PINE STREET STORMWATER MANAGEMENT FACILITIES STUDY

Town of Highlands

MACON COUNTY, NORTH CAROLINA

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PINE STREET STORMWATER MANAGEMENT FACILITIES STUDY
(INNOVATIVE STORMWATER PROJECT IMPLEMENTATION)

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SEPTEMBER 2011
10.00336

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EXECUTIVE SUMMARY

The Town of Highlands straddles the Eastern Continental Divide in the Blue Ridge Mountains of Western North Carolina. Its position at 4,118 feet above sea level results in unique weather patterns including relatively cool average summer temperatures and nearly 90 inches of rainfall annually. While the 70 degree days in July and the abundant natural resources in the neighboring Nantahala National Forest draw many visitors to the area each year, the extreme rainfall and resulting runoff from developed areas can cause problems for this growing community. Stormwater is a national issue and the Town of Highlands has its own unique stormwater characteristics. Flooding impacts and water quality effects are of primary importance here and across the country.

The purpose of this study is to monitor stormwater runoff pollutant loadings within a small urban watershed of the Town of Highlands and to determine the effectiveness of the innovative stormwater system installed in the Pine Street area. This system consists of the use of a hydrodynamic separation box and an underground stormwater retention structure which were installed as part of the Pine Street Stormwater Treatment project. This technology, according to the manufacturer and based on a review of the current installations, has not yet been previously field tested in an environment like Highlands, which receives a high degree of annual rainfall that often occurs over many short duration, high-intensity events within an urban mountain watershed. The approach used for Pine Street can be considered an engineered BMP (Best Management Practice) system using two technologies which alone or together are not designed to retain large volumes of stormwater, but rather to abate pollutants typically found in developed watershed stormwater runoff.

The study's basic goal was to determine stormwater runoff pollutant loadings from this mountain community's sub-watershed and evaluate the effectiveness of hydrodynamic separators in removing these pollutant loadings. The evaluation also includes a review of the pollutant removal characteristics of the entire system. The key determination of this evaluation is to document the beneficial use of these stormwater technologies in these specific environments. The results of this study can then be used as a baseline for the applicability of these BMPs in other western North Carolina locations.

The evaluation collected rainfall data over the entire study period and looked at twenty (20) specific storm events. Flow modeling was performed for each noted storm event and hydrograph and discharge routing information was developed for each storm monitored. Of the events monitored, one (1) included the full range of data collection (basic water quality data, nutrient data and metals analyses), twenty (20) of the events included basic water quality data, seven (7) included nutrient data, and two (2) included metals analyses. For four of the five cleaning events, sediment capture volume and weight was determined, particle distribution samples were collected and analyzed, coconut fiber pollutant removal performance was determined and general characteristics of the debris and trash removed noted. Detailed information on these efforts, observations about the sampling procedures used, and analytical results are outlined in this report and included in the appendices. Overall, more than 24 water quality parameter results were generated from this effort.

Based on the collection and evaluation of samples and data obtained throughout the October 18, 2010 to July 31, 2011 study period, the following major conclusions can be made:

- The use of hydrodynamic separators similar in design and construction to those employed in the Pine Street system can remove significant amounts of sediment, nutrients and certain types of metals.

- Removal rates for total suspended solids (TSS) are impressive and well beyond North Carolina's performance criteria for post-construction stormwater treatment.

- Average TSS removal ranged from 90-99% for all storm events with influent TSS concentrations greater than 40 mg/L.

- Nutrient data indicate significant removal, with an average of 74% removal of total phosphorus (TP) over the study period and positive removal event rates ranging from 30-95%; total nitrogen (TN) also saw an average of 74% removal over the study period with individual event rates ranging from 35-89%;

- The separators were effective in removing all particles ranging in size from greater than 2 millimeters to less than 0.05 millimeters.

- The fixed coconut fiber filters demonstrated the ability to capture fine particles along with the pollutants associated with the solids. While the ability of the filters to perform is clearly limited due to the fact that once they become saturated, the storm discharge essentially "flows around" the filter, the data shows that pollutants are captured. It is essential that these filters be removed and replaced along with each tank cleaning event to help assure the benefits of this component of the design.

- Critical to the ongoing effectiveness of hydrodynamic separators in removal of pollutants from the affected surface water system and the environment is the regular cleaning and maintenance of the structures and the proper disposal of the material removed.

