0.00
0.35
0.30
0.25
0.20
0.15
0.10
0.05
0.00
Oct 28 13:00
Oct 28 15:00
Oct 28 17:00
Oct 28 19:00
Oct 28 21:00
Oct 28 23:00
Oct 29 01:00
Oct 29 03:00
Oct 29 05:00
Oct 29 07:00
Oct 29 09:00
Oct 29 11:00
Oct 29 13:00
Oct 29 15:00
Oct 29 17:00
Oct 29 19:00
Oct 29 21:00
Precipitation
Event (Start/End)
Sample Aliquot
Sample Missed
Grab Sample
Flow

Residential Site - R1- Storm Event Hydrograph
Stormwater Characterization Project
SE-04: November 05-06, 2009

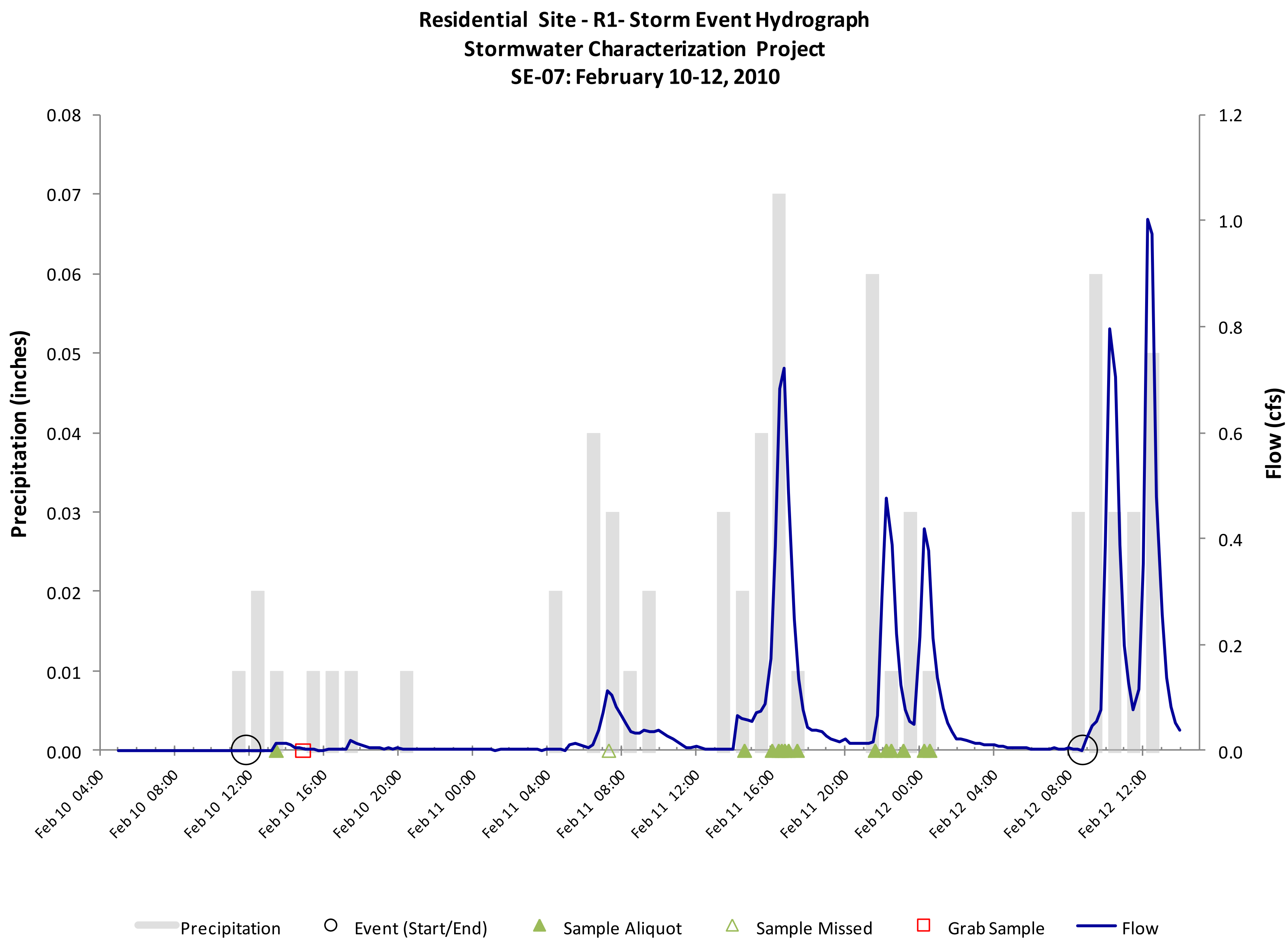




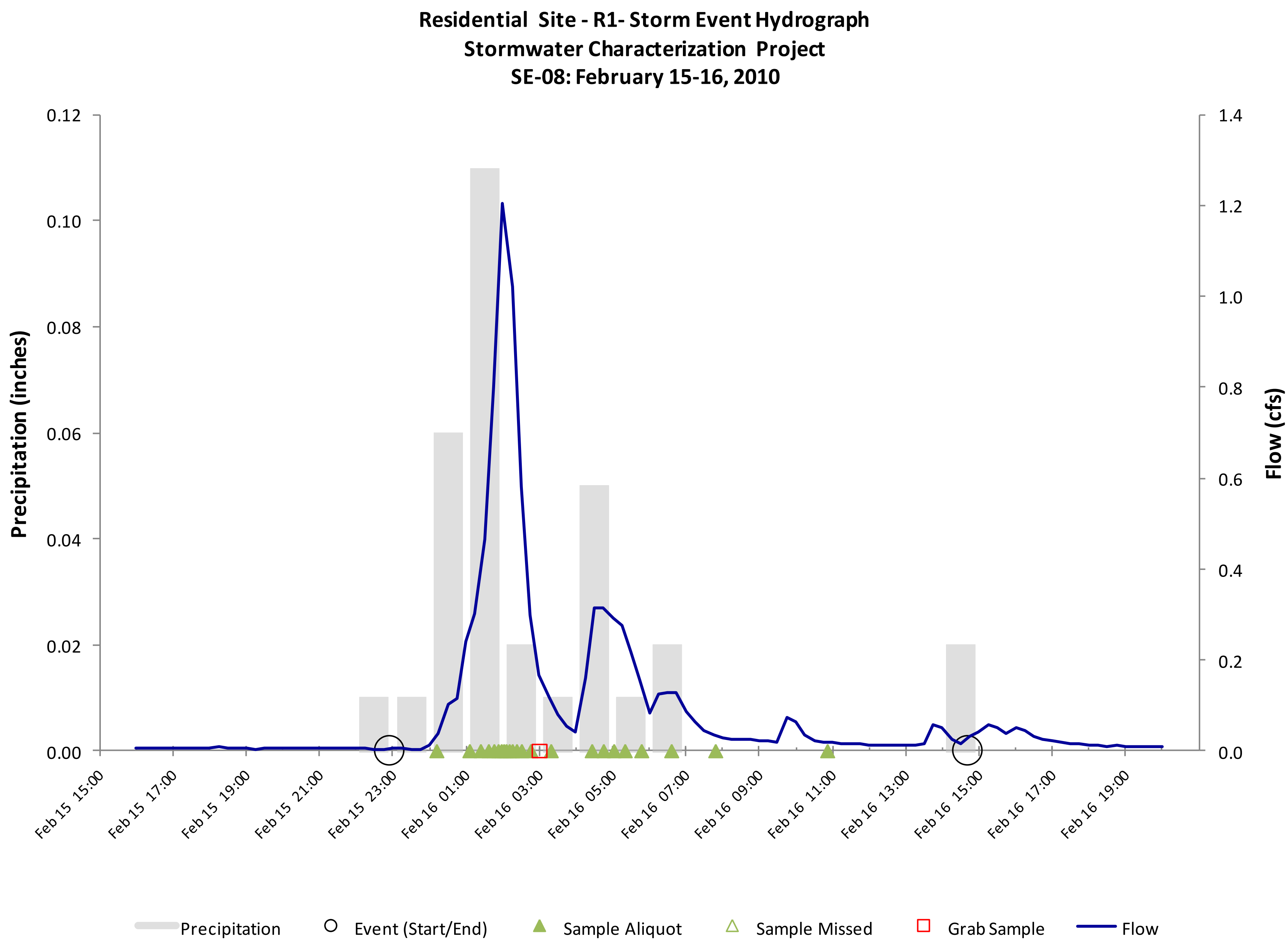
Residential Site - R1- Storm Event Hydrograph
Stormwater Characterization Project
SE-05: December 31, 2009-January 01, 2010
Precipitation (inches)
Flow (cfs)
0.12
0.10
0.08
0.06
0.04
0.02
0.00
1.0
0.9
0.8
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0.0
Dec 31 05:00
Dec 31 08:00
Dec 31 11:00
Dec 31 14:00
Dec 31 17:00
Dec 31 20:00
Dec 31 23:00
Jan 01 02:00
Jan 01 05:00
Jan 01 08:00
Jan 01 11:00
Jan 01 14:00
Jan 01 17:00
Jan 01 20:00
Jan 01 23:00
Precipitation
Event (Start/End)
Sample Aliquot
Sample Missed
Grab Sample
Flow



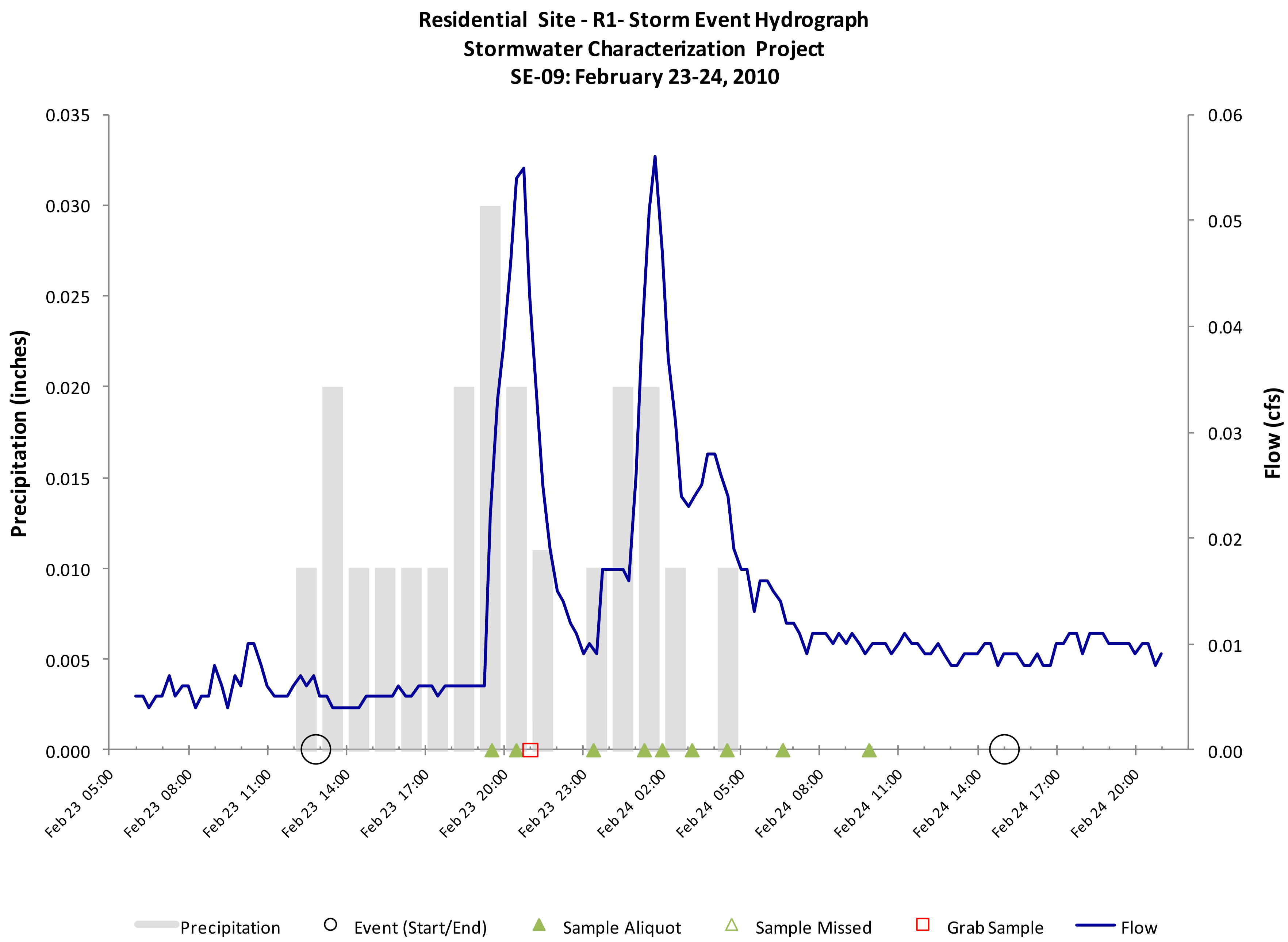
Residential Site - R1- Storm Event Hydrograph
Stormwater Characterization Project
SE-06: January 07-09, 2010
Precipitation (inches)
Flow (cfs)
0.20
0.18
0.16
0.14
0.12
0.10
0.08
0.06
0.04
0.02
0.00
2.5
2.0
1.5
1.0
0.5
0.0
Jan 07 16:00
Jan 07 19:00
Jan 07 22:00
Jan 08 01:00
Jan 08 04:00
Jan 08 07:00
Jan 08 10:00
Jan 08 13:00
Jan 08 16:00
Jan 08 19:00
Jan 08 22:00
Jan 09 01:00
Jan 09 04:00
Jan 09 07:00
Jan 09 10:00
Jan 09 13:00
Jan 09 16:00
Precipitation
Event (Start/End)
Sample Aliquot
Sample Missed
Grab Sample
Flow

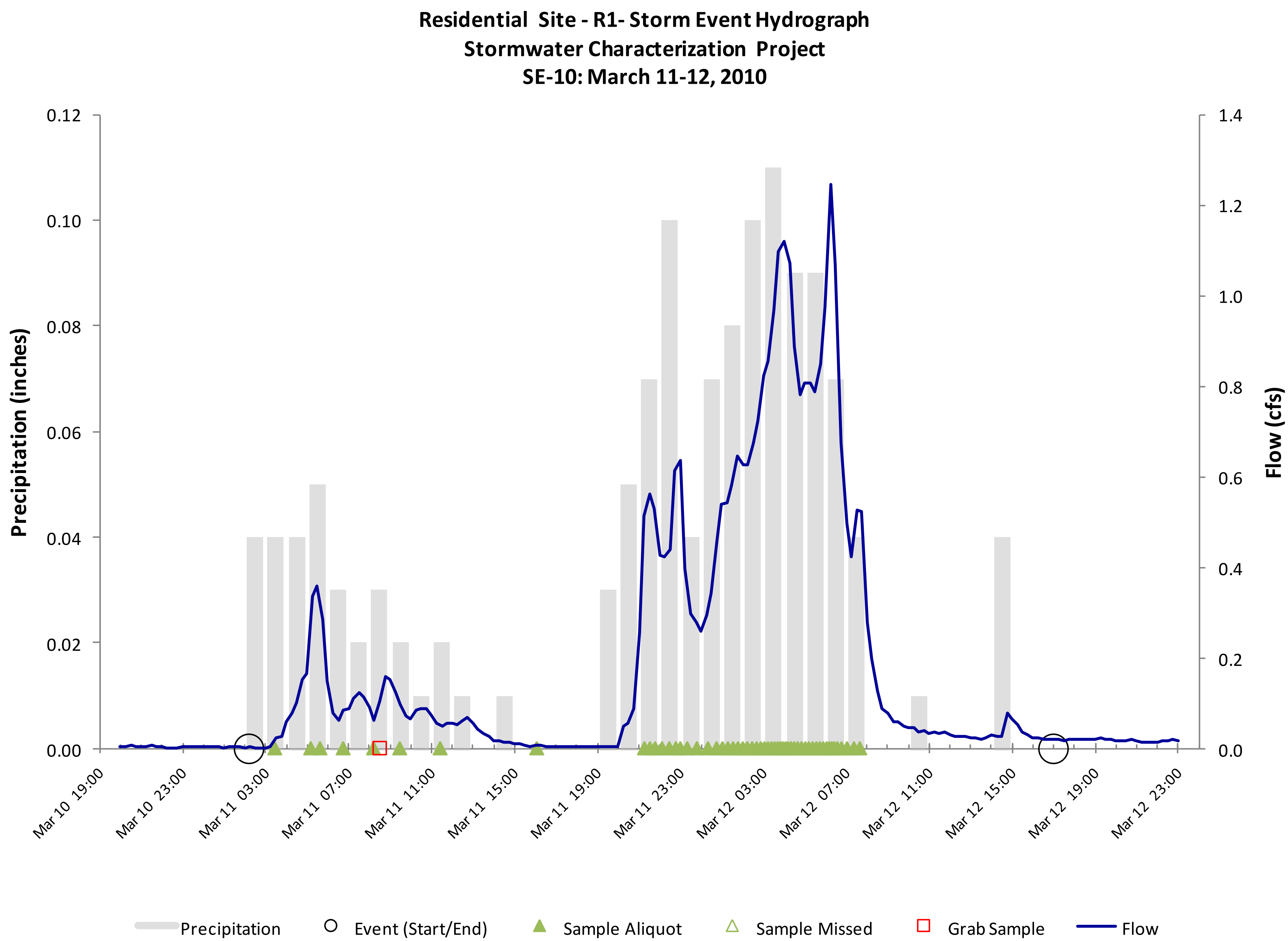


Residential Site - R1- Storm Event Hydrograph
Stormwater Characterization Project
SE-07: February 10-12, 2010
Precipitation (inches)
Flow (cfs)
0.08
0.07
0.06
0.05
0.04
0.03
0.02
0.01
0.00
1.2
1.0
0.8
0.6
0.4
0.2
0.0
Feb 10 04:00
Feb 10 08:00
Feb 10 12:00
Feb 10 16:00
Feb 10 20:00
Feb 11 00:00
Feb 11 04:00
Feb 11 08:00
Feb 11 12:00
Feb 11 16:00
Feb 11 20:00
Feb 12 00:00
Feb 12 04:00
Feb 12 08:00
Feb 12 12:00
Precipitation
Event (Start/End)
Sample Aliquot
Sample Missed
Grab Sample
Flow

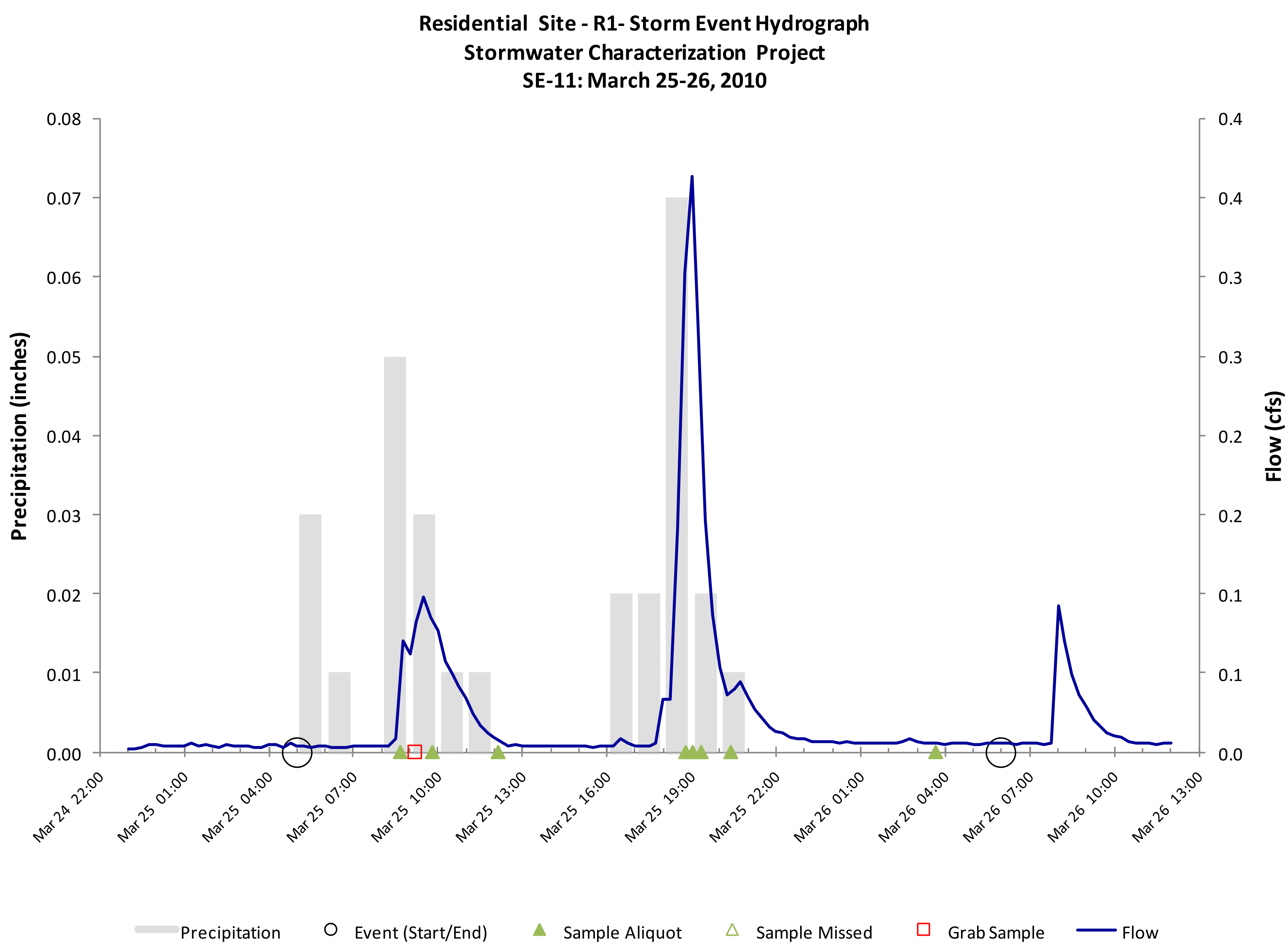


Residential Site - R1- Storm Event Hydrograph
Stormwater Characterization Project
SE-08: February 15-16, 2010
Precipitation (inches)
Flow (cfs)
0.12
0.10
0.08
0.06
0.04
0.02
0.00
1.4
1.2
1.0
0.8
0.6
0.4
0.2
0.0
Feb 15 15:00
Feb 15 17:00
Feb 15 19:00
Feb 15 21:00
Feb 15 23:00
Feb 16 01:00
Feb 16 03:00
Feb 16 05:00
Feb 16 07:00
Feb 16 09:00
Feb 16 11:00
Feb 16 13:00
Feb 16 15:00
Feb 16 17:00
Feb 16 19:00
Precipitation
Event (Start/End)
Sample Aliquot
Sample Missed
Grab Sample
Flow

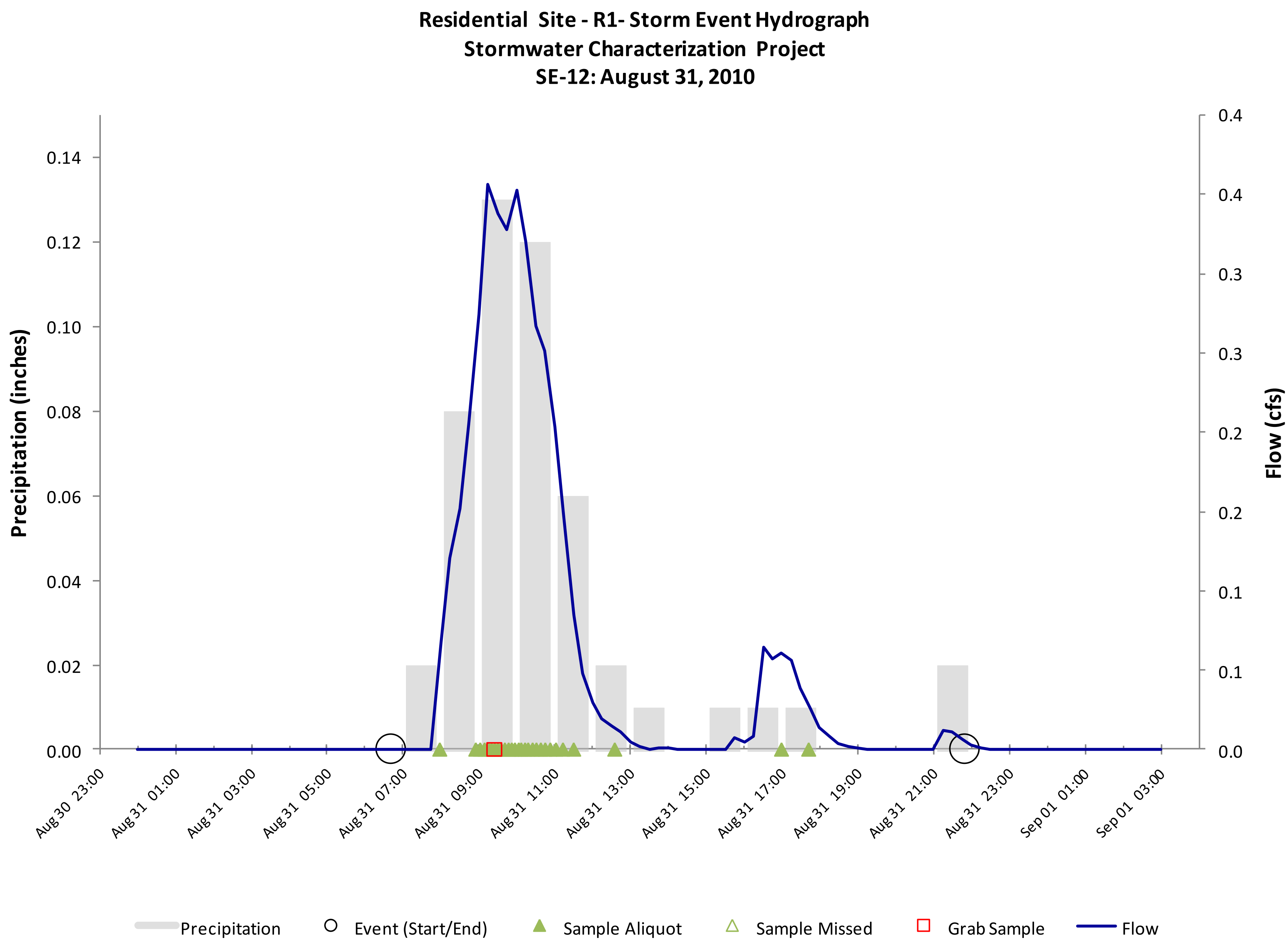

Residential Site - R1- Storm Event Hydrograph
Stormwater Characterization Project
SE-09: February 23-24, 2010
Precipitation (inches)
Flow (cfs)
0.035
0.030
0.025
0.020
0.015
0.010
0.005
0.000
0.06
0.05
0.04
0.03
0.02
0.01
0.00
Feb 23 05:00
Feb 23 08:00
Feb 23 11:00
Feb 23 14:00
Feb 23 17:00
Feb 23 20:00
Feb 23 23:00
Feb 24 02:00
Feb 24 05:00
Feb 24 08:00
Feb 24 11:00
Feb 24 14:00
Feb 24 17:00
Feb 24 20:00
Precipitation
Event (Start/End)
Sample Aliquot
Sample Missed
Grab Sample
Flow



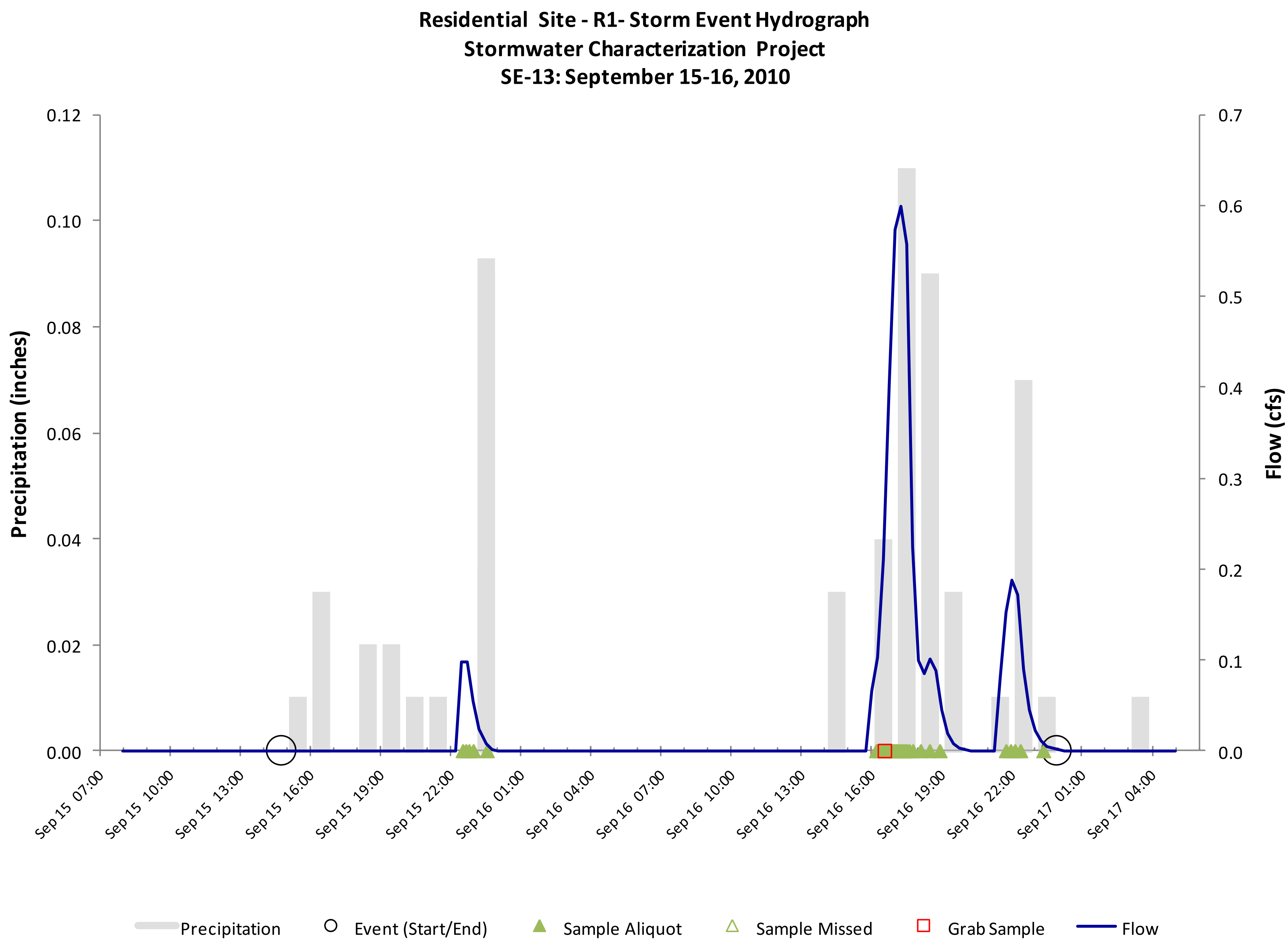
Residential Site - R1- Storm Event Hydrograph
Stormwater Characterization Project
SE-10: March 11-12, 2010
Precipitation (inches)
Flow (cfs)
0.12
0.10
0.08
0.06
0.04
0.02
0.00
1.4
1.2
1.0
0.8
0.6
0.4
0.2
0.0
Mar 10 19:00
Mar 10 23:00
Mar 11 03:00
Mar 11 07:00
Mar 11 11:00
Mar 11 15:00
Mar 11 19:00
Mar 11 23:00
Mar 12 03:00
Mar 12 07:00
Mar 12 11:00
Mar 12 15:00
Mar 12 19:00
Mar 12 23:00
Precipitation
Event (Start/End)
Sample Aliquot
Sample Missed
Grab Sample
Flow

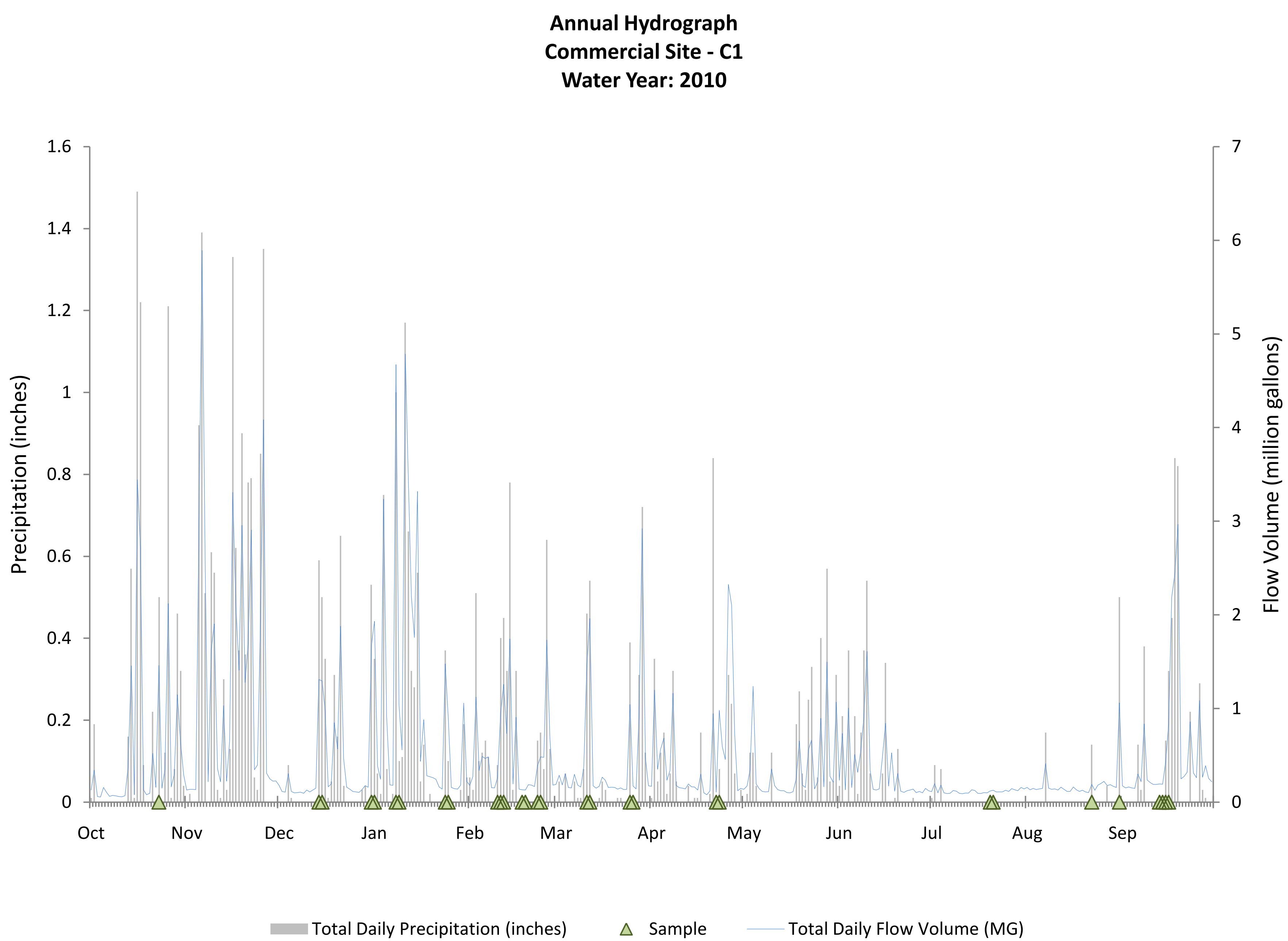


Residential Site - R1- Storm Event Hydrograph
Stormwater Characterization Project
SE-11: March 25-26, 2010
Precipitation (inches)
Flow (cfs)
0.08
0.07
0.06
0.05
0.04
0.03
0.02
0.01
0.00
0.4
0.4
0.3
0.3
0.2
0.2
0.1
0.1
0.0
Mar 24 22:00
Mar 25 01:00
Mar 25 04:00
Mar 25 07:00
Mar 25 10:00
Mar 25 13:00
Mar 25 16:00
Mar 25 19:00
Mar 25 22:00
Mar 26 01:00
Mar 26 04:00
Mar 26 07:00
Mar 26 10:00
Mar 26 13:00
Precipitation
Event (Start/End)
Sample Aliquot
Sample Missed
Grab Sample
Flow

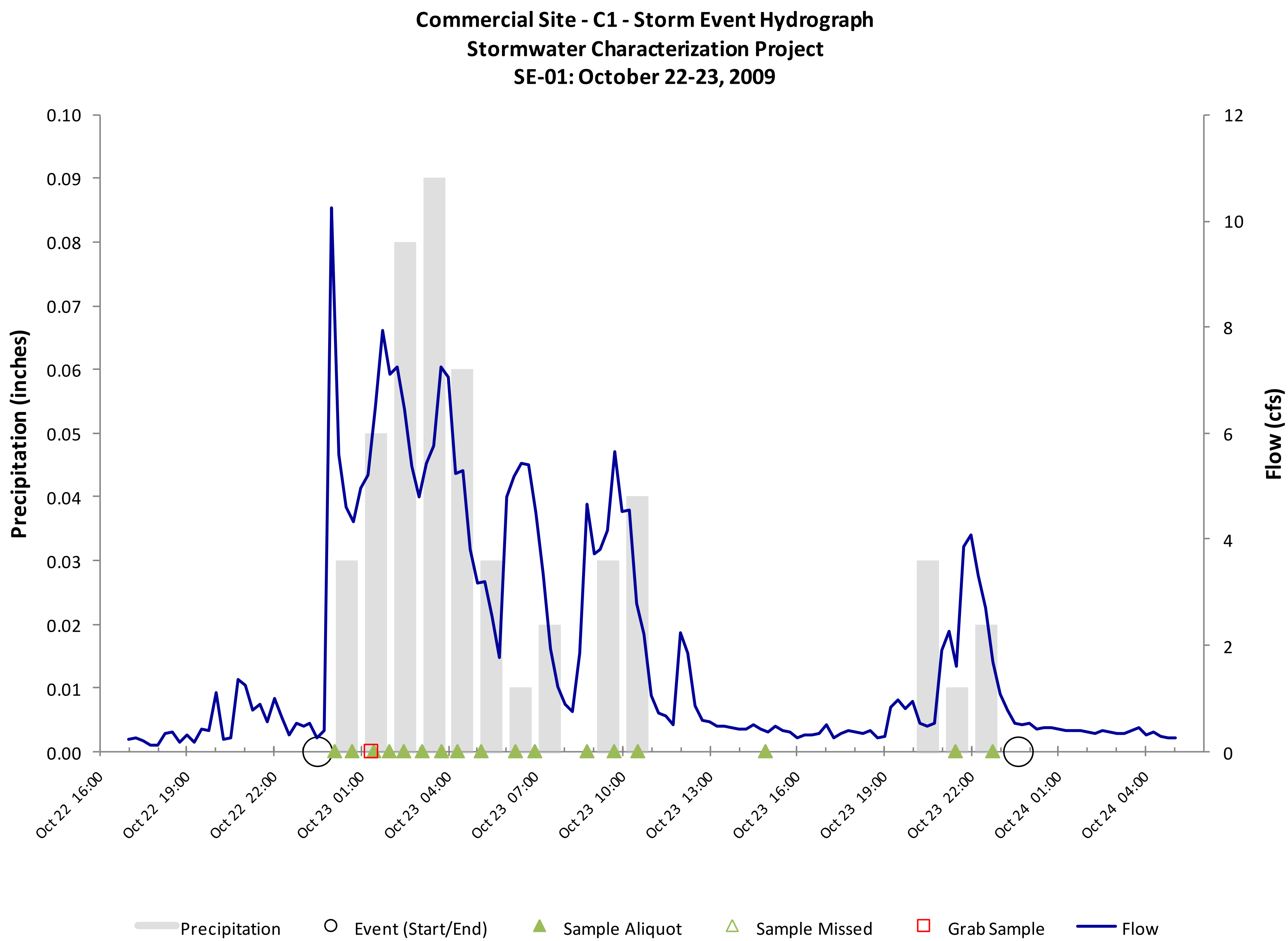


Residential Site - R1- Storm Event Hydrograph
Stormwater Characterization Project
SE-12: August 31, 2010
Precipitation (inches)
0.14
0.12
0.10
0.08
0.06
0.04
0.02
0.00
Flow (cfs)
0.4
0.4
0.3
0.3
0.2
0.2
0.1
0.1
0.0
Aug 30 23:00
Aug 31 01:00
Aug 31 03:00
Aug 31 05:00
Aug 31 07:00
Aug 31 09:00
Aug 31 11:00
Aug 31 13:00
Aug 31 15:00
Aug 31 17:00
Aug 31 19:00
Aug 31 21:00
Aug 31 23:00
Sep 01 01:00
Sep 01 03:00
Precipitation
Event (Start/End)
Sample Aliquot
Sample Missed
Grab Sample
Flow

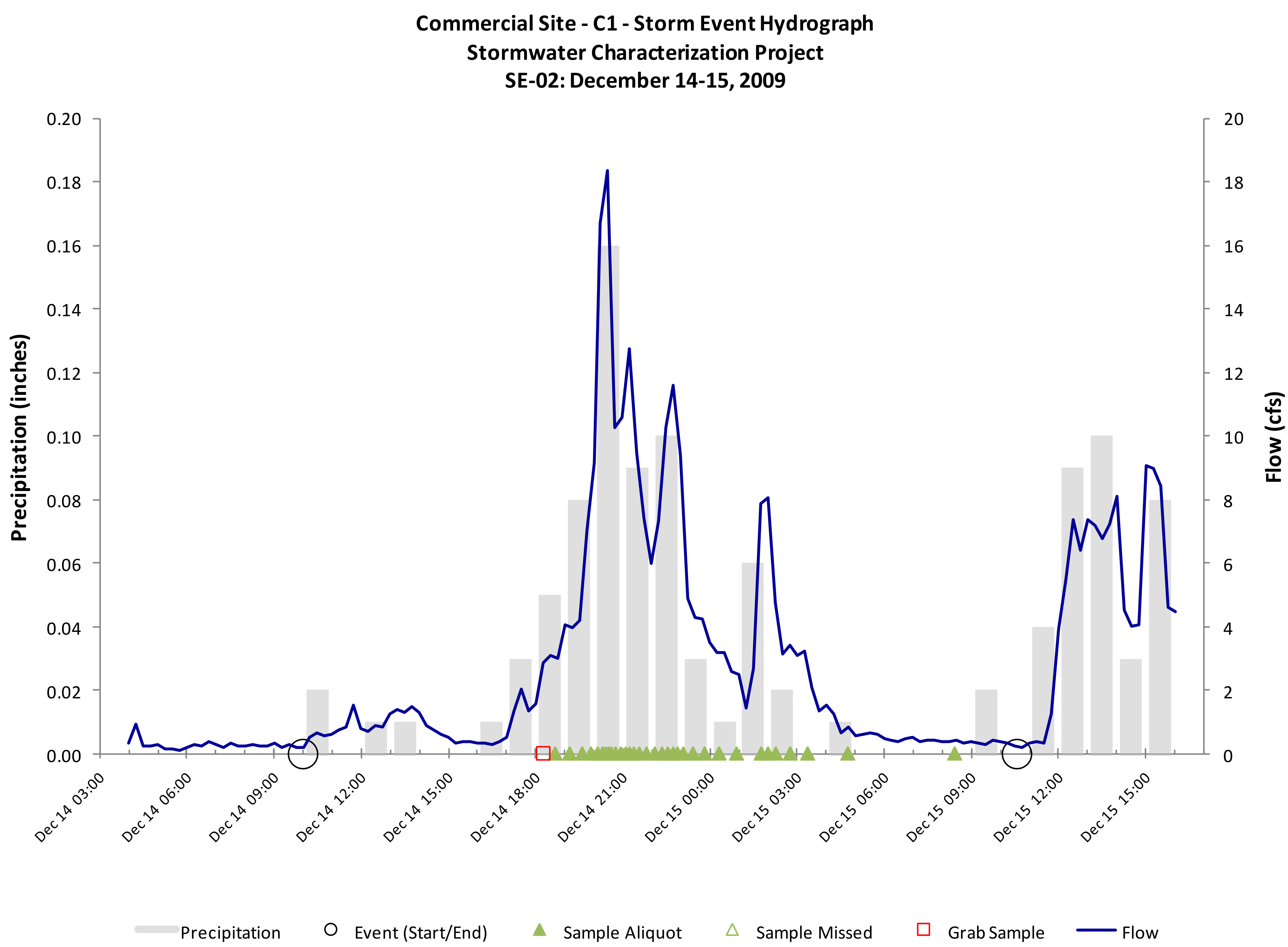

Residential Site - R1- Storm Event Hydrograph
Stormwater Characterization Project
SE-13: September 15-16, 2010
Precipitation (inches)
Flow (cfs)
0.12
0.10
0.08
0.06
0.04
0.02
0.00
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0.0
Sep 15 07:00
Sep 15 10:00
Sep 15 13:00
Sep 15 16:00
Sep 15 19:00
Sep 15 22:00
Sep 16 01:00
Sep 16 04:00
Sep 16 07:00
Sep 16 10:00
Sep 16 13:00
Sep 16 16:00
Sep 16 19:00
Sep 16 22:00
Sep 17 01:00
Sep 17 04:00
Precipitation
Event (Start/End)
Sample Aliquot
Sample Missed
Grab Sample
Flow