- Extremely heavy storm events can cause (as in all stormwater systems) the release of huge amounts of debris, bed load and sediment from a watershed that can physically impair the ability of a storm drainage or stormwater treatment system. This means that inspection following such events is critical to the ongoing effectiveness of this BMP.

- Overall system performance data, which includes the effect of the post-separator stormwater underground volume, shows variable effect on outflow quality. This is due to several factors, including sample collection timing, possible biological, chemical and physical changes in the stormwater as it is retained for some time in the storage area and the variable time between storm events.

- Post-separator volume helps to "dampen" the peaking of storm events, but is insufficient in size to provide significant storm storage volume.

The Pine Street stormwater management system provides a reasonable example of the use of a hydrodynamic separator followed by underground storage volume aimed at improving stream quality in a watershed already developed. This or a similarly designed system should be considered for similar watersheds to meet stormwater management objectives. The authors appreciatively acknowledge the staff of the Town of Highlands, particularly Mr. Lamar Nix, PE, which made the successful completion of this document possible. In addition, assistance in gathering and evaluation of the data was provided by Crystal Stream Technologies, the manufacturer of the hydrodynamic separator system.

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1.0 BACKGROUND INFORMATION

1.1 Location

Nestled in one of few temperate rain forests found in North America and surrounded by the Nantahala National Forest, Highlands lies on the highest crest of the Western North Carolina plateau in the Southern Appalachian Mountains. The Town sits at an elevation of 4,118 feet above sea level. This location results in approximately 90 inches of rainfall annually primarily due to the orographic lifting as air masses from the west are forced upward from lower elevation as they approach the Appalachian Mountains. The rising air cools adiabatically raising the relative humidity to 100% creating clouds and frequent precipitation. Incorporated in 1883, Highlands is one of two incorporated towns in Macon County, the other being the County Seat—Franklin. With a small part of the eastern portions of the town located in neighboring Jackson County, Highlands is composed of a central area of commercial activities and surrounding residential areas. The northern portion of the Town includes a reservoir, Lake Sequoyah, formed in 1927 by the construction of a concrete dam across the Cullasaja River. The dam was originally built for hydroelectric generation but is now owned by the Town. The penstock is no longer in use and power generating equipment was removed long ago. Southern dwellers have for decades escaped the summer heat by coming to this picturesque setting and as such there are a large number of seasonal visitors and second home owners in the area.