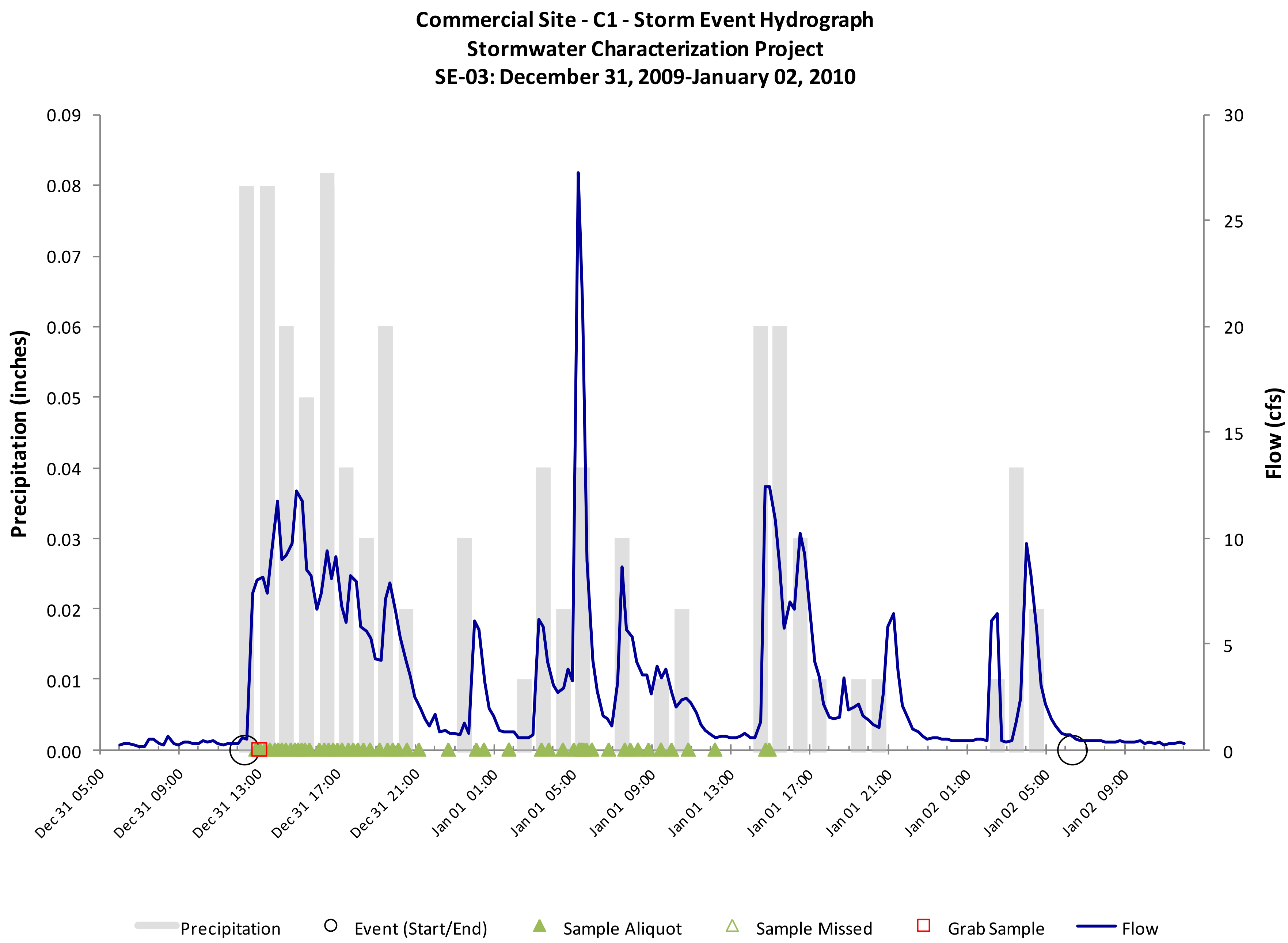
Annual Hydrograph
Commercial Site - C1
Water Year: 2010
Precipitation (inches)
Flow Volume (million gallons)
1.6
1.4
1.2
1
0.8
0.6
0.4
0.2
0
7
6
5
4
3
2
1
0
Oct
Nov
Dec
Jan
Feb
Mar
Apr
May
Jun
Jul
Aug
Sep
Total Daily Precipitation (inches)
Sample
Total Daily Flow Volume (MG)



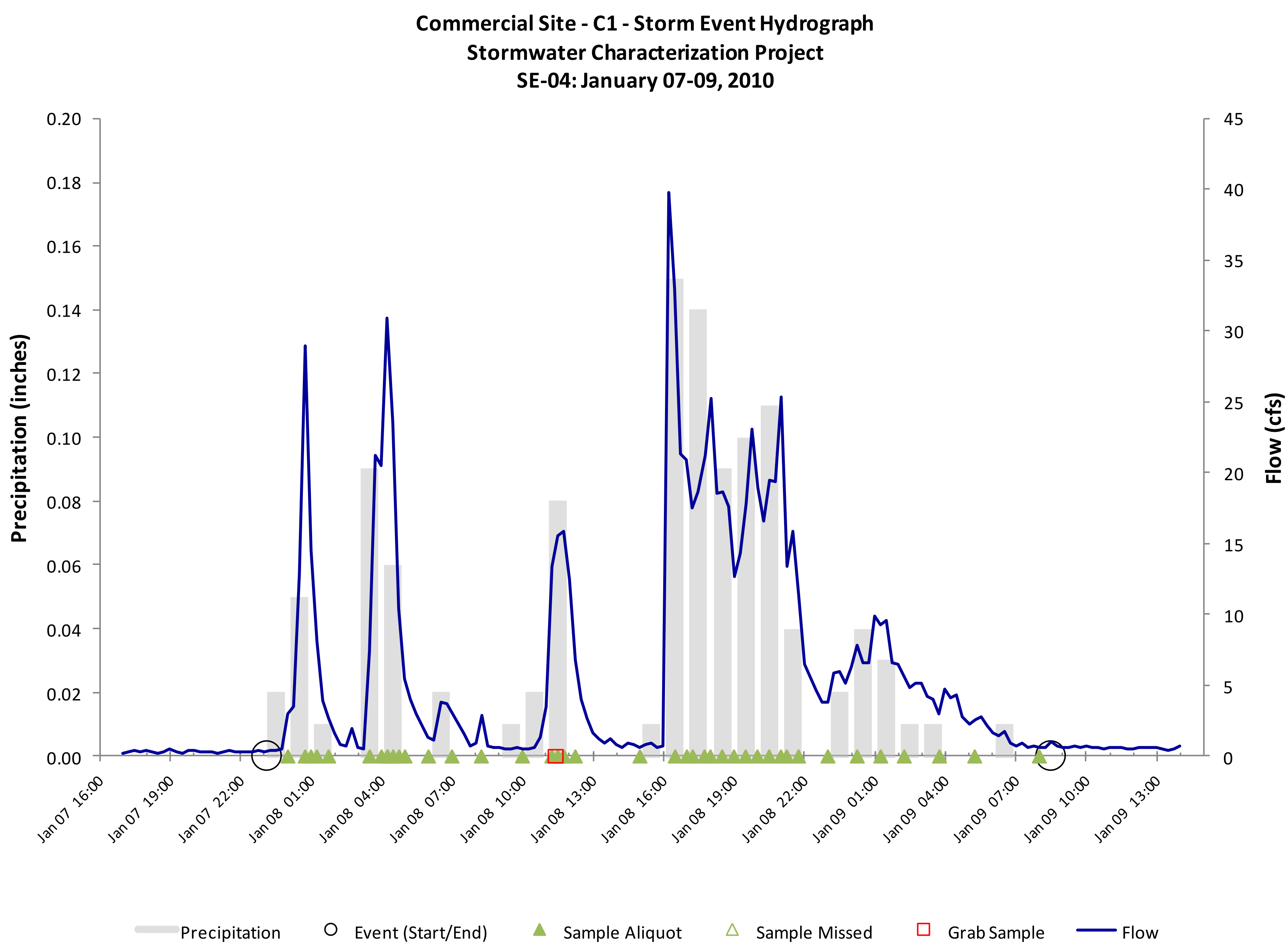
Commercial Site - C1 - Storm Event Hydrograph
Stormwater Characterization Project
SE-01: October 22-23, 2009
Precipitation (inches)
Flow (cfs)
0.10
0.09
0.08
0.07
0.06
0.05
0.04
0.03
0.02
0.01
0.00
12
10
8
6
4
2
0
Oct 22 16:00
Oct 22 19:00
Oct 22 22:00
Oct 23 01:00
Oct 23 04:00
Oct 23 07:00
Oct 23 10:00
Oct 23 13:00
Oct 23 16:00
Oct 23 19:00
Oct 23 22:00
Oct 24 01:00
Oct 24 04:00
Precipitation
Event (Start/End)
Sample Aliquot
Sample Missed
Grab Sample
Flow



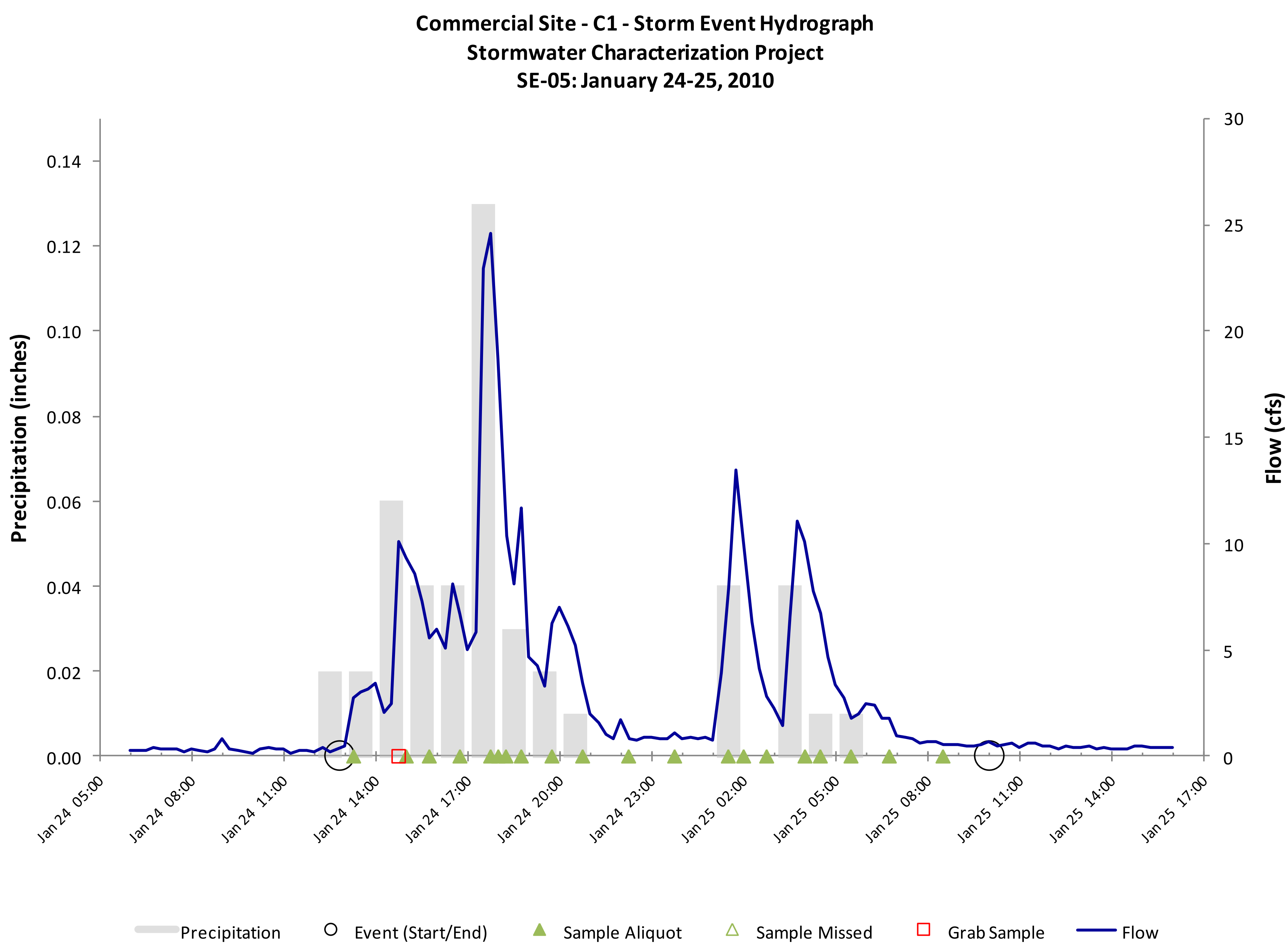
Commercial Site - C1 - Storm Event Hydrograph
Stormwater Characterization Project
SE-02: December 14-15, 2009
Precipitation (inches)
Flow (cfs)
0.00
0.02
0.04
0.06
0.08
0.10
0.12
0.14
0.16
0.18
0.20
0
2
4
6
8
10
12
14
16
18
20
Dec 14 03:00
Dec 14 06:00
Dec 14 09:00
Dec 14 12:00
Dec 14 15:00
Dec 14 18:00
Dec 14 21:00
Dec 15 00:00
Dec 15 03:00
Dec 15 06:00
Dec 15 09:00
Dec 15 12:00
Dec 15 15:00
Precipitation
Event (Start/End)
Sample Aliquot
Sample Missed
Grab Sample
Flow



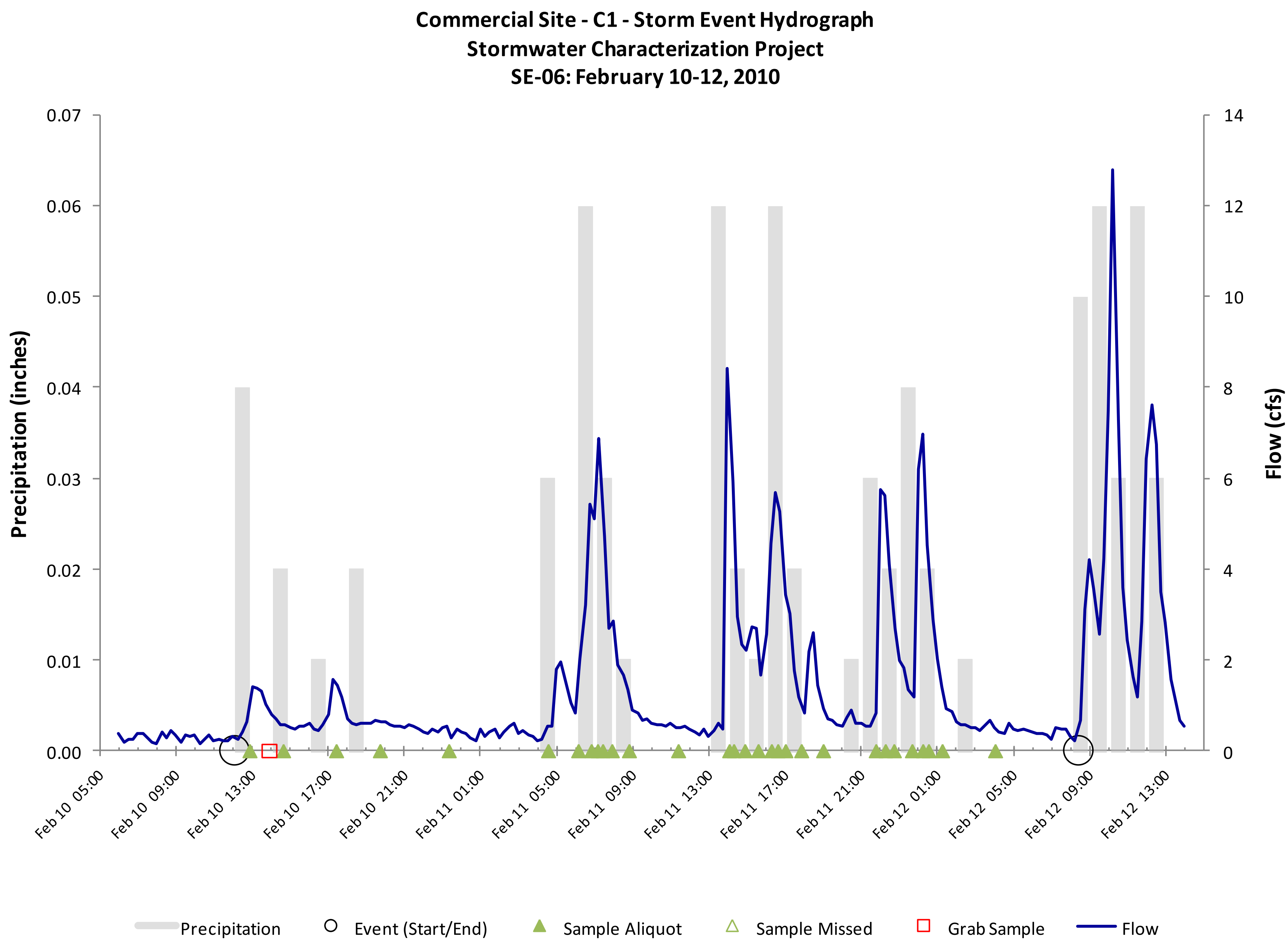
Commercial Site - C1 - Storm Event Hydrograph
Stormwater Characterization Project
SE-03: December 31, 2009-January 02, 2010
Precipitation (inches)
0.09
0.08
0.07
0.06
0.05
0.04
0.03
0.02
0.01
0.00
Flow (cfs)
30
25
20
15
10
5
0
Dec 31 05:00
Dec 31 09:00
Dec 31 13:00
Dec 31 17:00
Dec 31 21:00
Jan 01 01:00
Jan 01 05:00
Jan 01 09:00
Jan 01 13:00
Jan 01 17:00
Jan 01 21:00
Jan 02 01:00
Jan 02 05:00
Jan 02 09:00
Precipitation
Event (Start/End)
Sample Aliquot
Sample Missed
Grab Sample
Flow

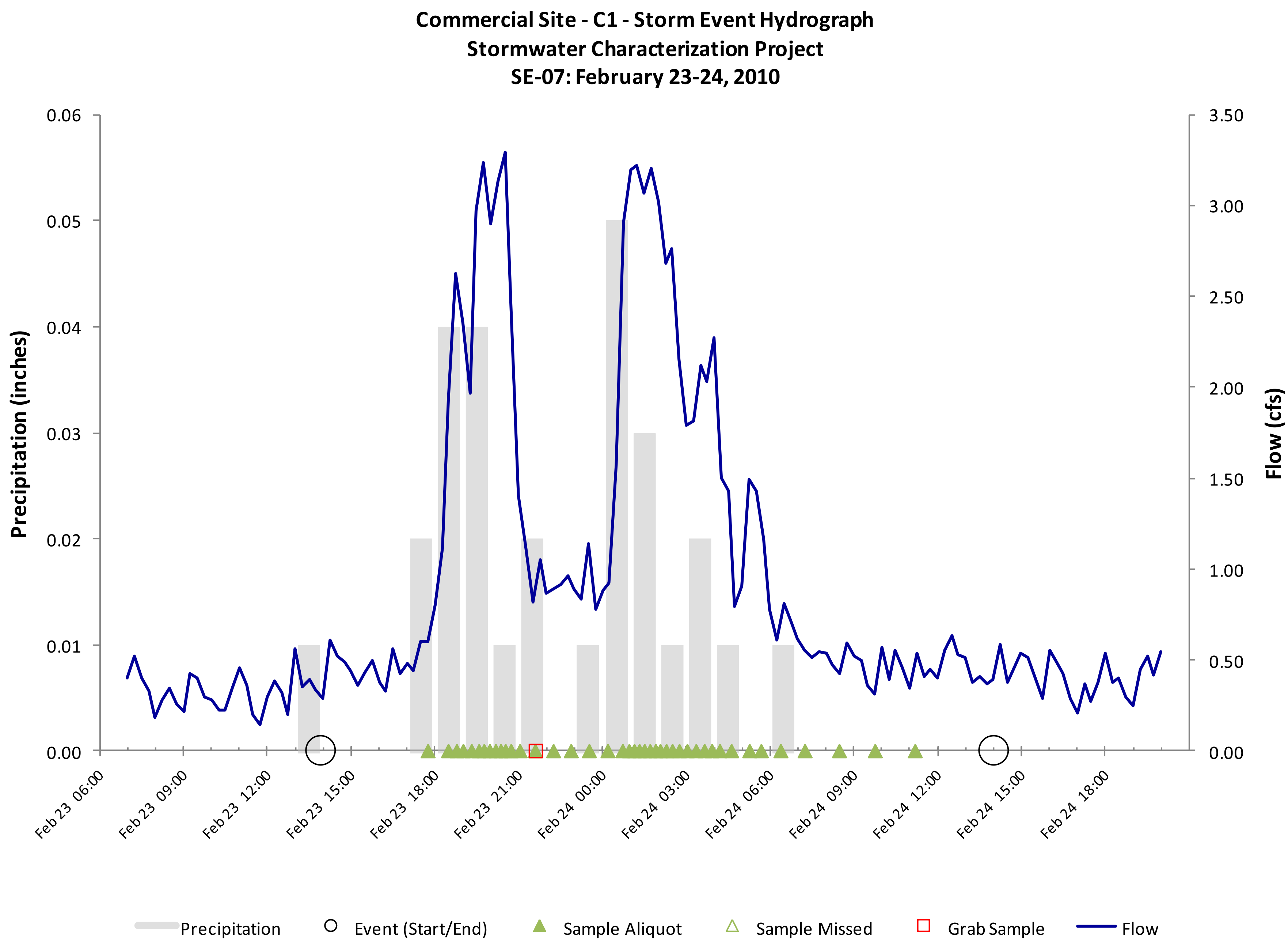


Commercial Site - C1 - Storm Event Hydrograph
Stormwater Characterization Project
SE-04: January 07-09, 2010
Precipitation (inches)
Flow (cfs)
0.20
0.18
0.16
0.14
0.12
0.10
0.08
0.06
0.04
0.02
0.00
45
40
35
30
25
20
15
10
5
0
Jan 07 16:00
Jan 07 19:00
Jan 07 22:00
Jan 08 01:00
Jan 08 04:00
Jan 08 07:00
Jan 08 10:00
Jan 08 13:00
Jan 08 16:00
Jan 08 19:00
Jan 08 22:00
Jan 09 01:00
Jan 09 04:00
Jan 09 07:00
Jan 09 10:00
Jan 09 13:00
Precipitation
Event (Start/End)
Sample Aliquot
Sample Missed
Grab Sample
Flow

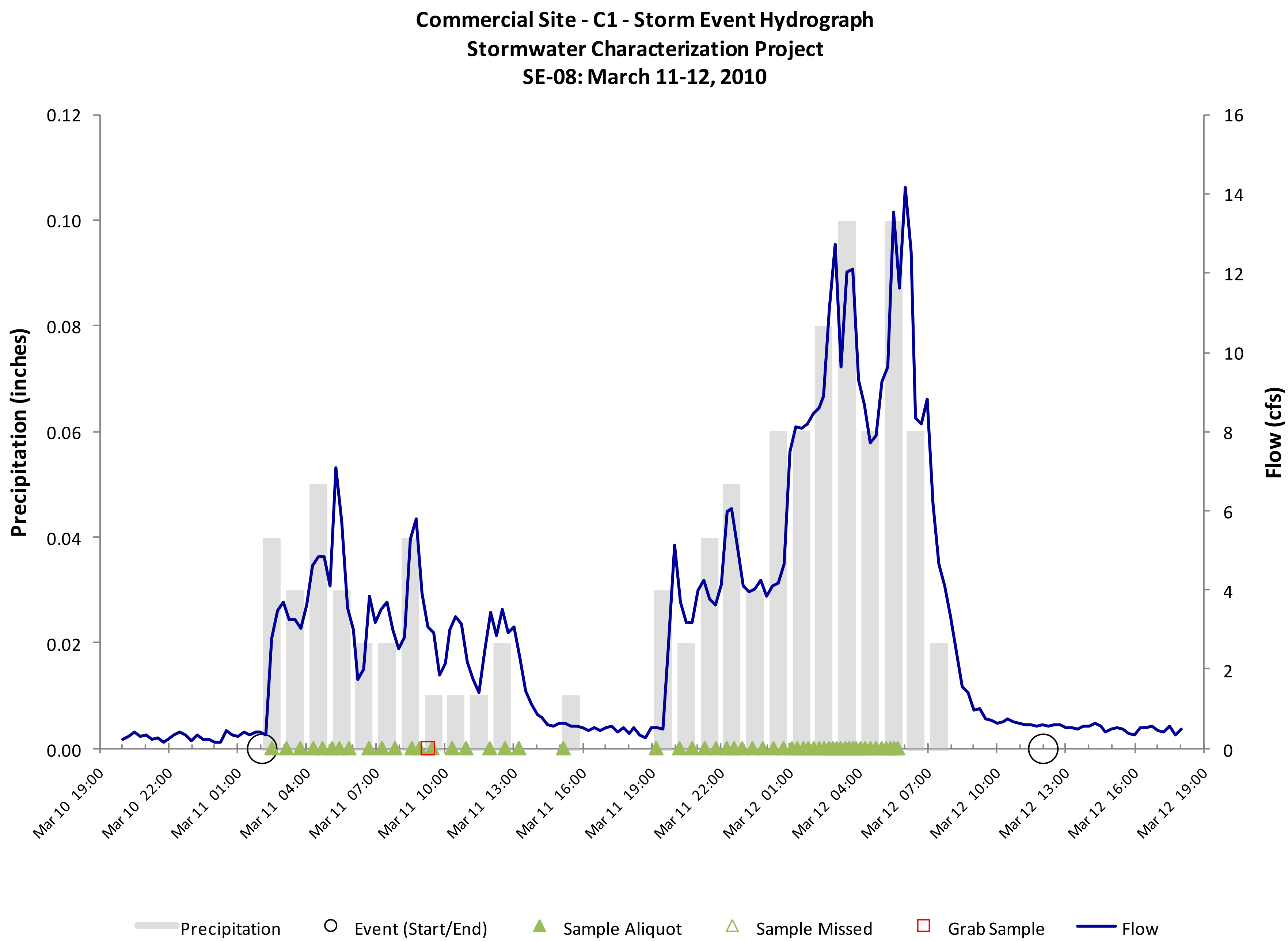


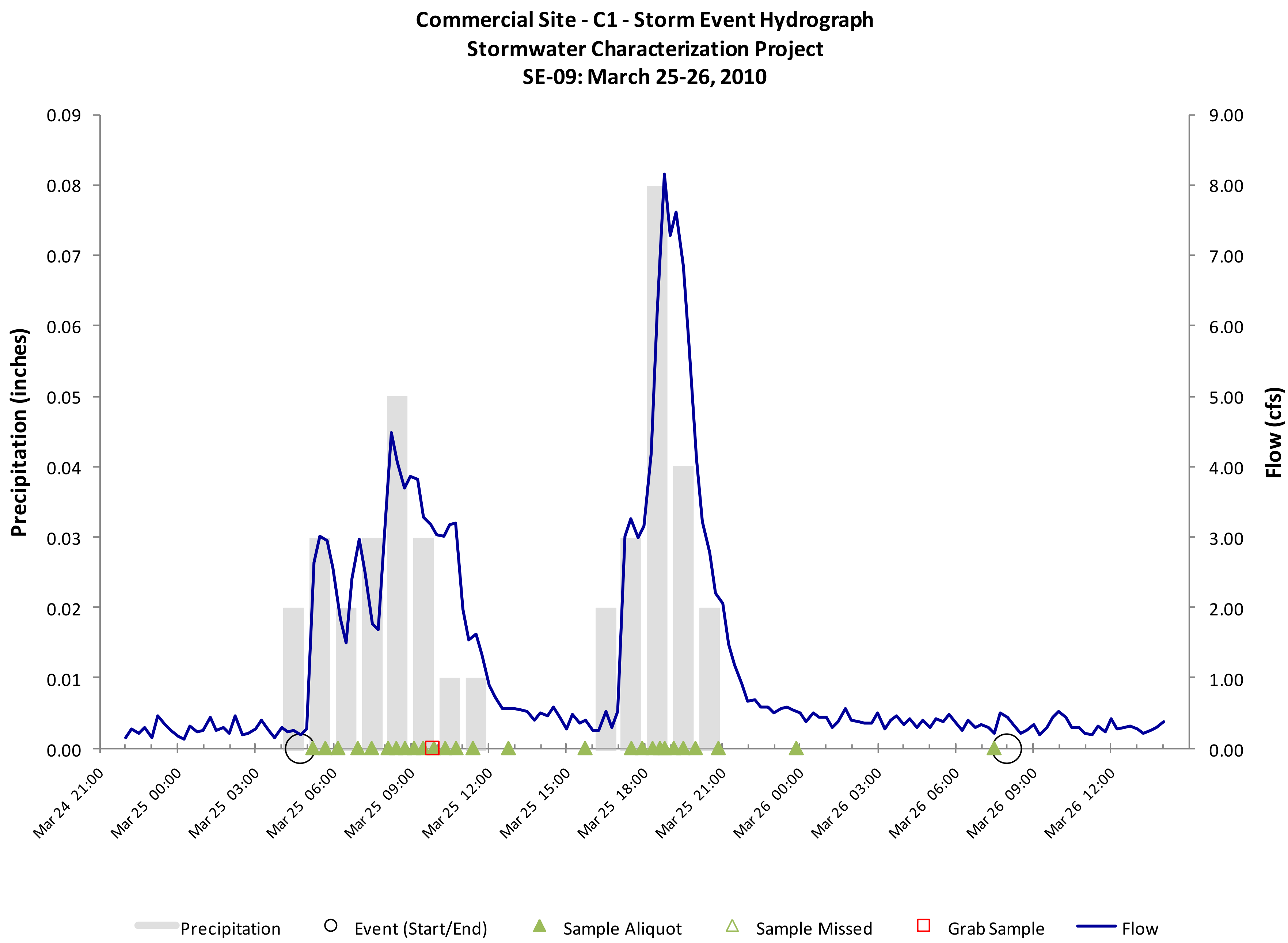
Commercial Site - C1 - Storm Event Hydrograph
Stormwater Characterization Project
SE-05: January 24-25, 2010
Precipitation (inches)
Flow (cfs)
0.00
0.02
0.04
0.06
0.08
0.10
0.12
0.14
0
5
10
15
20
25
30
Jan 24 05:00
Jan 24 08:00
Jan 24 11:00
Jan 24 14:00
Jan 24 17:00
Jan 24 20:00
Jan 24 23:00
Jan 25 02:00
Jan 25 05:00
Jan 25 08:00
Jan 25 11:00
Jan 25 14:00
Jan 25 17:00
Precipitation
Event (Start/End)
Sample Aliquot
Sample Missed
Grab Sample
Flow


Commercial Site - C1 - Storm Event Hydrograph
Stormwater Characterization Project
SE-06: February 10-12, 2010
Precipitation (inches)
Flow (cfs)
0.07
0.06
0.05
0.04
0.03
0.02
0.01
0.00
14
12
10
8
6
4
2
0
Feb 10 05:00
Feb 10 09:00
Feb 10 13:00
Feb 10 17:00
Feb 10 21:00
Feb 11 01:00
Feb 11 05:00
Feb 11 09:00
Feb 11 13:00
Feb 11 17:00
Feb 11 21:00
Feb 12 01:00
Feb 12 05:00
Feb 12 09:00
Feb 12 13:00
Precipitation
Event (Start/End)
Sample Aliquot
Sample Missed
Grab Sample
Flow

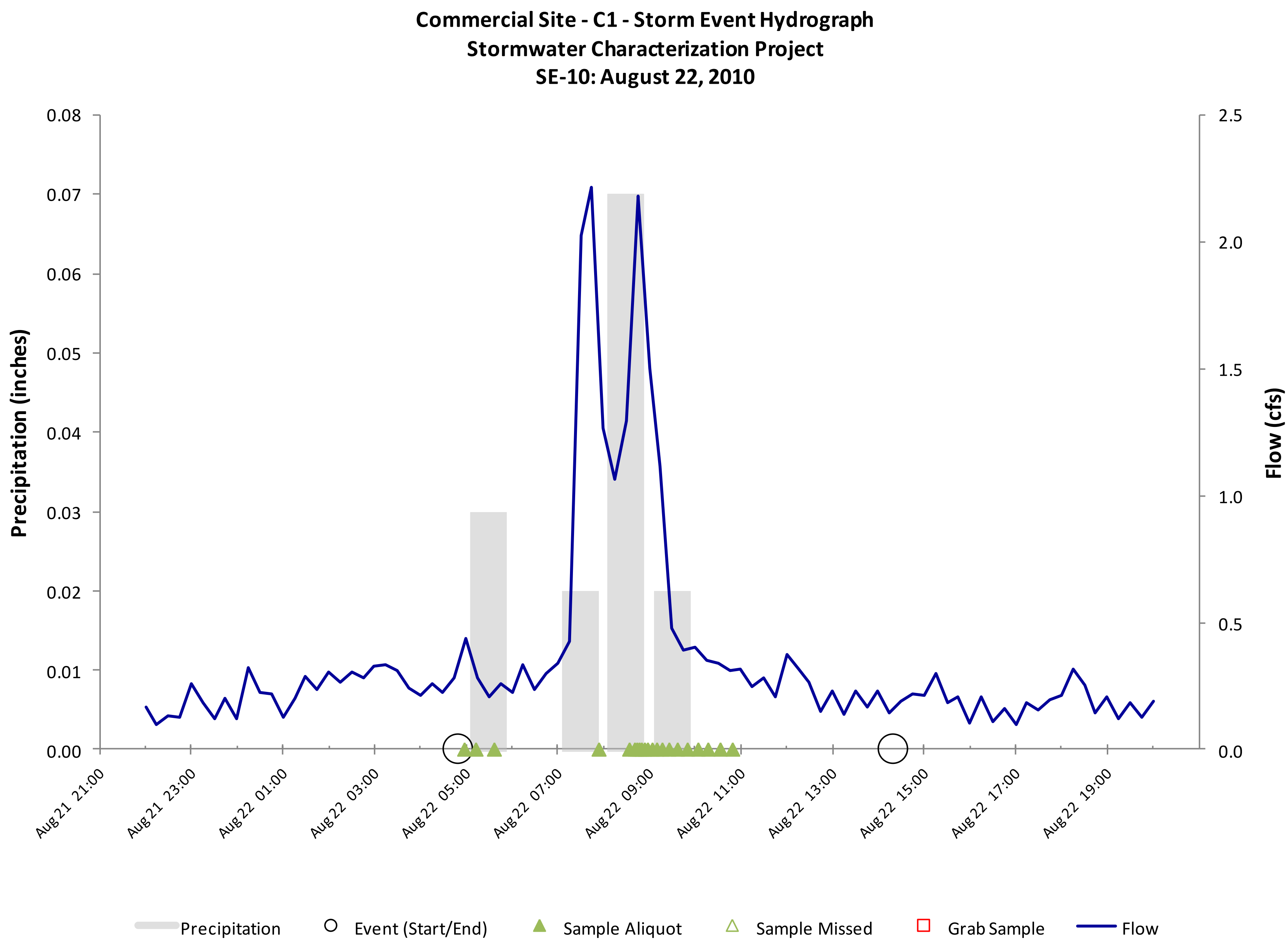


Commercial Site - C1 - Storm Event Hydrograph
Stormwater Characterization Project
SE-07: February 23-24, 2010
Precipitation (inches)
Flow (cfs)
0.06
0.05
0.04
0.03
0.02
0.01
0.00
3.50
3.00
2.50
2.00
1.50
1.00
0.50
0.00
Feb 23 06:00
Feb 23 09:00
Feb 23 12:00
Feb 23 15:00
Feb 23 18:00
Feb 23 21:00
Feb 24 00:00
Feb 24 03:00
Feb 24 06:00
Feb 24 09:00
Feb 24 12:00
Feb 24 15:00
Feb 24 18:00
Precipitation
Event (Start/End)
Sample Aliquot
Sample Missed
Grab Sample
Flow

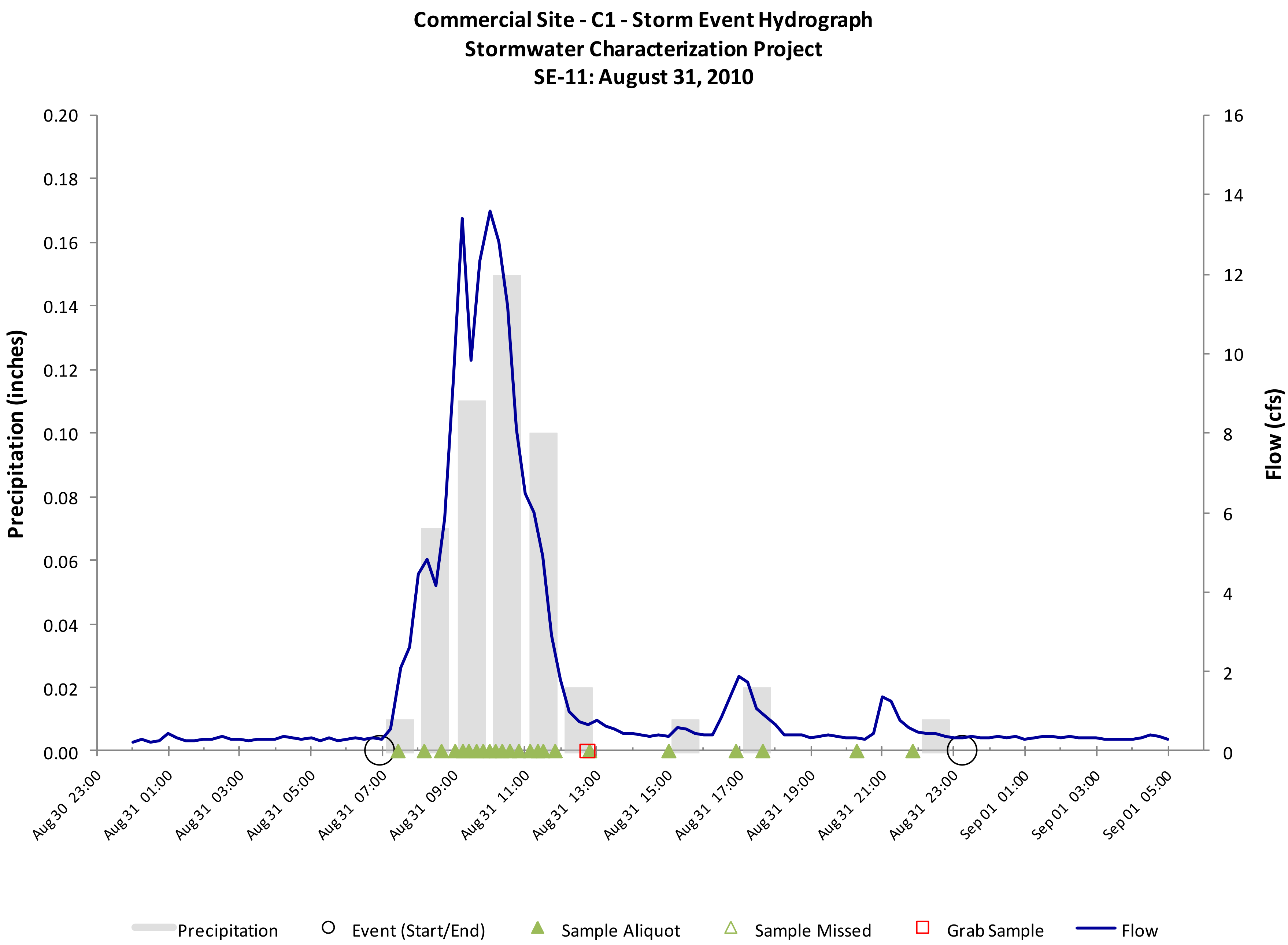

Commercial Site - C1 - Storm Event Hydrograph
Stormwater Characterization Project
SE-08: March 11-12, 2010
Precipitation (inches)
0.12
0.10
0.08
0.06
0.04
0.02
0.00
Flow (cfs)
16
14
12
10
8
6
4
2
0
Mar 10 19:00
Mar 10 22:00
Mar 11 01:00
Mar 11 04:00
Mar 11 07:00
Mar 11 10:00
Mar 11 13:00
Mar 11 16:00
Mar 11 19:00
Mar 11 22:00
Mar 12 01:00
Mar 12 04:00
Mar 12 07:00
Mar 12 10:00
Mar 12 13:00
Mar 12 16:00
Mar 12 19:00
Precipitation
Event (Start/End)
Sample Aliquot
Sample Missed
Grab Sample
Flow



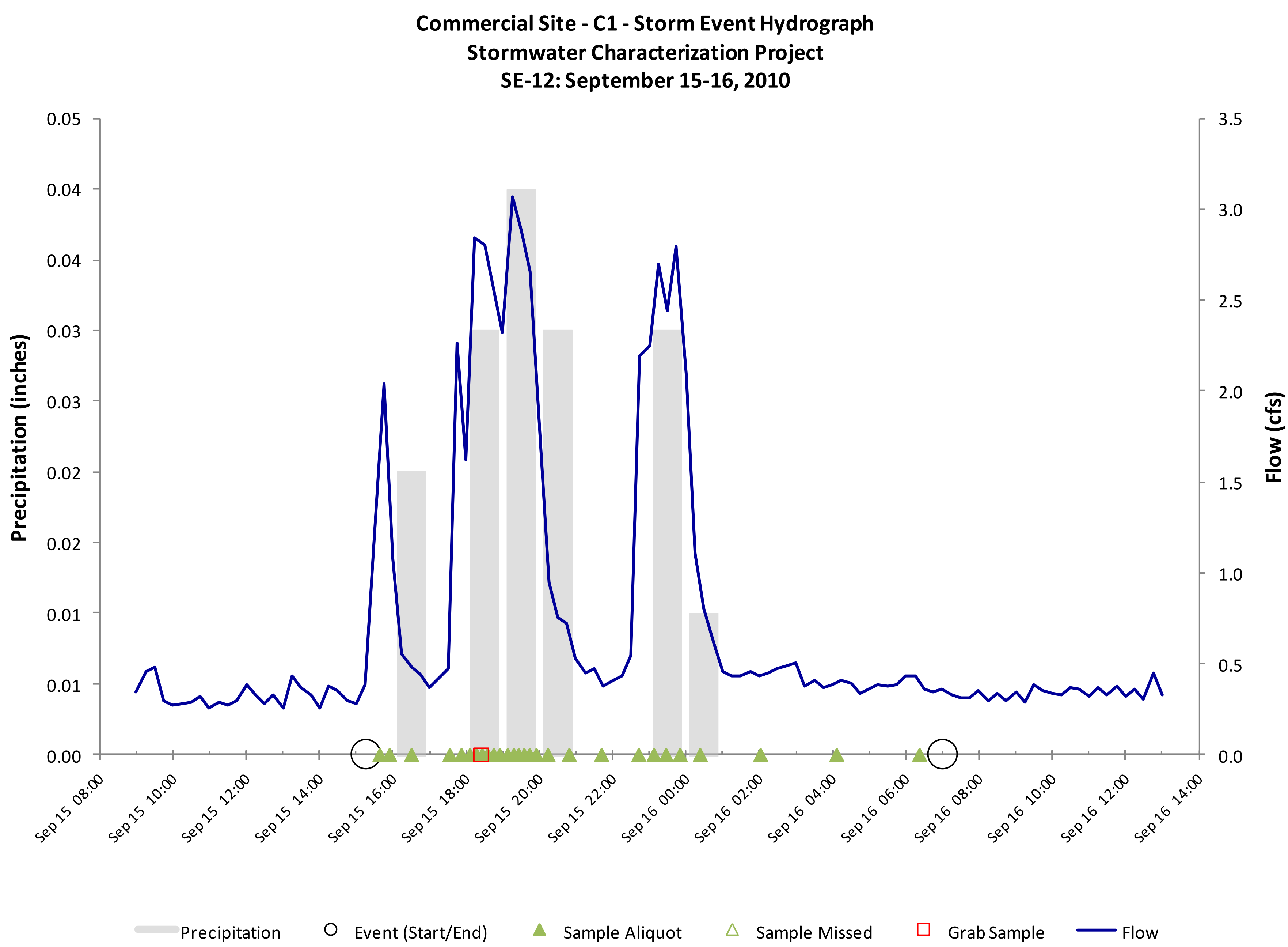
Commercial Site - C1 - Storm Event Hydrograph
Stormwater Characterization Project
SE-09: March 25-26, 2010
Precipitation (inches)
Flow (cfs)
0.09
0.08
0.07
0.06
0.05
0.04
0.03
0.02
0.01
0.00
9.00
8.00
7.00
6.00
5.00
4.00
3.00
2.00
1.00
0.00
Mar 24 21:00
Mar 25 00:00
Mar 25 03:00
Mar 25 06:00
Mar 25 09:00
Mar 25 12:00
Mar 25 15:00
Mar 25 18:00
Mar 25 21:00
Mar 26 00:00
Mar 26 03:00
Mar 26 06:00
Mar 26 09:00
Mar 26 12:00
Precipitation
Event (Start/End)
Sample Aliquot
Sample Missed
Grab Sample
Flow