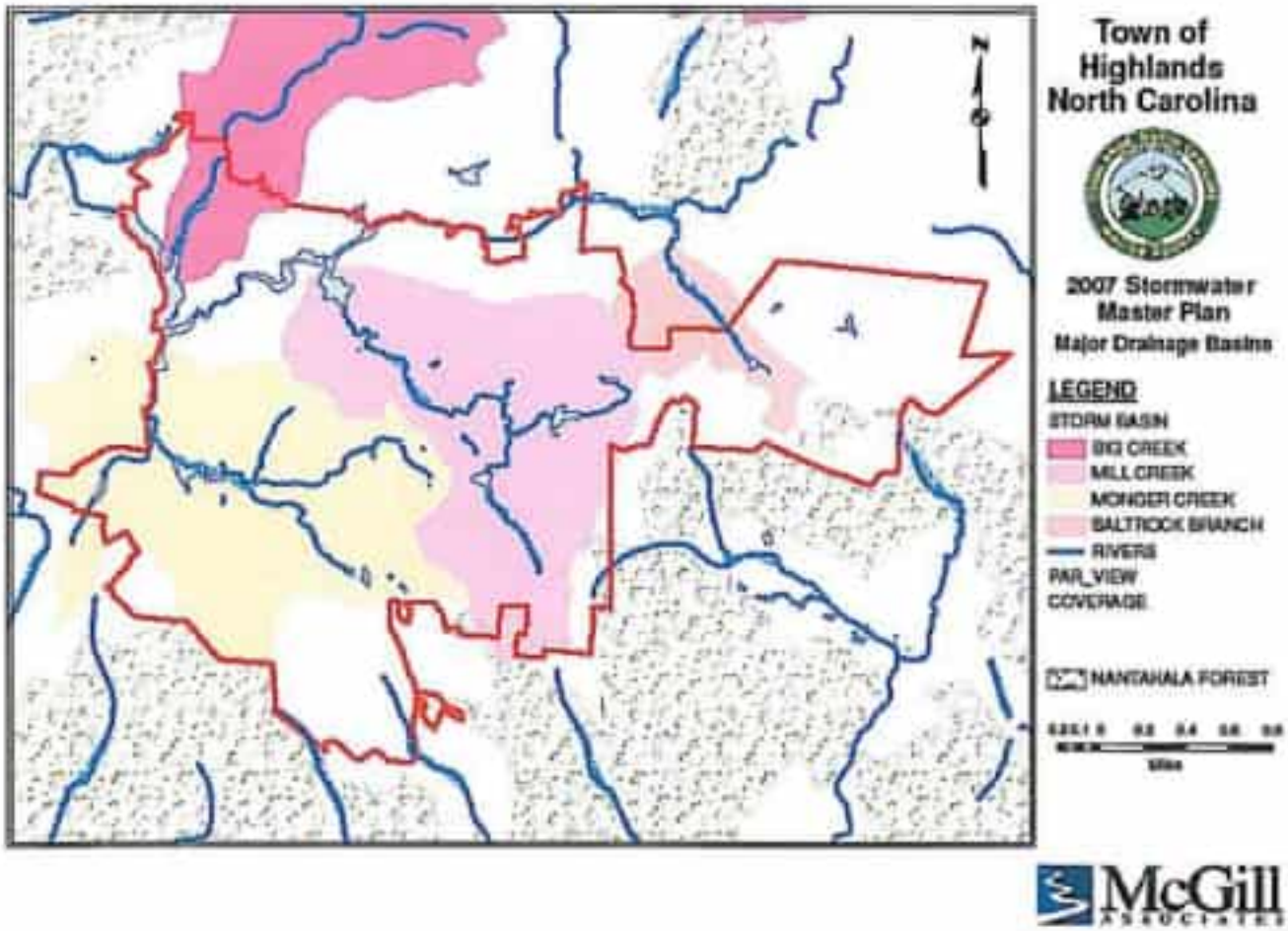
1.2 Hydrology

The Town of Highlands sits atop the Eastern Continental Divide, dividing the town into two major watersheds. The largest area of the 6.25 square miles incorporated area drains north into the Cullasaja River Basin, approximately 4.65 sq miles. The remaining 1.6 sq. mi. discharges into the Chattooga River Basin through Clear Creek and Big Creek (not to be confused with Big Creek that discharges into the Cullasaja River). Highlands generally consists of single family residential development on large, semi-forested lots. There is also one (1) golf course, over twenty lakes and ponds, and an urbanized central business district of about 0.15 square miles within Town limits. Highlands is surrounded by the Nantahala National Forest, with the 3.75 miles of the southern portion of the Town limits bordering it. In addition to a few

portions of the National Forest inside Town limits, there are also approximately eighty (80) acres held in trust by Highlands Cashiers Land Trust.