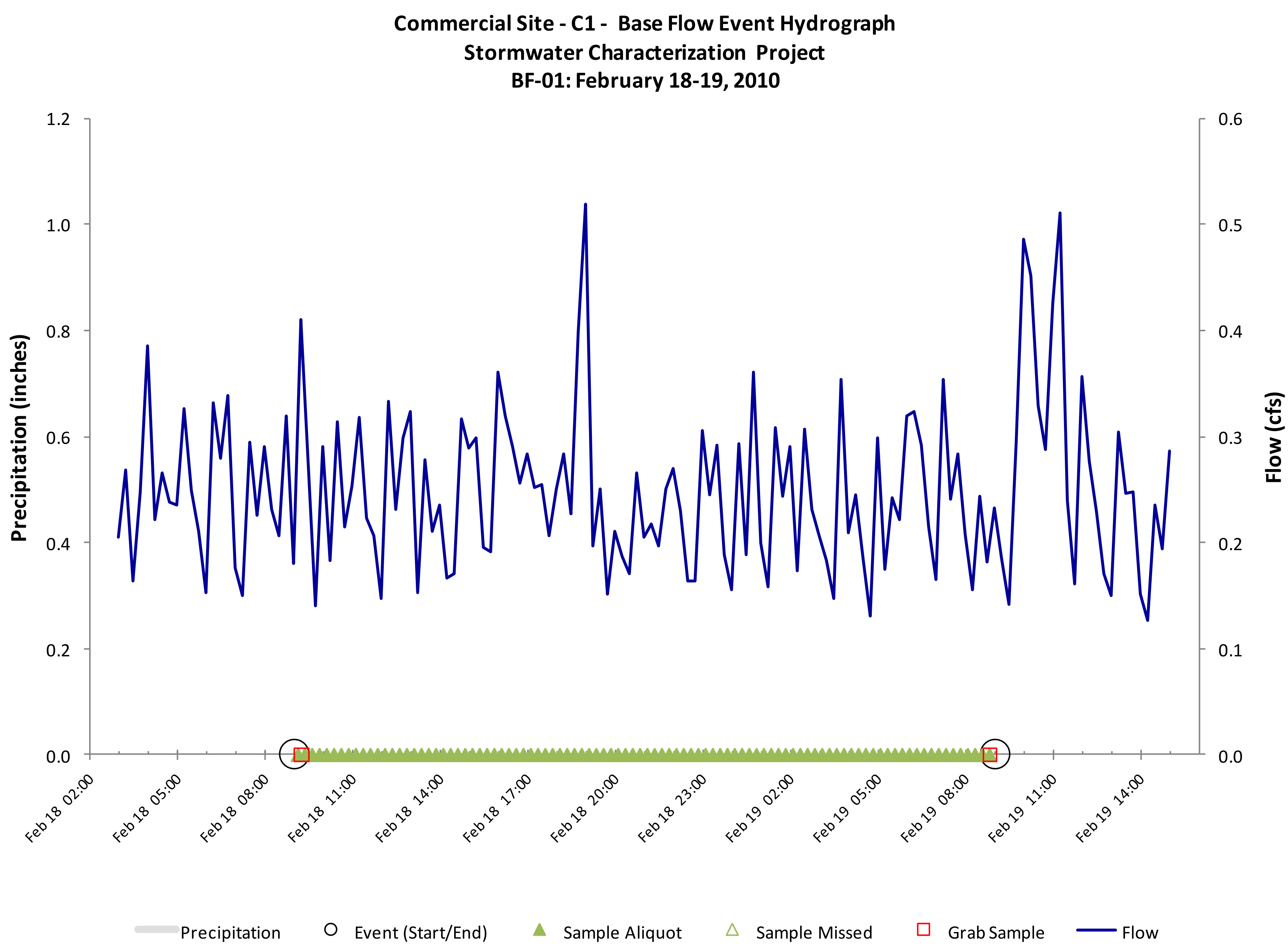
Commercial Site - C1 - Storm Event Hydrograph
Stormwater Characterization Project
SE-10: August 22, 2010
Precipitation (inches)
Flow (cfs)
0.08
0.07
0.06
0.05
0.04
0.03
0.02
0.01
0.00
2.5
2.0
1.5
1.0
0.5
0.0
Aug 21 21:00
Aug 21 23:00
Aug 22 01:00
Aug 22 03:00
Aug 22 05:00
Aug 22 07:00
Aug 22 09:00
Aug 22 11:00
Aug 22 13:00
Aug 22 15:00
Aug 22 17:00
Aug 22 19:00
Precipitation
Event (Start/End)
Sample Aliquot
Sample Missed
Grab Sample
Flow

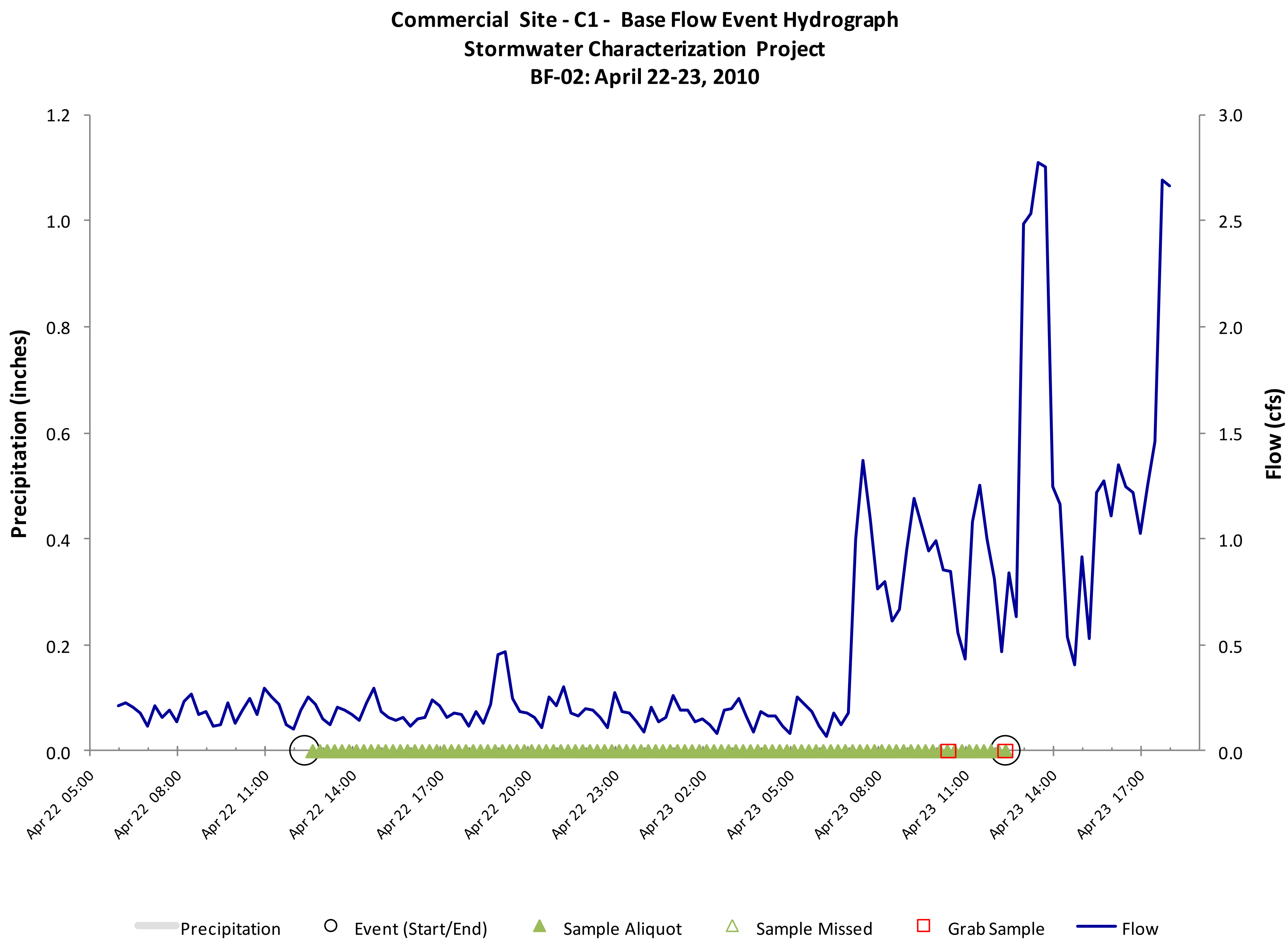


Commercial Site - C1 - Storm Event Hydrograph
Stormwater Characterization Project
SE-11: August 31, 2010
Precipitation (inches)
Flow (cfs)
0.20
0.18
0.16
0.14
0.12
0.10
0.08
0.06
0.04
0.02
0.00
16
14
12
10
8
6
4
2
0
Aug 30 23:00
Aug 31 01:00
Aug 31 03:00
Aug 31 05:00
Aug 31 07:00
Aug 31 09:00
Aug 31 11:00
Aug 31 13:00
Aug 31 15:00
Aug 31 17:00
Aug 31 19:00
Aug 31 21:00
Aug 31 23:00
Sep 01 01:00
Sep 01 03:00
Sep 01 05:00
Precipitation
Event (Start/End)
Sample Aliquot
Sample Missed
Grab Sample
Flow

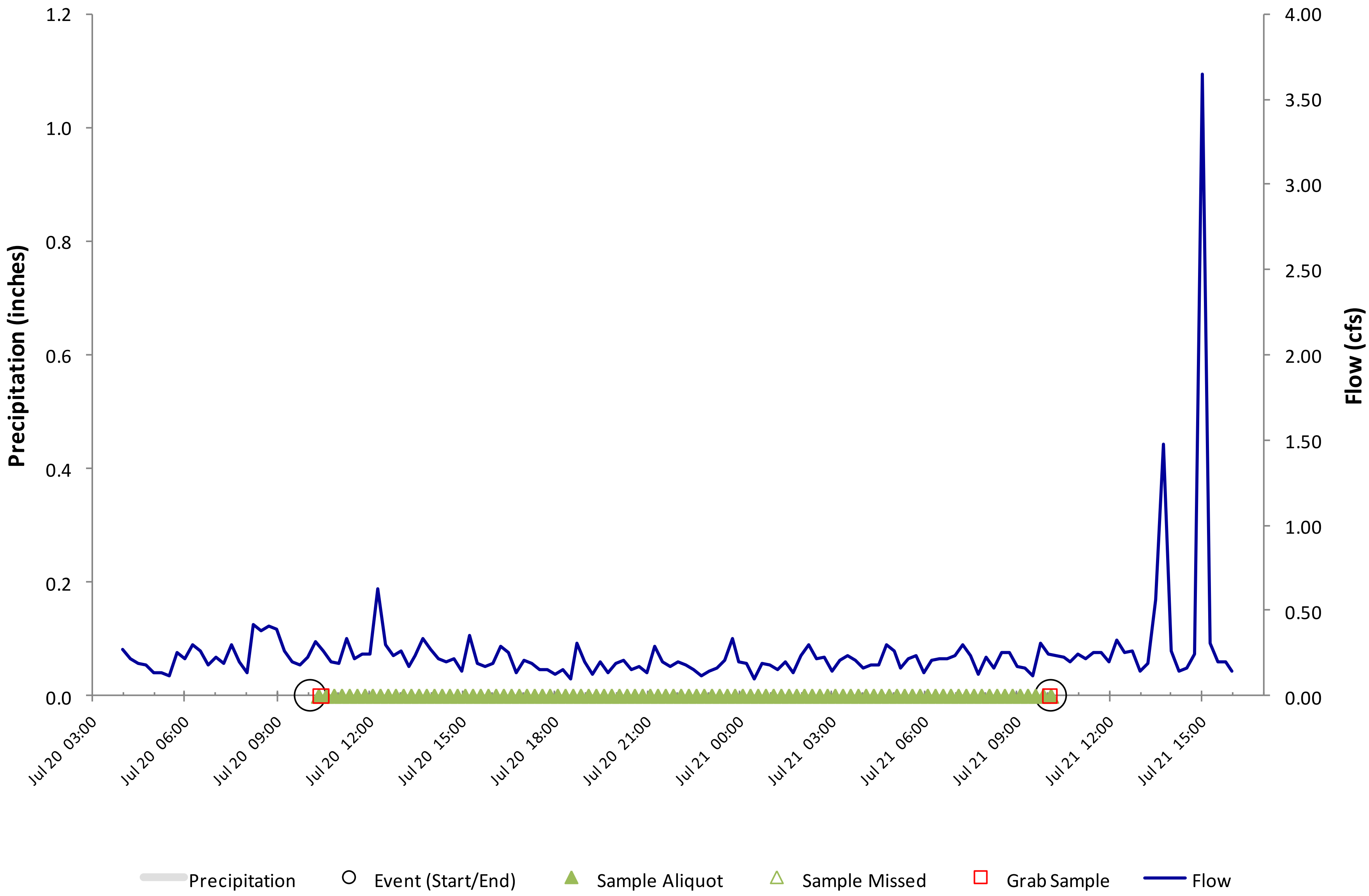


Commercial Site - C1 - Storm Event Hydrograph
Stormwater Characterization Project
SE-12: September 15-16, 2010
Precipitation (inches)
Flow (cfs)
0.05
0.04
0.04
0.03
0.03
0.02
0.02
0.01
0.01
0.00
3.5
3.0
2.5
2.0
1.5
1.0
0.5
0.0
Sep 15 08:00
Sep 15 10:00
Sep 15 12:00
Sep 15 14:00
Sep 15 16:00
Sep 15 18:00
Sep 15 20:00
Sep 15 22:00
Sep 16 00:00
Sep 16 02:00
Sep 16 04:00
Sep 16 06:00
Sep 16 08:00
Sep 16 10:00
Sep 16 12:00
Sep 16 14:00
Precipitation
Event (Start/End)
Sample Aliquot
Sample Missed
Grab Sample
Flow

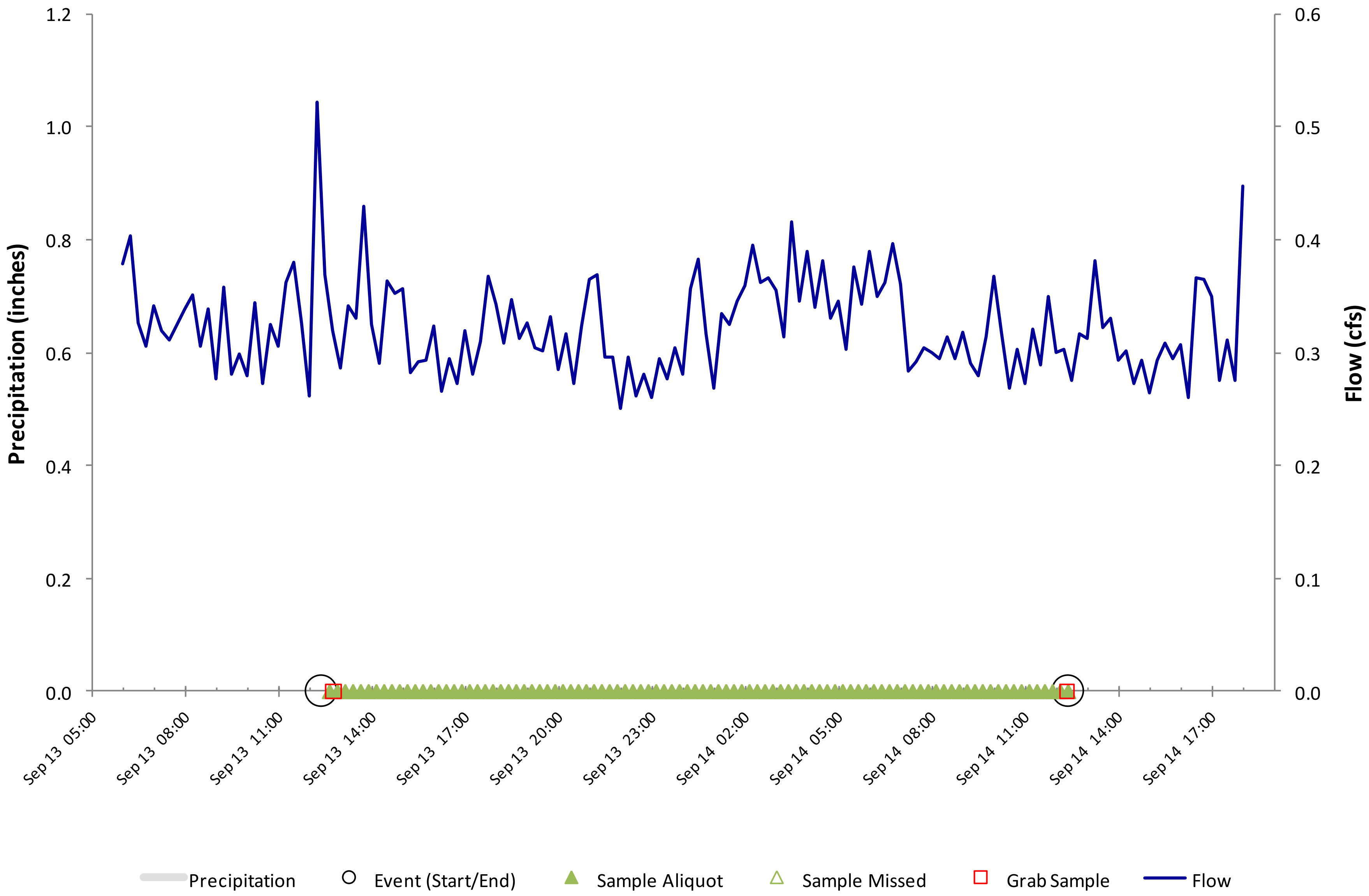

Commercial Site - C1 - Base Flow Event Hydrograph
Stormwater Characterization Project
BF-01: February 18-19, 2010
Precipitation (inches)
Flow (cfs)
1.2
1.0
0.8
0.6
0.4
0.2
0.0
0.6
0.5
0.4
0.3
0.2
0.1
0.0
Feb 18 02:00
Feb 18 05:00
Feb 18 08:00
Feb 18 11:00
Feb 18 14:00
Feb 18 17:00
Feb 18 20:00
Feb 18 23:00
Feb 19 02:00
Feb 19 05:00
Feb 19 08:00
Feb 19 11:00
Feb 19 14:00
Precipitation
Event (Start/End)
Sample Aliquot
Sample Missed
Grab Sample
Flow

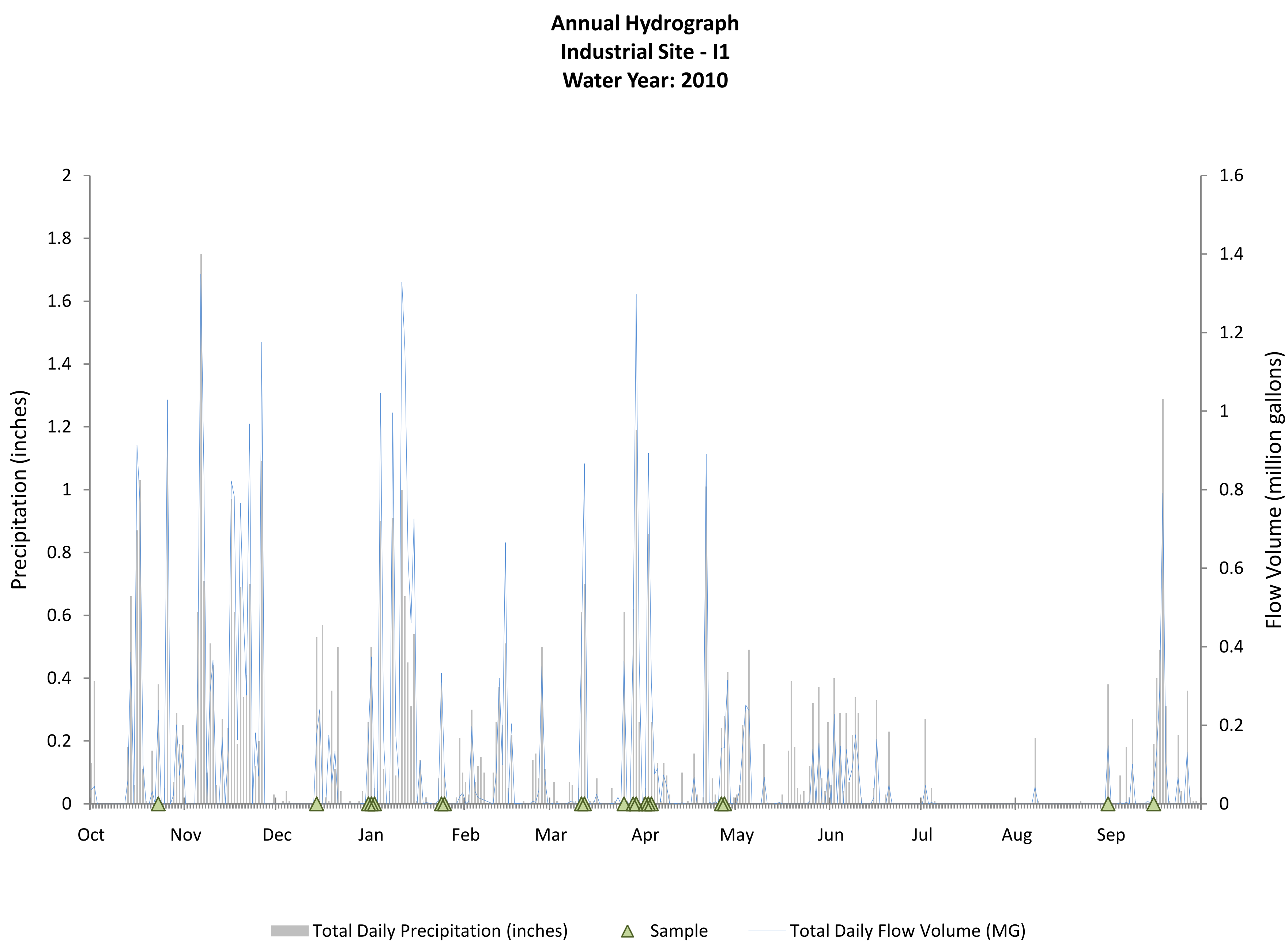

Commercial Site - C1 - Base Flow Event Hydrograph
Stormwater Characterization Project
BF-02: April 22-23, 2010
Precipitation (inches)
Flow (cfs)
1.2
1.0
0.8
0.6
0.4
0.2
0.0
3.0
2.5
2.0
1.5
1.0
0.5
0.0
Apr 22 05:00
Apr 22 08:00
Apr 22 11:00
Apr 22 14:00
Apr 22 17:00
Apr 22 20:00
Apr 22 23:00
Apr 23 02:00
Apr 23 05:00
Apr 23 08:00
Apr 23 11:00
Apr 23 14:00
Apr 23 17:00
Precipitation
Event (Start/End)
Sample Aliquot
Sample Missed
Grab Sample
Flow

Commercial Site- C1 - Base Flow Event Hydrograph
Stormwater Characterization Project
BF-03: July 20-21, 2010

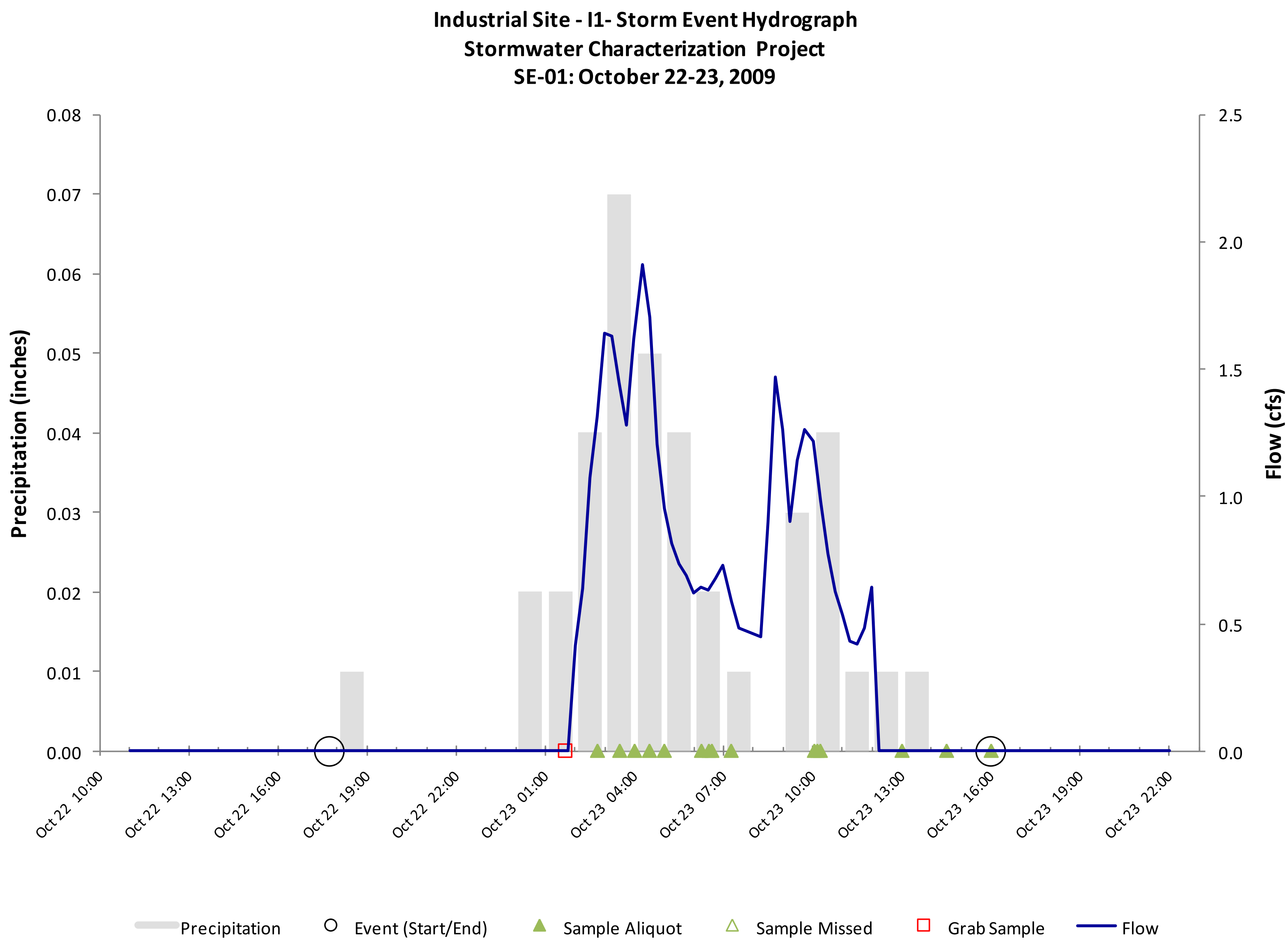


Commercial Site - C1 - Base Flow Event Hydrograph
Stormwater Characterization Project
BF-04: September 13-14, 2010

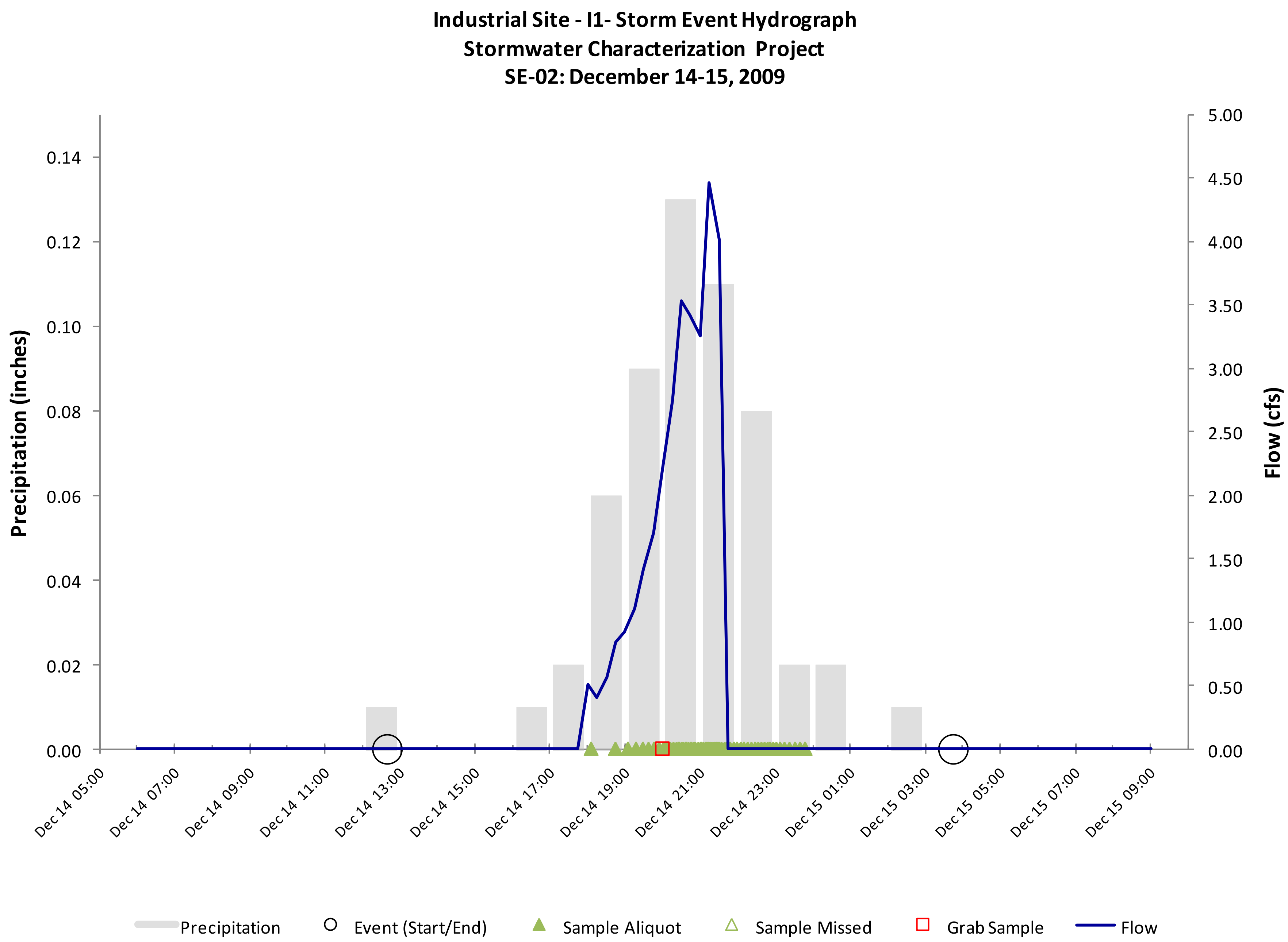


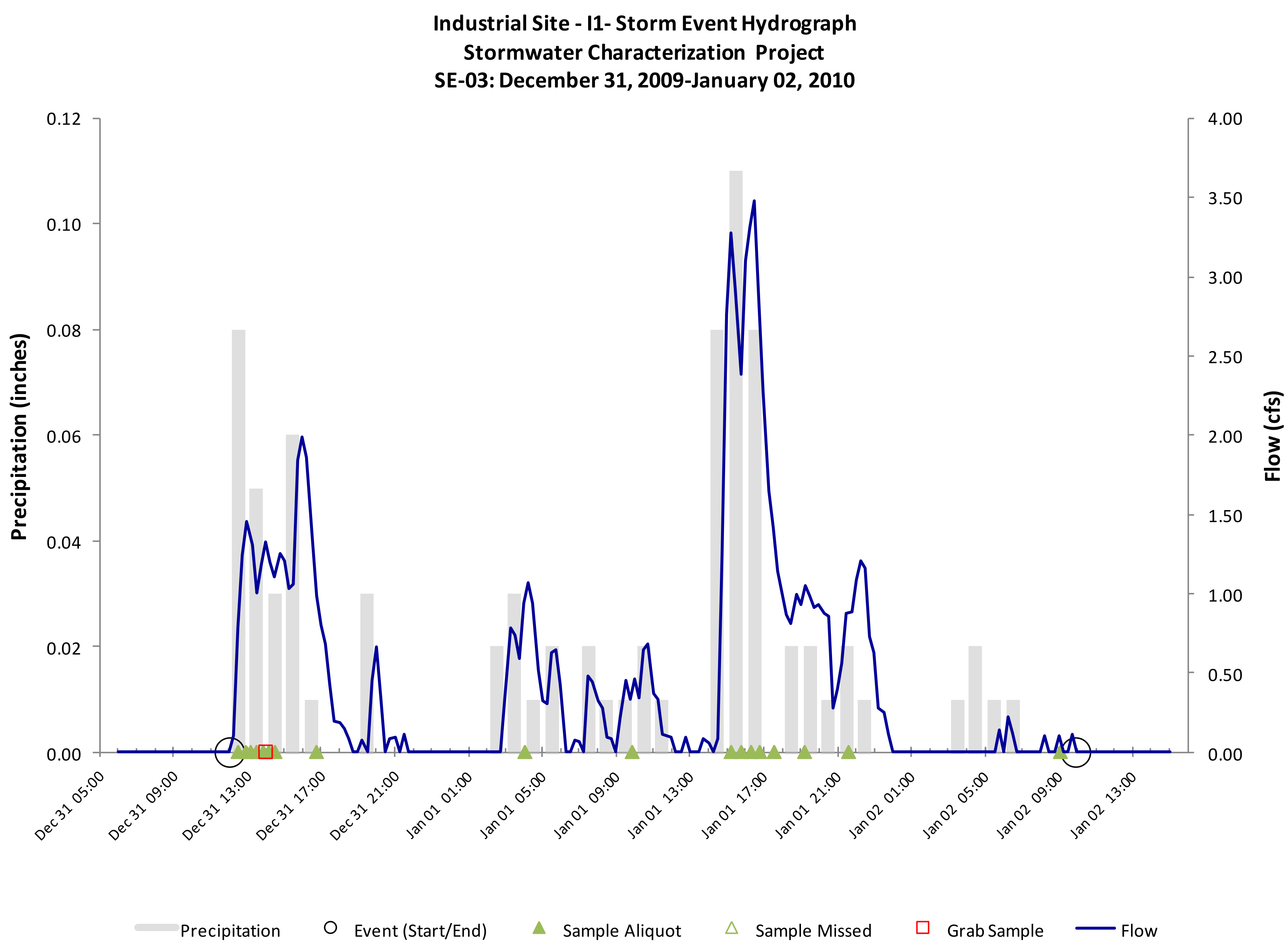


Annual Hydrograph
Industrial Site - I1
Water Year: 2010
Precipitation (inches)
Flow Volume (million gallons)
2
1.8
1.6
1.4
1.2
1
0.8
0.6
0.4
0.2
0
1.6
1.4
1.2
1
0.8
0.6
0.4
0.2
0
Oct
Nov
Dec
Jan
Feb
Mar
Apr
May
Jun
Jul
Aug
Sep
Total Daily Precipitation (inches)
Sample
Total Daily Flow Volume (MG)

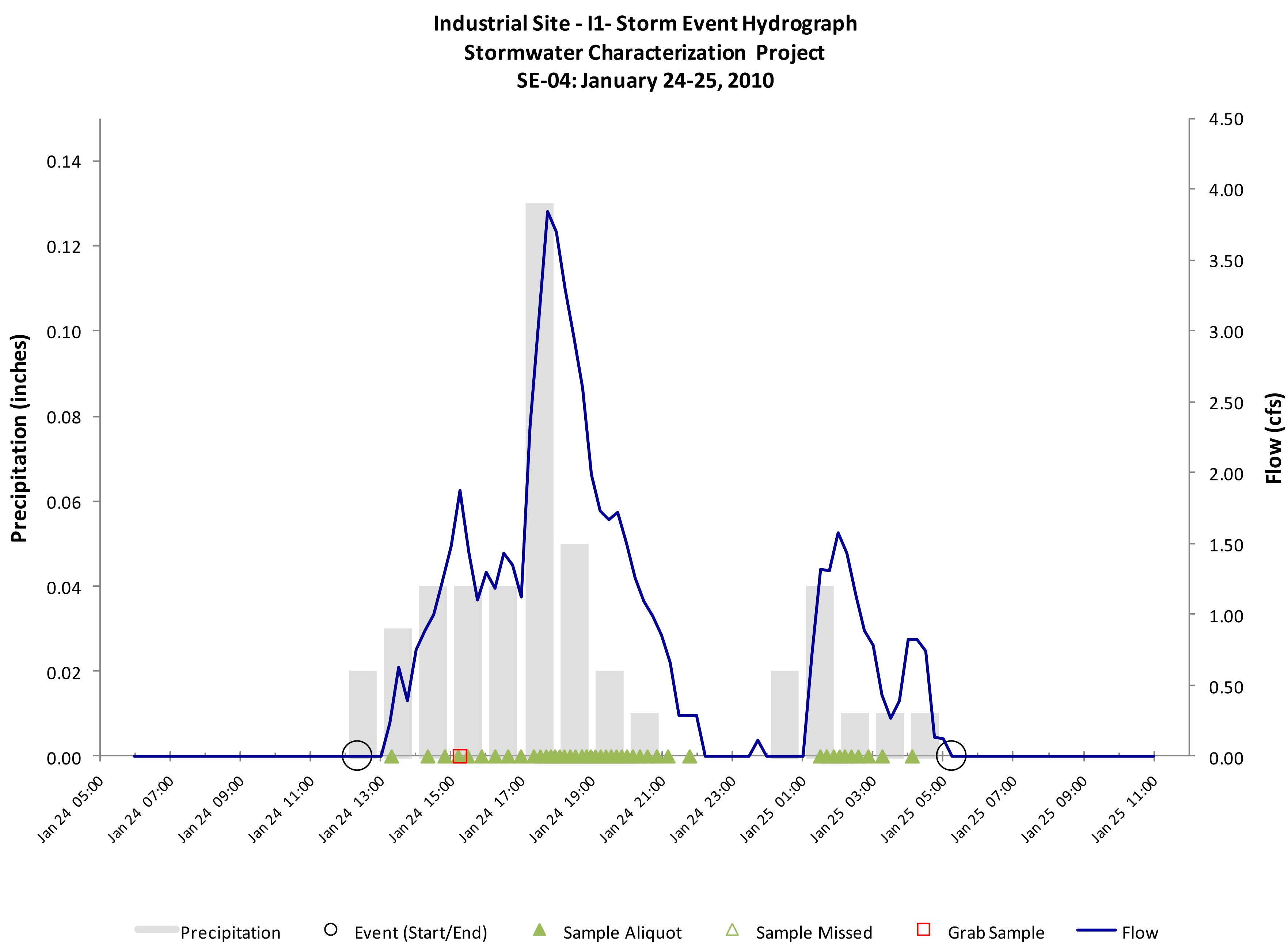


Industrial Site - I1- Storm Event Hydrograph
Stormwater Characterization Project
SE-01: October 22-23, 2009
Precipitation (inches)
Flow (cfs)
0.08
0.07
0.06
0.05
0.04
0.03
0.02
0.01
0.00
2.5
2.0
1.5
1.0
0.5
0.0
Oct 22 10:00
Oct 22 13:00
Oct 22 16:00
Oct 22 19:00
Oct 22 22:00
Oct 23 01:00
Oct 23 04:00
Oct 23 07:00
Oct 23 10:00
Oct 23 13:00
Oct 23 16:00
Oct 23 19:00
Oct 23 22:00
Precipitation
Event (Start/End)
Sample Aliquot
Sample Missed
Grab Sample
Flow

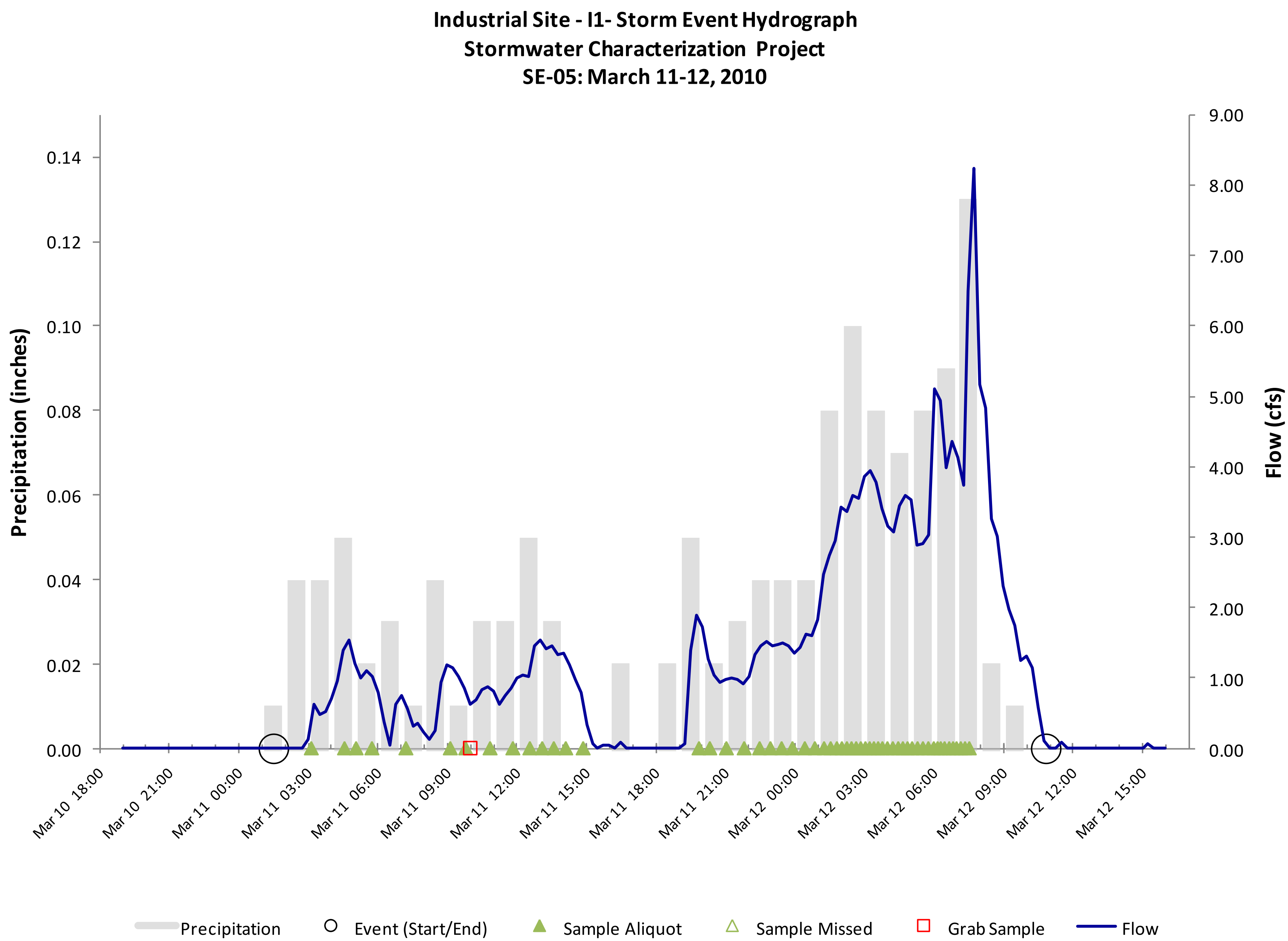

Industrial Site - I1- Storm Event Hydrograph
Stormwater Characterization Project
SE-02: December 14-15, 2009
Precipitation (inches)
Flow (cfs)
0.14
0.12
0.10
0.08
0.06
0.04
0.02
0.00
5.00
4.50
4.00
3.50
3.00
2.50
2.00
1.50
1.00
0.50
0.00
Dec 14 05:00
Dec 14 07:00
Dec 14 09:00
Dec 14 11:00
Dec 14 13:00
Dec 14 15:00
Dec 14 17:00
Dec 14 19:00
Dec 14 21:00
Dec 14 23:00
Dec 15 01:00
Dec 15 03:00
Dec 15 05:00
Dec 15 07:00
Dec 15 09:00
Precipitation
Event (Start/End)
Sample Aliquot
Sample Missed
Grab Sample
Flow