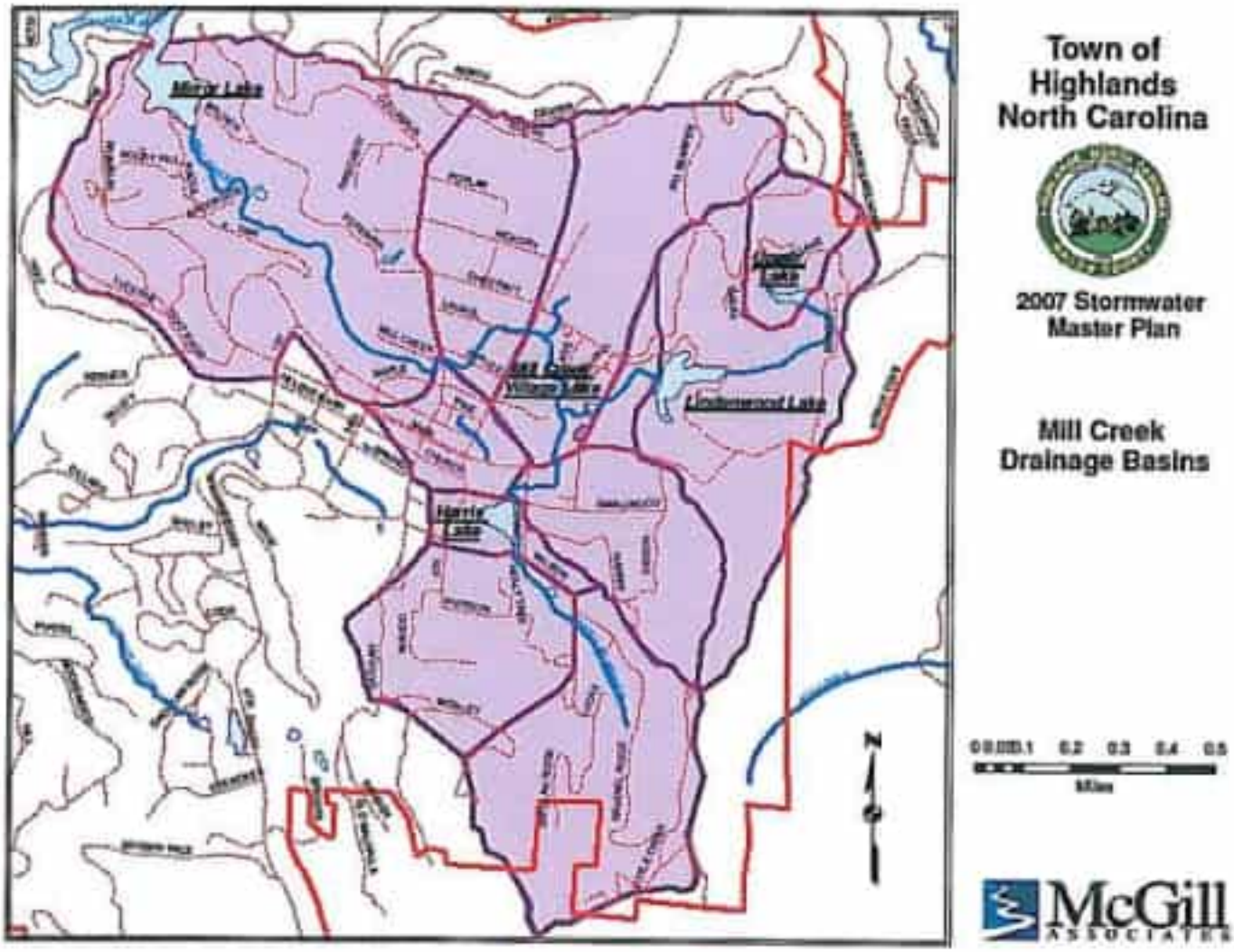
The Cullasaja River is dammed at the northwestern town limits to form the previously noted Lake Sequoyah, which along with Big Creek is a source of drinking water for the Town. The areas of the Town that drain into the Cullasaja River can be divided into four sub-basins: 1) Mill Creek, 2) Monger Creek, 3) Saltrock Branch, and 4) Big Creek, and areas that directly discharge into the Cullasaja River. Figure 1 below illustrates the Cullasaja River watershed sub-basins relative to Town municipal limits.

Figure 1: Town of Highlands Major Drainage Basins



The Mill Creek watershed is approximately 1,095 acres (1.71 sq mi). With the relatively urbanized downtown Highlands located near the center of the basin, and forest preserves at its headwaters, this watershed has a wide variety of land coverage. There is approximately 820 feet of relief in the basin with an average slope through-out the basin of 5.8%; however, some areas have slopes greater than 50%. The basin is dominated by "B" type soils with hydric soils along the streams and in low areas. Mill Creek discharges into Mirror Lake, a private lake on the Cullasaja River upstream of Lake Sequoyah, and also contains two lakes, Harris and Lindenwood (a.k.a. Ravenel Lake or Biological Station Lake) in addition to many smaller lakes and ponds. Figure 2 below illustrates the Mill Creek watershed and its sub-basins.

Figure 2: Mill Creek Drainage Basins



1.3 Stormwater Issues

1.3.1 Water Quality

The North Carolina Division of Water Quality (NCDWQ) Degraded Stream List (303(d) list under the Federal Clean Water Act) identifies Mill Creek as an impaired stream. The primary source of impairment is stormwater nonpoint source pollution, sediment from development and construction activities, and impaired biological integrity due to these and other factors. Each of these impairments is typical of mountain water bodies with significant portions of their drainage that is urbanized or urbanizing. The stream is also classified as a WS-III; Tr- (water supply class III, trout waters) by NCDWQ. Included in the urbanized area of Mill Creek is the drainage of the Pine Street Stormwater Treatment project, the subject of this report. This project was undertaken by the Town to help address stormwater nonpoint pollution in the impaired stream system, focusing on reducing total suspended solids (TSS) and mitigating high velocity of stormwater from the Pine Street drainage outfall that contributes to the section of Mill Creek with impaired biological integrity and degraded stream habitat.

The NCDWQ Degraded Stream List also identifies the Cullasaja River above Mirror Lake as impaired as follows: The Cullasaja River from its headwaters to the SR1545 Bridge at Mirror Lake (4.8 miles). Bioclassification – Fair. The cited water quality impact is "*impaired biological integrity*" caused by dams, hydrological modification of the watershed, and excessive stream velocities due to urban stormwater runoff. A detailed description of this impairment and the evaluation of the noted impacts are thoroughly covered in the following references:

- *Little Tennessee Basinwide Water Quality Plan;* Draft November 2006, NCDWQ, (http://h2o.enr.state.nc.us/basinwide/)
- *Basinwide Assessment Report, Little Tennessee River ;* April 2005, NCDWQ, (http://h2o.enr.state.nc.us/esb/Basinwide/LTN2005.pdf)
- *Upper Cullasaja Watershed Assessment Report*; November 2002, NCDENR (http://h2o.enr.state.nc.us/swpu/)
- The specific impairments relate directly to the 2006 draft 303(d) list, published by NCDWQ, can be found at (http://h2o.enr.state.nc.us/tmdl/documents/2006303dListPublicReviewDraft.pdf)

In addition to the agency evaluations, several local organizations and citizens have demonstrated a strong interest in the water quality of the area, including Mirror Lake and Lake Sequoyah as well as streams within the Highlands area. Specifically, the Upper Cullasaja Watershed Association and the Mirror Lake Improvement Association have noted sediment impacts within the Town drainage area and Mill Creek in particular. The Town of Highlands has consistently addressed these concerns through their local erosion control program and by establishing a strong commitment to effective evaluation and management of stormwater within the Town. While Highlands isn't a designated stormwater management municipality (under State and Federal Law, Phase II of the stormwater requirements), the leadership of the community has undertaken on its own steps to address the impacts from the developed areas within their drainage system. The Town has also taken steps to reduce local flooding from storm events and is working to improve its stormwater infrastructure. The Town developed a Stormwater Master Plan developed in 2007 which has been used as a general blueprint of the stormwater improvement efforts of Highlands.