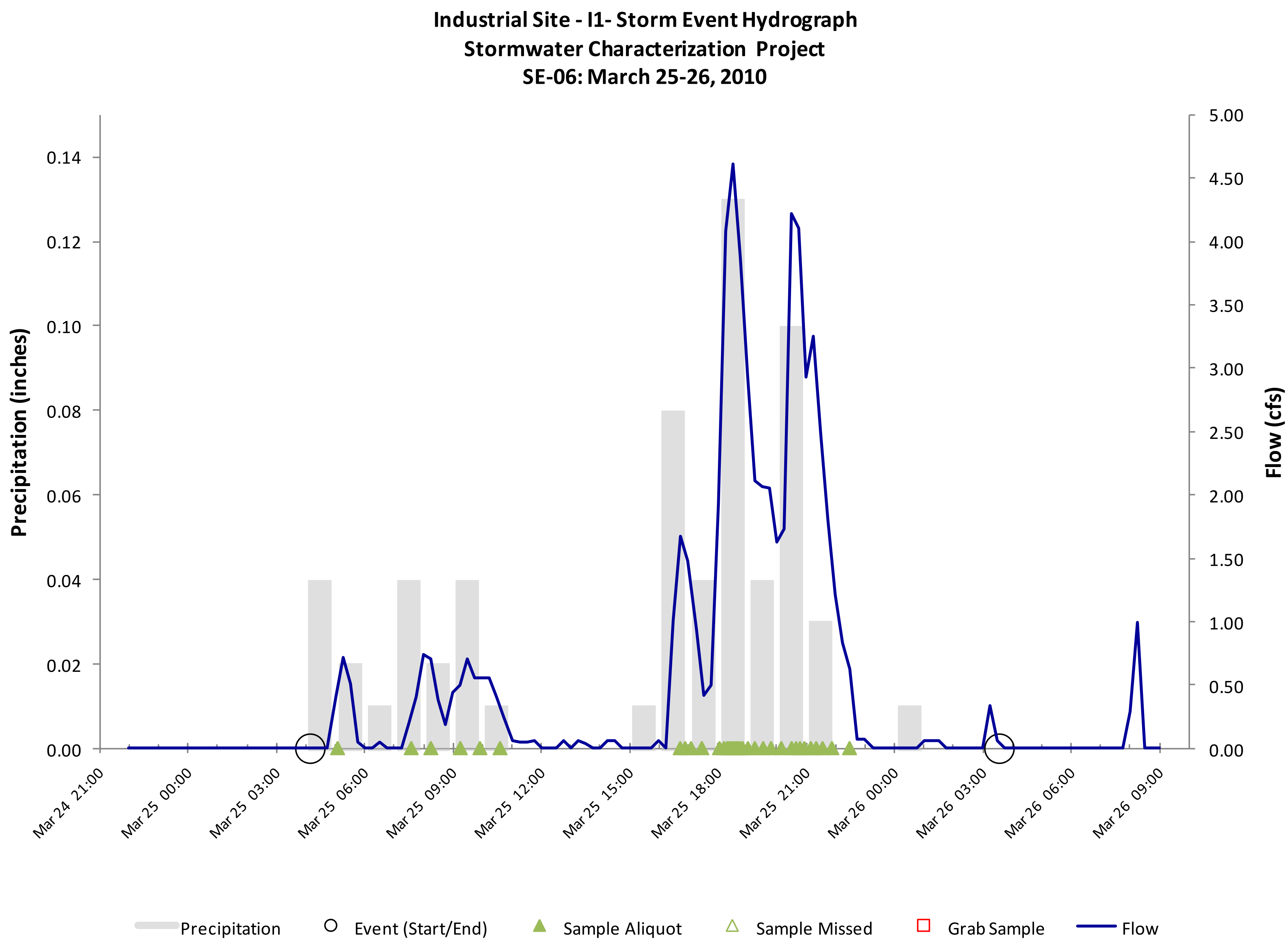


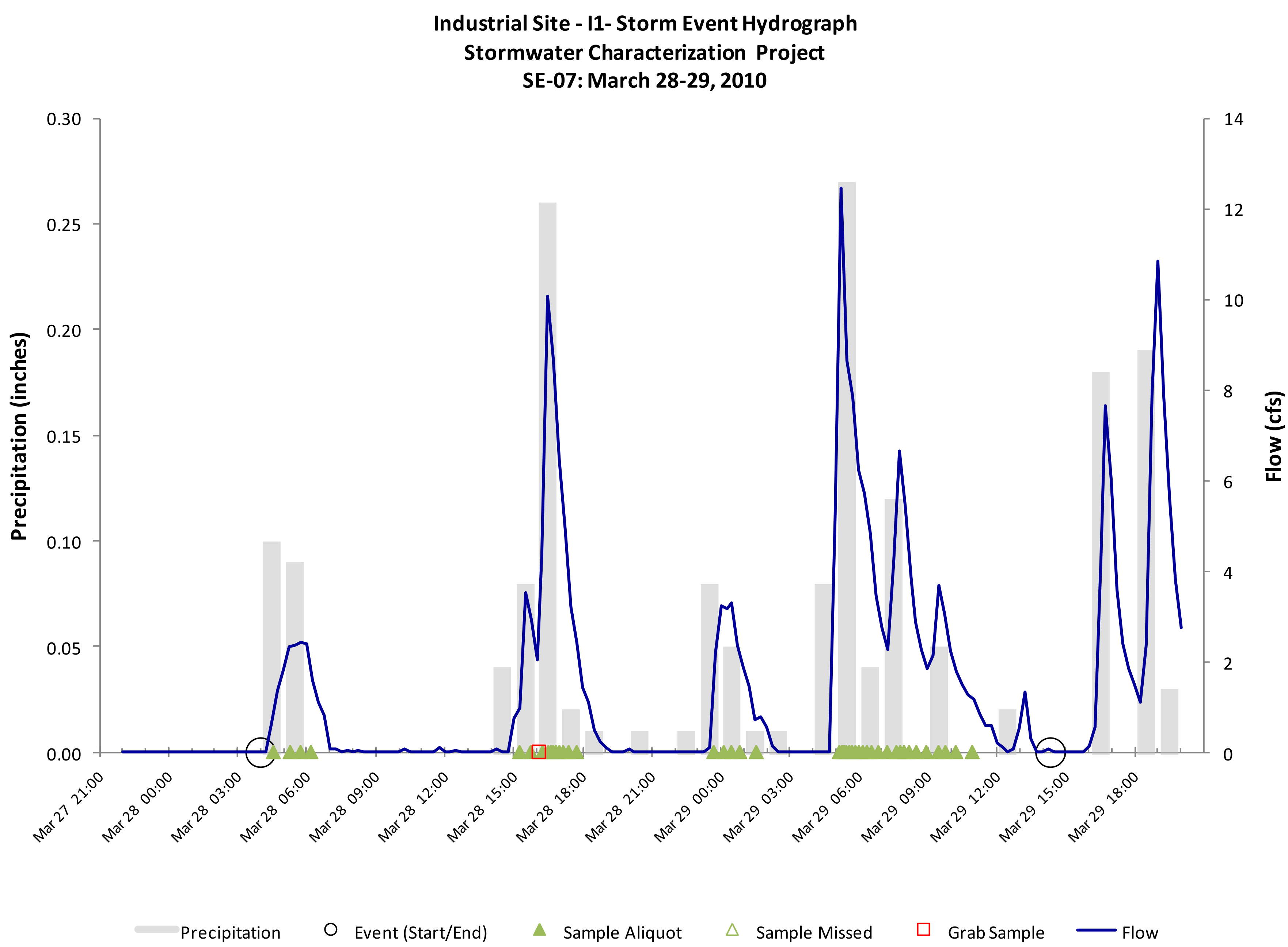
Industrial Site - I1- Storm Event Hydrograph
Stormwater Characterization Project
SE-03: December 31, 2009-January 02, 2010
Precipitation (inches)
Flow (cfs)
0.12
0.10
0.08
0.06
0.04
0.02
0.00
4.00
3.50
3.00
2.50
2.00
1.50
1.00
0.50
0.00
Dec 31 05:00
Dec 31 09:00
Dec 31 13:00
Dec 31 17:00
Dec 31 21:00
Jan 01 01:00
Jan 01 05:00
Jan 01 09:00
Jan 01 13:00
Jan 01 17:00
Jan 01 21:00
Jan 02 01:00
Jan 02 05:00
Jan 02 09:00
Jan 02 13:00
Precipitation
Event (Start/End)
Sample Aliquot
Sample Missed
Grab Sample
Flow

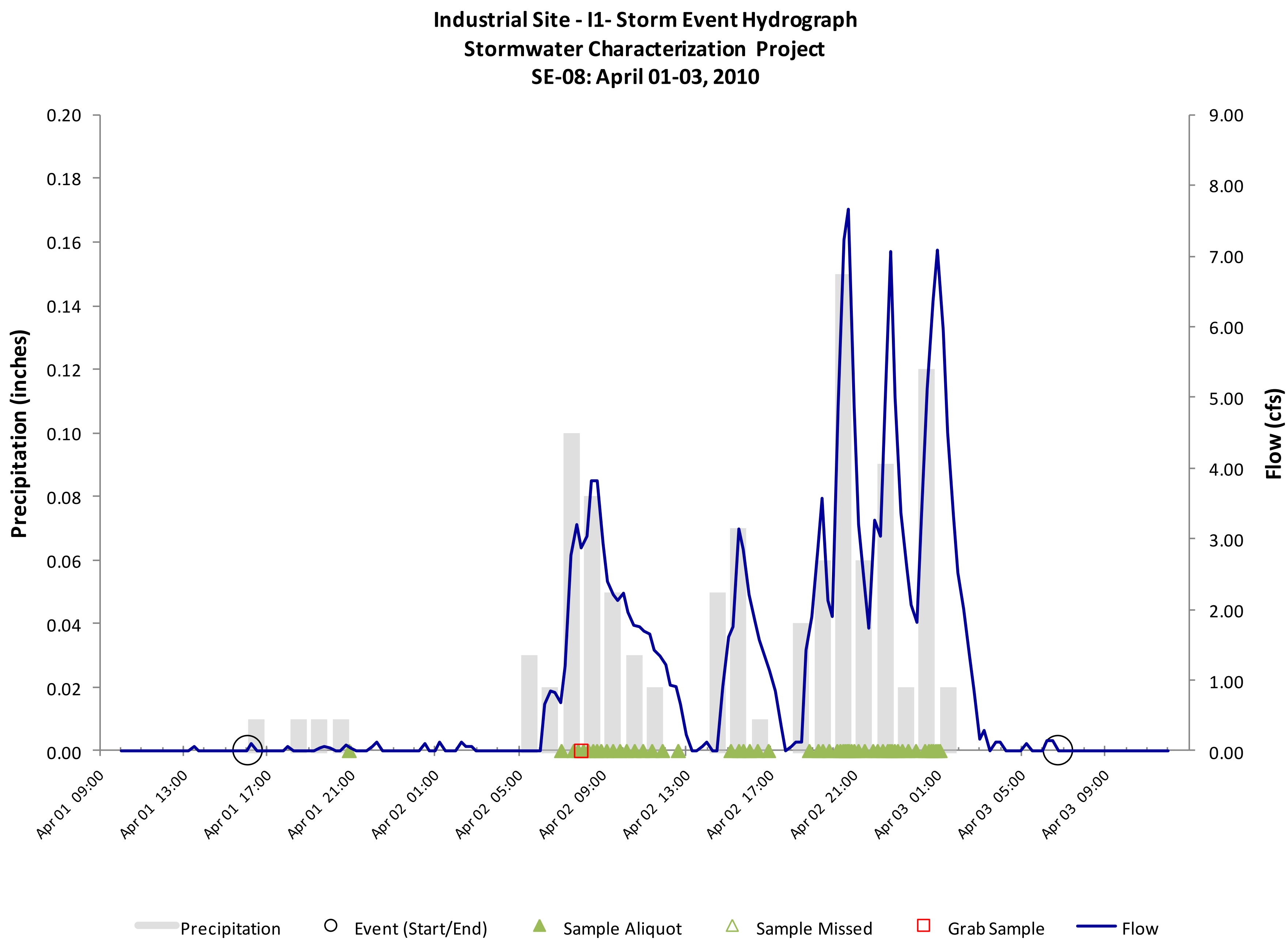


Industrial Site - I1- Storm Event Hydrograph
Stormwater Characterization Project
SE-04: January 24-25, 2010
Precipitation (inches)
Flow (cfs)
0.14
0.12
0.10
0.08
0.06
0.04
0.02
0.00
4.50
4.00
3.50
3.00
2.50
2.00
1.50
1.00
0.50
0.00
Jan 24 05:00
Jan 24 07:00
Jan 24 09:00
Jan 24 11:00
Jan 24 13:00
Jan 24 15:00
Jan 24 17:00
Jan 24 19:00
Jan 24 21:00
Jan 24 23:00
Jan 25 01:00
Jan 25 03:00
Jan 25 05:00
Jan 25 07:00
Jan 25 09:00
Jan 25 11:00
Precipitation
Event (Start/End)
Sample Aliquot
Sample Missed
Grab Sample
Flow

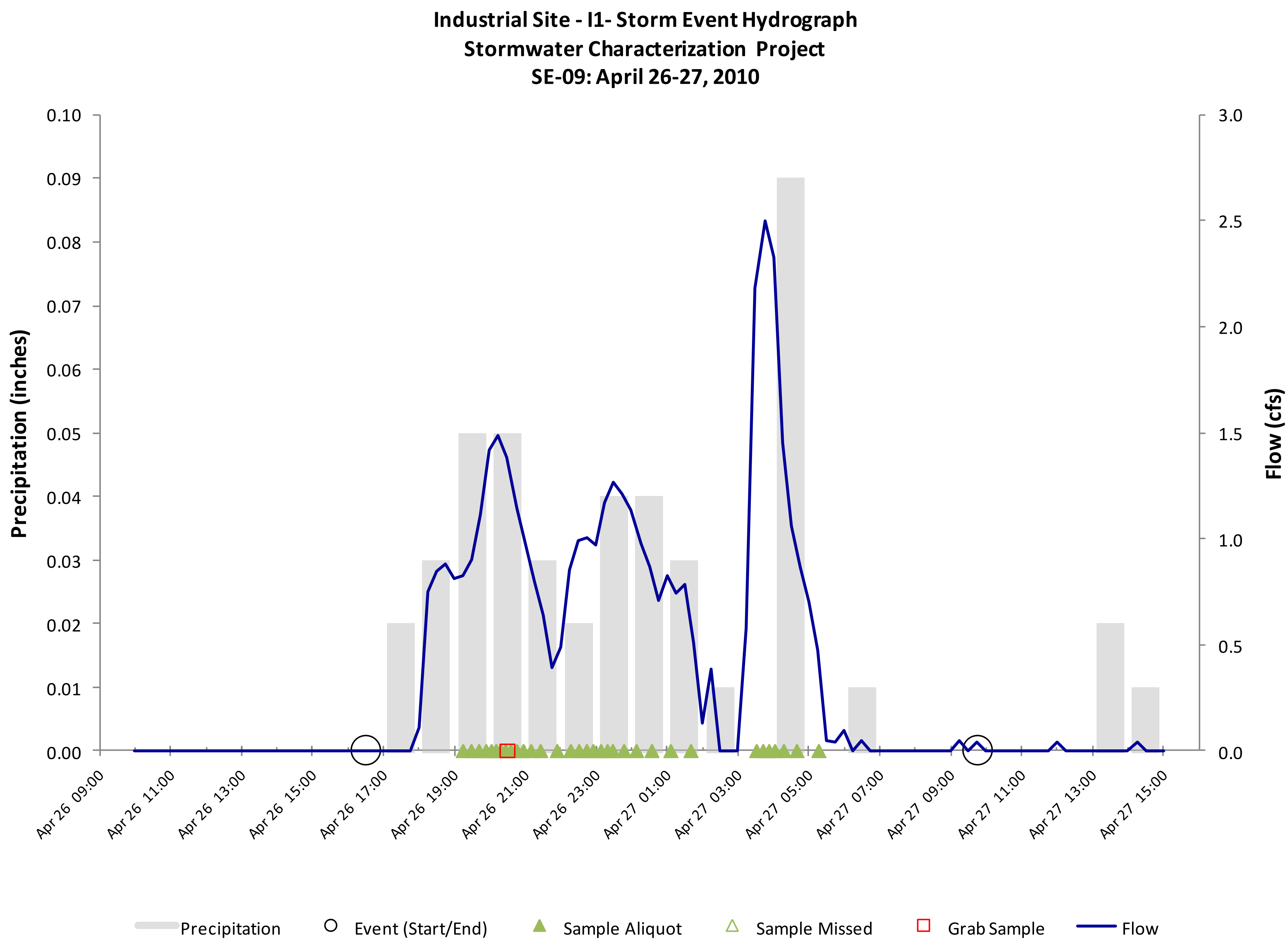

Industrial Site - I1- Storm Event Hydrograph
Stormwater Characterization Project
SE-05: March 11-12, 2010
Precipitation (inches)
Flow (cfs)
0.00
0.02
0.04
0.06
0.08
0.10
0.12
0.14
0.00
1.00
2.00
3.00
4.00
5.00
6.00
7.00
8.00
9.00
Mar 10 18:00
Mar 10 21:00
Mar 11 00:00
Mar 11 03:00
Mar 11 06:00
Mar 11 09:00
Mar 11 12:00
Mar 11 15:00
Mar 11 18:00
Mar 11 21:00
Mar 12 00:00
Mar 12 03:00
Mar 12 06:00
Mar 12 09:00
Mar 12 12:00
Mar 12 15:00
Precipitation
Event (Start/End)
Sample Aliquot
Sample Missed
Grab Sample
Flow


Industrial Site - I1- Storm Event Hydrograph
Stormwater Characterization Project
SE-06: March 25-26, 2010
Precipitation (inches)
Flow (cfs)
0.00
0.02
0.04
0.06
0.08
0.10
0.12
0.14
0.00
0.50
1.00
1.50
2.00
2.50
3.00
3.50
4.00
4.50
5.00
Mar 24 21:00
Mar 25 00:00
Mar 25 03:00
Mar 25 06:00
Mar 25 09:00
Mar 25 12:00
Mar 25 15:00
Mar 25 18:00
Mar 25 21:00
Mar 26 00:00
Mar 26 03:00
Mar 26 06:00
Mar 26 09:00
Precipitation
Event (Start/End)
Sample Aliquot
Sample Missed
Grab Sample
Flow

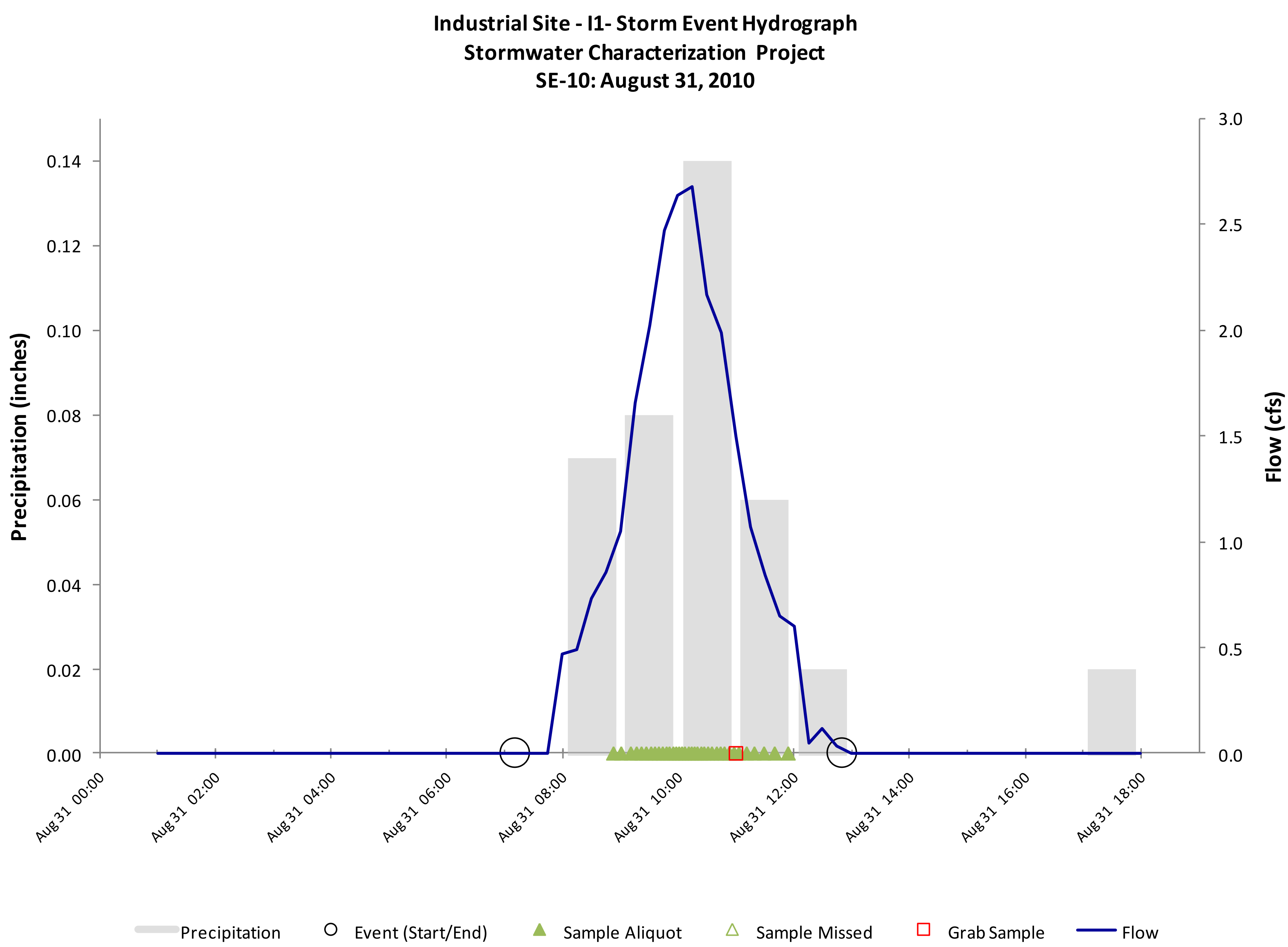

Industrial Site - I1- Storm Event Hydrograph
Stormwater Characterization Project
SE-07: March 28-29, 2010
Precipitation (inches)
0.30
0.25
0.20
0.15
0.10
0.05
0.00
Flow (cfs)
14
12
10
8
6
4
2
0
Mar 27 21:00
Mar 28 00:00
Mar 28 03:00
Mar 28 06:00
Mar 28 09:00
Mar 28 12:00
Mar 28 15:00
Mar 28 18:00
Mar 28 21:00
Mar 29 00:00
Mar 29 03:00
Mar 29 06:00
Mar 29 09:00
Mar 29 12:00
Mar 29 15:00
Mar 29 18:00
Precipitation
Event (Start/End)
Sample Aliquot
Sample Missed
Grab Sample
Flow

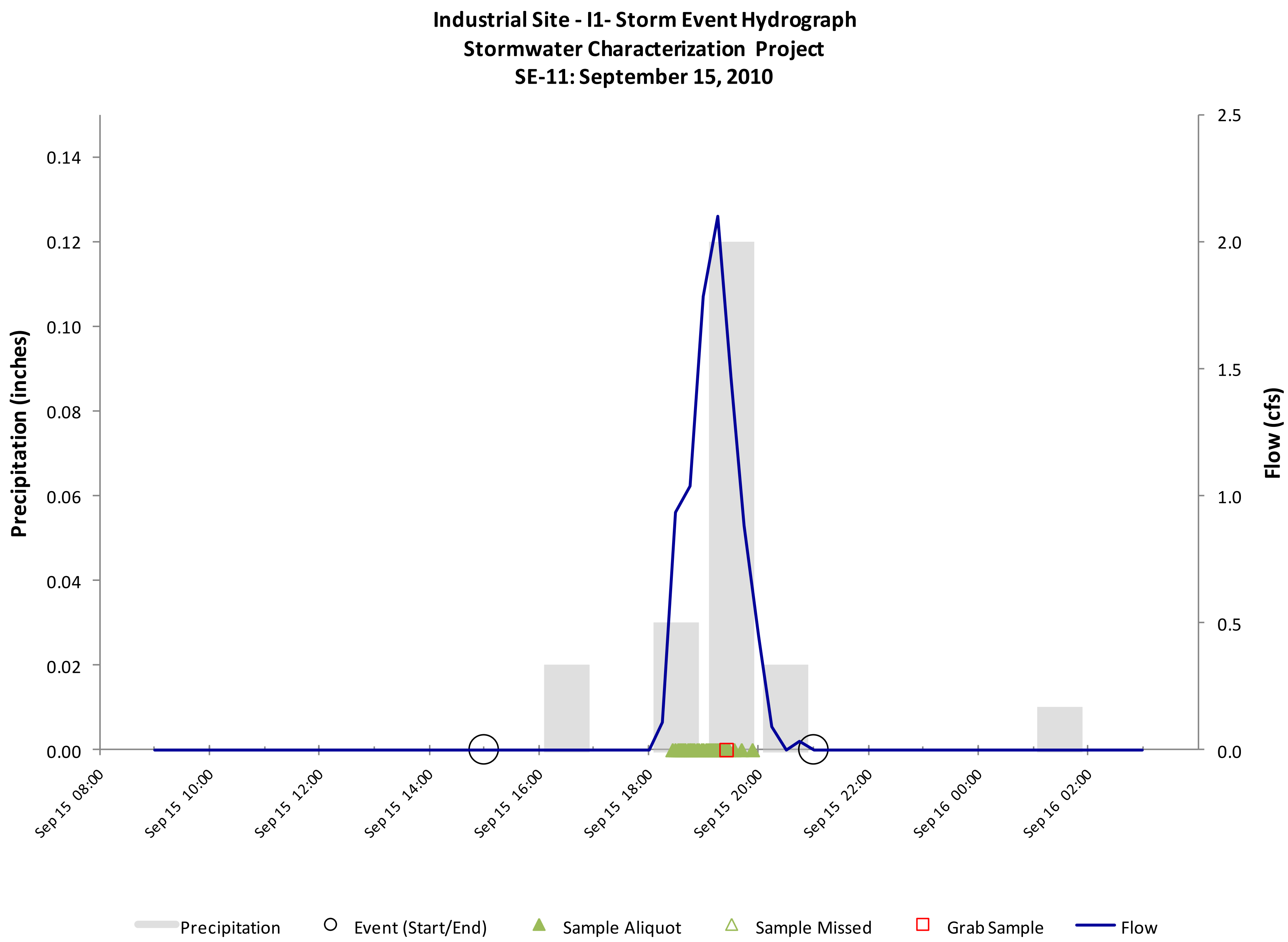


Industrial Site - I1- Storm Event Hydrograph
Stormwater Characterization Project
SE-08: April 01-03, 2010
Precipitation (inches)
Flow (cfs)
0.20
0.18
0.16
0.14
0.12
0.10
0.08
0.06
0.04
0.02
0.00
9.00
8.00
7.00
6.00
5.00
4.00
3.00
2.00
1.00
0.00
Apr 01 09:00
Apr 01 13:00
Apr 01 17:00
Apr 01 21:00
Apr 02 01:00
Apr 02 05:00
Apr 02 09:00
Apr 02 13:00
Apr 02 17:00
Apr 02 21:00
Apr 03 01:00
Apr 03 05:00
Apr 03 09:00
Precipitation
Event (Start/End)
Sample Aliquot
Sample Missed
Grab Sample
Flow



Industrial Site - I1- Storm Event Hydrograph
Stormwater Characterization Project
SE-09: April 26-27, 2010
Precipitation (inches)
Flow (cfs)
0.10
0.09
0.08
0.07
0.06
0.05
0.04
0.03
0.02
0.01
0.00
3.0
2.5
2.0
1.5
1.0
0.5
0.0
Apr 26 09:00
Apr 26 11:00
Apr 26 13:00
Apr 26 15:00
Apr 26 17:00
Apr 26 19:00
Apr 26 21:00
Apr 26 23:00
Apr 27 01:00
Apr 27 03:00
Apr 27 05:00
Apr 27 07:00
Apr 27 09:00
Apr 27 11:00
Apr 27 13:00
Apr 27 15:00
Precipitation
Event (Start/End)
Sample Aliquot
Sample Missed
Grab Sample
Flow


Industrial Site - I1- Storm Event Hydrograph
Stormwater Characterization Project
SE-10: August 31, 2010
Precipitation (inches)
Flow (cfs)
0.14
0.12
0.10
0.08
0.06
0.04
0.02
0.00
3.0
2.5
2.0
1.5
1.0
0.5
0.0
Aug 31 00:00
Aug 31 02:00
Aug 31 04:00
Aug 31 06:00
Aug 31 08:00
Aug 31 10:00
Aug 31 12:00
Aug 31 14:00
Aug 31 16:00
Aug 31 18:00
Precipitation
Event (Start/End)
Sample Aliquot
Sample Missed
Grab Sample
Flow


Industrial Site - I1- Storm Event Hydrograph
Stormwater Characterization Project
SE-11: September 15, 2010
Precipitation (inches)
0.14
0.12
0.10
0.08
0.06
0.04
0.02
0.00
Flow (cfs)
2.5
2.0
1.5
1.0
0.5
0.0
Sep 15 08:00
Sep 15 10:00
Sep 15 12:00
Sep 15 14:00
Sep 15 16:00
Sep 15 18:00
Sep 15 20:00
Sep 15 22:00
Sep 16 00:00
Sep 16 02:00
Precipitation
Event (Start/End)
Sample Aliquot
Sample Missed
Grab Sample
Flow

Appendix C.3: Toxicity Comprehensive Environmental Toxicity Information System (CETIS) Test Evaluation Reports

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CETIS Test Evaluation Report

Report Date: 01 Nov-10 13:30 (1 of 2)
Test Code: RMAR2041 | 05-0293-8468

Facility:	Seattle Municipal Stormwater	**Test Title:**	Salmonid Embryo Survival and Development Test
Sample Site:	Residential (Venema; R001)	**Organism:**	Oncorhynchus mykiss (Rainbow Trout)
Sample Code:	RMAR2041	**Protocol:**	EC/EPS 1/RM/28
Sample Date:	31 Aug-10 17:41	**Start Date:**	01 Sep-10 17:15
Sample Age:	24h (0.8 °C)	**End Date:**	08 Sep-10 16:20
Project:		**Test Duration:**	6d 23h **Organism Age:**

Permitee:	City of Seattle	**Laboratory:**	Nautilus Environmental
Address:	Seattle Public Utilities PO Box 34018 Seattle, WA 98124-4018	**Address:**	5009 Pacific Hwy E Suite 2 Tacoma, WA 98424
Contact:	Doug Hutchinson, Stormwater Monitoring Program Lea	**Contact:**	Catherine Curran, Washington Manager
Phone:	206-233-7899	**Phone:**	(253) 922-4296
Email:	Doug.Hutchinson@seattle.gov	**Email:**	cat@nautilusenvironmental.com

Batch Note: Sample was hardness adjusted

Chronic Toxicity Evaluation

Endpoint	Parameter	Conc-%	IWC	Pass/Fail	Method
Development Rate	LC50/EC50	745243.3	100	Pass	Linear Regression (MLE)
Survival Rate	LC50/EC50	5554961	100	Pass	Linear Regression (MLE)

Test Review Comments

This toxicity test is acceptable according to test review criteria. There were no significant deficiencies in sample handling, test performance, test organism response, or statistical analysis.

The sample tested was nontoxic to this test organism.

No follow-up action needed.

Test Reviewer

Reviewer: Randall Marshall, WET Coordinator
Phone: 360-407-6445, 360-407-6426(fax)
Email: rmar461@ecy.wa.gov

Signature Date

CETIS Test Evaluation Report

Report Date: 01 Nov-10 13:30 (2 of 2)
Test Code: RMAR2041 | 05-0293-8468

Development Rate Summary

Conc-%	Control Type	Count	Mean	95% LCL	95% UCL	Min	Max	Std Err	Std Dev	CV%	%Effect
0	Dilution Water	4	0.8744	0.8298	0.919	0.7	0.9667	0.05972	0.1194	13.66%	0.0%
0	Treatment Con	4	0.8741	0.8371	0.9112	0.7333	0.9667	0.04963	0.09926	11.36%	0.03%
6.25		4	0.95	0.9339	0.9661	0.9	1	0.02152	0.04303	4.53%	-8.64%
12.5		4	0.9417	0.923	0.9603	0.9	1	0.025	0.05	5.31%	-7.69%
25		4	0.9244	0.9126	0.9363	0.9	0.9667	0.01587	0.03173	3.43%	-5.72%
50		4	0.925	0.9188	0.9312	0.9	0.9333	0.008333	0.01667	1.8%	-5.78%
100		4	0.8894	0.8647	0.914	0.7931	0.9333	0.03298	0.06595	7.42%	-1.71%

Survival Rate Summary

Conc-%	Control Type	Count	Mean	95% LCL	95% UCL	Min	Max	Std Err	Std Dev	CV%	%Effect
0	Dilution Water	4	0.9917	0.9854	0.9979	0.9667	1	0.008333	0.01667	1.68%	0.0%
0	Treatment Con	4	0.9917	0.9854	0.9979	0.9667	1	0.008333	0.01667	1.68%	0.0%
6.25		4	1	1	1	1	1	0	0	0.0%	-0.84%
12.5		4	0.9917	0.9854	0.9979	0.9667	1	0.008333	0.01667	1.68%	0.0%
25		4	0.9917	0.9854	0.9979	0.9667	1	0.008333	0.01667	1.68%	0.0%
50		4	1	1	1	1	1	0	0	0.0%	-0.84%
100		4	0.9833	0.9761	0.9905	0.9667	1	0.009623	0.01925	1.96%	0.84%

CETIS Test Evaluation Report

Report Date: 01 Nov-10 13:34 (1 of 2)
Test Code: RMAR2042 | 09-4552-5445

Facility: Seattle Municipal Stormwater
Sample Site: Commercial (University District; C001)
Sample Code: RMAR2042
Sample Date: 22 Aug-10 10:50
Sample Age: 28h (4 °C)
Project:

Test Title: Salmonid Embryo Survival and Development Test
Organism: Oncorhynchus mykiss (Rainbow Trout)
Protocol: EC/EPS 1/RM/28
Start Date: 23 Aug-10 14:45
End Date: 30 Aug-10 14:45
Test Duration: 7d 0h
Organism Age:

Permitee: City of Seattle
Address: Seattle Public Utilities
PO Box 34018
Seattle, WA 98124-4018
Contact: Doug Hutchinson, Stormwater Monitoring Program Lea
Phone: 206-233-7899
Email: Doug.Hutchinson@seattle.gov

Laboratory: Nautilus Environmental
Address: 5009 Pacific Hwy E Suite 2
Tacoma, WA 98424
Contact: Catherine Curran, Washington Manager
Phone: (253) 922-4296
Email: cat@nautilusenvironmental.com

Chronic Toxicity Evaluation

Endpoint	Parameter	Conc-%	IWC	Pass/Fail	Method
Development Rate	LC50/EC50	145.5435	100	Pass	Linear Regression (MLE)
Survival Rate	LC50/EC50	168.0262	100	Pass	Linear Regression (MLE)

Test Review Comments

This toxicity test is acceptable according to test review criteria. There were no significant deficiencies in sample handling, test performance, test organism response, or statistical analysis.

The test result showed some toxicity but not at levels of regulatory concern.

No follow-up action needed.

Test Reviewer

Reviewer: Randall Marshall, WET Coordinator
Phone: 360-407-6445, 360-407-6426(fax)
Email: rmar461@ecy.wa.gov

Signature **Date**

CETIS Test Evaluation Report

Report Date: 01 Nov-10 13:34 (2 of 2)
Test Code: RMAR2042 | 09-4552-5445

Development Rate Summary

Conc-%	Control Type	Count	Mean	95% LCL	95% UCL	Min	Max	Std Err	Std Dev	CV%	%Effect
0	Dilution Water	4	0.8741	0.8129	0.9352	0.6296	0.9667	0.08186	0.1637	18.73%	0.0%
50		4	0.9115	0.8621	0.9609	0.72	1	0.06617	0.1323	14.52%	-4.28%
100		4	0.5818	0.3978	0.7659	0.04167	1	0.2465	0.493	84.73%	33.43%

Survival Rate Summary

Conc-%	Control Type	Count	Mean	95% LCL	95% UCL	Min	Max	Std Err	Std Dev	CV%	%Effect
0	Dilution Water	4	0.975	0.9563	0.9937	0.9	1	0.025	0.05	5.13%	0.0%
50		4	0.9333	0.9028	0.9638	0.8333	1	0.04082	0.08165	8.75%	4.27%
100		4	0.75	0.6173	0.8827	0.2333	1	0.1777	0.3554	47.38%	23.08%

CETIS Test Evaluation Report

Report Date: 01 Nov-10 13:29 (1 of 2)
Test Code: RMAR2040 | 08-5941-5546

Facility: Seattle Municipal Stormwater
Sample Site: Industrial (Norfolk; I001)
Sample Code: RMAR2040
Sample Date: 31 Aug-10 11:52
Sample Age: 29h (1 °C)
Project:

Test Title: Salmonid Embryo Survival and Development Test
Organism: Oncorhynchus mykiss (Rainbow Trout)
Protocol: EC/EPS 1/RM/28
Start Date: 01 Sep-10 17:15
End Date: 08 Sep-10 16:20
Test Duration: 6d 23h
Organism Age:

Permitee: City of Seattle
Address: Seattle Public Utilities
PO Box 34018
Seattle, WA 98124-4018
Contact: Doug Hutchinson, Stormwater Monitoring Program Lea
Phone: 206-233-7899
Email: Doug.Hutchinson@seattle.gov

Laboratory: Nautilus Environmental
Address: 5009 Pacific Hwy E Suite 2
Tacoma, WA 98424
Contact: Catherine Curran, Washington Manager
Phone: (253) 922-4296
Email: cat@nautilusenvironmental.com

Batch Note: Sample was hardness adjusted

Chronic Toxicity Evaluation

Endpoint	Parameter	Conc-%	IWC	Pass/Fail	Method
Development Rate	LC50/EC50	2.275963E+18	100	Pass	Linear Regression (MLE)
Survival Rate	LC50/EC50	398220	100	Pass	Linear Regression (MLE)

Test Review Comments

This toxicity test is acceptable according to test review criteria. There were no significant deficiencies in sample handling, test performance, test organism response, or statistical analysis.

The sample tested was nontoxic to this test organism.

No follow-up action needed.

Test Reviewer

Reviewer: Randall Marshall, WET Coordinator
Phone: 360-407-6445, 360-407-6426(fax)
Email: rmar461@ecy.wa.gov

Signature ______________________ Date

CETIS Test Evaluation Report

Report Date: 01 Nov-10 13:29 (2 of 2)
Test Code: RMAR2040 | 08-5941-5546

Development Rate Summary

Conc-%	Control Type	Count	Mean	95% LCL	95% UCL	Min	Max	Std Err	Std Dev	CV%	%Effect
0	Dilution Water	4	0.8578	0.8168	0.8987	0.7333	0.9667	0.05481	0.1096	12.78%	0.0%
0	Treatment Con	4	0.9232	0.9115	0.9349	0.8966	0.963	0.01563	0.03126	3.39%	-7.63%
6.25		4	0.9083	0.8807	0.9359	0.8333	1	0.03696	0.07391	8.14%	-5.9%
12.5		4	0.925	0.8993	0.9507	0.8333	1	0.03436	0.06872	7.43%	-7.84%
25		4	0.8986	0.8692	0.9279	0.8276	0.9667	0.03934	0.07867	8.76%	-4.76%
50		4	0.925	0.8974	0.9526	0.8333	1	0.03696	0.07391	7.99%	-7.84%
100		4	0.8917	0.8469	0.9364	0.7333	1	0.0599	0.1198	13.44%	-3.95%

Survival Rate Summary

Conc-%	Control Type	Count	Mean	95% LCL	95% UCL	Min	Max	Std Err	Std Dev	CV%	%Effect
0	Dilution Water	4	0.9917	0.9854	0.9979	0.9667	1	0.008333	0.01667	1.68%	0.0%
0	Treatment Con	4	0.9667	0.9491	0.9843	0.9	1	0.02357	0.04714	4.88%	2.52%
6.25		4	1	1	1	1	1	0	0	0.0%	-0.84%
12.5		4	0.9833	0.9709	0.9958	0.9333	1	0.01667	0.03333	3.39%	0.84%
25		4	0.9917	0.9854	0.9979	0.9667	1	0.008333	0.01667	1.68%	0.0%
50		4	0.9583	0.9272	0.9895	0.8333	1	0.04167	0.08333	8.7%	3.36%
100		4	0.9833	0.9709	0.9958	0.9333	1	0.01667	0.03333	3.39%	0.84%

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Appendix C.4: Catch Basin StormFilter – Quality Assurance/Quality Control Report

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This Quality Assurance/Quality Control (QA/QC) report documents results of the QA/QC review of time series and analytical data generated for the permit-required (section S8.F) Catch Basin StormFilter (CBSF) project. The following discussion will include QA/QC practices and results for flow monitoring, laboratory analytical testing and field sample analysis. The discussion will conclude with a table of all sample results qualified by the validation process.

Flow Monitoring QA/QC Results

Over 50 level calibrations were performed for each project level sensor during WY2010. Level data were generally very accurate, with before and after values being within closer than +/- 0.02 feet and very minor drift (upward or downward movement of monitor level readings away from accurate values) observed from October 2009 through June 2010. Beginning June 2010, level drift began occurring at all four level sensors which increased throughout the summer. It is unknown whether the drift was a result of drier summer conditions and stagnant flow (sensors remain submerged even during dry weather) or the age of the sensors (submerged pressure transducers contain a flexible internal diaphragm which can deform or harden over time resulting in increased level drift and the need for replacement). Due to the drift, all level sensors were removed and replaced with new ones on October 6, 2010. Level data were edited for the drift using before and after readings recorded during every calibration event, so finalized level data are considered accurate.

Comparisons of total flow (measured at the outlet station) to bypass flow (measured at the internal weir located upstream from the total flow/outlet station) indicated that there were certain intense storms were the calculated bypass flow exceeded the total flow. This occurred during two of the 20 storms sampled during WY2010. Comparisons of total flow to bypass flow hydrographs also reveal incidences within storm events where bypass flow rates exceeded total flow rates for short periods within storms. Actual bypass flow cannot exceed total flow since total flow is the combination of treated and bypass flow. Total flow is measured using a volumetric weir located at the downstream end of approximately 20 feet of straight outlet piping so the flow conditions are laminar. The weir manufacturer produced the level to flow conversion table based on empirical data from flow tests. Due to these reasons, the outlet flow data are assumed to be accurate. The bypass flow is measured within the CBSF units and bypass flow only occurs during intense storms which produce more turbulent flows. Flow dynamics in this compact unit result in turbulent flows cresting over the bypass weir during intense runoff periods. Bypass level data are converted to flow using standard, theoretical weir equations which are unconfirmed. Due to these reasons, there is lower confidence in the calculated bypass flow data values. However, the occurrence of bypass is considered accurate.

Collecting accurate flow data within manufactured BMPs is very challenging. Even with retrofits to the BMP (i.e., the addition of a custom sharp-crested weir to the bypass and inserting a volumetric weir into the outlet pipe), the ability to collect highly accurate flow data from a compact and previously-installed BMP is difficult.

Since this study will continue into WY2011, the flow data detailed in this report are considered preliminary. To improve the confidence in, and accuracy of, the flow data; an attempt will be made in WY2011 to empirically calculate actual level to flow conversions for both weirs by controlled flow testing with water applied from a hydrant or water truck. If this testing is performed, all flow data for the project will be recalculated using the new level-flow conversions. Until this flow testing is performed, all flow data in this report are considered estimates.

Analytical QA/QC Results

This analytical data QA/QC report addresses analytical data collected for the Catch Basin StormFilter project during WY2010.

All laboratory data packages received included a hardcopy report and an electronic data deliverable (EDD). The laboratory case narratives were reviewed for quality control issues and corrective action taken for each sample delivery group. The data were evaluated for required methods, holding times, reporting limits, accuracy, precision, and blank contamination.

Each EDD was imported into a review template where deviations from the measurement quality objectives (MQOs) were identified and associated samples were qualified accordingly. The following describes the details of this review.

Analytical Methods and Reporting Limits

The following table is used to describe the methods and reporting limits used by the laboratory. Reporting limits represents the minimum concentration of an analyte in a specific matrix that can be identified and quantified above the method detection limit and within specified limits of precision and bias during routine analytical operating conditions. Reporting limits can vary by individual samples, particularly for sediments where the quantity and dilution analyzed affect the minimum detectable value.

Catch Basin StormFilter Water Sample Analytes, Methods and Reporting Limits

Analyte Group	Analyte	Reporting Limit	Units	Lab Method
Conventionals	Hardness	1	mg/L CaCO3	SM2340C
	pH	0.01	std units	SM4500H
	Solids, Total Suspended	0.5	mg/L	SM2540D
	Particle Size	0.01	mg/L	ASTMD3977C
Metals	Copper - Dissolved	1	ug/L	EPA200.8
	Copper - Total	1	ug/L	EPA200.8
	Zinc - Dissolved	1	ug/L	EPA200.8

Analyte Group	Analyte	Reporting Limit	Units	Lab Method
	Zinc - Total	1	ug/L	EPA200.8
Nutrients	Ortho-phosphate	0.001	mg-P/L	SM4500PF
	Phosphorus, Total	0.002	mg-P/L	SM4500PF

Catch Basin StormFilter Sediment Sample Analytes, Methods and Reporting Limits

Analyte Group	Analyte	Reporting Limit	Units	Lab Method
Conventionals	Solids, Total	0.01	%	EPA160.3
	Grain Size	0.1	%	PSEP-PS
	Solids, Total Volatile	0.01	%	EPA160.4
Petroleum Hydrocarbons	Diesel Range	5	mg/Kg	NWTPH-DX
	Motor Oil	10	mg/Kg	NWTPH-DX
	Gasoline Range	5	mg/Kg	NWTPH-GX
Metals	Cadmium	0.2	mg/kg	EPA200.8
	Copper	0.5	mg/kg	EPA200.8
	Lead	1	mg/kg	EPA200.8
	Zinc	4	mg/kg	EPA200.8
Nutrients	Phosphorus, Total	0.8	mg/kg	EPA365.2

Data Qualifier Definitions

Data qualifiers were applied to sample chemistry data based on the results of validation. Three data qualifier codes were used; U, J and UJ.

One result value per sample per analyte is reported. In instances where the laboratory performed dilutions or re-analyses, the most acceptable result with the lowest detection limit is reported.

Qualifier	Definition
U	Analyte was analyzed for, but not detected above reported result.
J	Reported result is an estimated quantity.
UJ	Analyte was analyzed for, but not detected above reported estimate.

Laboratory QA/QC Results

Holding Time

All sample results were assessed for holding time compliance 40 Code for Federal Regulations (CFR) part 136. Holding times were met for all results except as listed below. Holding time exceedances for total suspended solids were determined to be the result of communication error with the laboratory. Corrective action was taken to insure samples would be analyzed within hold. No further action necessary.

Analytical results obtained outside of holding time have been qualified as estimated (J). Qualification based on holding time is only applied to the specific results listed below.

Holding Time Exceedances for Water Samples

Analyte	Sample ID	Sample Date	Reason
pH	CBSF1-IN	12/14/09 23:00	Analyzed past holding by 2 days
pH	CBSF1-OUT	12/14/09 23:00	Analyzed past holding by 2 days
pH	CBSF2-IN	12/14/09 23:45	Analyzed past holding by 2 days
pH	CBSF2-OUT	12/14/09 23:45	Analyzed past holding by 2 days
pH	CBSF2-IN	6/2/10 9:44	Analyzed past holding by 1 day
pH	CBSF2-OUT	6/2/10 9:44	Analyzed past holding by 1 day
pH	CBSF1-IN	6/2/10 11:21	Analyzed past holding by 1 day
pH	CBSF1-OUT	6/2/10 11:25	Analyzed past holding by 1 day
pH	CBSF1-OUT	6/2/10 11:26	Analyzed past holding by 1 day
pH	CBSF1-IN	6/8/10 0:00	Analyzed past holding by 1 day
pH	CBSF1-OUT	6/8/10 0:00	Analyzed past holding by 1 day
pH	CBSF1-OUT	6/8/10 0:00	Analyzed past holding by 1 day
Solids, Total Suspended	CBSF1-IN	10/21/09 11:50	Analyzed past holding by 2 days
Solids, Total Suspended	CBSF1-OUT	10/21/09 11:50	Analyzed past holding by 2 days
Solids, Total Suspended	CBSF2-IN	11/6/09 7:19	Analyzed past holding by 6 days
Solids, Total Suspended	CBSF2-OUT	11/6/09 7:19	Analyzed past holding by 6 days
Solids, Total Suspended	CBSF1-IN	11/6/09 9:35	Analyzed past holding by 6 days
Solids, Total Suspended	CBSF1-OUT	11/6/09 9:35	Analyzed past holding by 6 days
Solids, Total Suspended	CBSF1-IN	12/14/09 23:00	Analyzed past holding by 2 days
Solids, Total Suspended	CBSF1-OUT	12/14/09 23:00	Analyzed past holding by 2 days
Solids, Total Suspended	CBSF2-IN	12/14/09 23:45	Analyzed past holding by 2 days
Solids, Total Suspended	CBSF2-OUT	12/14/09 23:45	Analyzed past holding by 2 days
Solids, Total Suspended	CBSF2-IN	2/5/10 6:40	Analyzed past holding by 7 days
Solids, Total Suspended	CBSF2-OUT	2/5/10 6:40	Analyzed past holding by 7 days
Solids, Total Suspended	CBSF1-IN	2/11/10 9:52	Analyzed past holding by 1 day
Solids, Total Suspended	CBSF1-OUT	2/11/10 9:52	Analyzed past holding by 1 day
Solids, Total Suspended	CBSF2-OUT	2/11/10 10:26	Analyzed past holding by 1 day
Solids, Total Suspended	CBSF2-IN	2/11/10 10:27	Analyzed past holding by 1 day

Holding Time Exceedances for Sediment Samples

Analyte	Sample ID	Sample Date	Reason
Solids, Total	CBSF1-SED1	9/28/10 12:12	Analyzed past holding by 2 days
Solids, Total	CBSF1-SED2	9/28/10 12:25	Analyzed past holding by 2 days
Solids, Total	CBSF1-SED3	9/28/10 12:40	Analyzed past holding by 2 days
Solids, Total	CBSF2-SED1	9/28/10 10:40	Analyzed past holding by 2 days
Solids, Total	CBSF2-SED2	9/28/10 10:32	Analyzed past holding by 2 days

Analyte	Sample ID	Sample Date	Reason
Solids, Total	CBSF2-SED3	9/28/10 11:35	Analyzed past holding by 2 days
Solids, Total Volatile	CBSF1-SED1	9/28/10 12:12	Analyzed past holding by 2 days
Solids, Total Volatile	CBSF1-SED2	9/28/10 12:25	Analyzed past holding by 2 days
Solids, Total Volatile	CBSF1-SED3	9/28/10 12:40	Analyzed past holding by 2 days
Solids, Total Volatile	CBSF2-SED1	9/28/10 10:40	Analyzed past holding by 2 days
Solids, Total Volatile	CBSF2-SED2	9/28/10 10:32	Analyzed past holding by 2 days
Solids, Total Volatile	CBSF2-SED3	9/28/10 11:35	Analyzed past holding by 2 days

Blanks

Laboratory method blanks were generated and analyzed by the laboratories in association with primary environmental samples. The following table lists the qualification actions resulting from the blank results.

Blank Validation Criteria

Blank	Sample	Action
Blank > RL	Sample < RL	Qualify sample result as non-detect (U) at the Reporting Limit. No note needed.
	RL < Sample < Blank	Qualify sample result as non-detect (U) at the reported concentration. Note in report.
	Blank < Sample < 10x Blank	Qualify sample result as estimated (J). Note in report.
	10x Blank < Sample	No qualification needed. Note in report.
Blank < (-RL)	Sample < RL	Qualify sample result as estimated non-detect (UJ) at Reporting Limit. Note in report.
	RL < Sample < 10x Blank	Qualify sample result as estimated (J). Note in report.
	10x Blank < Sample	No qualification needed. Note in report.
(-RL) < Blank < RL	Sample < RL	Qualify sample result as non-detect (U) at Reporting Limit. No note needed.
	RL < Sample	No qualification needed. No note needed.

The following table illustrates the application of qualifiers to sample results based on the blank QC sample types.

Association of Blank QC Qualifiers to Results

QC Type	Associated Results
Method Blank	All results in prep batch
Filter Blank	All results from same SDG
Trip Blank	All results from same SDG
Tubing Blank/Bottle Blank/Splitter Blank/Bailer Blank	All composite results from project water year
Grab Sampler Equipment Blank	All grab results from project water year

Blank Results Discussion

All method blank results were within control limits with the exception of those listed below.

Method blank contamination for dissolved zinc was determined to be the result of filter contamination. Corrective action has been taken and associated sample results were qualified accordingly.

Field and equipment blanks were collected and analyzed in addition to laboratory method blanks. The results of these additional blanks can be found in the Field QC Sample Results section.

Method Blank Exceedances for Water Samples

Analyte	Result	Units	Action
Ortho-phosphate	1.09	ug/L	Associated results > 1.09 and < 10.9 qualified "J"
Phosphorus, Total	3.17	ug/L	Associated results > 3.17 and < 31.7 qualified "J"
Phosphorus, Total	4.16	ug/L	Associated results > 4.16 and < 41.6 qualified "J"
Zinc, Dissolved	2.08	ug/L	Associated results > 2.08 and < 20.8 qualified "J"
Zinc, Dissolved	2.47	ug/L	Associated results > 2.47 and < 24.7 qualified "J"
Zinc, Dissolved	2.32	ug/L	Associated results > 2.32 and < 23.2qualified "J"
Zinc, Dissolved	1.79	ug/L	Associated results > 1.79and < 17.9 qualified "J"
Zinc, Dissolved	2.64	ug/L	Associated results > 2.64 and < 26.4 qualified "J"
Zinc, Dissolved	2.32	ug/L	Associated results > 23.2 - No Qualification Needed

Accuracy

Accuracy is the degree of agreement between an observed value and an accepted reference value. Accuracy was demonstrated by analysis of matrix spikes (MS), laboratory control samples (LCS), reference materials (RM) and surrogate compounds (SUR). Laboratory control limits were used when provided. The following table lists the qualification actions resulting from the accuracy analysis.

Accuracy Validation Criteria

%R*	Sample	Action
%R < LowLimit	Sample ≤ RL	Qualify sample result as estimated non-detect (UJ). Note in report.
	RL < Sample	Qualify sample result as estimated (J). Note in Report.
	Parent† > 4x spike added	No qualification needed. Note in report.
UppLimit < %R	Sample ≤ RL	No qualification needed. Note in report.
	RL < Sample	Qualify sample result as estimated (J). Note in Report.
	Parent > 4x spike added	No qualification needed. Note in report.

† Parent - The sample from which an aliquot is used to make the spiked QC sample.

* %R - The percent recovery of the spiked compound and is calculated as:

The following table illustrates the application of qualifiers to sample results based on the accuracy QC sample types.

Association of Accuracy QC

QC Type	Associated Results
LCS/LCSD/RM	All results in prep batch
MS/MSD	All results in prep batch
Surrogate	Results for associated analyte in current sample only

Accuracy QC Results

All accuracy QC results were within control limits except as noted below. Sample results associated with QC exceedances have been qualified accordingly.

Accuracy Exceedances for Water Samples

Analyte	Type	Analysis Date	Out	Action
Ortho-phosphate	MS	12/30/2009	Low	Associated results qualified (J).
Ortho-phosphate	MS	12/30/2009	Low	Associated results qualified (J/UJ).
Ortho-phosphate	MS	6/15/2010	Low	Associated results qualified (J/UJ).
Ortho-phosphate	MS	6/15/2010	Low	Associated results qualified (J/UJ).
Ortho-phosphate	MS	6/15/2010	Low	Associated results qualified (J/UJ).
Ortho-phosphate	RM	6/15/2010	Low	Associated results qualified (J/UJ).
Phosphorus, Total	MS	1/14/2010	High	Associated results qualified (J)
Phosphorus, Total	MS	1/14/2010	High	Associated results qualified (J)
Phosphorus, Total	RM	3/18/2010	High	Associated results qualified (J)
Phosphorus, Total	MS	4/14/2010	High	1 of 7 batch MS. All other MS in control - no action taken.
Phosphorus, Total	MS	7/7/2010	Low	1 of 5 batch MS. All other MS in control - No action taken.
Phosphorus, Total	MS	7/7/2010	High	Parent sample is > 4x Spike - No action taken.
Phosphorus, Total	RM	7/7/2010	Low	Lab reanalyzed RM. RM in control. - No action taken.
Zinc, Dissolved	LCS	4/2/2010	High	Associated results qualified (J)
Zinc, Dissolved	LCS	5/28/2010	High	Associated results qualified (J)
Zinc, Dissolved	LCS	5/28/2010	High	Associated results qualified (J)

Surrogate Exceedances for Sediment Samples

Sample Id	Sample Date	Surrogate	%R	LOWLIMIT	UPPLIMIT
CBSF1-SED2	9/28/10 12:25	Bromobenzene	45.8	62	130
CBSF1-SED2	9/28/10 12:25	Trifluorotoluene	52	66	123
CBSF1-SED3	9/28/10 12:40	Bromobenzene	24.8	62	130
CBSF1-SED3	9/28/10 12:40	Trifluorotoluene	31	66	123
CBSF2-SED1	9/28/10 10:40	Bromobenzene	59	62	130
CBSF2-SED1	9/28/10 10:40	Trifluorotoluene	64	66	123
CBSF2-SED2	9/28/10 10:32	Bromobenzene	35.7	62	130

Sample Id	Sample Date	Surrogate	%R	LOWLIMIT	UPPLIMIT
CBSF2-SED2	9/28/10 10:32	Trifluorotoluene	41.1	66	123
CBSF2-SED3	9/28/10 11:35	Bromobenzene	44.8	62	130
CBSF2-SED3	9/28/10 11:35	Trifluorotoluene	48.8	66	123

The results in the table above represent one batch of samples analyzed for gasoline range hydrocarbons that were reported with low surrogate recoveries of bromobenzene and trifluorotoluene. The laboratory reanalyzed the samples, and surrogate recoveries were still below control limits. The laboratory concluded that the low recovery was the result of matrix interference. Results for gasoline range hydrocarbons in samples with low surrogate recovery have been qualified as estimated (J). No further action needed.

Precision

Precision is the degree observed reproducibility of measurement results. Precision was demonstrated by analysis of laboratory sample duplicates (LD), field sample duplicates (FD), laboratory control sample duplicates (LCSD) and matrix spike duplicates (MSD). The following table lists the qualification actions resulting from the precision analysis.

Precision Validation Criteria

<table>
<tr><th rowspan="2">Matrix</th><th colspan="2">Original & Duplicate</th><th rowspan="2">Associated Sample</th><th rowspan="2">Action</th></tr>
<tr><th>Criteria 1</th><th>Criteria 2</th></tr>
<tr><td rowspan="3">AQ</td><td rowspan="6">Both Original and Dup Results < 5x RL</td><td rowspan="2">|original - duplicate| > RL</td><td>Result < RL</td><td>Qualify sample results as estimated non-detect (UJ). Note in report.</td></tr>
<tr><td>Result > RL</td><td>Qualify sample results as estimated (J). Note in report.</td></tr>
<tr><td>|original - duplicate|≤ RL</td><td>All</td><td>No qualification needed. No note needed.</td></tr>
<tr><td rowspan="3">SED</td><td rowspan="2">|original - duplicate| > 2x RL</td><td>Result < RL</td><td>Qualify sample results as estimated non-detect (UJ). Note in report.</td></tr>
<tr><td>Result > RL</td><td>Qualify sample results as estimated non-detect (UJ). Note in report.</td></tr>
<tr><td>|original - duplicate|≤ 2x RL</td><td>All</td><td>No qualification needed. No note needed.</td></tr>
<tr><td rowspan="3">AQ</td><td rowspan="6">Either Original or Dup Results > 5x RL</td><td rowspan="2">RPD† > 20*%</td><td>Result < RL</td><td>Qualify sample results as estimated non-detect (UJ). Note in report.</td></tr>
<tr><td>Result > RL</td><td>Qualify sample results as estimated (J). Note in report.</td></tr>
<tr><td>RPD ≤ 20*%</td><td>All</td><td>No qualification needed. No note needed.</td></tr>
<tr><td rowspan="3">SED</td><td rowspan="2">RPD > 35%</td><td>Result < RL</td><td>Qualify sample results as estimated non-detect (UJ). Note in report.</td></tr>
<tr><td>Result > RL</td><td>Qualify sample results as estimated (J). Note in report.</td></tr>
<tr><td>RPD ≤ 35%</td><td>All</td><td>No qualification needed. No note needed.</td></tr>
</table>

† RPD – Relative Percent Difference between the original and the duplicate, calculated as follows:

* An RPD control limit of 25% was used when assessing field duplicate water samples.

The following table illustrates the application of qualifiers to sample results based on the precision QC sample types.

Association of Precision QC

QC Type	Associated Results
Lab Dup	All results in prep batch
LCSD	All results in prep batch
MSD	All results in prep batch
Field Dup/ Field Split	Parent sample results only

Precision QC Results

All precision QC results were within control parameters except as noted below. Two of twenty-three total phosphorus lab duplicates were analyzed with two exceeding the control limits. This is considered acceptable.

Associated sample results were qualified, and no further action was needed

Precision Exceedances for Water Samples

Analyte	Type	Result	Units	RL	RPD (|Δ|)	Action
Orthophosphate	DUP	1.39	ug/L	1	NA	Batch QC Duplicate - No Parent. Result < RL No action taken.
Phosphorus, Total	DUP	1.11	ug/L	2	NA	Batch QC Duplicate - No Parent. Result < RL. No action taken.
Phosphorus, Total	DUP	349	ug/L	2	26.4	Associated results qualified (J/UJ)
Phosphorus, Total	DUP	21.9	ug/L	2	20.6	Associated results qualified (J/UJ)
Solids, Total Suspended	DUP	1	mg/L	1	NA	Batch QC Duplicate - No Parent. Result < RL. No action taken.

RPD – Relative percent difference

|Δ| - Absolute difference

Laboratory Reporting Observations

Some qualification of data was done based on observations of laboratory reporting.

Particle size distribution

Professional judgment was used to assess the usability of particle size distribution (PSD) data generated by method ASTMD3977C. The majority of precision QC samples (Lab and Field Duplicates) were outside control limits. This combined with an ambiguity regarding method application and instrumentation, and a lack of control data has resulted in reduced confidence in data. Specifically, there is a notable absence of particles reported in the 250 to 125 micron and 125 to 62.5 micron ranges, which are the two ranges below the 250 micron sieve (the smallest of the nest sieves used before measuring the sediment not retained on the sieves by laser diffraction). The laboratory analyst reported that she did not rinse the sieves with reagent-grade water because of concerns with sample dilution. The lack of rinsing likely resulted in smaller particles being retained in the sieves. Due to these reasons, all PSD results have been qualified J/UJ.

Field Sample QA/QC Results

Tubing Blanks

Results of the four tubing blank samples are summarized in the table below. One sample was collected from the sampler tubing at each monitoring station on February 4, 2010 after decontaminating the tubing during setup for a storm event. The tubing blanks samples were analyzed for all of the composite analytes except for particle size distribution, pH and hardness. No analytes were detected with the exception of low levels of total and dissolved zinc, and total phosphorus.

CBSF Sampler Tubing Blank Data

			Tubing_Poly Blank Samples			
Analyte	Report Limit	Units	CBSF1- IN 2/4/2010 1:40:00 PM	CBSF1-OUT 2/4/2010 2:00:00 PM	CBSF2-IN 2/4/2010 10:46:00 AM	CBSF2-OUT 2/4/2010 10:50:00 AM
Copper, Dissolved	1	ug/L	1 U	1 U	1 U	1 U
Copper, Total	1	ug/L	1 U	1 U	1 U	1 U
Zinc, Dissolved	1	ug/L	**1.76**	**2.78**	**2.55**	**3.46**
Zinc, Total	1	ug/L	1 U	1 U	1 U	**1.56**
Ortho-phosphate	1	ug/L	1 U	1 U	1 U	1 U
Phosphorus, Total	2	mg/L	**0.00211**	**0.00231**	**0.00303**	**0.00245**

Notes

U – Analyte was not detected above the reported result.

Total zinc was detected in one of the four blanks from site CBSF2-Out at a concentration of 1.56 ug/L compared to actual stormwater concentrations ranging from 17.5 to 184 ug/L. Since the sample results were all greater than 10 times the blank contamination, no sample result qualification was required.

The dissolved zinc concentrations in the four blanks ranged from 1.76 to 3.46 µg/L compared to dissolved zinc concentrations in the actual WY2010 stormwater samples ranging from 12 to 76.2 ug/L. Twenty out of the 40 sample results were within 10 times the blank concentrations, and were qualified accordingly.

Filter blank samples (made in the laboratory by running blank water through a new 0.45 micron filter) were collected prior to each batch of stormwater samples (one batch per storm event). The ten filter blank samples from WY2010 had dissolved zinc concentrations ranging from 1.07 to 2.91 µg/L. Since there was no detectable *total* zinc in three out of four tubing blank samples and there were *dissolved* zinc detections in all tubing and filter blank samples, the filter itself is considered the source of the dissolved zinc contamination. When using a different lab in WY2009 with a dissolved zinc reporting limit of 4 ug/L, no dissolved zinc was detected in the tubing blank samples. This lack of detectable dissolved zinc is attributed to the higher reporting limit censoring the trace amounts of zinc added by the filtering process. The permit's reporting limits for total and dissolved zinc are 5 and 1 ug/L, respectively. If the reporting limits for dissolved zinc were equivalent to the required total zinc reporting limit, there would be no detectable concentrations of zinc concentrations to report. In addition, the dissolved zinc contamination attributed to the filter is very consistent in all 14 blank samples. Given that trace contributions are evenly added to all dissolved zinc samples through the filtration process, the bias to the samples is equivalent so the influent to effluent comparison in this performance study is not significantly affected by the filter blank contamination. The proposed corrective action is to have all filters (which are purchased pre-cleaned) receive an additional nitric acid rinse prior to use in the laboratory. If this additional rinse proves effective in eliminating the zinc contamination, no further action will be necessary.

Total phosphorus was detected in the four blanks ranging from 0.00211 to 0.00303 mg-P/L with actual sample results ranging from 0.0159 to 0.268 mg-P/L. Two sample results were within 10 times the blank contamination levels, and were qualified accordingly. No further action was required.

Water Quality Split Samples

Five stormwater composite split samples were collected throughout WY2010. Analytical precision, demonstrated by relative percent differences (RPD) or absolute difference, were within control limits for all analytes except total suspended solids, total and orthophosphate, and particle size distribution.

Two of the five composite split samples exceeded the control limit for TSS. As a comparison, five TSS lab duplicates were analyzed with none exceeding control limits. Thus, a total of 10 TSS duplicate/split samples were analyzed during WY2010 with only two sample pairs outside control limits, which is considered acceptable. Associated results were qualified accordingly, and no further action was required.

It is very difficult for TSS RPDs to remain below the 25 percent control limit due to settling that occurs while processing and analyzing stormwater solids. Even when using churn splitter equipment, as was used during this project, further settling can occur when the laboratory analyst subsamples from sample containers while performing the TSS analysis. Due to these reasons, there is general agreement in the stormwater monitoring industry that Suspended Solids Concentration (SSC) is a more representative test when evaluating stormwater because the entire sample is utilized without sub sampling. Since the permit requires the TSS method be used to measure suspended solids, TSS was the method used in this study. Associated sample results were qualified. No further action was needed.

Two out of five orthophosphate composite splits exceeded the control limits. As a comparison, 10 orthophosphate lab duplicates were analyzed with none exceeding control limits. Thus, a total of 15 orthophosphate duplicate/split samples were analyzed during WY2010 with only two sample pairs outside control limits, which is considered acceptable. Associated sample results have been qualified accordingly. No further action was necessary.

One of five total phosphate composite splits exceeded the control limits. As a comparison, 23 total phosphate lab duplicates were analyzed with two exceeding control limits. Thus, a total of 28 orthophosphate duplicate/split samples were analyzed during WY2010 with only three sample pairs outside control limits, which is considered acceptable. Associated sample results were qualified, and no further action was needed.

Multiple samples for multiple particle size fractions were outside control limits for particle size distribution. As is discussed above in the analytical QA/QC section, there is lower confidence in the quality of the particle size distribution data especially in the 250-125 and 125-62.5 micron size ranges due to the lack of rinsing of the sieves. Due to these reasons, all particle size distribution data are considered estimates.

Split sample results are summarized in the table below. The table lists the original lab qualifier adjacent to the corresponding sample result. The sample results qualifier, which is based on qualification rules, is listed after the RPD or absolute difference.

CBSF Composite Water Sample Split Data

			CBSF1-IN				CBSF1-OUT				CBSF1-OUT				CBSF1-OUT				CBSF1-OUT			
			3/26/2010	3/26/2010	RPD		4/2/2010	4/2/2010	RPD		5/20/2010	5/20/2010	RPD		6/2/2010	6/2/2010	RPD		6/9/2010	6/9/2010	RPD	
Analyte	Reporting Limit	Units	Parent	Split	or (|Δ|)	Qual.	Parent	Split	or (|Δ|)	Qual.	Parent	Split	or (|Δ|)	Qual.	Parent	Split	or (|Δ|)	Qual.	Parent	Split	or (|Δ|)	Qual.
Sediment Conc. < 1 um	0.01	mg/L	4.85	3.96	20.2		5.1	3.73	**31**	**J/UJ**	0.86	0.82	4.76		0.54	0.1	**138**	**J/UJ**	1.01	0.79	24.4	
Sediment Conc. > 500 um	0.01	mg/L	91.85	148.9	**47.4**	**J/UJ**	0.11	0.79	**151**	**J/UJ**	0.85	0.01 U	**(0.85)**	**J/UJ**	0.21	0.33	**44.4**	**J/UJ**	0.34	0.01 U	**(0.34)**	**J/UJ**
Sediment Conc. 125 to 62.5 um	0.01	mg/L	14.38	14	2.68		0.01 U	0.01 U	0		6.5	6.16	5.37		4.07	0.83	**132**	**J/UJ**	6.72	5.65	17.8	
Sediment Conc. 250 to 125 um	0.01	mg/L	0.09	0.06	**40**	**J/UJ**	0.01 U	0.01 U	0		1.76	2.1	19.3		1.28	0.27	**130**	**J/UJ**	0.15	1.07	**151**	**J/UJ**
Sediment Conc. 3.9 to 1 um	0.01	mg/L	7.64	6.99	8.88		2.97	2.24	**28**	**J/UJ**	2.09	2.08	0.48		1.77	0.33	**137**	**J/UJ**	4.52	3.39	**28.6**	**J/UJ**
Sediment Conc. 500 to 250 um	0.01	mg/L	13.41	10.87	20.9		0.01 U	0.01 U	0		0.73	0.01 U	**(0.73)**	**J/UJ**	0.11	0.44	**120**	**J/UJ**	0.34	0.33	2.98	
Sediment Conc. 62.5 to 3.9 um	0.01	mg/L	52.05	49.04	5.96		0.01 U	0.01 U	0		16.78	15.4	8.51		8.75	1.63	**137**	**J/UJ**	23.14	18.08	24.6	
pH	1	PH	7.03	7.03	0		6.71	6.71	0		6.44				6.86	6.82	(0.04)		6.54	6.54	0	
Dissolved Copper	1	ug/L	8.75	8.78	0.34		5.79	5.73	1.04		11.8	12.2	3.33		5.48	5.89	7.21		7.79	7.93	1.78	
Total Copper	1	ug/L	32.5	30.3	7.01		8.53	8.54	0.117		19.4	19.5	0.514		8.41	9.77	15		11.3	11	2.69	
Dissolved Zinc	1	ug/L	29.8	29.6	0.67		28.8	28.5	1.05		76.2	82	7.33		35.2	37.9	7.39		54.7	56.1	2.53	
Total Zinc	1	ug/L	146	136	7.09		37.8	36.5	3.45		96.2	98.1	1.96		42.6	43.1	1.17		62.1	64.1	3.17	
Hardness	2	mg/L CaCO3	16.9	17.9	5.75		15	14.7	2.02		40.9	36.3	11.9		20.9	20.6	1.44		23.9	25.9	8.03	
Solids, Total Suspended	0.5	mg/L	106	154	**36.9**	**J/UJ**	7.22	6	18.4		19.1	15.9	18.3		15.7	15.3	2.58		11	5.85	**60.1**	**J/UJ**
Ortho-phosphate	1	ug/L	29.1	25.9	11.6		18.5	18.7	1.08		28.6	38.3	**29**	**J/UJ**	16.1	9.9	**47.7**	**J/UJ**	26.9	26.9	0	
Phosphorus, Total	2	ug/L	182	170	6.82		65.6	61.8	5.96		134	95.4	**33.6**	**J/UJ**	41.5	40.4	2.69		57.7	59.1	2.4	

Notes:

Qual. - qualifier

U - Analyte was not detected above the reported result.

J- Analyte was positively identified. The reported result is an estimate.

UJ- Analyte was not detected above the reported estimate.

RPD – Relative percent difference

|Δ| - Absolute difference

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Sediment Duplicate Samples

The following table presents a comparison of the sediment sample collected at CBSF2-Sed1 with the corresponding duplicate sample results and the RPDs. All data are within control limits for the sediment duplicate sample except for gasoline range hydrocarbons. Associated gasoline range hydrocarbon results have been qualified accordingly and no further action was needed.

CBSF Sediment Duplicate Sample Data

Analyte	Reporting Limit	Units	CBSF2-Sed1 Parent Sample 9/28/2010	CBSF2-Sed1 Duplicate Sample 9/28/2010	Relative Percent Difference (or Absolute Difference)	Qualifier
Dry Density	0.1	LB/CUFT	22.6	23.7	4.75	
Wet Density	0.1	LB/CUFT	73.5	76.1	3.48	
Solids, Total	0.01	%	45.3	52.1	14	
Solids, Total Volatile	0.01	%	19.82	15.43	24.9	
Cadmium	0.2	mg/kg	0.7	0.8	(0.1)	
Copper	0.5	mg/kg	51	54	5.71	
Lead	1	mg/kg	58	71	20.2	
Zinc	4	mg/kg	230	240	4.26	
Phosphorus, Total	0.4	mg/kg	249	180	32.2	
Diesel Range Hydrocarbons	5	mg/kg	360	480	28.6	
Motor Oil	10	mg/kg	2100	2700	25	
Gasoline Range Hydrocarbons	5	mg/L	**54**	**85**	**(31)**	**J/JU**
Gravel	0.1	%	25.9	23.3	10.6	
Very Coarse Sand	0.1	%	14.2	14.5	2.09	
Coarse Sand	0.1	%	17.9	18.3	2.21	
Medium Sand	0.1	%	20.3	20.5	0.98	
Fine Sand	0.1	%	11.6	11.6	0	
Very Fine Sand	0.1	%	3.8	3.9	2.6	
Coarse Silt	0.1	%	NM	0.6	NA	
Medium Silt	0.1	%	NM	2.4	NA	
Fine Silt	0.1	%	NM	1.7	NA	
Very Fine Silt	0.1	%	NM	1.4	NA	
8-9 Phi Clay	0.1	%	NM	0.7	NA	
9-10 Phi Clay	0.1	%	NM	0.6	NA	

Analyte	Reporting Limit	Units	CBSF2-Sed1 Parent Sample 9/28/2010		CBSF2-Sed1 Duplicate Sample 9/28/2010		Relative Percent Difference (or Absolute Difference)	Qualifier
>10 Phi Clay	0.1	%	NM		0.5		NA	
Total Fines	0.1	%	6.3		7.8		21.3	

Notes:
NM - Not measured. Insufficient fines to perform analysis.

All Qualified Results by Analyte

The following tables list by analyte all results qualified in the validation process.

All Qualified Results for CBSF Water Samples

Analyte	Sample ID	Sample Date	Result	Units	Qualifier	Reason
Ortho-phosphate	CBSF1-IN	10/21/09 11:50	96.8	ug/L	J	Matrix Spike Recovery < Lower Limit
Ortho-phosphate	CBSF1-OUT	10/21/09 11:50	53.5	ug/L	J	Matrix Spike Recovery < Lower Limit
Ortho-phosphate	CBSF1-IN	10/26/09 11:10	39.6	ug/L	J	Matrix Spike Recovery < Lower Limit
Ortho-phosphate	CBSF1-OUT	10/26/09 11:10	32.7	ug/L	J	Matrix Spike Recovery < Lower Limit
Ortho-phosphate	CBSF2-IN	10/26/09 11:50	38	ug/L	J	Matrix Spike Recovery < Lower Limit
Ortho-phosphate	CBSF2-OUT	10/26/09 11:50	23.8	ug/L	J	Matrix Spike Recovery < Lower Limit
Ortho-phosphate	CBSF2-IN	11/6/09 7:19	32.2	ug/L	J	Matrix Spike Recovery < Lower Limit
Ortho-phosphate	CBSF2-OUT	11/6/09 7:19	38.8	ug/L	J	Matrix Spike Recovery < Lower Limit
Ortho-phosphate	CBSF1-IN	11/6/09 9:35	76.5	ug/L	J	Matrix Spike Recovery < Lower Limit
Ortho-phosphate	CBSF1-OUT	11/6/09 9:35	85.4	ug/L	J	Matrix Spike Recovery < Lower Limit
Ortho-phosphate	CBSF1-IN	12/14/09 23:00	33.4	ug/L	J	Matrix Spike Recovery < Lower Limit
Ortho-phosphate	CBSF1-OUT	12/14/09 23:00	31.7	ug/L	J	Matrix Spike Recovery < Lower Limit
Ortho-phosphate	CBSF2-IN	12/14/09 23:45	43	ug/L	J	Matrix Spike Recovery < Lower Limit
Ortho-phosphate	CBSF2-OUT	12/14/09 23:45	22.3	ug/L	J	Matrix Spike Recovery < Lower Limit
Ortho-phosphate	CBSF2-IN	12/17/09 1:37	12.3	ug/L	J	Matrix Spike Recovery < Lower Limit
Ortho-phosphate	CBSF2-OUT	12/17/09 1:37	10.6	ug/L	J	Matrix Spike Recovery < Lower Limit
Ortho-phosphate	CBSF1-IN	5/20/10 2:41	99.7	ug/L	J	Matrix Spike < Lower Limit, Reference Material < Lower Limit

Analyte	Sample ID	Sample Date	Result	Units	Qualifier	Reason
Ortho-phosphate	CBSF1-OUT	5/20/10 2:45	28.6	ug/L	J	Field Dup Precision Exceedance, Matrix Spike < Lower Limit, Reference Material < Lower Limit
Ortho-phosphate	CBSF2-IN	5/20/10 3:28	37.2	ug/L	J	Matrix Spike < Lower Limit, Reference Material < Lower Limit
Ortho-phosphate	CBSF2-OUT	5/20/10 3:28	20.7	ug/L	J	Matrix Spike < Lower Limit, Reference Material < Lower Limit
Ortho-phosphate	CBSF2-IN	6/2/10 9:44	6.01	ug/L	J	Matrix Spike < Lower Limit, Reference Material < Lower Limit
Ortho-phosphate	CBSF2-OUT	6/2/10 9:44	2.29	ug/L	J	Matrix Spike < Lower Limit, Reference Material < Lower Limit
Ortho-phosphate	CBSF1-IN	6/2/10 11:21	5.76	ug/L	J	Matrix Spike < Lower Limit, Reference Material < Lower Limit
Ortho-phosphate	CBSF1-OUT	6/2/10 11:25	16.1	ug/L	J	Field Dup Precision Exceedance, Matrix Spike < Lower Limit, Reference Material < Lower Limit
Ortho-phosphate	CBSF1-IN	6/9/10 11:39	7.2	ug/L	J	Matrix Spike < Lower Limit, Reference Material < Lower Limit
Ortho-phosphate	CBSF1-OUT	6/9/10 11:43	26.9	ug/L	J	Matrix Spike < Lower Limit, Reference Material < Lower Limit
pH	CBSF1-IN	12/14/09 23:00	6.75	pH	J	Holding Time Exceeded
pH	CBSF1-OUT	12/14/09 23:00	7.07	pH	J	Holding Time Exceeded
pH	CBSF2-IN	12/14/09 23:45	7	pH	J	Holding Time Exceeded
pH	CBSF2-OUT	12/14/09 23:45	6.85	pH	J	Holding Time Exceeded
pH	CBSF2-IN	6/2/10 9:44	7.16	pH	J	Holding Time Exceeded
pH	CBSF2-OUT	6/2/10 9:44	7.2	pH	J	Holding Time Exceeded
pH	CBSF1-IN	6/2/10 11:21	7.32	pH	J	Holding Time Exceeded
pH	CBSF1-OUT	6/2/10 11:25	6.86	pH	J	Holding Time Exceeded
Phosphorus, Total	CBSF2-IN	10/26/09 11:50	103	ug/L	J	Matrix Spike Recovery > Upper Limit
Phosphorus, Total	CBSF2-OUT	10/26/09 11:50	44.7	ug/L	J	Matrix Spike Recovery > Upper Limit
Phosphorus, Total	CBSF2-IN	12/14/09 23:45	117	ug/L	J	Matrix Spike Recovery > Upper Limit
Phosphorus, Total	CBSF2-OUT	12/14/09 23:45	112	ug/L	J	Matrix Spike Recovery > Upper Limit
Phosphorus, Total	CBSF2-IN	12/17/09 1:37	73.1	ug/L	J	Matrix Spike Recovery > Upper Limit
Phosphorus, Total	CBSF2-OUT	12/17/09 1:37	68.5	ug/L	J	Matrix Spike Recovery > Upper Limit
Phosphorus, Total	CBSF2-IN	2/5/10 6:40	15.9	ug/L	J	Lab Dup Precision Exceedance, Equipment Blank > RL
Phosphorus, Total	CBSF2-OUT	2/5/10 6:40	17.8	ug/L	J	Lab Dup Precision Exceedance, Equipment Blank > RL

Analyte	Sample ID	Sample Date	Result	Units	Qualifier	Reason
Phosphorus, Total	CBSF2-OUT	2/11/10 10:26	64.2	ug/L	J	Lab Dup Precision Exceedance
Phosphorus, Total	CBSF2-IN	2/11/10 10:27	86.6	ug/L	J	Lab Dup Precision Exceedance
Phosphorus, Total	CBSF2-IN	3/11/10 11:58	78.9	ug/L	J	Reference Material Recovery > Upper Limit
Phosphorus, Total	CBSF2-OUT	3/11/10 11:58	49.3	ug/L	J	Reference Material Recovery > Upper Limit
Phosphorus, Total	CBSF1-IN	3/11/10 12:44	129	ug/L	J	Reference Material Recovery > Upper Limit
Phosphorus, Total	CBSF1-OUT	3/11/10 12:44	86.6	ug/L	J	Reference Material Recovery > Upper Limit
Phosphorus, Total	CBSF1-IN	5/20/10 2:41	268	ug/L	J	Lab Dup Precision Exceedance
Phosphorus, Total	CBSF1-OUT	5/20/10 2:45	134	ug/L	J	Lab Dup Precision Exceedance, Field Dup Precision Exceedance
Phosphorus, Total	CBSF2-IN	5/20/10 3:28	111	ug/L	J	Lab Dup Precision Exceedance
Phosphorus, Total	CBSF2-OUT	5/20/10 3:28	77	ug/L	J	Lab Dup Precision Exceedance
Phosphorus, Total	CBSF2-IN	6/2/10 9:44	44.2	ug/L	J	Lab Dup Precision Exceedance
Phosphorus, Total	CBSF2-OUT	6/2/10 9:44	39.8	ug/L	J	Method Blank > RL, Lab Dup Precision Exceedance
Phosphorus, Total	CBSF1-IN	6/2/10 11:21	79.5	ug/L	J	Lab Dup Precision Exceedance
Phosphorus, Total	CBSF1-OUT	6/2/10 11:25	41.5	ug/L	J	Method Blank > RL, Lab Dup Precision Exceedance
Phosphorus, Total	CBSF1-IN	6/9/10 11:39	26.5	ug/L	J	Method Blank > RL, Equipment Blank > RL
Sediment Conc. < 1 um	CBSF1-IN	10/21/09 11:50	10.2	mg/L	J	Imprecision in Laboratory Process
Sediment Conc. < 1 um	CBSF1-OUT	10/21/09 11:50	15.04	mg/L	J	Imprecision in Laboratory Process
Sediment Conc. < 1 um	CBSF1-IN	10/26/09 11:10	1.61	mg/L	J	Imprecision in Laboratory Process
Sediment Conc. < 1 um	CBSF1-OUT	10/26/09 11:10	1.3	mg/L	J	Imprecision in Laboratory Process
Sediment Conc. < 1 um	CBSF2-IN	10/26/09 11:50	1.58	mg/L	J	Imprecision in Laboratory Process
Sediment Conc. < 1 um	CBSF2-OUT	10/26/09 11:50	1.07	mg/L	J	Imprecision in Laboratory Process
Sediment	CBSF2-IN	11/6/09 7:19	1.95	mg/L	J	Imprecision in Laboratory Process

Analyte	Sample ID	Sample Date	Result	Units	Qualifier	Reason
Conc. < 1 um						
Sediment Conc. < 1 um	CBSF2-OUT	11/6/09 7:19	1.95	mg/L	J	Imprecision in Laboratory Process
Sediment Conc. < 1 um	CBSF1-IN	11/6/09 9:35	1.22	mg/L	J	Imprecision in Laboratory Process
Sediment Conc. < 1 um	CBSF1-OUT	11/6/09 9:35	3.07	mg/L	J	Imprecision in Laboratory Process
Sediment Conc. < 1 um	CBSF1-IN	12/14/09 23:00	2.29	mg/L	J	Imprecision in Laboratory Process
Sediment Conc. < 1 um	CBSF1-OUT	12/14/09 23:00	0.7	mg/L	J	Imprecision in Laboratory Process
Sediment Conc. < 1 um	CBSF2-IN	12/14/09 23:45	16.19	mg/L	J	Imprecision in Laboratory Process
Sediment Conc. < 1 um	CBSF2-OUT	12/14/09 23:45	2.25	mg/L	J	Imprecision in Laboratory Process
Sediment Conc. < 1 um	CBSF2-IN	12/17/09 1:37	55.9	mg/L	J	Imprecision in Laboratory Process
Sediment Conc. < 1 um	CBSF2-OUT	12/17/09 1:37	6.82	mg/L	J	Imprecision in Laboratory Process
Sediment Conc. < 1 um	CBSF2-IN	2/5/10 6:40	9.51	mg/L	J	Imprecision in Laboratory Process
Sediment Conc. < 1 um	CBSF2-OUT	2/5/10 6:40	7.37	mg/L	J	Imprecision in Laboratory Process
Sediment Conc. < 1 um	CBSF2-OUT	2/11/10 10:26	2.78	mg/L	J	Imprecision in Laboratory Process
Sediment Conc. < 1 um	CBSF2-IN	2/11/10 10:27	3.89	mg/L	J	Imprecision in Laboratory Process
Sediment Conc. < 1 um	CBSF2-IN	3/11/10 11:58	12.53	mg/L	J	Imprecision in Laboratory Process
Sediment Conc. < 1 um	CBSF2-OUT	3/11/10 11:58	1.65	mg/L	J	Imprecision in Laboratory Process
Sediment Conc. < 1	CBSF1-IN	3/11/10 12:44	5.37	mg/L	J	Imprecision in Laboratory Process

Analyte	Sample ID	Sample Date	Result	Units	Qualifier	Reason
um						
Sediment Conc. < 1 um	CBSF1-OUT	3/11/10 12:44	6.63	mg/L	J	Imprecision in Laboratory Process
Sediment Conc. < 1 um	CBSF2-IN	3/26/10 2:16	14.71	mg/L	J	Imprecision in Laboratory Process
Sediment Conc. < 1 um	CBSF2-OUT	3/26/10 2:16	10.58	mg/L	J	Imprecision in Laboratory Process
Sediment Conc. < 1 um	CBSF1-IN	3/26/10 6:50	4.85	mg/L	J	Imprecision in Laboratory Process
Sediment Conc. < 1 um	CBSF1-OUT	3/26/10 6:51	8.19	mg/L	J	Imprecision in Laboratory Process
Sediment Conc. < 1 um	CBSF1-IN	4/2/10 12:31	15.14	mg/L	J	Imprecision in Laboratory Process
Sediment Conc. < 1 um	CBSF1-OUT	4/2/10 12:31	5.1	mg/L	J	Imprecision in Laboratory Process
Sediment Conc. < 1 um	CBSF1-IN	5/20/10 2:41	2.66	mg/L	J	Imprecision in Laboratory Process
Sediment Conc. < 1 um	CBSF1-OUT	5/20/10 2:45	0.86	mg/L	J	Imprecision in Laboratory Process
Sediment Conc. < 1 um	CBSF2-IN	5/20/10 3:28	2.54	mg/L	J	Imprecision in Laboratory Process
Sediment Conc. < 1 um	CBSF2-OUT	5/20/10 3:28	0.95	mg/L	J	Imprecision in Laboratory Process
Sediment Conc. < 1 um	CBSF2-IN	6/2/10 9:44	0.46	mg/L	J	Field Dup Precision Exceedance, Imprecision in Laboratory Process
Sediment Conc. < 1 um	CBSF2-OUT	6/2/10 9:44	0.18	mg/L	J	Field Dup Precision Exceedance, Imprecision in Laboratory Process
Sediment Conc. < 1 um	CBSF1-IN	6/2/10 11:21	0.79	mg/L	J	Field Dup Precision Exceedance, Imprecision in Laboratory Process
Sediment Conc. < 1 um	CBSF1-OUT	6/2/10 11:25	0.54	mg/L	J	Field Dup Precision Exceedance, Imprecision in Laboratory Process
Sediment Conc. < 1 um	CBSF1-IN	6/9/10 11:39	0.01	mg/L	UJ	Imprecision in Laboratory Process

Analyte	Sample ID	Sample Date	Result	Units	Qualifier	Reason
Sediment Conc. < 1 um	CBSF1-OUT	6/9/10 11:43	1.01	mg/L	J	Imprecision in Laboratory Process
Sediment Conc. > 500 um	CBSF1-IN	10/21/09 11:50	69.61	mg/L	J	Imprecision in Laboratory Process
Sediment Conc. > 500 um	CBSF1-OUT	10/21/09 11:50	0.01	mg/L	UJ	Imprecision in Laboratory Process
Sediment Conc. > 500 um	CBSF1-IN	10/26/09 11:10	43.27	mg/L	J	Imprecision in Laboratory Process
Sediment Conc. > 500 um	CBSF1-OUT	10/26/09 11:10	0.11	mg/L	J	Imprecision in Laboratory Process
Sediment Conc. > 500 um	CBSF2-IN	10/26/09 11:50	13.99	mg/L	J	Imprecision in Laboratory Process
Sediment Conc. > 500 um	CBSF2-OUT	10/26/09 11:50	0.01	mg/L	UJ	Imprecision in Laboratory Process
Sediment Conc. > 500 um	CBSF2-IN	11/6/09 7:19	0.34	mg/L	J	Imprecision in Laboratory Process
Sediment Conc. > 500 um	CBSF2-OUT	11/6/09 7:19	0.34	mg/L	J	Imprecision in Laboratory Process
Sediment Conc. > 500 um	CBSF1-IN	11/6/09 9:35	7.92	mg/L	J	Imprecision in Laboratory Process
Sediment Conc. > 500 um	CBSF1-OUT	11/6/09 9:35	0.34	mg/L	J	Imprecision in Laboratory Process
Sediment Conc. > 500 um	CBSF1-IN	12/14/09 23:00	105	mg/L	J	Imprecision in Laboratory Process
Sediment Conc. > 500 um	CBSF1-OUT	12/14/09 23:00	0.01	mg/L	UJ	Imprecision in Laboratory Process
Sediment Conc. > 500 um	CBSF2-IN	12/14/09 23:45	20.45	mg/L	J	Imprecision in Laboratory Process
Sediment Conc. > 500 um	CBSF2-OUT	12/14/09 23:45	0.11	mg/L	J	Imprecision in Laboratory Process
Sediment Conc. > 500 um	CBSF2-IN	12/17/09 1:37	9.19	mg/L	J	Imprecision in Laboratory Process
Sediment	CBSF2-OUT	12/17/09	0.01	mg/L	UJ	Imprecision in Laboratory Process

Analyte	Sample ID	Sample Date	Result	Units	Qualifier	Reason
Conc. > 500 um		1:37				
Sediment Conc. > 500 um	CBSF2-IN	2/5/10 6:40	6.73	mg/L	J	Imprecision in Laboratory Process
Sediment Conc. > 500 um	CBSF2-OUT	2/5/10 6:40	0.12	mg/L	J	Imprecision in Laboratory Process
Sediment Conc. > 500 um	CBSF2-OUT	2/11/10 10:26	0.01	mg/L	UJ	Imprecision in Laboratory Process
Sediment Conc. > 500 um	CBSF2-IN	2/11/10 10:27	23.19	mg/L	J	Imprecision in Laboratory Process
Sediment Conc. > 500 um	CBSF2-IN	3/11/10 11:58	25.89	mg/L	J	Imprecision in Laboratory Process
Sediment Conc. > 500 um	CBSF2-OUT	3/11/10 11:58	0.01	mg/L	UJ	Imprecision in Laboratory Process
Sediment Conc. > 500 um	CBSF1-IN	3/11/10 12:44	3.51	mg/L	J	Imprecision in Laboratory Process
Sediment Conc. > 500 um	CBSF1-OUT	3/11/10 12:44	0.01	mg/L	UJ	Imprecision in Laboratory Process
Sediment Conc. > 500 um	CBSF2-IN	3/26/10 2:16	123.3	mg/L	J	Field Dup Precision Exceedance, Imprecision in Laboratory Process
Sediment Conc. > 500 um	CBSF2-OUT	3/26/10 2:16	2.33	mg/L	J	Field Dup Precision Exceedance, Imprecision in Laboratory Process
Sediment Conc. > 500 um	CBSF1-IN	3/26/10 6:50	91.85	mg/L	J	Field Dup Precision Exceedance, Imprecision in Laboratory Process
Sediment Conc. > 500 um	CBSF1-OUT	3/26/10 6:51	0.01	mg/L	UJ	Field Dup Precision Exceedance, Imprecision in Laboratory Process
Sediment Conc. > 500 um	CBSF1-IN	4/2/10 12:31	3.29	mg/L	J	Imprecision in Laboratory Process
Sediment Conc. > 500 um	CBSF1-OUT	4/2/10 12:31	0.11	mg/L	J	Imprecision in Laboratory Process
Sediment Conc. > 500 um	CBSF1-IN	5/20/10 2:41	186.5	mg/L	J	Field Dup Precision Exceedance, Imprecision in Laboratory Process
Sediment Conc. > 500	CBSF1-OUT	5/20/10 2:45	0.85	mg/L	J	Field Dup Precision Exceedance, Imprecision in Laboratory Process

Analyte	Sample ID	Sample Date	Result	Units	Qualifier	Reason
um						
Sediment Conc. > 500 um	CBSF2-IN	5/20/10 3:28	107.4	mg/L	J	Field Dup Precision Exceedance, Imprecision in Laboratory Process
Sediment Conc. > 500 um	CBSF2-OUT	5/20/10 3:28	2.6	mg/L	J	Field Dup Precision Exceedance, Imprecision in Laboratory Process
Sediment Conc. > 500 um	CBSF2-IN	6/2/10 9:44	53.64	mg/L	J	Field Dup Precision Exceedance, Imprecision in Laboratory Process
Sediment Conc. > 500 um	CBSF2-OUT	6/2/10 9:44	0.34	mg/L	J	Field Dup Precision Exceedance, Imprecision in Laboratory Process
Sediment Conc. > 500 um	CBSF1-IN	6/2/10 11:21	6.95	mg/L	J	Field Dup Precision Exceedance, Imprecision in Laboratory Process
Sediment Conc. > 500 um	CBSF1-OUT	6/2/10 11:25	0.21	mg/L	J	Field Dup Precision Exceedance, Imprecision in Laboratory Process
Sediment Conc. > 500 um	CBSF1-IN	6/9/10 11:39	46.18	mg/L	J	Field Dup Precision Exceedance, Imprecision in Laboratory Process
Sediment Conc. > 500 um	CBSF1-OUT	6/9/10 11:43	0.34	mg/L	J	Field Dup Precision Exceedance, Imprecision in Laboratory Process
Sediment Conc. 125 to 62.5 um	CBSF1-IN	10/21/09 11:50	0.01	mg/L	UJ	Imprecision in Laboratory Process
Sediment Conc. 125 to 62.5 um	CBSF1-OUT	10/21/09 11:50	0.01	mg/L	UJ	Imprecision in Laboratory Process
Sediment Conc. 125 to 62.5 um	CBSF1-IN	10/26/09 11:10	0.01	mg/L	UJ	Imprecision in Laboratory Process
Sediment Conc. 125 to 62.5 um	CBSF1-OUT	10/26/09 11:10	0.01	mg/L	UJ	Imprecision in Laboratory Process
Sediment Conc. 125 to 62.5 um	CBSF2-IN	10/26/09 11:50	0.01	mg/L	UJ	Imprecision in Laboratory Process
Sediment Conc. 125 to 62.5 um	CBSF2-OUT	10/26/09 11:50	0.01	mg/L	UJ	Imprecision in Laboratory Process
Sediment Conc. 125 to 62.5 um	CBSF2-IN	11/6/09 7:19	0.01	mg/L	UJ	Imprecision in Laboratory Process
Sediment Conc. 125 to 62.5 um	CBSF2-OUT	11/6/09 7:19	0.01	mg/L	UJ	Imprecision in Laboratory Process

Analyte	Sample ID	Sample Date	Result	Units	Qualifier	Reason
Sediment Conc. 125 to 62.5 um	CBSF1-IN	11/6/09 9:35	0.01	mg/L	UJ	Imprecision in Laboratory Process
Sediment Conc. 125 to 62.5 um	CBSF1-OUT	11/6/09 9:35	0.01	mg/L	UJ	Imprecision in Laboratory Process
Sediment Conc. 125 to 62.5 um	CBSF1-IN	12/14/09 23:00	0.01	mg/L	UJ	Imprecision in Laboratory Process
Sediment Conc. 125 to 62.5 um	CBSF1-OUT	12/14/09 23:00	0.01	mg/L	UJ	Imprecision in Laboratory Process
Sediment Conc. 125 to 62.5 um	CBSF2-IN	12/14/09 23:45	0.01	mg/L	UJ	Imprecision in Laboratory Process
Sediment Conc. 125 to 62.5 um	CBSF2-OUT	12/14/09 23:45	0.01	mg/L	UJ	Imprecision in Laboratory Process
Sediment Conc. 125 to 62.5 um	CBSF2-IN	12/17/09 1:37	0.01	mg/L	UJ	Imprecision in Laboratory Process
Sediment Conc. 125 to 62.5 um	CBSF2-OUT	12/17/09 1:37	0.01	mg/L	UJ	Imprecision in Laboratory Process
Sediment Conc. 125 to 62.5 um	CBSF2-IN	2/5/10 6:40	0.01	mg/L	UJ	Imprecision in Laboratory Process
Sediment Conc. 125 to 62.5 um	CBSF2-OUT	2/5/10 6:40	0.01	mg/L	UJ	Imprecision in Laboratory Process
Sediment Conc. 125 to 62.5 um	CBSF2-OUT	2/11/10 10:26	0.01	mg/L	UJ	Imprecision in Laboratory Process
Sediment Conc. 125 to 62.5 um	CBSF2-IN	2/11/10 10:27	0.01	mg/L	UJ	Imprecision in Laboratory Process
Sediment Conc. 125 to 62.5 um	CBSF2-IN	3/11/10 11:58	0.01	mg/L	UJ	Imprecision in Laboratory Process
Sediment Conc. 125 to 62.5 um	CBSF2-OUT	3/11/10 11:58	0.01	mg/L	UJ	Imprecision in Laboratory Process
Sediment Conc. 125 to 62.5 um	CBSF1-IN	3/11/10 12:44	0.01	mg/L	UJ	Imprecision in Laboratory Process
Sediment Conc. 125 to 62.5 um	CBSF1-OUT	3/11/10 12:44	0.01	mg/L	UJ	Imprecision in Laboratory Process
Sediment	CBSF2-IN	3/26/10 2:16	0.01	mg/L	UJ	Imprecision in Laboratory Process

Analyte	Sample ID	Sample Date	Result	Units	Qualifier	Reason
Conc. 125 to 62.5 um						
Sediment Conc. 125 to 62.5 um	CBSF2-OUT	3/26/10 2:16	0.01	mg/L	UJ	Imprecision in Laboratory Process
Sediment Conc. 125 to 62.5 um	CBSF1-IN	3/26/10 6:50	14.38	mg/L	J	Imprecision in Laboratory Process
Sediment Conc. 125 to 62.5 um	CBSF1-OUT	3/26/10 6:51	0.01	mg/L	UJ	Imprecision in Laboratory Process
Sediment Conc. 125 to 62.5 um	CBSF1-IN	4/2/10 12:31	0.01	mg/L	UJ	Imprecision in Laboratory Process
Sediment Conc. 125 to 62.5 um	CBSF1-OUT	4/2/10 12:31	0.01	mg/L	UJ	Imprecision in Laboratory Process
Sediment Conc. 125 to 62.5 um	CBSF1-IN	5/20/10 2:41	15.01	mg/L	J	Imprecision in Laboratory Process
Sediment Conc. 125 to 62.5 um	CBSF1-OUT	5/20/10 2:45	6.5	mg/L	J	Imprecision in Laboratory Process
Sediment Conc. 125 to 62.5 um	CBSF2-IN	5/20/10 3:28	25.9	mg/L	J	Imprecision in Laboratory Process
Sediment Conc. 125 to 62.5 um	CBSF2-OUT	5/20/10 3:28	7.01	mg/L	J	Imprecision in Laboratory Process
Sediment Conc. 125 to 62.5 um	CBSF2-IN	6/2/10 9:44	3.53	mg/L	J	Field Dup Precision Exceedance, Imprecision in Laboratory Process
Sediment Conc. 125 to 62.5 um	CBSF2-OUT	6/2/10 9:44	1.34	mg/L	J	Field Dup Precision Exceedance, Imprecision in Laboratory Process
Sediment Conc. 125 to 62.5 um	CBSF1-IN	6/2/10 11:21	8.05	mg/L	J	Field Dup Precision Exceedance, Imprecision in Laboratory Process
Sediment Conc. 125 to 62.5 um	CBSF1-OUT	6/2/10 11:25	4.07	mg/L	J	Field Dup Precision Exceedance, Imprecision in Laboratory Process
Sediment Conc. 125 to 62.5 um	CBSF1-IN	6/9/10 11:39	3.35	mg/L	J	Imprecision in Laboratory Process
Sediment Conc. 125 to 62.5 um	CBSF1-OUT	6/9/10 11:43	6.72	mg/L	J	Imprecision in Laboratory Process
Sediment Conc. 250	CBSF1-IN	10/21/09 11:50	0.01	mg/L	UJ	Imprecision in Laboratory Process

Analyte	Sample ID	Sample Date	Result	Units	Qualifier	Reason
to 125 um						
Sediment Conc. 250 to 125 um	CBSF1-OUT	10/21/09 11:50	0.01	mg/L	UJ	Imprecision in Laboratory Process
Sediment Conc. 250 to 125 um	CBSF1-IN	10/26/09 11:10	0.01	mg/L	UJ	Imprecision in Laboratory Process
Sediment Conc. 250 to 125 um	CBSF1-OUT	10/26/09 11:10	0.01	mg/L	UJ	Imprecision in Laboratory Process
Sediment Conc. 250 to 125 um	CBSF2-IN	10/26/09 11:50	0.01	mg/L	UJ	Imprecision in Laboratory Process
Sediment Conc. 250 to 125 um	CBSF2-OUT	10/26/09 11:50	0.01	mg/L	UJ	Imprecision in Laboratory Process
Sediment Conc. 250 to 125 um	CBSF2-IN	11/6/09 7:19	0.01	mg/L	UJ	Imprecision in Laboratory Process
Sediment Conc. 250 to 125 um	CBSF2-OUT	11/6/09 7:19	0.01	mg/L	UJ	Imprecision in Laboratory Process
Sediment Conc. 250 to 125 um	CBSF1-IN	11/6/09 9:35	0.01	mg/L	UJ	Imprecision in Laboratory Process
Sediment Conc. 250 to 125 um	CBSF1-OUT	11/6/09 9:35	0.01	mg/L	UJ	Imprecision in Laboratory Process
Sediment Conc. 250 to 125 um	CBSF1-IN	12/14/09 23:00	0.01	mg/L	UJ	Imprecision in Laboratory Process
Sediment Conc. 250 to 125 um	CBSF1-OUT	12/14/09 23:00	0.01	mg/L	UJ	Imprecision in Laboratory Process
Sediment Conc. 250 to 125 um	CBSF2-IN	12/14/09 23:45	0.01	mg/L	UJ	Imprecision in Laboratory Process
Sediment Conc. 250 to 125 um	CBSF2-OUT	12/14/09 23:45	0.01	mg/L	UJ	Imprecision in Laboratory Process
Sediment Conc. 250 to 125 um	CBSF2-IN	12/17/09 1:37	0.01	mg/L	UJ	Imprecision in Laboratory Process
Sediment Conc. 250 to 125 um	CBSF2-OUT	12/17/09 1:37	0.01	mg/L	UJ	Imprecision in Laboratory Process
Sediment Conc. 250 to 125 um	CBSF2-IN	2/5/10 6:40	0.01	mg/L	UJ	Imprecision in Laboratory Process

Analyte	Sample ID	Sample Date	Result	Units	Qualifier	Reason
Sediment Conc. 250 to 125 um	CBSF2-OUT	2/5/10 6:40	0.01	mg/L	UJ	Imprecision in Laboratory Process
Sediment Conc. 250 to 125 um	CBSF2-OUT	2/11/10 10:26	0.01	mg/L	UJ	Imprecision in Laboratory Process
Sediment Conc. 250 to 125 um	CBSF2-IN	2/11/10 10:27	0.01	mg/L	UJ	Imprecision in Laboratory Process
Sediment Conc. 250 to 125 um	CBSF2-IN	3/11/10 11:58	0.01	mg/L	UJ	Imprecision in Laboratory Process
Sediment Conc. 250 to 125 um	CBSF2-OUT	3/11/10 11:58	0.01	mg/L	UJ	Imprecision in Laboratory Process
Sediment Conc. 250 to 125 um	CBSF1-IN	3/11/10 12:44	0.01	mg/L	UJ	Imprecision in Laboratory Process
Sediment Conc. 250 to 125 um	CBSF1-OUT	3/11/10 12:44	0.01	mg/L	UJ	Imprecision in Laboratory Process
Sediment Conc. 250 to 125 um	CBSF2-IN	3/26/10 2:16	0.01	mg/L	UJ	Field Dup Precision Exceedance, Imprecision in Laboratory Process
Sediment Conc. 250 to 125 um	CBSF2-OUT	3/26/10 2:16	0.01	mg/L	UJ	Field Dup Precision Exceedance, Imprecision in Laboratory Process
Sediment Conc. 250 to 125 um	CBSF1-IN	3/26/10 6:50	0.09	mg/L	J	Field Dup Precision Exceedance, Imprecision in Laboratory Process
Sediment Conc. 250 to 125 um	CBSF1-OUT	3/26/10 6:51	0.01	mg/L	UJ	Field Dup Precision Exceedance, Imprecision in Laboratory Process
Sediment Conc. 250 to 125 um	CBSF1-IN	4/2/10 12:31	0.01	mg/L	UJ	Imprecision in Laboratory Process
Sediment Conc. 250 to 125 um	CBSF1-OUT	4/2/10 12:31	0.01	mg/L	UJ	Imprecision in Laboratory Process
Sediment Conc. 250 to 125 um	CBSF1-IN	5/20/10 2:41	8.33	mg/L	J	Imprecision in Laboratory Process
Sediment Conc. 250 to 125 um	CBSF1-OUT	5/20/10 2:45	1.76	mg/L	J	Imprecision in Laboratory Process
Sediment Conc. 250 to 125 um	CBSF2-IN	5/20/10 3:28	18.9	mg/L	J	Imprecision in Laboratory Process
Sediment	CBSF2-OUT	5/20/10 3:28	2.55	mg/L	J	Imprecision in Laboratory Process

Analyte	Sample ID	Sample Date	Result	Units	Qualifier	Reason
Conc. 250 to 125 um						
Sediment Conc. 250 to 125 um	CBSF2-IN	6/2/10 9:44	2.4	mg/L	J	Field Dup Precision Exceedance, Imprecision in Laboratory Process
Sediment Conc. 250 to 125 um	CBSF2-OUT	6/2/10 9:44	0.43	mg/L	J	Field Dup Precision Exceedance, Imprecision in Laboratory Process
Sediment Conc. 250 to 125 um	CBSF1-IN	6/2/10 11:21	3.97	mg/L	J	Field Dup Precision Exceedance, Imprecision in Laboratory Process
Sediment Conc. 250 to 125 um	CBSF1-OUT	6/2/10 11:25	1.28	mg/L	J	Field Dup Precision Exceedance, Imprecision in Laboratory Process
Sediment Conc. 250 to 125 um	CBSF1-IN	6/9/10 11:39	0.62	mg/L	J	Field Dup Precision Exceedance, Imprecision in Laboratory Process
Sediment Conc. 250 to 125 um	CBSF1-OUT	6/9/10 11:43	0.15	mg/L	J	Field Dup Precision Exceedance, Imprecision in Laboratory Process
Sediment Conc. 3.9 to 1 um	CBSF1-IN	10/21/09 11:50	24.49	mg/L	J	Imprecision in Laboratory Process
Sediment Conc. 3.9 to 1 um	CBSF1-OUT	10/21/09 11:50	33.65	mg/L	J	Imprecision in Laboratory Process
Sediment Conc. 3.9 to 1 um	CBSF1-IN	10/26/09 11:10	4.32	mg/L	J	Imprecision in Laboratory Process
Sediment Conc. 3.9 to 1 um	CBSF1-OUT	10/26/09 11:10	3.5	mg/L	J	Imprecision in Laboratory Process
Sediment Conc. 3.9 to 1 um	CBSF2-IN	10/26/09 11:50	5.25	mg/L	J	Imprecision in Laboratory Process
Sediment Conc. 3.9 to 1 um	CBSF2-OUT	10/26/09 11:50	3.88	mg/L	J	Imprecision in Laboratory Process
Sediment Conc. 3.9 to 1 um	CBSF2-IN	11/6/09 7:19	4.54	mg/L	J	Imprecision in Laboratory Process
Sediment Conc. 3.9 to 1 um	CBSF2-OUT	11/6/09 7:19	4.54	mg/L	J	Imprecision in Laboratory Process
Sediment Conc. 3.9 to 1 um	CBSF1-IN	11/6/09 9:35	4.72	mg/L	J	Imprecision in Laboratory Process
Sediment Conc. 3.9 to	CBSF1-OUT	11/6/09 9:35	7.8	mg/L	J	Imprecision in Laboratory Process

Analyte	Sample ID	Sample Date	Result	Units	Qualifier	Reason
1 um						
Sediment Conc. 3.9 to 1 um	CBSF1-IN	12/14/09 23:00	6.19	mg/L	J	Imprecision in Laboratory Process
Sediment Conc. 3.9 to 1 um	CBSF1-OUT	12/14/09 23:00	1.69	mg/L	J	Imprecision in Laboratory Process
Sediment Conc. 3.9 to 1 um	CBSF2-IN	12/14/09 23:45	27.81	mg/L	J	Imprecision in Laboratory Process
Sediment Conc. 3.9 to 1 um	CBSF2-OUT	12/14/09 23:45	1.75	mg/L	J	Imprecision in Laboratory Process
Sediment Conc. 3.9 to 1 um	CBSF2-IN	12/17/09 1:37	44.1	mg/L	J	Imprecision in Laboratory Process
Sediment Conc. 3.9 to 1 um	CBSF2-OUT	12/17/09 1:37	5.18	mg/L	J	Imprecision in Laboratory Process
Sediment Conc. 3.9 to 1 um	CBSF2-IN	2/5/10 6:40	6.42	mg/L	J	Imprecision in Laboratory Process
Sediment Conc. 3.9 to 1 um	CBSF2-OUT	2/5/10 6:40	3.92	mg/L	J	Imprecision in Laboratory Process
Sediment Conc. 3.9 to 1 um	CBSF2-OUT	2/11/10 10:26	4.68	mg/L	J	Imprecision in Laboratory Process
Sediment Conc. 3.9 to 1 um	CBSF2-IN	2/11/10 10:27	6.89	mg/L	J	Imprecision in Laboratory Process
Sediment Conc. 3.9 to 1 um	CBSF2-IN	3/11/10 11:58	8.53	mg/L	J	Imprecision in Laboratory Process
Sediment Conc. 3.9 to 1 um	CBSF2-OUT	3/11/10 11:58	1.01	mg/L	J	Imprecision in Laboratory Process
Sediment Conc. 3.9 to 1 um	CBSF1-IN	3/11/10 12:44	10.36	mg/L	J	Imprecision in Laboratory Process
Sediment Conc. 3.9 to 1 um	CBSF1-OUT	3/11/10 12:44	3.83	mg/L	J	Imprecision in Laboratory Process
Sediment Conc. 3.9 to 1 um	CBSF2-IN	3/26/10 2:16	29.43	mg/L	J	Imprecision in Laboratory Process
Sediment Conc. 3.9 to 1 um	CBSF2-OUT	3/26/10 2:16	7.23	mg/L	J	Imprecision in Laboratory Process

Analyte	Sample ID	Sample Date	Result	Units	Qualifier	Reason
Sediment Conc. 3.9 to 1 um	CBSF1-IN	3/26/10 6:50	7.64	mg/L	J	Imprecision in Laboratory Process
Sediment Conc. 3.9 to 1 um	CBSF1-OUT	3/26/10 6:51	4.49	mg/L	J	Imprecision in Laboratory Process
Sediment Conc. 3.9 to 1 um	CBSF1-IN	4/2/10 12:31	11.56	mg/L	J	Imprecision in Laboratory Process
Sediment Conc. 3.9 to 1 um	CBSF1-OUT	4/2/10 12:31	2.97	mg/L	J	Imprecision in Laboratory Process
Sediment Conc. 3.9 to 1 um	CBSF1-IN	5/20/10 2:41	6.46	mg/L	J	Imprecision in Laboratory Process
Sediment Conc. 3.9 to 1 um	CBSF1-OUT	5/20/10 2:45	2.09	mg/L	J	Imprecision in Laboratory Process
Sediment Conc. 3.9 to 1 um	CBSF2-IN	5/20/10 3:28	5.05	mg/L	J	Imprecision in Laboratory Process
Sediment Conc. 3.9 to 1 um	CBSF2-OUT	5/20/10 3:28	1.32	mg/L	J	Imprecision in Laboratory Process
Sediment Conc. 3.9 to 1 um	CBSF2-IN	6/2/10 9:44	1.01	mg/L	J	Field Dup Precision Exceedance, Imprecision in Laboratory Process
Sediment Conc. 3.9 to 1 um	CBSF2-OUT	6/2/10 9:44	0.35	mg/L	J	Field Dup Precision Exceedance, Imprecision in Laboratory Process
Sediment Conc. 3.9 to 1 um	CBSF1-IN	6/2/10 11:21	3.67	mg/L	J	Field Dup Precision Exceedance, Imprecision in Laboratory Process
Sediment Conc. 3.9 to 1 um	CBSF1-OUT	6/2/10 11:25	1.77	mg/L	J	Field Dup Precision Exceedance, Imprecision in Laboratory Process
Sediment Conc. 3.9 to 1 um	CBSF1-IN	6/9/10 11:39	2.34	mg/L	J	Field Dup Precision Exceedance, Imprecision in Laboratory Process
Sediment Conc. 3.9 to 1 um	CBSF1-OUT	6/9/10 11:43	4.52	mg/L	J	Field Dup Precision Exceedance, Imprecision in Laboratory Process
Sediment Conc. 500 to 250 um	CBSF1-IN	10/21/09 11:50	4.66	mg/L	J	Imprecision in Laboratory Process
Sediment Conc. 500 to 250 um	CBSF1-OUT	10/21/09 11:50	0.01	mg/L	UJ	Imprecision in Laboratory Process
Sediment	CBSF1-IN	10/26/09	6.36	mg/L	J	Imprecision in Laboratory Process

Analyte	Sample ID	Sample Date	Result	Units	Qualifier	Reason
Conc. 500 to 250 um		11:10				
Sediment Conc. 500 to 250 um	CBSF1-OUT	10/26/09 11:10	0.01	mg/L	UJ	Imprecision in Laboratory Process
Sediment Conc. 500 to 250 um	CBSF2-IN	10/26/09 11:50	9.22	mg/L	J	Imprecision in Laboratory Process
Sediment Conc. 500 to 250 um	CBSF2-OUT	10/26/09 11:50	0.01	mg/L	UJ	Imprecision in Laboratory Process
Sediment Conc. 500 to 250 um	CBSF2-IN	11/6/09 7:19	0.45	mg/L	J	Imprecision in Laboratory Process
Sediment Conc. 500 to 250 um	CBSF2-OUT	11/6/09 7:19	0.45	mg/L	J	Imprecision in Laboratory Process
Sediment Conc. 500 to 250 um	CBSF1-IN	11/6/09 9:35	5.1	mg/L	J	Imprecision in Laboratory Process
Sediment Conc. 500 to 250 um	CBSF1-OUT	11/6/09 9:35	1.49	mg/L	J	Imprecision in Laboratory Process
Sediment Conc. 500 to 250 um	CBSF1-IN	12/14/09 23:00	12.77	mg/L	J	Imprecision in Laboratory Process
Sediment Conc. 500 to 250 um	CBSF1-OUT	12/14/09 23:00	0.01	mg/L	UJ	Imprecision in Laboratory Process
Sediment Conc. 500 to 250 um	CBSF2-IN	12/14/09 23:45	4.61	mg/L	J	Imprecision in Laboratory Process
Sediment Conc. 500 to 250 um	CBSF2-OUT	12/14/09 23:45	0.01	mg/L	UJ	Imprecision in Laboratory Process
Sediment Conc. 500 to 250 um	CBSF2-IN	12/17/09 1:37	1.84	mg/L	J	Imprecision in Laboratory Process
Sediment Conc. 500 to 250 um	CBSF2-OUT	12/17/09 1:37	0.01	mg/L	UJ	Imprecision in Laboratory Process
Sediment Conc. 500 to 250 um	CBSF2-IN	2/5/10 6:40	1.35	mg/L	J	Imprecision in Laboratory Process
Sediment Conc. 500 to 250 um	CBSF2-OUT	2/5/10 6:40	1.17	mg/L	J	Imprecision in Laboratory Process
Sediment Conc. 500	CBSF2-OUT	2/11/10 10:26	0.34	mg/L	J	Imprecision in Laboratory Process

Analyte	Sample ID	Sample Date	Result	Units	Qualifier	Reason
to 250 um						
Sediment Conc. 500 to 250 um	CBSF2-IN	2/11/10 10:27	4.3	mg/L	J	Imprecision in Laboratory Process
Sediment Conc. 500 to 250 um	CBSF2-IN	3/11/10 11:58	4.49	mg/L	J	Imprecision in Laboratory Process
Sediment Conc. 500 to 250 um	CBSF2-OUT	3/11/10 11:58	0.5	mg/L	J	Imprecision in Laboratory Process
Sediment Conc. 500 to 250 um	CBSF1-IN	3/11/10 12:44	0.36	mg/L	J	Imprecision in Laboratory Process
Sediment Conc. 500 to 250 um	CBSF1-OUT	3/11/10 12:44	0.01	mg/L	UJ	Imprecision in Laboratory Process
Sediment Conc. 500 to 250 um	CBSF2-IN	3/26/10 2:16	24.48	mg/L	J	Imprecision in Laboratory Process
Sediment Conc. 500 to 250 um	CBSF2-OUT	3/26/10 2:16	0.01	mg/L	UJ	Imprecision in Laboratory Process
Sediment Conc. 500 to 250 um	CBSF1-IN	3/26/10 6:50	13.41	mg/L	J	Imprecision in Laboratory Process
Sediment Conc. 500 to 250 um	CBSF1-OUT	3/26/10 6:51	0.01	mg/L	UJ	Imprecision in Laboratory Process
Sediment Conc. 500 to 250 um	CBSF1-IN	4/2/10 12:31	1.88	mg/L	J	Imprecision in Laboratory Process
Sediment Conc. 500 to 250 um	CBSF1-OUT	4/2/10 12:31	0.01	mg/L	UJ	Imprecision in Laboratory Process
Sediment Conc. 500 to 250 um	CBSF1-IN	5/20/10 2:41	9.77	mg/L	J	Field Dup Precision Exceedance, Imprecision in Laboratory Process
Sediment Conc. 500 to 250 um	CBSF1-OUT	5/20/10 2:45	0.73	mg/L	J	Field Dup Precision Exceedance, Imprecision in Laboratory Process
Sediment Conc. 500 to 250 um	CBSF2-IN	5/20/10 3:28	30.99	mg/L	J	Field Dup Precision Exceedance, Imprecision in Laboratory Process
Sediment Conc. 500 to 250 um	CBSF2-OUT	5/20/10 3:28	0.34	mg/L	J	Field Dup Precision Exceedance, Imprecision in Laboratory Process
Sediment Conc. 500 to 250 um	CBSF2-IN	6/2/10 9:44	10.92	mg/L	J	Field Dup Precision Exceedance, Imprecision in Laboratory Process

Analyte	Sample ID	Sample Date	Result	Units	Qualifier	Reason
Sediment Conc. 500 to 250 um	CBSF2-OUT	6/2/10 9:44	1.01	mg/L	J	Field Dup Precision Exceedance, Imprecision in Laboratory Process
Sediment Conc. 500 to 250 um	CBSF1-IN	6/2/10 11:21	0.7	mg/L	J	Field Dup Precision Exceedance, Imprecision in Laboratory Process
Sediment Conc. 500 to 250 um	CBSF1-OUT	6/2/10 11:25	0.11	mg/L	J	Field Dup Precision Exceedance, Imprecision in Laboratory Process
Sediment Conc. 500 to 250 um	CBSF1-IN	6/9/10 11:39	18.67	mg/L	J	Imprecision in Laboratory Process
Sediment Conc. 500 to 250 um	CBSF1-OUT	6/9/10 11:43	0.34	mg/L	J	Imprecision in Laboratory Process
Sediment Conc. 62.5 to 3.9 um	CBSF1-IN	10/21/09 11:50	12.31	mg/L	J	Imprecision in Laboratory Process
Sediment Conc. 62.5 to 3.9 um	CBSF1-OUT	10/21/09 11:50	4.6	mg/L	J	Imprecision in Laboratory Process
Sediment Conc. 62.5 to 3.9 um	CBSF1-IN	10/26/09 11:10	28.08	mg/L	J	Imprecision in Laboratory Process
Sediment Conc. 62.5 to 3.9 um	CBSF1-OUT	10/26/09 11:10	17.2	mg/L	J	Imprecision in Laboratory Process
Sediment Conc. 62.5 to 3.9 um	CBSF2-IN	10/26/09 11:50	25.18	mg/L	J	Imprecision in Laboratory Process
Sediment Conc. 62.5 to 3.9 um	CBSF2-OUT	10/26/09 11:50	15.06	mg/L	J	Imprecision in Laboratory Process
Sediment Conc. 62.5 to 3.9 um	CBSF2-IN	11/6/09 7:19	21.53	mg/L	J	Imprecision in Laboratory Process
Sediment Conc. 62.5 to 3.9 um	CBSF2-OUT	11/6/09 7:19	21.53	mg/L	J	Imprecision in Laboratory Process
Sediment Conc. 62.5 to 3.9 um	CBSF1-IN	11/6/09 9:35	30.06	mg/L	J	Imprecision in Laboratory Process
Sediment Conc. 62.5 to 3.9 um	CBSF1-OUT	11/6/09 9:35	49.14	mg/L	J	Imprecision in Laboratory Process
Sediment Conc. 62.5 to 3.9 um	CBSF1-IN	12/14/09 23:00	19.52	mg/L	J	Imprecision in Laboratory Process
Sediment	CBSF1-OUT	12/14/09	1.62	mg/L	J	Imprecision in Laboratory Process

Analyte	Sample ID	Sample Date	Result	Units	Qualifier	Reason
Conc. 62.5 to 3.9 um		23:00				
Sediment Conc. 62.5 to 3.9 um	CBSF2-IN	12/14/09 23:45	0.03	mg/L	J	Imprecision in Laboratory Process
Sediment Conc. 62.5 to 3.9 um	CBSF2-OUT	12/14/09 23:45	0.01	mg/L	UJ	Imprecision in Laboratory Process
Sediment Conc. 62.5 to 3.9 um	CBSF2-IN	12/17/09 1:37	0.01	mg/L	UJ	Imprecision in Laboratory Process
Sediment Conc. 62.5 to 3.9 um	CBSF2-OUT	12/17/09 1:37	0.01	mg/L	UJ	Imprecision in Laboratory Process
Sediment Conc. 62.5 to 3.9 um	CBSF2-IN	2/5/10 6:40	0.01	mg/L	UJ	Imprecision in Laboratory Process
Sediment Conc. 62.5 to 3.9 um	CBSF2-OUT	2/5/10 6:40	0.01	mg/L	UJ	Imprecision in Laboratory Process
Sediment Conc. 62.5 to 3.9 um	CBSF2-OUT	2/11/10 10:26	15.52	mg/L	J	Imprecision in Laboratory Process
Sediment Conc. 62.5 to 3.9 um	CBSF2-IN	2/11/10 10:27	24.93	mg/L	J	Imprecision in Laboratory Process
Sediment Conc. 62.5 to 3.9 um	CBSF2-IN	3/11/10 11:58	0.01	mg/L	UJ	Imprecision in Laboratory Process
Sediment Conc. 62.5 to 3.9 um	CBSF2-OUT	3/11/10 11:58	0.01	mg/L	UJ	Imprecision in Laboratory Process
Sediment Conc. 62.5 to 3.9 um	CBSF1-IN	3/11/10 12:44	14.43	mg/L	J	Imprecision in Laboratory Process
Sediment Conc. 62.5 to 3.9 um	CBSF1-OUT	3/11/10 12:44	0.01	mg/L	UJ	Imprecision in Laboratory Process
Sediment Conc. 62.5 to 3.9 um	CBSF2-IN	3/26/10 2:16	23.67	mg/L	J	Imprecision in Laboratory Process
Sediment Conc. 62.5 to 3.9 um	CBSF2-OUT	3/26/10 2:16	0.01	mg/L	UJ	Imprecision in Laboratory Process
Sediment Conc. 62.5 to 3.9 um	CBSF1-IN	3/26/10 6:50	52.05	mg/L	J	Imprecision in Laboratory Process
Sediment Conc. 62.5	CBSF1-OUT	3/26/10 6:51	0.01	mg/L	UJ	Imprecision in Laboratory Process

Analyte	Sample ID	Sample Date	Result	Units	Qualifier	Reason
to 3.9 um						
Sediment Conc. 62.5 to 3.9 um	CBSF1-IN	4/2/10 12:31	0.01	mg/L	UJ	Imprecision in Laboratory Process
Sediment Conc. 62.5 to 3.9 um	CBSF1-OUT	4/2/10 12:31	0.01	mg/L	UJ	Imprecision in Laboratory Process
Sediment Conc. 62.5 to 3.9 um	CBSF1-IN	5/20/10 2:41	50.05	mg/L	J	Imprecision in Laboratory Process
Sediment Conc. 62.5 to 3.9 um	CBSF1-OUT	5/20/10 2:45	16.78	mg/L	J	Imprecision in Laboratory Process
Sediment Conc. 62.5 to 3.9 um	CBSF2-IN	5/20/10 3:28	53.81	mg/L	J	Imprecision in Laboratory Process
Sediment Conc. 62.5 to 3.9 um	CBSF2-OUT	5/20/10 3:28	15.05	mg/L	J	Imprecision in Laboratory Process
Sediment Conc. 62.5 to 3.9 um	CBSF2-IN	6/2/10 9:44	8.15	mg/L	J	Field Dup Precision Exceedance, Imprecision in Laboratory Process
Sediment Conc. 62.5 to 3.9 um	CBSF2-OUT	6/2/10 9:44	3.08	mg/L	J	Field Dup Precision Exceedance, Imprecision in Laboratory Process
Sediment Conc. 62.5 to 3.9 um	CBSF1-IN	6/2/10 11:21	21.63	mg/L	J	Field Dup Precision Exceedance, Imprecision in Laboratory Process
Sediment Conc. 62.5 to 3.9 um	CBSF1-OUT	6/2/10 11:25	8.75	mg/L	J	Field Dup Precision Exceedance, Imprecision in Laboratory Process
Sediment Conc. 62.5 to 3.9 um	CBSF1-IN	6/9/10 11:39	14.76	mg/L	J	Imprecision in Laboratory Process
Sediment Conc. 62.5 to 3.9 um	CBSF1-OUT	6/9/10 11:43	23.14	mg/L	J	Imprecision in Laboratory Process
Solids, Total Suspended	CBSF1-IN	10/21/09 11:50	92.5	mg/L	J	Holding Time Exceeded
Solids, Total Suspended	CBSF1-OUT	10/21/09 11:50	26.5	mg/L	J	Holding Time Exceeded
Solids, Total Suspended	CBSF2-IN	11/6/09 7:19	29.3	mg/L	J	Holding Time Exceeded
Solids, Total Suspended	CBSF2-OUT	11/6/09 7:19	14.3	mg/L	J	Holding Time Exceeded
Solids, Total Suspended	CBSF1-IN	11/6/09 9:35	54.5	mg/L	J	Holding Time Exceeded
Solids, Total Suspended	CBSF1-OUT	11/6/09 9:35	24.4	mg/L	J	Holding Time Exceeded

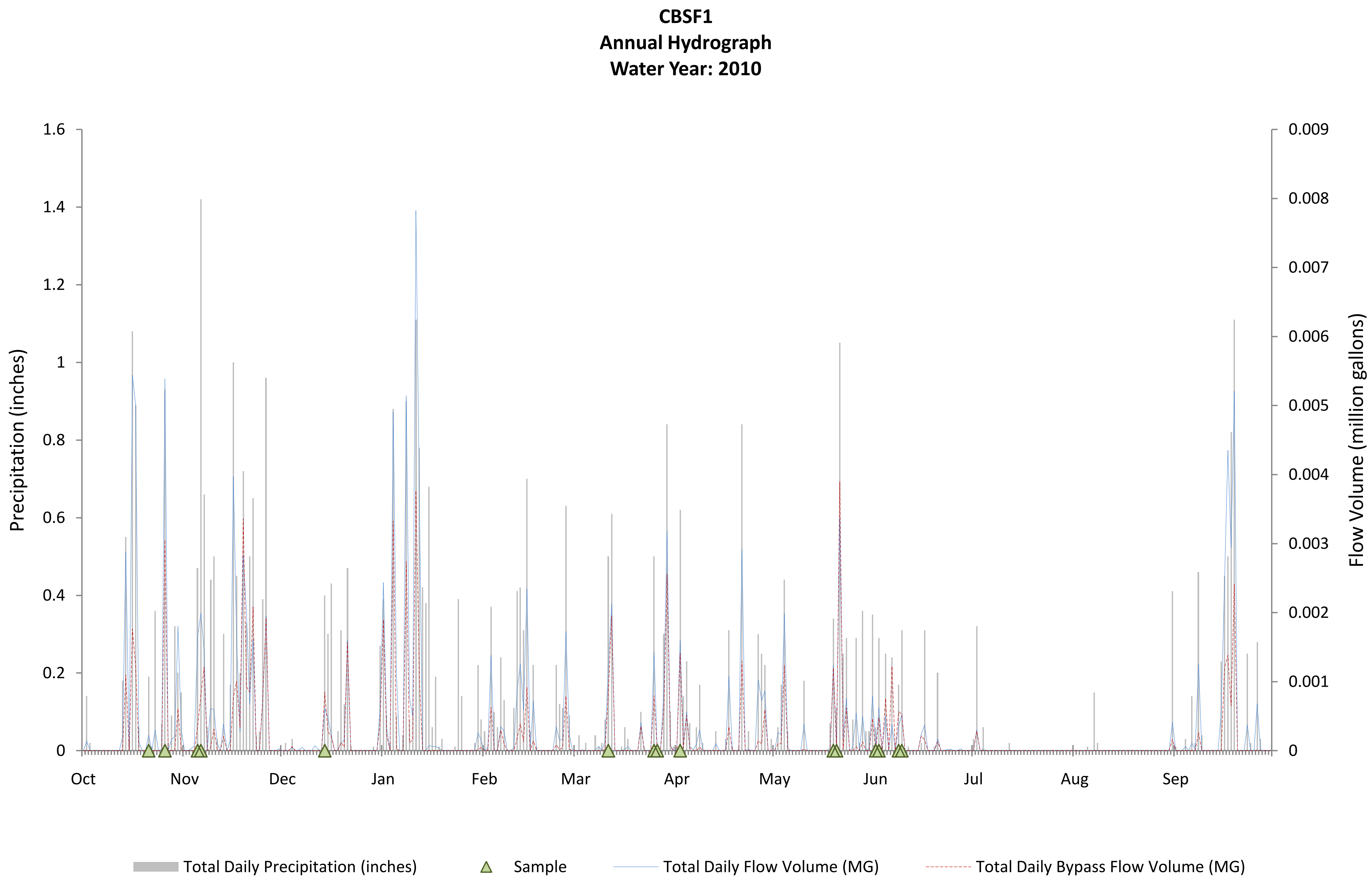
Analyte	Sample ID	Sample Date	Result	Units	Qualifier	Reason
Solids, Total Suspended	CBSF1-IN	12/14/09 23:00	105	mg/L	J	Holding Time Exceeded
Solids, Total Suspended	CBSF1-OUT	12/14/09 23:00	31.8	mg/L	J	Holding Time Exceeded
Solids, Total Suspended	CBSF2-IN	12/14/09 23:45	61	mg/L	J	Holding Time Exceeded
Solids, Total Suspended	CBSF2-OUT	12/14/09 23:45	22.2	mg/L	J	Holding Time Exceeded
Solids, Total Suspended	CBSF2-IN	2/5/10 6:40	5.95	mg/L	J	Holding Time Exceeded
Solids, Total Suspended	CBSF2-OUT	2/5/10 6:40	19.6	mg/L	J	Holding Time Exceeded
Solids, Total Suspended	CBSF2-OUT	2/11/10 10:26	20	mg/L	J	Holding Time Exceeded
Solids, Total Suspended	CBSF2-IN	2/11/10 10:27	52.2	mg/L	J	Holding Time Exceeded
Solids, Total Suspended	CBSF1-IN	3/26/10 6:51	154	mg/L	J	Field Dup Precision Exceedance
Solids, Total Suspended	CBSF1-OUT	6/9/10 11:43	11	mg/L	J	Field Dup Precision Exceedance
Zinc, Dissolved	CBSF1-IN	10/21/09 11:50	34.1	ug/L	J	Equipment Blank > RL
Zinc, Dissolved	CBSF1-OUT	10/21/09 11:50	31.9	ug/L	J	Equipment Blank > RL
Zinc, Dissolved	CBSF1-IN	10/26/09 11:10	18.8	ug/L	J	Method Blank > RL, Equipment Blank > RL
Zinc, Dissolved	CBSF1-OUT	10/26/09 11:10	15.2	ug/L	J	Method Blank > RL, Equipment Blank > RL
Zinc, Dissolved	CBSF2-IN	10/26/09 11:50	15.7	ug/L	J	Method Blank > RL, Equipment Blank > RL
Zinc, Dissolved	CBSF2-OUT	10/26/09 11:50	12	ug/L	J	Method Blank > RL, Equipment Blank > RL
Zinc, Dissolved	CBSF2-IN	11/6/09 7:19	18.5	ug/L	J	Method Blank > RL, Equipment Blank > RL
Zinc, Dissolved	CBSF2-OUT	11/6/09 7:19	29.6	ug/L	J	Equipment Blank > RL
Zinc, Dissolved	CBSF1-IN	11/6/09 9:35	32.3	ug/L	J	Equipment Blank > RL
Zinc, Dissolved	CBSF1-OUT	11/6/09 9:35	22.9	ug/L	J	Equipment Blank > RL
Zinc, Dissolved	CBSF1-IN	12/14/09 23:00	18.5	ug/L	J	Filter Blank > RL, Method Blank > RL, Equipment Blank > RL
Zinc, Dissolved	CBSF1-OUT	12/14/09 23:00	21.5	ug/L	J	Filter Blank > RL, Method Blank > RL, Equipment Blank > RL
Zinc, Dissolved	CBSF2-IN	12/14/09 23:45	27.1	ug/L	J	Filter Blank > RL, Equipment Blank > RL
Zinc, Dissolved	CBSF2-OUT	12/14/09 23:45	29.6	ug/L	J	Filter Blank > RL, Equipment Blank > RL
Zinc,	CBSF2-IN	12/17/09	17.2	ug/L	J	Filter Blank > RL, Method Blank > RL,

Analyte	Sample ID	Sample Date	Result	Units	Qualifier	Reason
Dissolved		1:37				Equipment Blank > RL
Zinc, Dissolved	CBSF2-OUT	12/17/09 1:37	19.6	ug/L	J	Filter Blank > RL, Method Blank > RL, Equipment Blank > RL
Zinc, Dissolved	CBSF2-IN	2/5/10 6:40	13.8	ug/L	J	Method Blank > RL, Equipment Blank > RL
Zinc, Dissolved	CBSF2-OUT	2/5/10 6:40	21.3	ug/L	J	Method Blank > RL, Equipment Blank > RL
Zinc, Dissolved	CBSF2-OUT	2/11/10 10:26	28.5	ug/L	J	Equipment Blank > RL
Zinc, Dissolved	CBSF2-IN	2/11/10 10:27	20.7	ug/L	J	Method Blank > RL, Equipment Blank > RL
Zinc, Dissolved	CBSF2-IN	3/11/10 11:58	19.5	ug/L	J	Method Blank > RL, Equipment Blank > RL
Zinc, Dissolved	CBSF2-OUT	3/11/10 11:58	22.4	ug/L	J	Method Blank > RL, Equipment Blank > RL
Zinc, Dissolved	CBSF1-IN	3/11/10 12:44	26.7	ug/L	J	Equipment Blank > RL
Zinc, Dissolved	CBSF1-OUT	3/11/10 12:44	28.7	ug/L	J	Equipment Blank > RL
Zinc, Dissolved	CBSF2-IN	3/26/10 2:16	22.2	ug/L	J	Equipment Blank > RL
Zinc, Dissolved	CBSF2-OUT	3/26/10 2:16	29.1	ug/L	J	Equipment Blank > RL
Zinc, Dissolved	CBSF1-IN	3/26/10 6:51	29.6	ug/L	J	Equipment Blank > RL
Zinc, Dissolved	CBSF1-IN	4/2/10 12:31	22.2	ug/L	J	Method Blank > RL, Equipment Blank > RL
Zinc, Dissolved	CBSF1-OUT	4/2/10 12:31	28.8	ug/L	J	Equipment Blank > RL
Zinc, Dissolved	CBSF1-IN	5/20/10 2:41	51.5	ug/L	J	LCS Recovery High
Zinc, Dissolved	CBSF1-OUT	5/20/10 2:45	76.2	ug/L	J	LCS Recovery High
Zinc, Dissolved	CBSF2-IN	5/20/10 3:28	29.4	ug/L	J	LCS Recovery High, Equipment Blank > RL
Zinc, Dissolved	CBSF2-OUT	5/20/10 3:28	53.8	ug/L	J	LCS Recovery High
Zinc, Dissolved	CBSF2-IN	6/2/10 9:44	23.3	ug/L	J	LCS Recovery High, Equipment Blank > RL
Zinc, Dissolved	CBSF2-OUT	6/2/10 9:44	26.7	ug/L	J	LCS Recovery High, Equipment Blank > RL
Zinc, Dissolved	CBSF1-IN	6/2/10 11:21	38.7	ug/L	J	LCS Recovery High
Zinc, Dissolved	CBSF1-OUT	6/2/10 11:25	35.2	ug/L	J	LCS Recovery High
Zinc, Dissolved	CBSF1-IN	6/9/10 11:39	38.2	ug/L	J	LCS Recovery High
Zinc, Dissolved	CBSF1-OUT	6/9/10 11:43	54.7	ug/L	J	LCS Recovery High

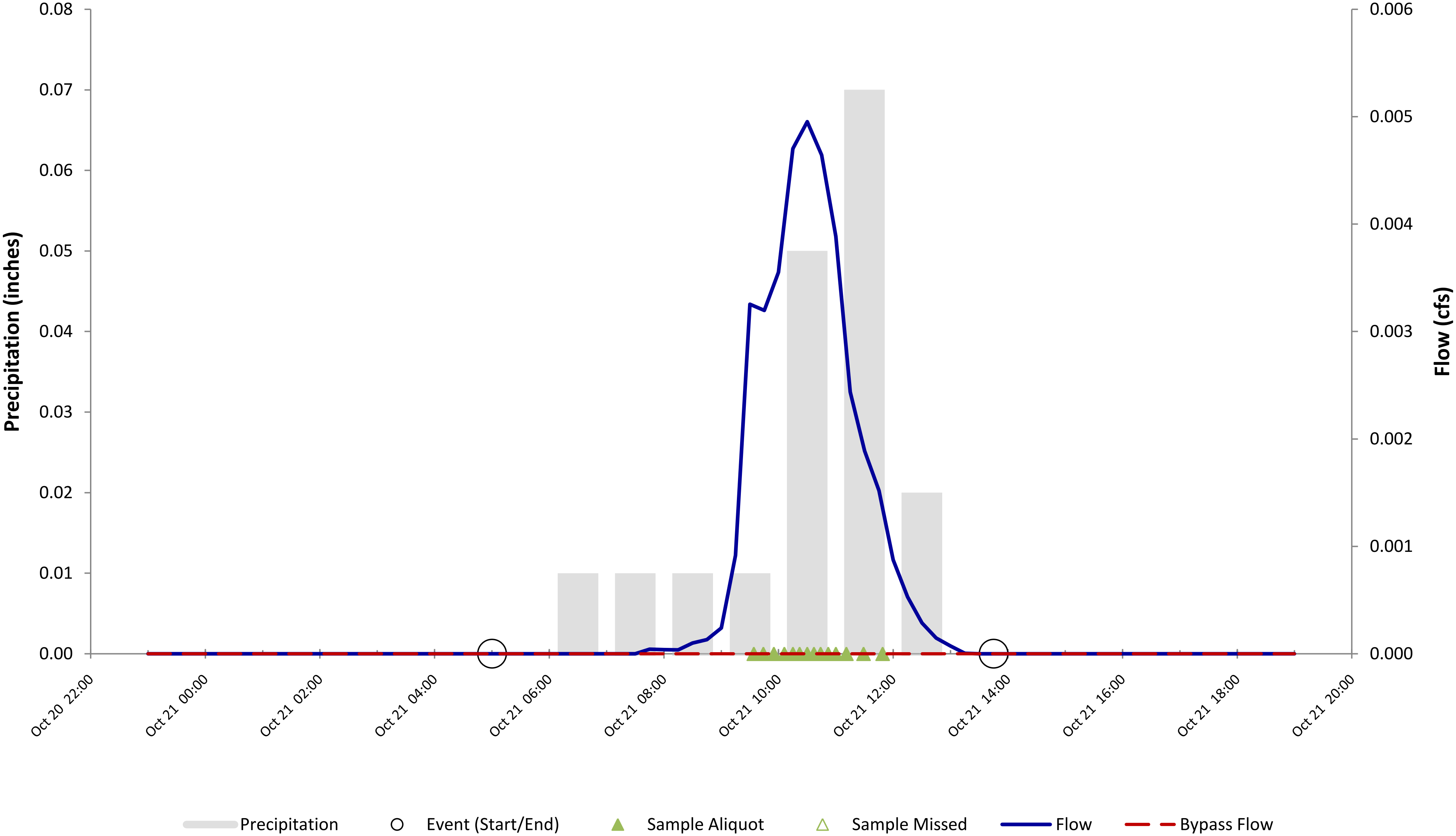
All Qualified Results for Sediment Samples

ANALYTE	SAMPLE ID	SAMPLE DATE	RESULT	UNITS	QUALIFIER	REASON
Gasoline Range Hydrocarbons	CBSF1-SED2	9/28/10 12:25	110	mg/L	J	Surrogate Exceedance (low)
Gasoline Range Hydrocarbons	CBSF1-SED3	9/28/10 12:40	39	mg/L	UJ	Surrogate Exceedance (low)
Gasoline Range Hydrocarbons	CBSF2-SED1	9/28/10 10:40	54	mg/L	J	Field Dup Precision Exceedance, Surrogate Exceedance (low)
Gasoline Range Hydrocarbons	CBSF2-SED2	9/28/10 10:32	59	mg/L	J	Surrogate Exceedance (low)
Gasoline Range Hydrocarbons	CBSF2-SED3	9/28/10 11:35	11	mg/L	UJ	Surrogate Exceedance (low)
Solids, Total	CBSF1-SED1	9/28/10 12:12	16.3	%	J	Hold Time Exceeded
Solids, Total	CBSF1-SED2	9/28/10 12:25	22.1	%	J	Hold Time Exceeded
Solids, Total	CBSF1-SED3	9/28/10 12:40	26.7	%	J	Hold Time Exceeded
Solids, Total	CBSF2-SED1	9/28/10 10:40	45.3	%	J	Hold Time Exceeded
Solids, Total	CBSF2-SED2	9/28/10 10:32	32.2	%	J	Hold Time Exceeded
Solids, Total	CBSF2-SED3	9/28/10 11:35	55.6	%	J	Hold Time Exceeded
Solids, Total Volatile	CBSF1-SED1	9/28/10 12:12	57.42	%	J	Hold Time Exceeded
Solids, Total Volatile	CBSF1-SED2	9/28/10 12:25	48.29	%	J	Hold Time Exceeded
Solids, Total Volatile	CBSF1-SED3	9/28/10 12:40	40.83	%	J	Hold Time Exceeded
Solids, Total Volatile	CBSF2-SED1	9/28/10 10:40	19.82	%	J	Hold Time Exceeded
Solids, Total Volatile	CBSF2-SED2	9/28/10 10:32	30.01	%	J	Hold Time Exceeded
Solids, Total Volatile	CBSF2-SED3	9/28/10 11:35	11.13	%	J	Hold Time Exceeded

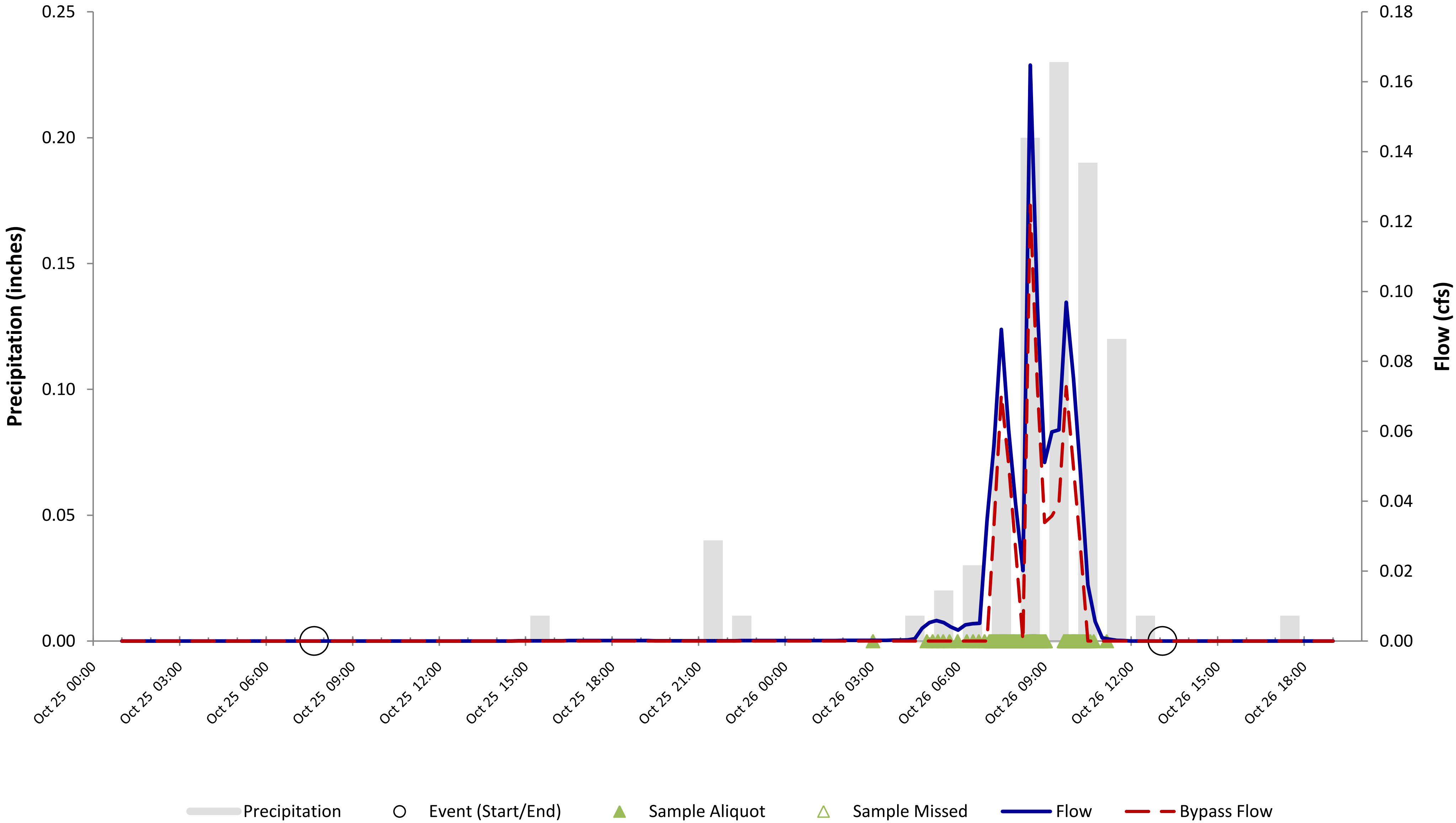
Appendix C.5: CATCH BASIN STORMFILTER - ANNUAL AND STORM EVENT HYDROGRAPHS

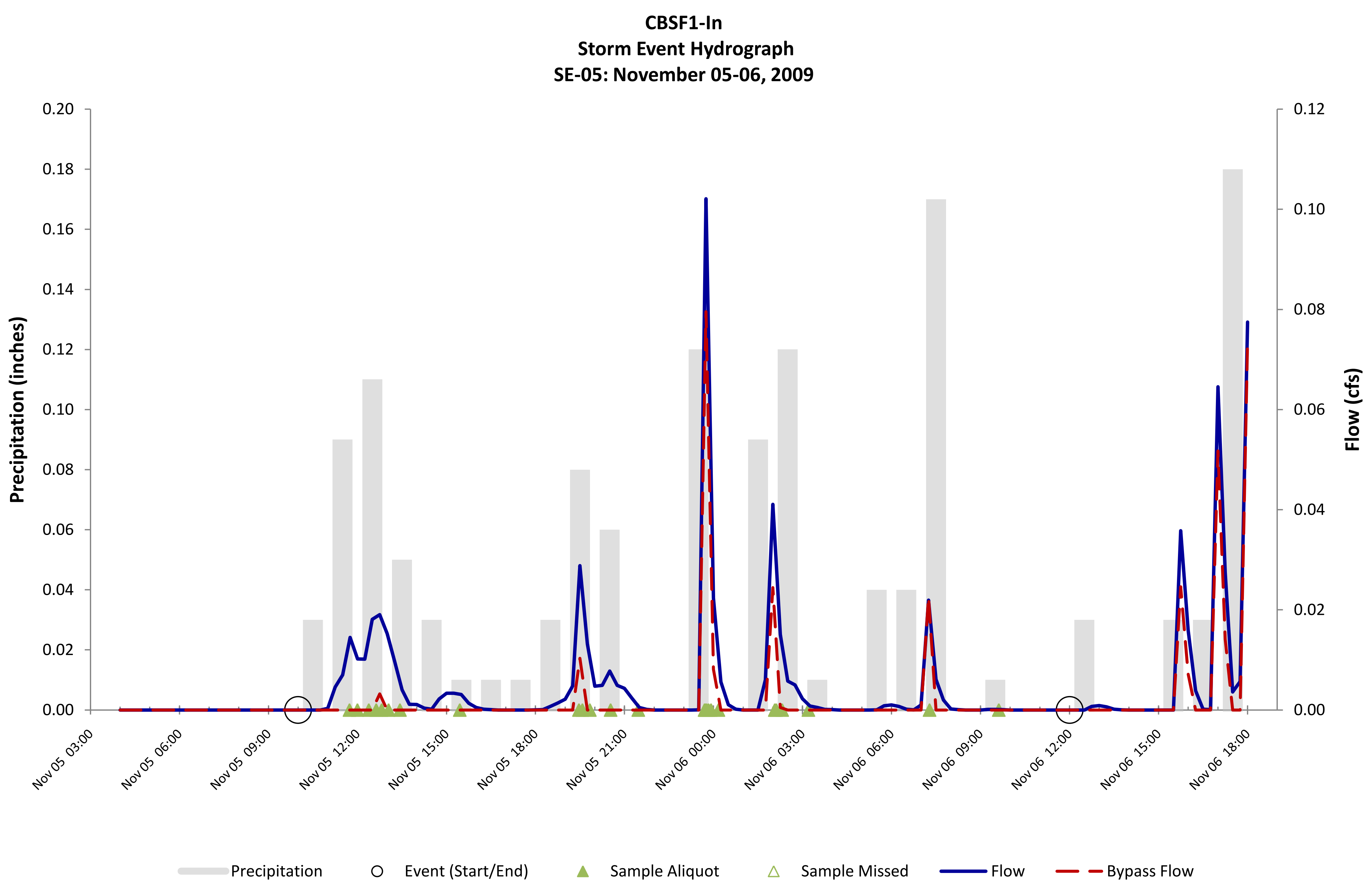

CBSF1
Annual Hydrograph
Water Year: 2010
Precipitation (inches)
Flow Volume (million gallons)
1.6
1.4
1.2
1
0.8
0.6
0.4
0.2
0
0.009
0.008
0.007
0.006
0.005
0.004
0.003
0.002
0.001
0
Oct
Nov
Dec
Jan
Feb
Mar
Apr
May
Jun
Jul
Aug
Sep
Total Daily Precipitation (inches)
Sample
Total Daily Flow Volume (MG)
Total Daily Bypass Flow Volume (MG)

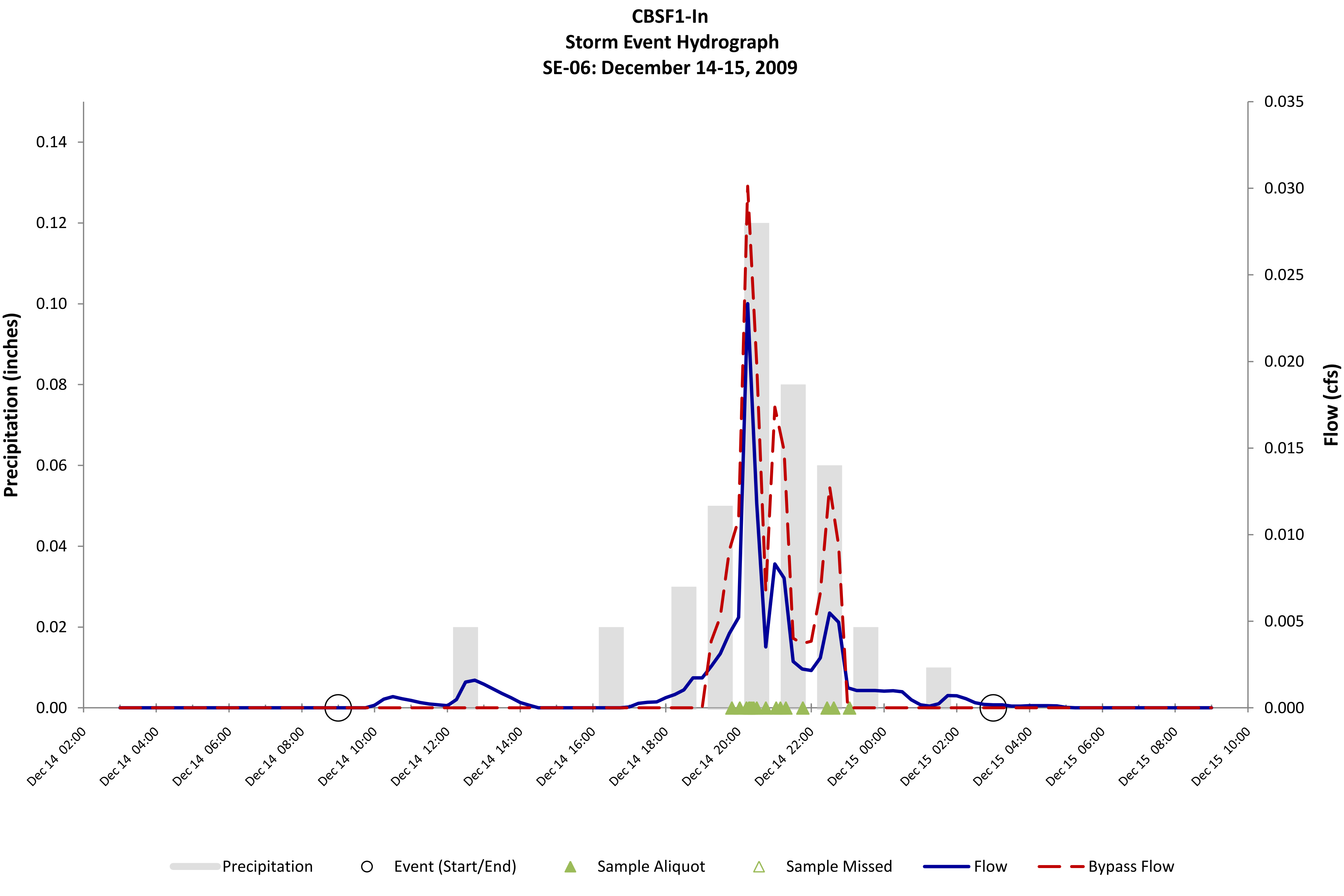
CBSF1-In
Storm Event Hydrograph
SE-03: October 21, 2009



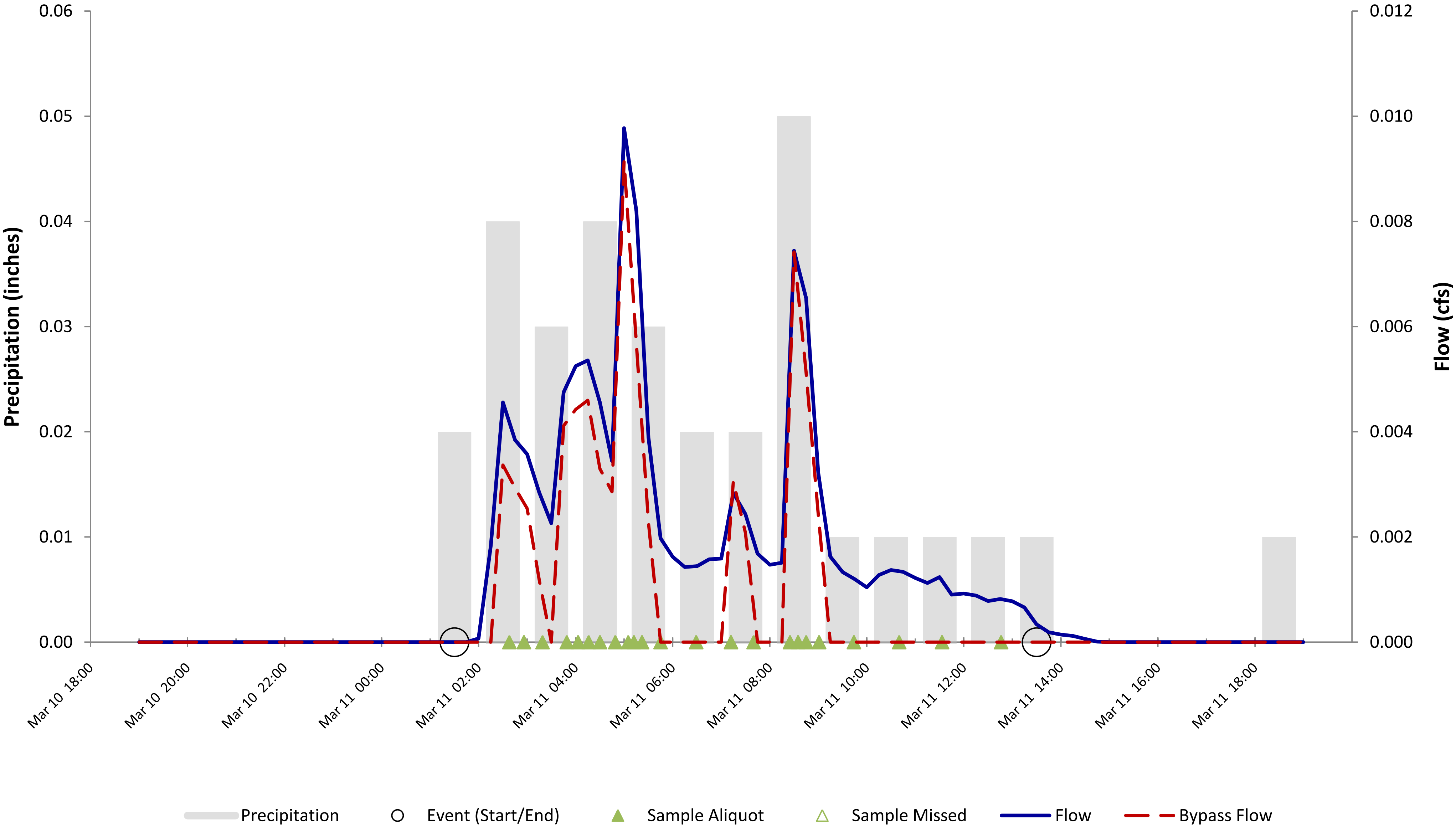
CBSF1-In
Storm Event Hydrograph
SE-04: October 25-26, 2009

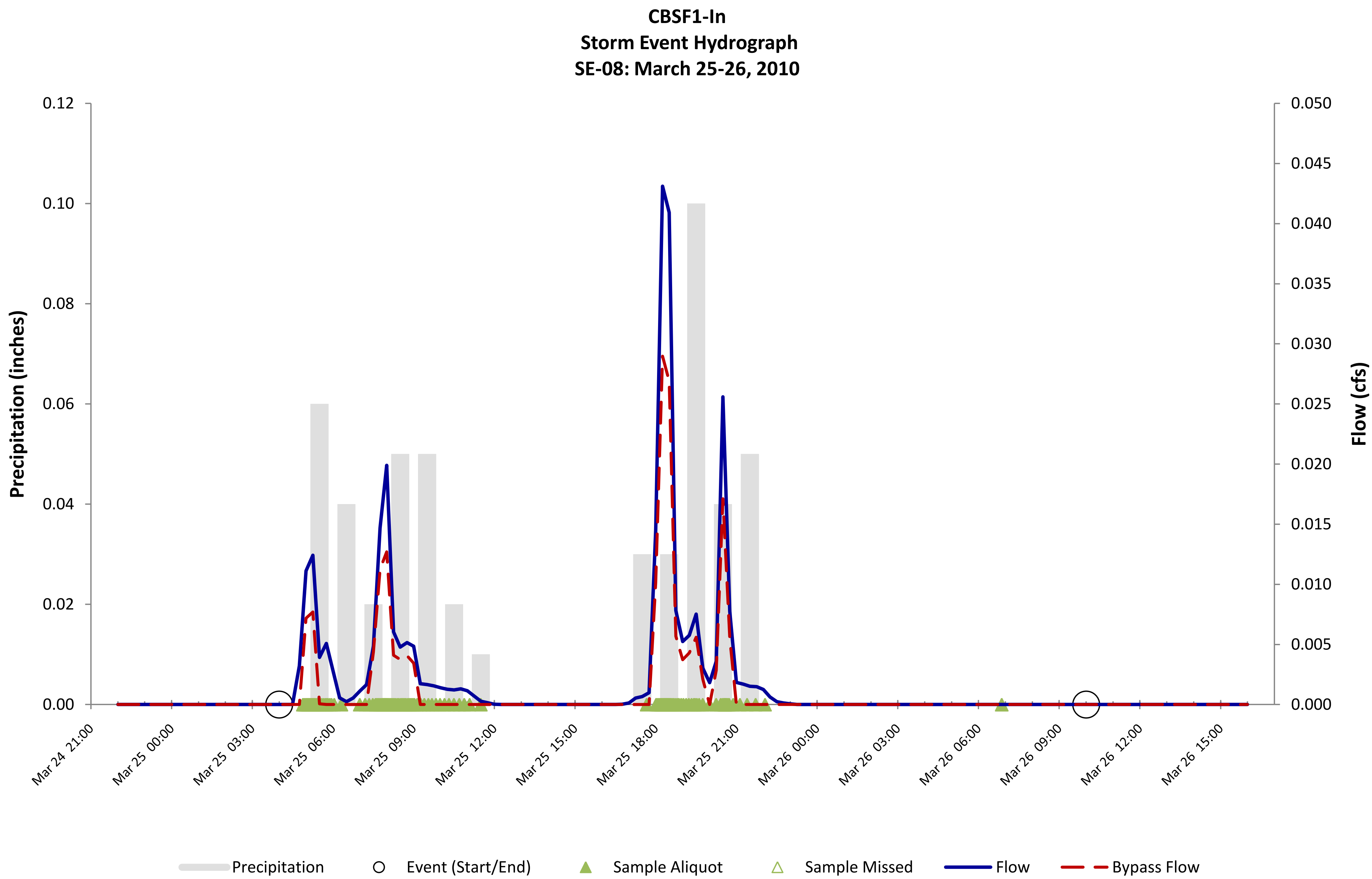



CBSF1-In
Storm Event Hydrograph
SE-05: November 05-06, 2009
Precipitation (inches)
Flow (cfs)
0.20
0.18
0.16
0.14
0.12
0.10
0.08
0.06
0.04
0.02
0.00
0.12
0.10
0.08
0.06
0.04
0.02
0.00
Nov 05 03:00
Nov 05 06:00
Nov 05 09:00
Nov 05 12:00
Nov 05 15:00
Nov 05 18:00
Nov 05 21:00
Nov 06 00:00
Nov 06 03:00
Nov 06 06:00
Nov 06 09:00
Nov 06 12:00
Nov 06 15:00
Nov 06 18:00
Precipitation
Event (Start/End)
Sample Aliquot
Sample Missed
Flow
Bypass Flow

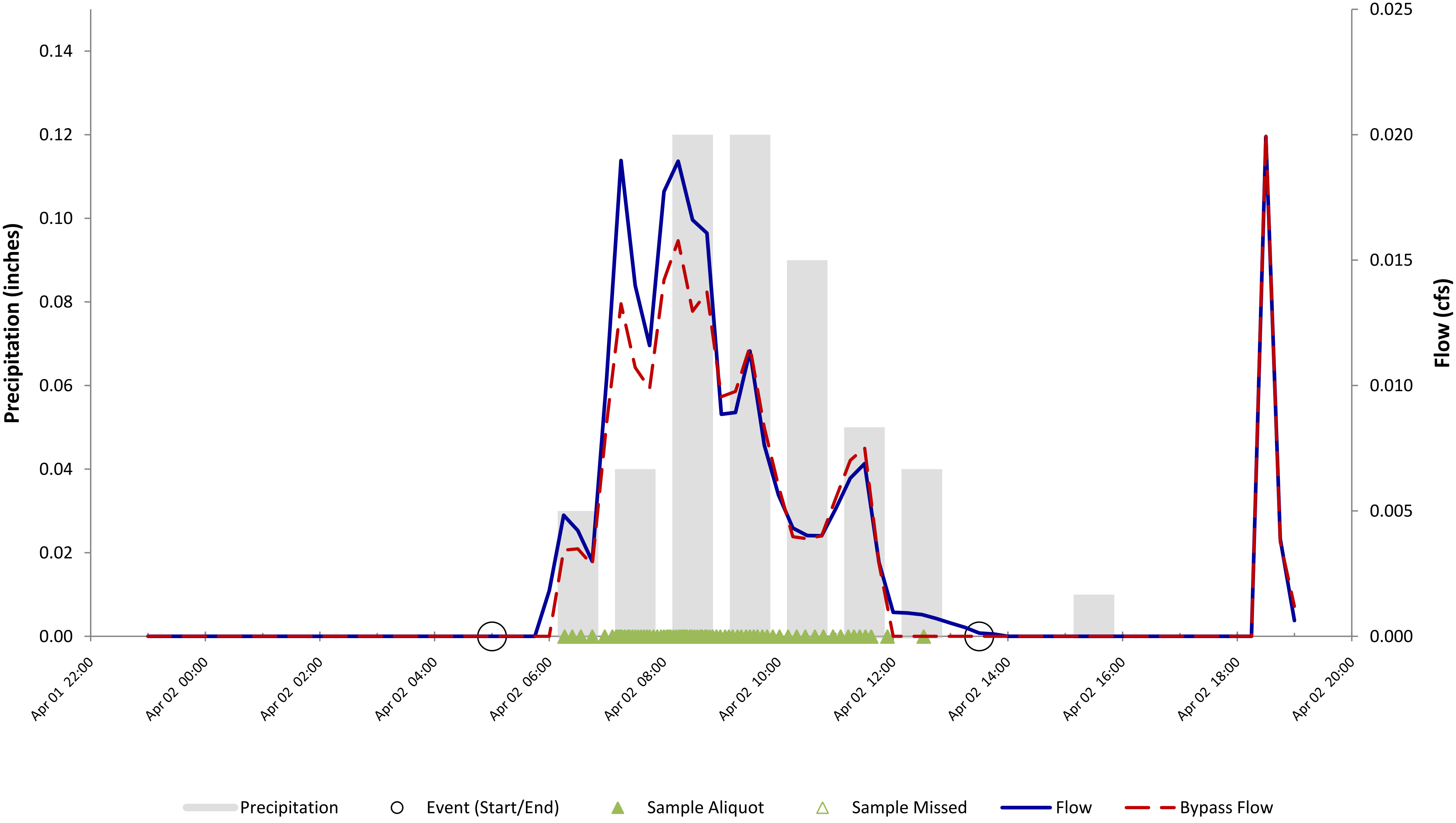

CBSF1-In
Storm Event Hydrograph
SE-06: December 14-15, 2009
Precipitation (inches)
Flow (cfs)
0.14
0.12
0.10
0.08
0.06
0.04
0.02
0.00
0.035
0.030
0.025
0.020
0.015
0.010
0.005
0.000
Dec 14 02:00
Dec 14 04:00
Dec 14 06:00
Dec 14 08:00
Dec 14 10:00
Dec 14 12:00
Dec 14 14:00
Dec 14 16:00
Dec 14 18:00
Dec 14 20:00
Dec 14 22:00
Dec 15 00:00
Dec 15 02:00
Dec 15 04:00
Dec 15 06:00
Dec 15 08:00
Dec 15 10:00
Precipitation
Event (Start/End)
Sample Aliquot
Sample Missed
Flow
Bypass Flow

CBSF1-In
Storm Event Hydrograph
SE-07: March 11, 2010

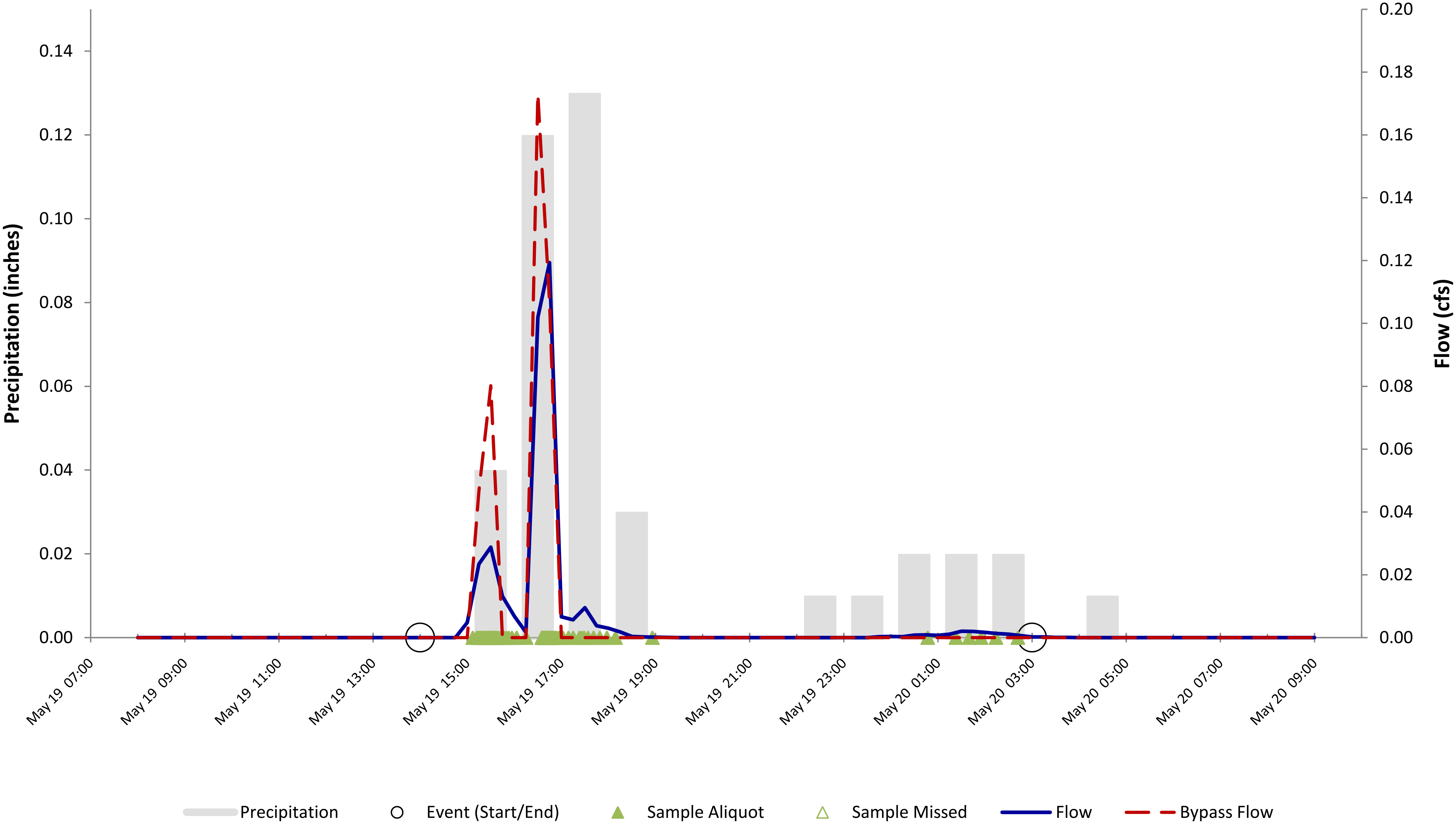


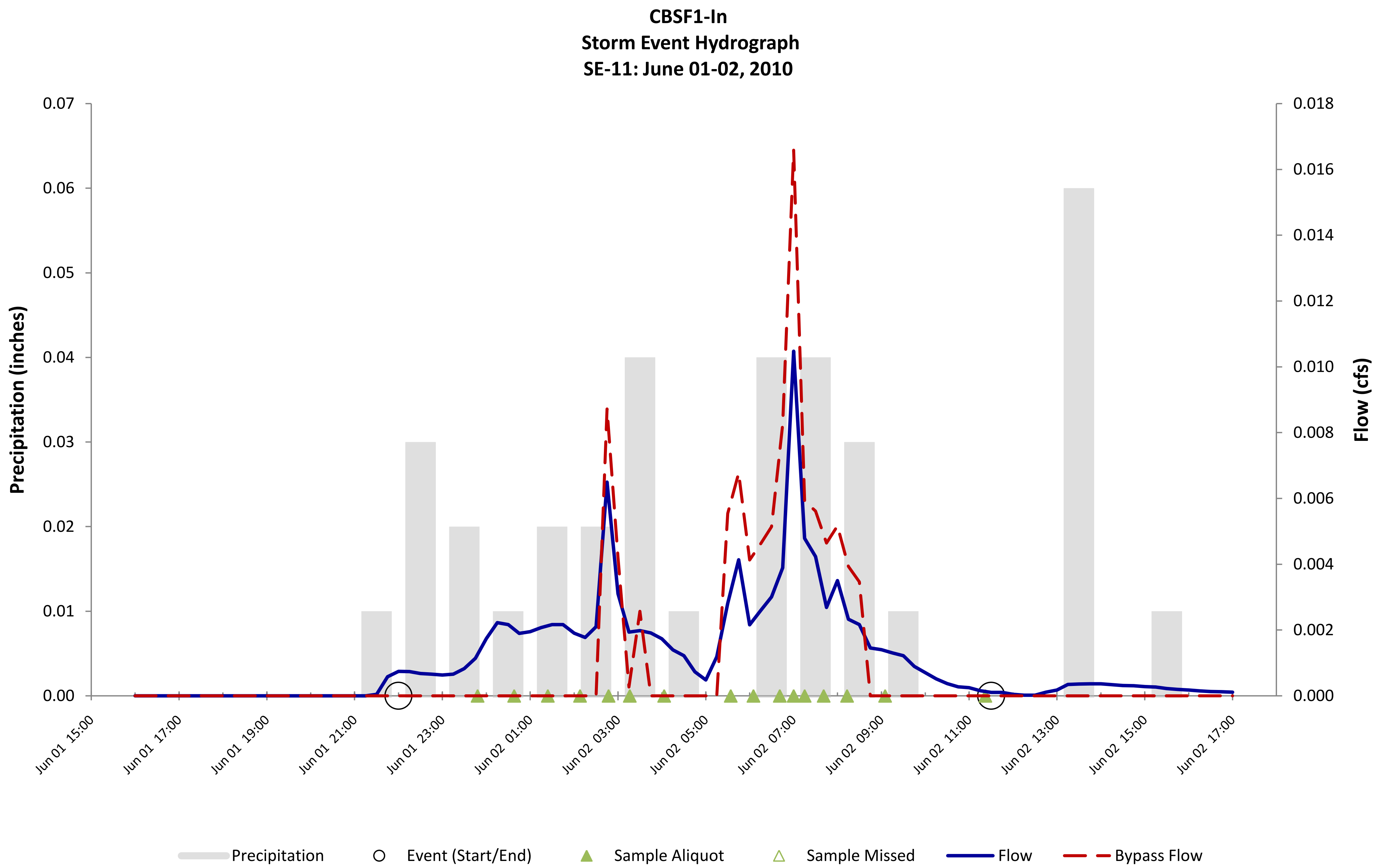

CBSF1-In
Storm Event Hydrograph
SE-08: March 25-26, 2010
Precipitation (inches)
Flow (cfs)
0.12
0.10
0.08
0.06
0.04
0.02
0.00
0.050
0.045
0.040
0.035
0.030
0.025
0.020
0.015
0.010
0.005
0.000
Mar 24 21:00
Mar 25 00:00
Mar 25 03:00
Mar 25 06:00
Mar 25 09:00
Mar 25 12:00
Mar 25 15:00
Mar 25 18:00
Mar 25 21:00
Mar 26 00:00
Mar 26 03:00
Mar 26 06:00
Mar 26 09:00
Mar 26 12:00
Mar 26 15:00
Precipitation
Event (Start/End)
Sample Aliquot
Sample Missed
Flow
Bypass Flow

CBSF1-In
Storm Event Hydrograph
SE-09: April 02, 2010

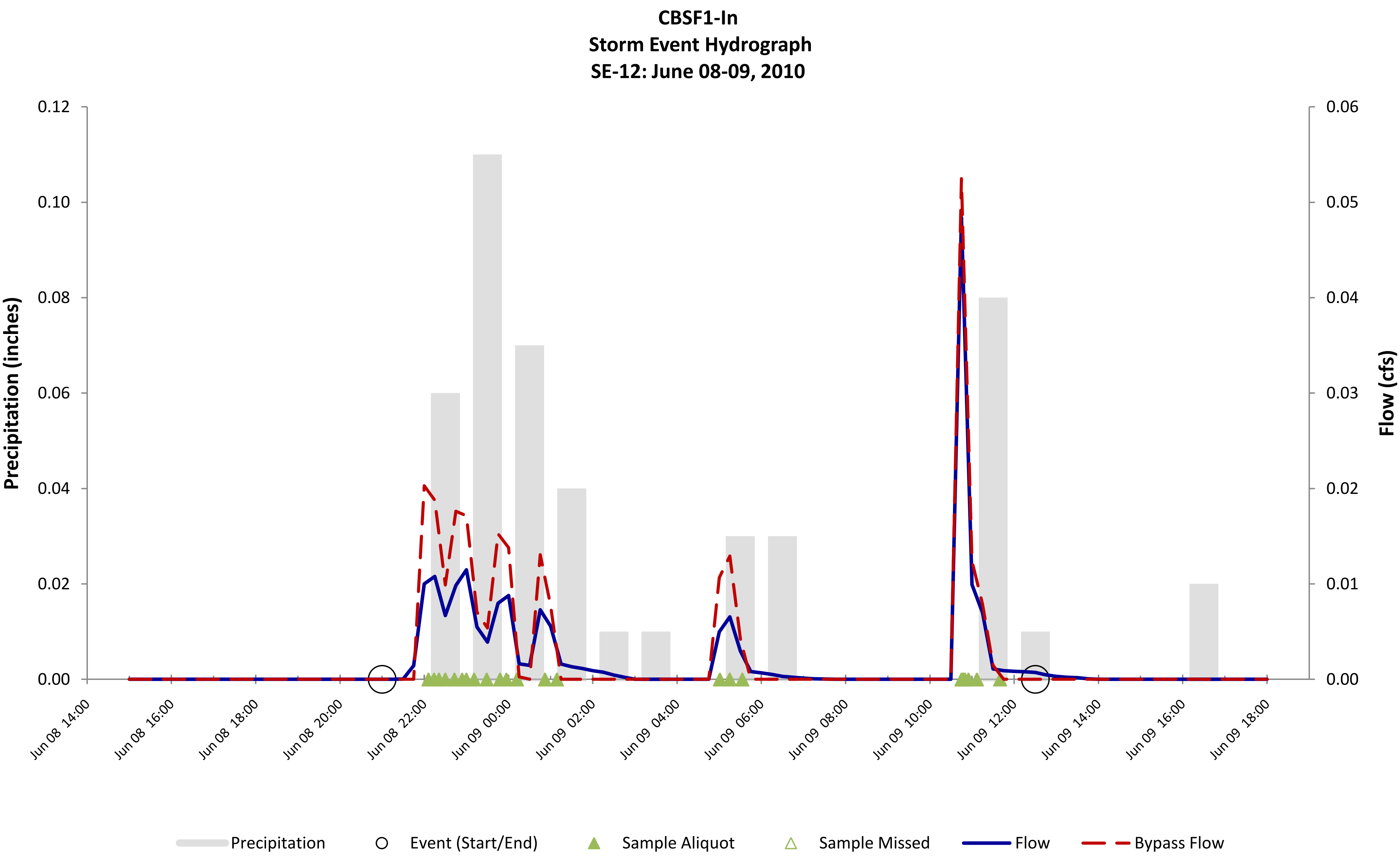


CBSF1-In
Storm Event Hydrograph
SE-10: May 19-20, 2010



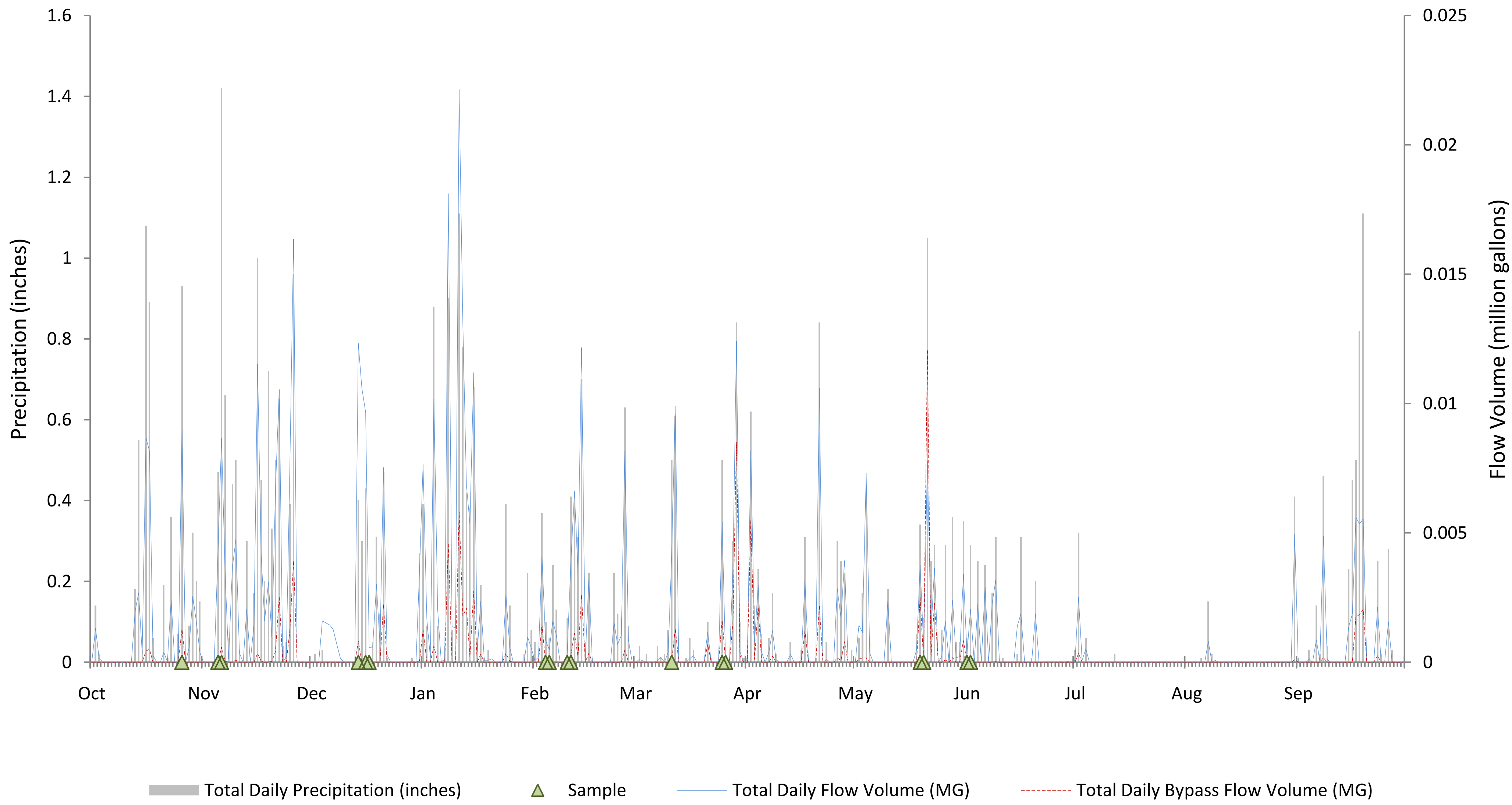


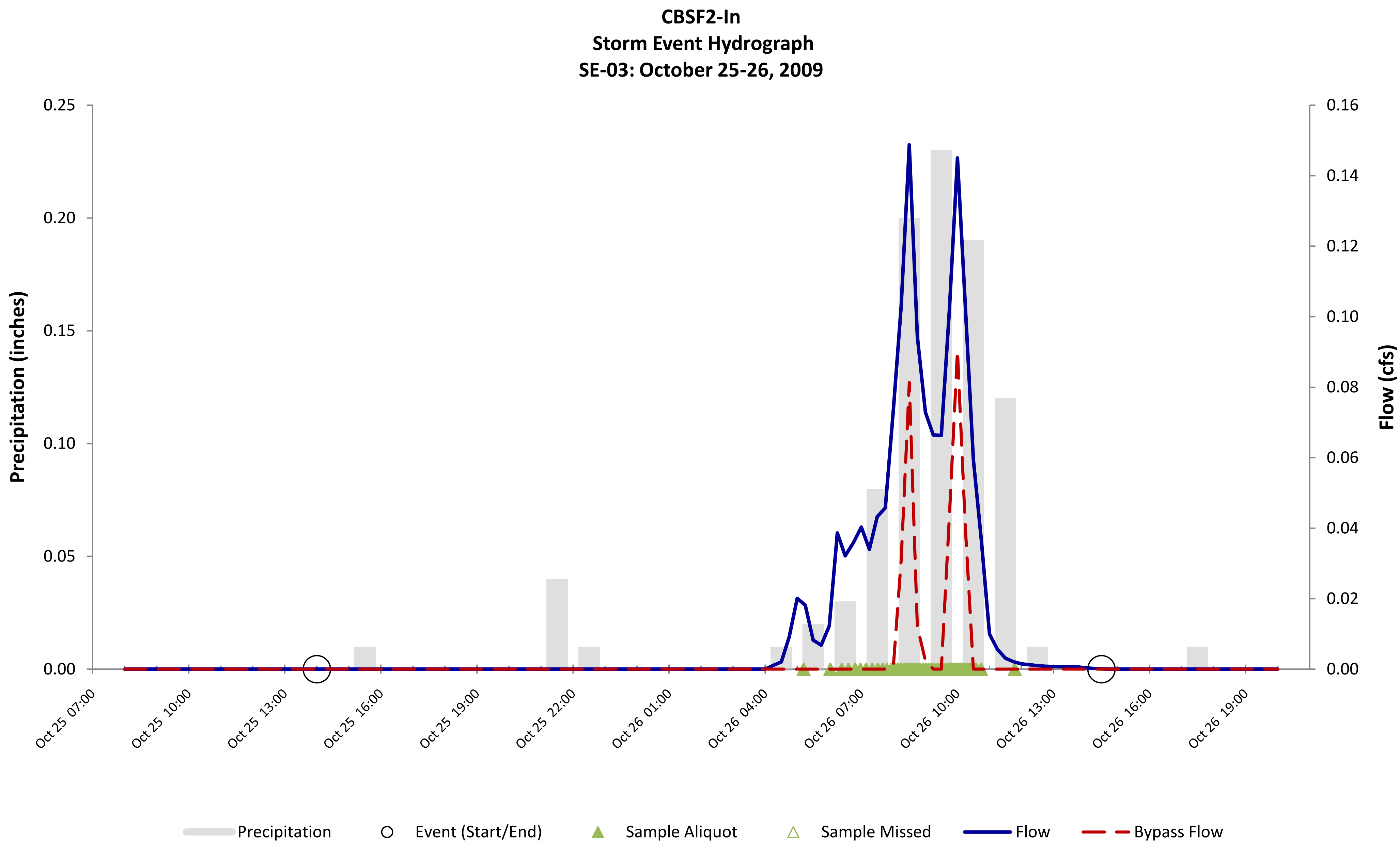
CBSF1-In
Storm Event Hydrograph
SE-11: June 01-02, 2010
Precipitation (inches)
Flow (cfs)
0.07
0.06
0.05
0.04
0.03
0.02
0.01
0.00
0.018
0.016
0.014
0.012
0.010
0.008
0.006
0.004
0.002
0.000
Jun 01 15:00
Jun 01 17:00
Jun 01 19:00
Jun 01 21:00
Jun 01 23:00
Jun 02 01:00
Jun 02 03:00
Jun 02 05:00
Jun 02 07:00
Jun 02 09:00
Jun 02 11:00
Jun 02 13:00
Jun 02 15:00
Jun 02 17:00
Precipitation
Event (Start/End)
Sample Aliquot
Sample Missed
Flow
Bypass Flow



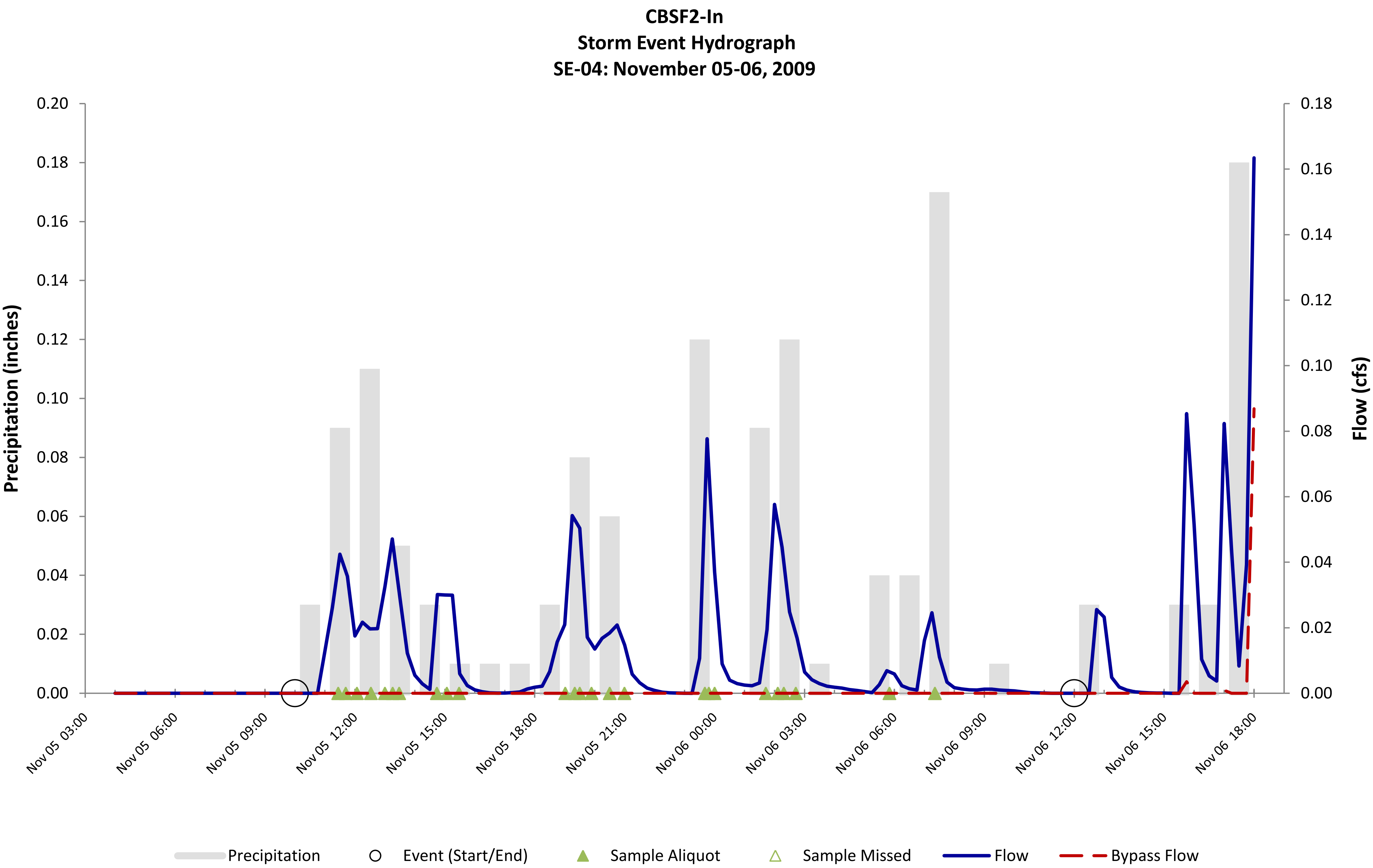
CBSF1-In
Storm Event Hydrograph
SE-12: June 08-09, 2010
Precipitation (inches)
Flow (cfs)
0.12
0.10
0.08
0.06
0.04
0.02
0.00
0.06
0.05
0.04
0.03
0.02
0.01
0.00
Jun 08 14:00
Jun 08 16:00
Jun 08 18:00
Jun 08 20:00
Jun 08 22:00
Jun 09 00:00
Jun 09 02:00
Jun 09 04:00
Jun 09 06:00
Jun 09 08:00
Jun 09 10:00
Jun 09 12:00
Jun 09 14:00
Jun 09 16:00
Jun 09 18:00
Precipitation
Event (Start/End)
Sample Aliquot
Sample Missed
Flow
Bypass Flow

CBSF2
Annual Hydrograph
Water Year: 2010

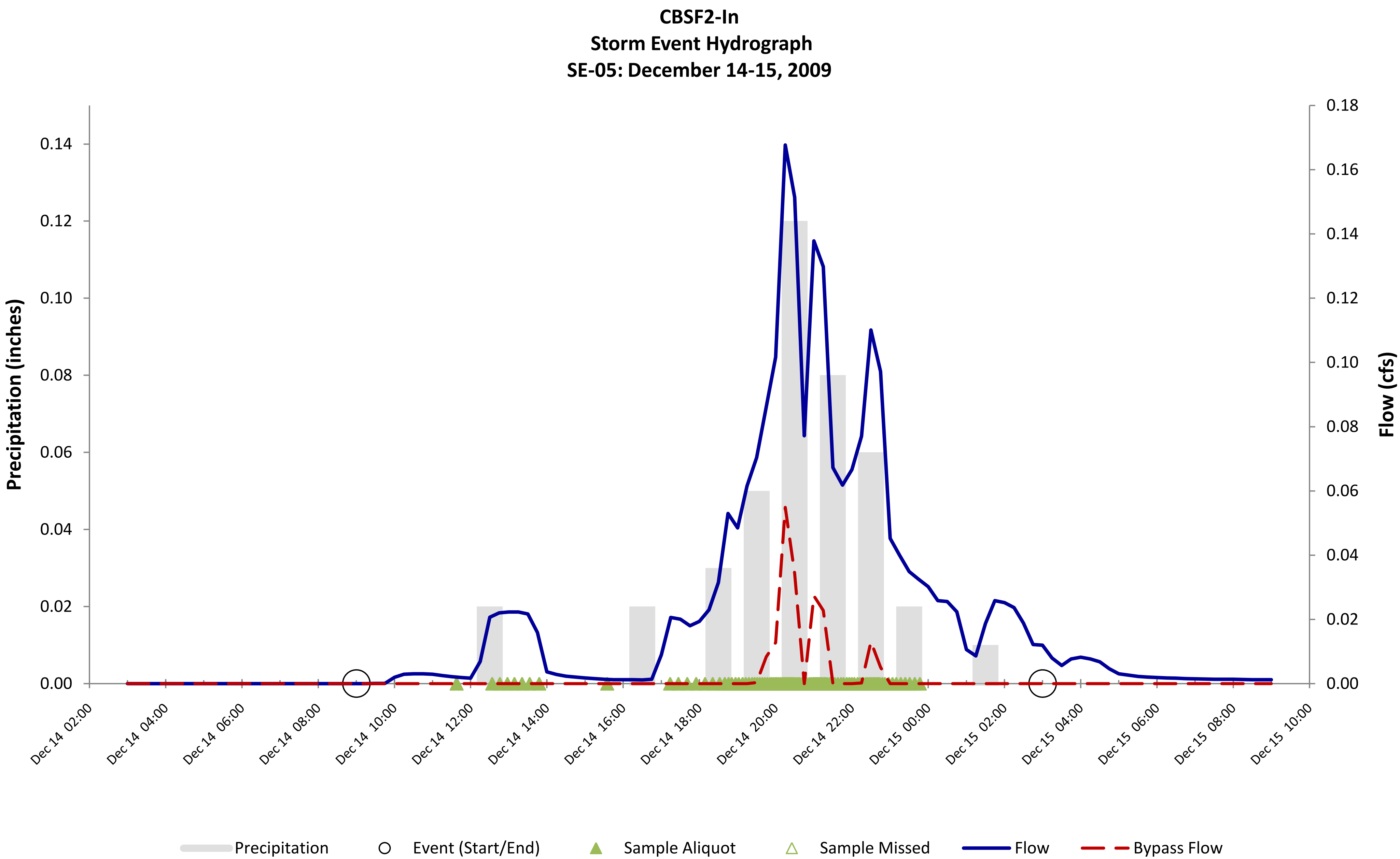


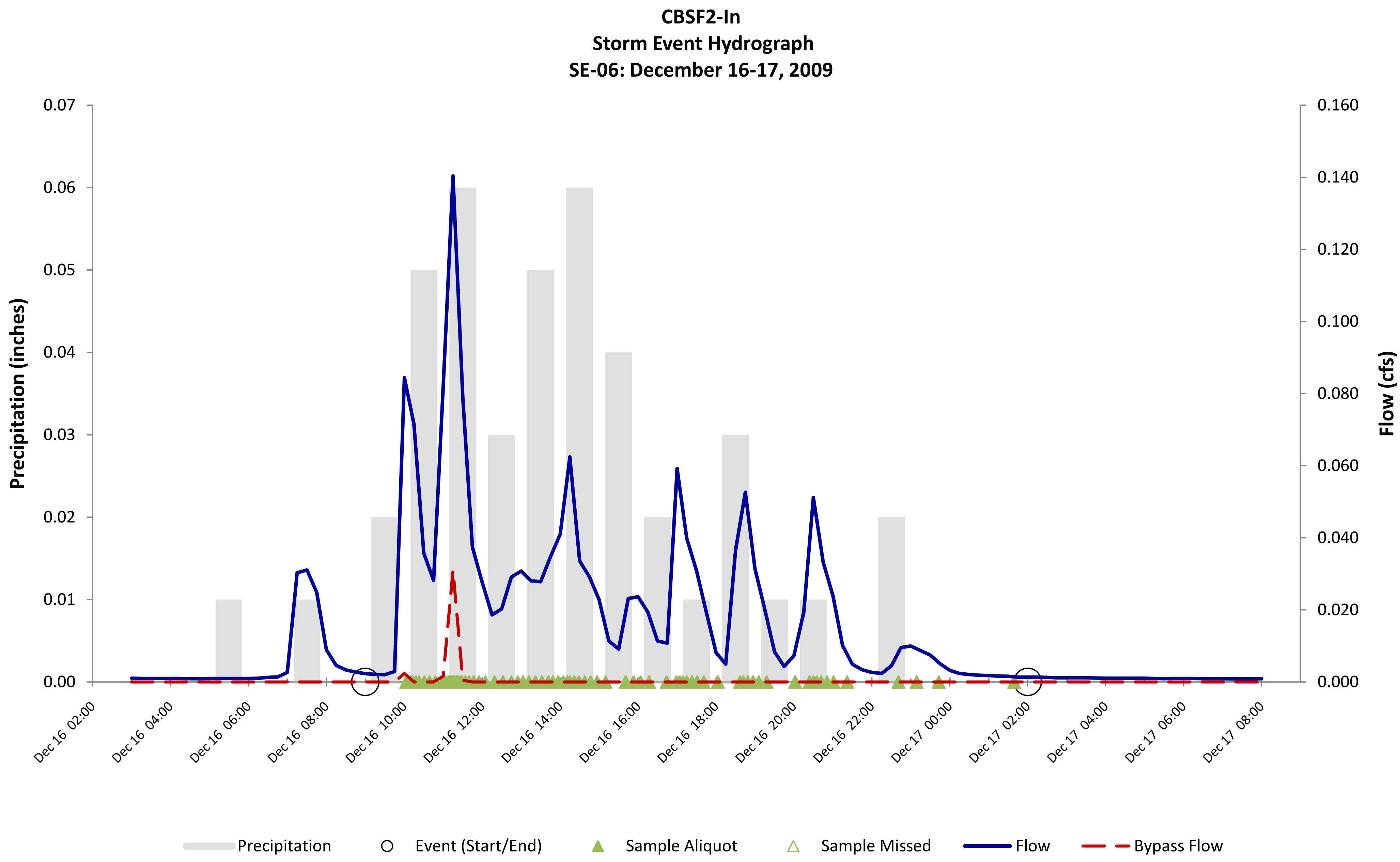


CBSF2-In
Storm Event Hydrograph
SE-03: October 25-26, 2009
Precipitation (inches)
Flow (cfs)
0.25
0.20
0.15
0.10
0.05
0.00
0.16
0.14
0.12
0.10
0.08
0.06
0.04
0.02
0.00
Oct 25 07:00
Oct 25 10:00
Oct 25 13:00
Oct 25 16:00
Oct 25 19:00
Oct 25 22:00
Oct 26 01:00
Oct 26 04:00
Oct 26 07:00
Oct 26 10:00
Oct 26 13:00
Oct 26 16:00
Oct 26 19:00
Precipitation
Event (Start/End)
Sample Aliquot
Sample Missed
Flow
Bypass Flow

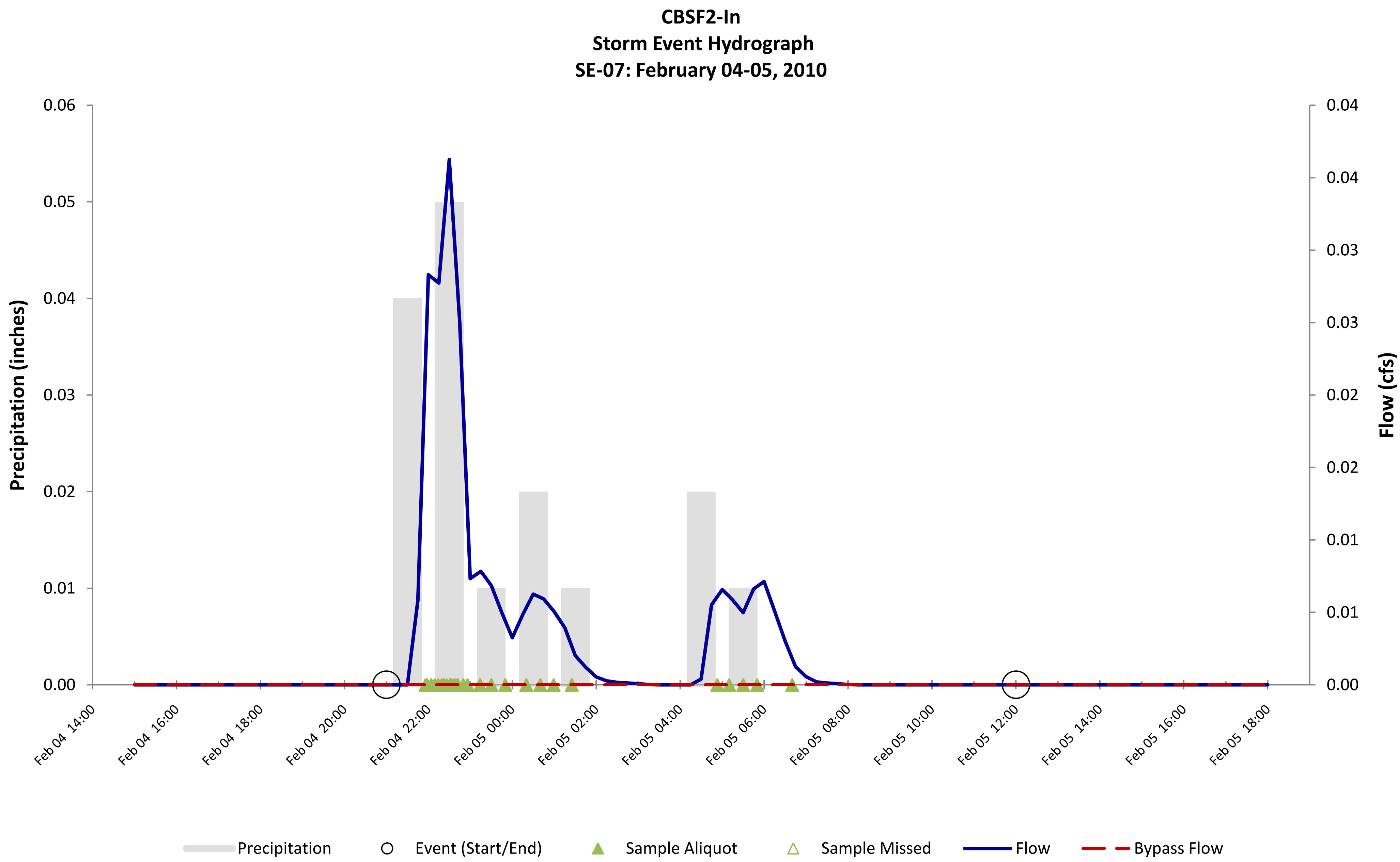


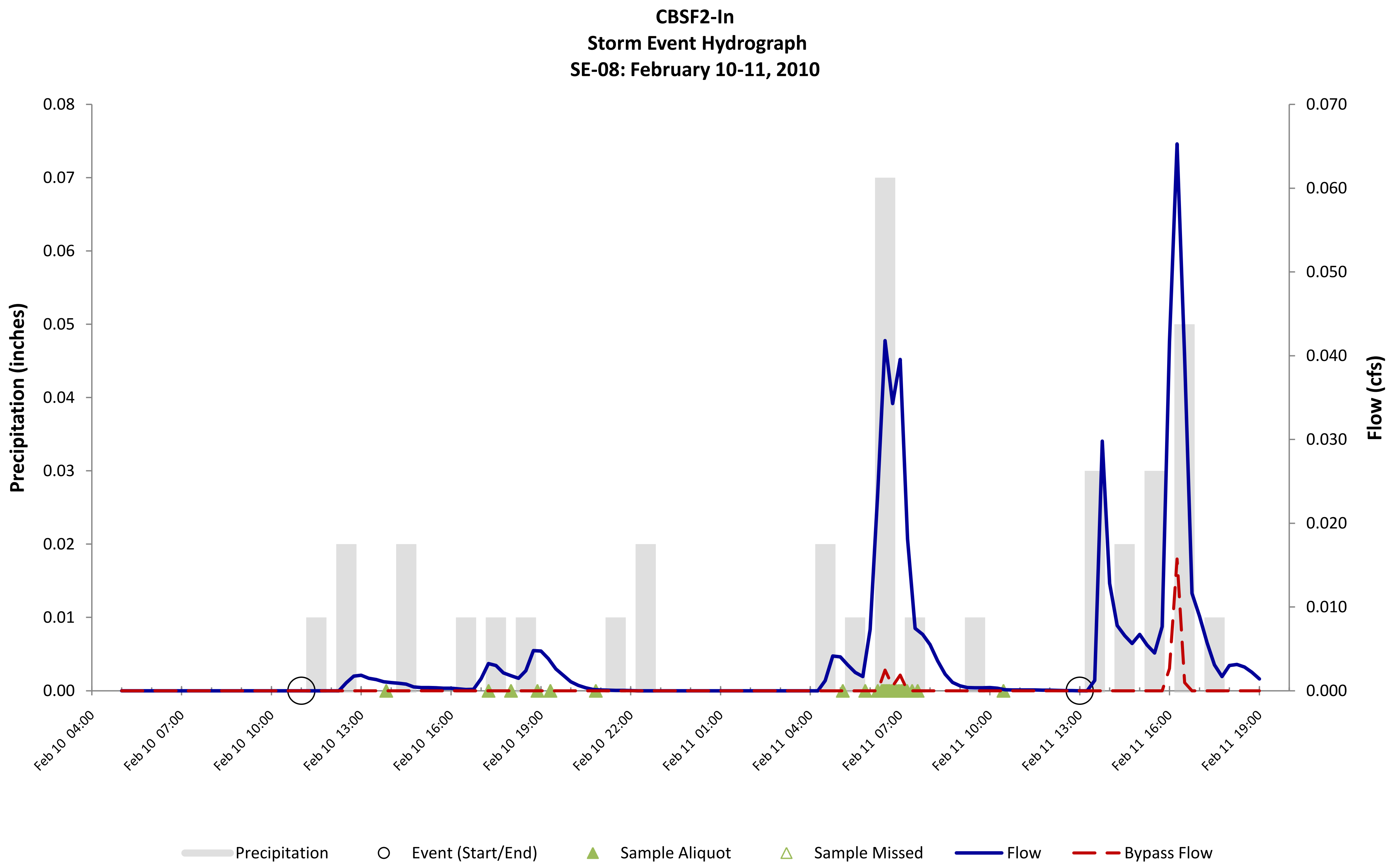
CBSF2-In
Storm Event Hydrograph
SE-04: November 05-06, 2009
Precipitation (inches)
Flow (cfs)
0.20
0.18
0.16
0.14
0.12
0.10
0.08
0.06
0.04
0.02
0.00
0.18
0.16
0.14
0.12
0.10
0.08
0.06
0.04
0.02
0.00
Nov 05 03:00
Nov 05 06:00
Nov 05 09:00
Nov 05 12:00
Nov 05 15:00
Nov 05 18:00
Nov 05 21:00
Nov 06 00:00
Nov 06 03:00
Nov 06 06:00
Nov 06 09:00
Nov 06 12:00
Nov 06 15:00
Nov 06 18:00
Precipitation
Event (Start/End)
Sample Aliquot
Sample Missed
Flow
Bypass Flow


CBSF2-In
Storm Event Hydrograph
SE-05: December 14-15, 2009
Precipitation (inches)
Flow (cfs)
0.00
0.02
0.04
0.06
0.08
0.10
0.12
0.14
0.16
0.18
Dec 14 02:00
Dec 14 04:00
Dec 14 06:00
Dec 14 08:00
Dec 14 10:00
Dec 14 12:00
Dec 14 14:00
Dec 14 16:00
Dec 14 18:00
Dec 14 20:00
Dec 14 22:00
Dec 15 00:00
Dec 15 02:00
Dec 15 04:00
Dec 15 06:00
Dec 15 08:00
Dec 15 10:00
Precipitation
Event (Start/End)
Sample Aliquot
Sample Missed
Flow
Bypass Flow

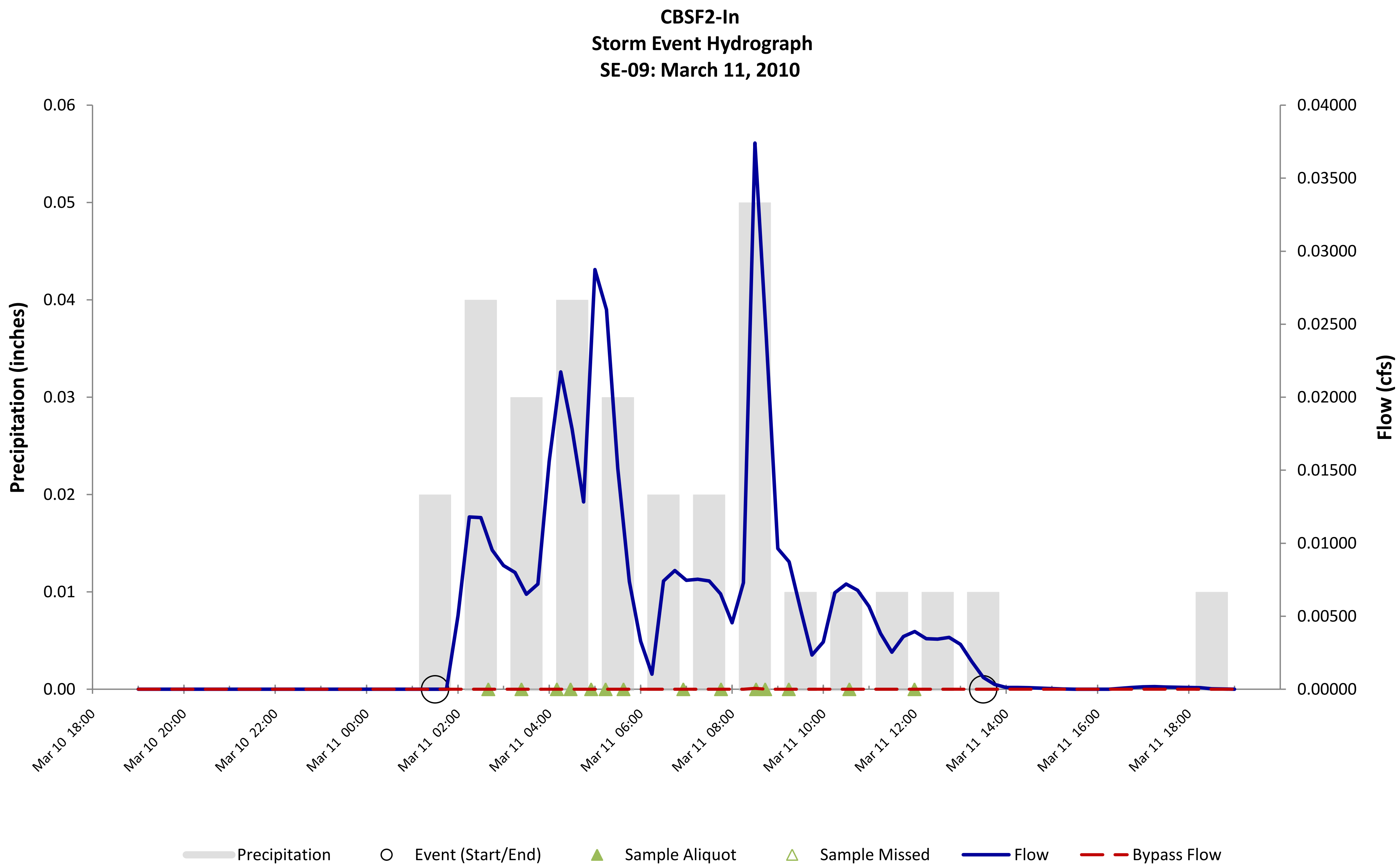


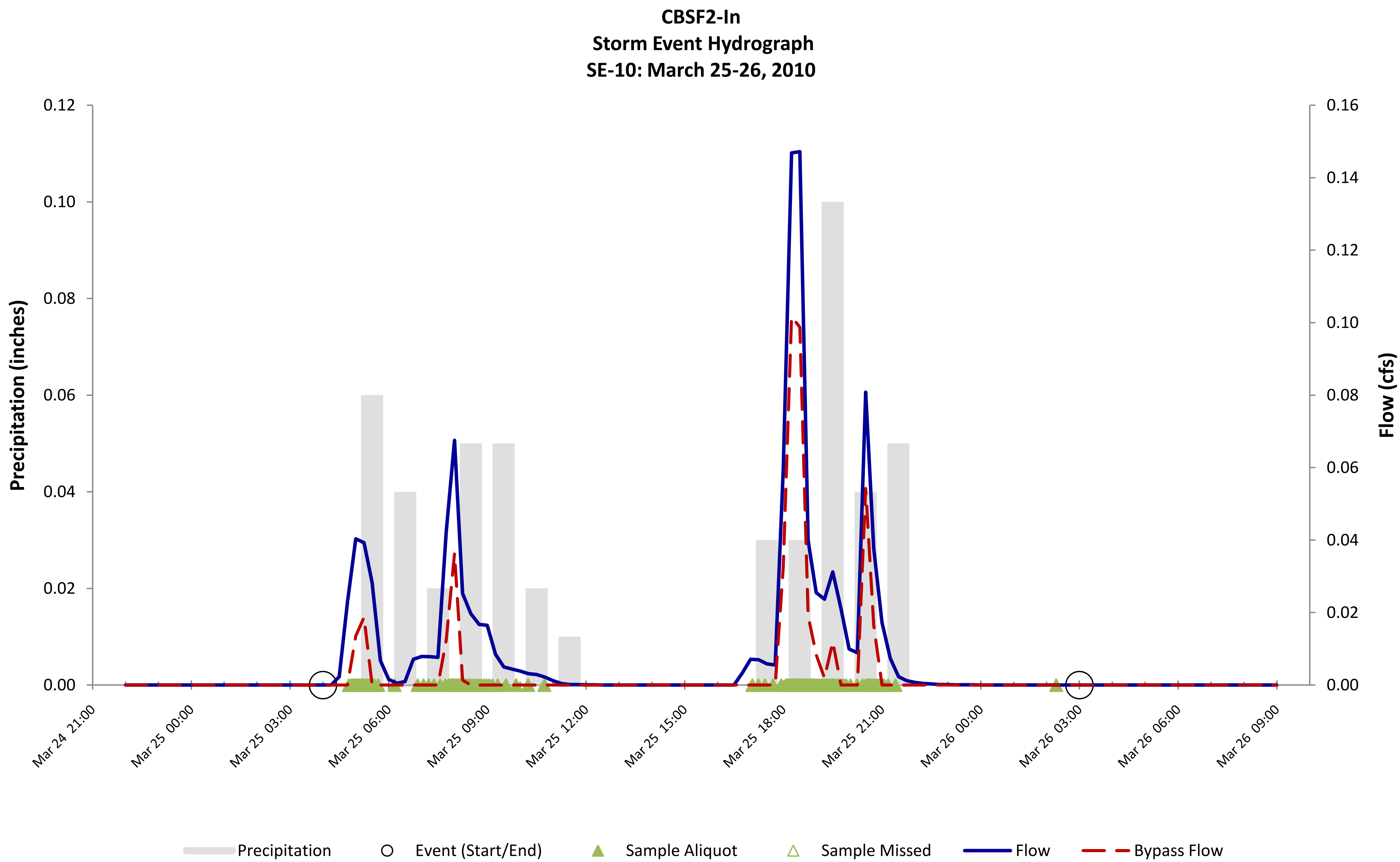
CBSF2-In
Storm Event Hydrograph
SE-06: December 16-17, 2009
Precipitation (inches)
Flow (cfs)
0.07
0.06
0.05
0.04
0.03
0.02
0.01
0.00
0.160
0.140
0.120
0.100
0.080
0.060
0.040
0.020
0.000
Dec 16 02:00
Dec 16 04:00
Dec 16 06:00
Dec 16 08:00
Dec 16 10:00
Dec 16 12:00
Dec 16 14:00
Dec 16 16:00
Dec 16 18:00
Dec 16 20:00
Dec 16 22:00
Dec 17 00:00
Dec 17 02:00
Dec 17 04:00
Dec 17 06:00
Dec 17 08:00
Precipitation
Event (Start/End)
Sample Aliquot
Sample Missed
Flow
Bypass Flow


CBSF2-In
Storm Event Hydrograph
SE-07: February 04-05, 2010
Precipitation (inches)
Flow (cfs)
0.06
0.05
0.04
0.03
0.02
0.01
0.00
0.04
0.04
0.03
0.03
0.02
0.02
0.01
0.01
0.00
Feb 04 14:00
Feb 04 16:00
Feb 04 18:00
Feb 04 20:00
Feb 04 22:00
Feb 05 00:00
Feb 05 02:00
Feb 05 04:00
Feb 05 06:00
Feb 05 08:00
Feb 05 10:00
Feb 05 12:00
Feb 05 14:00
Feb 05 16:00
Feb 05 18:00
Precipitation
Event (Start/End)
Sample Aliquot
Sample Missed
Flow
Bypass Flow

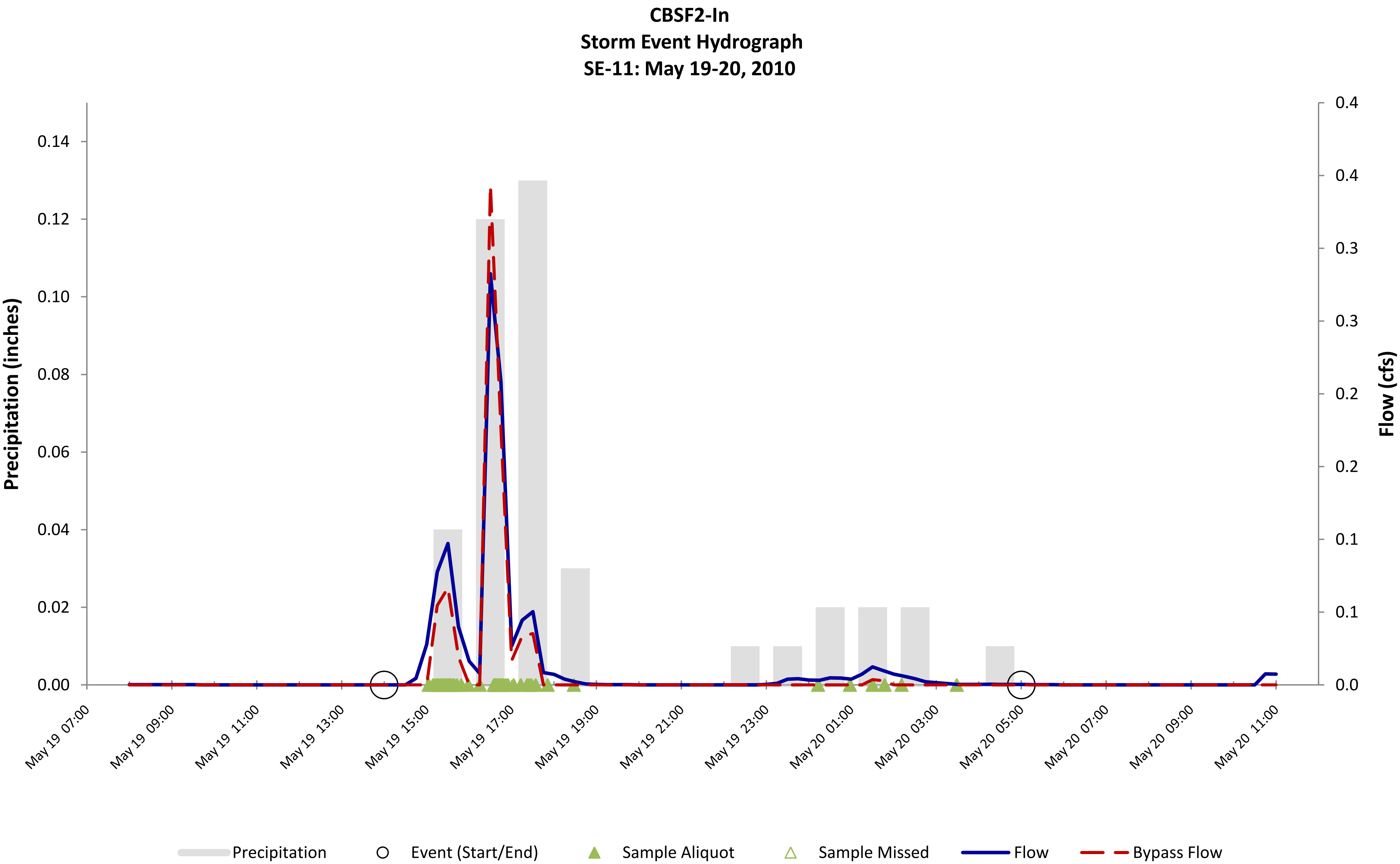


CBSF2-In
Storm Event Hydrograph
SE-08: February 10-11, 2010
Precipitation (inches)
Flow (cfs)
0.08
0.07
0.06
0.05
0.04
0.03
0.02
0.01
0.00
0.070
0.060
0.050
0.040
0.030
0.020
0.010
0.000
Feb 10 04:00
Feb 10 07:00
Feb 10 10:00
Feb 10 13:00
Feb 10 16:00
Feb 10 19:00
Feb 10 22:00
Feb 11 01:00
Feb 11 04:00
Feb 11 07:00
Feb 11 10:00
Feb 11 13:00
Feb 11 16:00
Feb 11 19:00
Precipitation
Event (Start/End)
Sample Aliquot
Sample Missed
Flow
Bypass Flow

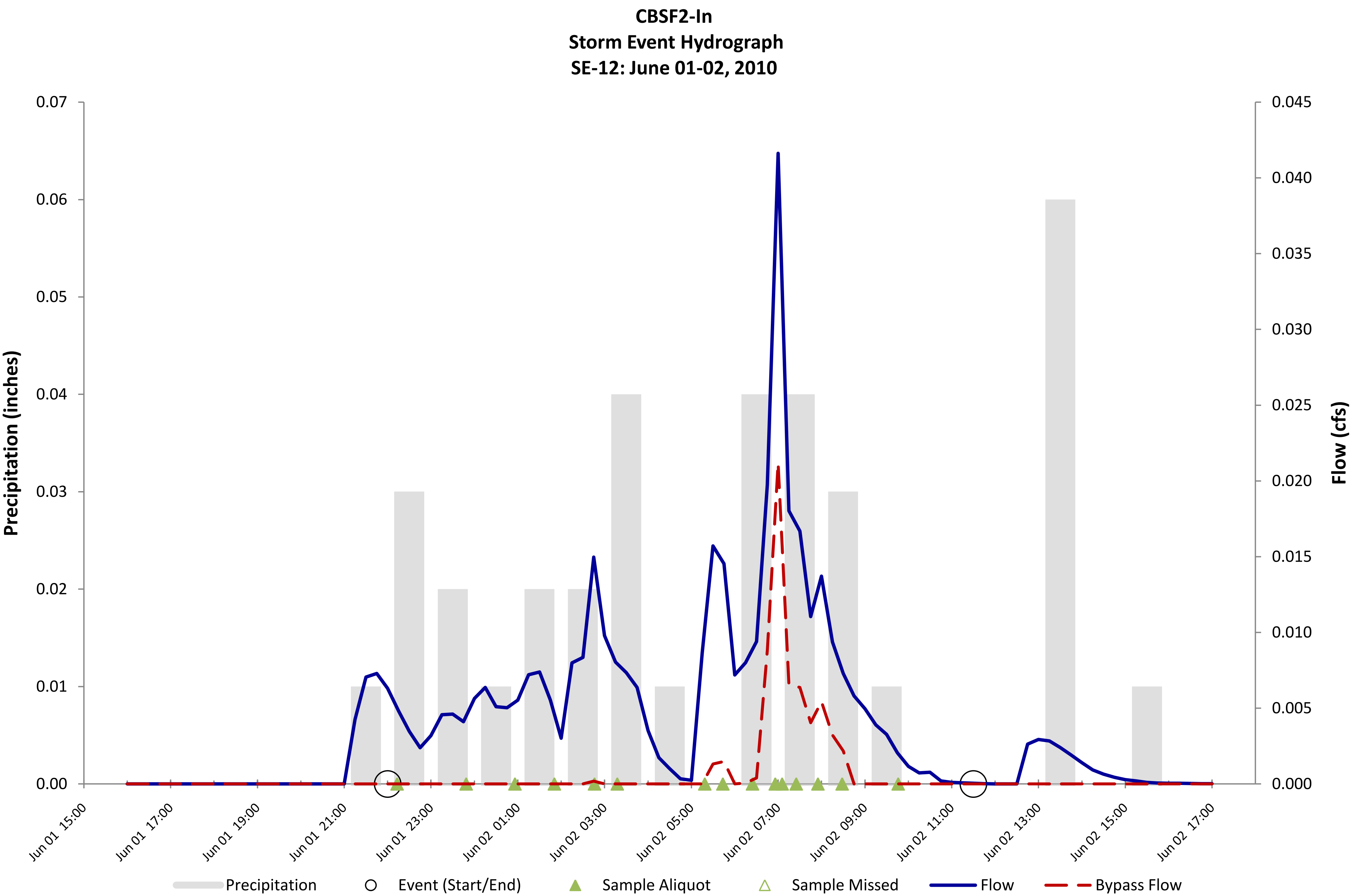

CBSF2-In
Storm Event Hydrograph
SE-09: March 11, 2010
Precipitation (inches)
Flow (cfs)
0.06
0.05
0.04
0.03
0.02
0.01
0.00
0.04000
0.03500
0.03000
0.02500
0.02000
0.01500
0.01000
0.00500
0.00000
Mar 10 18:00
Mar 10 20:00
Mar 10 22:00
Mar 11 00:00
Mar 11 02:00
Mar 11 04:00
Mar 11 06:00
Mar 11 08:00
Mar 11 10:00
Mar 11 12:00
Mar 11 14:00
Mar 11 16:00
Mar 11 18:00
Precipitation
Event (Start/End)
Sample Aliquot
Sample Missed
Flow
Bypass Flow



CBSF2-In
Storm Event Hydrograph
SE-10: March 25-26, 2010
Precipitation (inches)
Flow (cfs)
0.12
0.10
0.08
0.06
0.04
0.02
0.00
0.16
0.14
0.12
0.10
0.08
0.06
0.04
0.02
0.00
Mar 24 21:00
Mar 25 00:00
Mar 25 03:00
Mar 25 06:00
Mar 25 09:00
Mar 25 12:00
Mar 25 15:00
Mar 25 18:00
Mar 25 21:00
Mar 26 00:00
Mar 26 03:00
Mar 26 06:00
Mar 26 09:00
Precipitation
Event (Start/End)
Sample Aliquot
Sample Missed
Flow
Bypass Flow



CBSF2-In
Storm Event Hydrograph
SE-11: May 19-20, 2010
Precipitation (inches)
Flow (cfs)
0.14
0.12
0.10
0.08
0.06
0.04
0.02
0.00
0.4
0.4
0.3
0.3
0.2
0.2
0.1
0.1
0.0
May 19 07:00
May 19 09:00
May 19 11:00
May 19 13:00
May 19 15:00
May 19 17:00
May 19 19:00
May 19 21:00
May 19 23:00
May 20 01:00
May 20 03:00
May 20 05:00
May 20 07:00
May 20 09:00
May 20 11:00
Precipitation
Event (Start/End)
Sample Aliquot
Sample Missed
Flow
Bypass Flow


CBSF2-In
Storm Event Hydrograph
SE-12: June 01-02, 2010
Precipitation (inches)
Flow (cfs)
0.07
0.06
0.05
0.04
0.03
0.02
0.01
0.00
0.045
0.040
0.035
0.030
0.025
0.020
0.015
0.010
0.005
0.000
Jun 01 15:00
Jun 01 17:00
Jun 01 19:00
Jun 01 21:00
Jun 01 23:00
Jun 02 01:00
Jun 02 03:00
Jun 02 05:00
Jun 02 07:00
Jun 02 09:00
Jun 02 11:00
Jun 02 13:00
Jun 02 15:00
Jun 02 17:00
Precipitation
Event (Start/End)
Sample Aliquot
Sample Missed
Flow
Bypass Flow

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