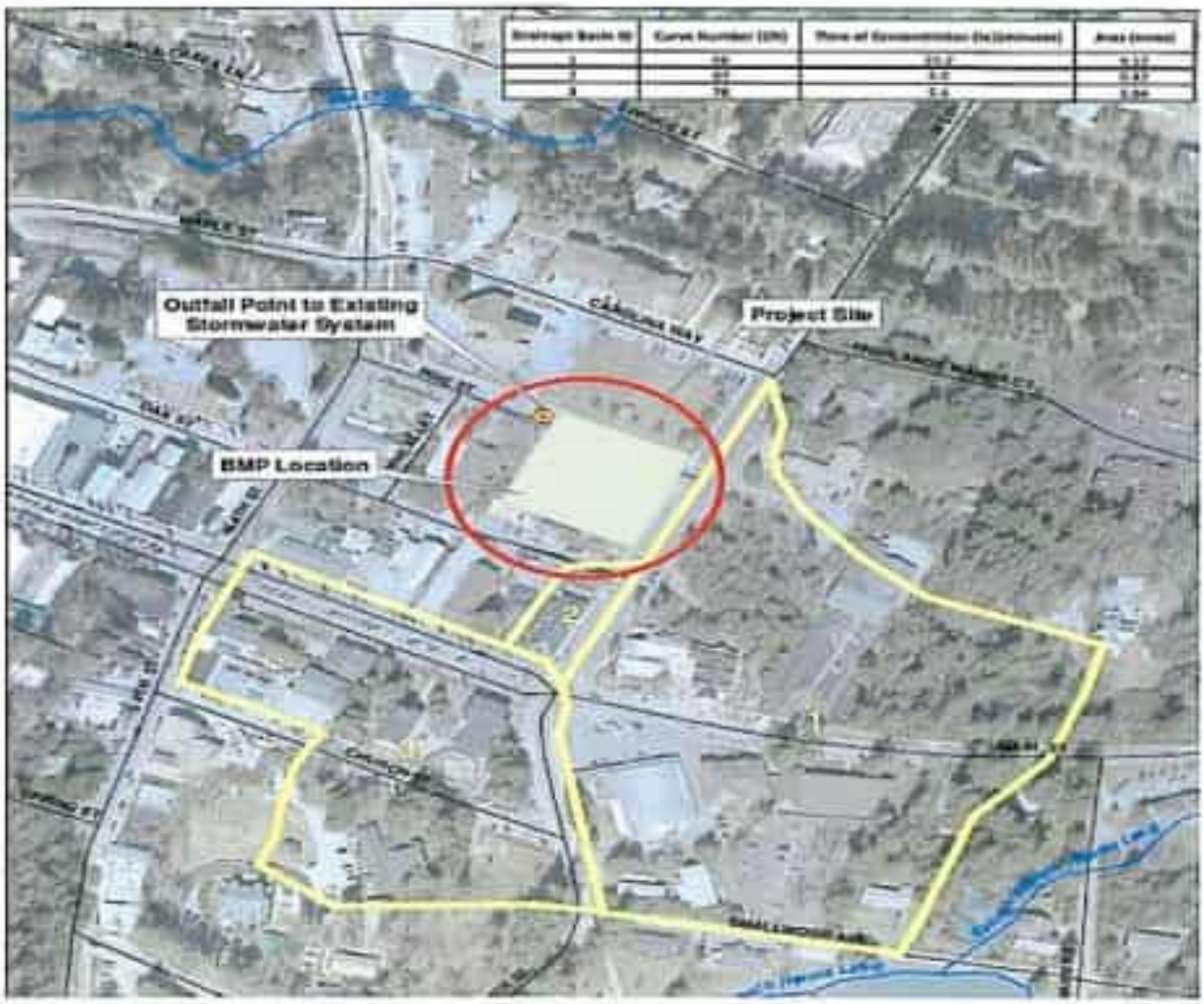
1.3.2 Water Quantity

As residential lots and commercial properties are developed and some small vacation structures are transformed into larger second homes, the Town's stormwater system is further strained, resulting in infrastructure impact and the related effects of increased stormwater velocity, higher flow volumes and sediment and other pollutants going into the lakes and streams of this community. Analysis of the central business district, performed as part of the 2007 Stormwater Master Plan, indicated that much of the stormwater system is not capable of handling the 1-year storm event. Fortunately, many of the culvert crossings in the Mill Creek watershed can pass the 25-year storm event without overtopping; however, most of the culverts are not configured to effectively handle storm flows, leading to on-going maintenance issues. While the infrastructure considerations are important for many reasons, the increased storm energy in the Town's watersheds contribute to water quality issues like pollutant runoff, stream bank erosion and habitat degradation. These impacts to the streams in and around Highlands are highlighted in reports by the NCDWQ and the Upper Cullasaja Watershed Association. The Town, committed to improving its stormwater system and to water quality improvement in all of

its watersheds identified several projects that could positively contribute to these efforts. One of the areas identified is the Pine Street drainage.

The Pine Street Stormwater Treatment project watershed sub-basin area consists of approximately 14.6 acres located within and adjacent to the central business district. A small unnamed stream tributary to Mill Creek flows through the sub-basin and is routed under Fifth Street where it then becomes very narrow as it meanders between several businesses before discharging to Mill Creek. The Fifth Street stream crossing has historically been a site of frequent flooding due to the local topography and the relative inability of the narrow downstream sections of the stream to pass significant peak flow events without surcharging. Figure 3 below illustrates the project area watershed.

Figure 3: Project Area Watershed



2.0 SYSTEM DESIGN AND CONSTRUCTION

2.1 Overall System Design

In 2006, the Town of Highlands received stormwater mini-grant funding from the Clean Water Management Trust Fund to complete a stormwater master plan for the Mill Creek watershed. The results of this master plan included recommended stormwater quality capital improvement projects in the Mill Creek basin. The Pine Street Stormwater Treatment project addresses two of the capital projects from the master plan.

The approach of most communities towards managing stormwater quantity is to simply convey it to a nearby waterway as efficiently as possible, including in some cases a detention pond or bio-retention facility if space and funding allows these treatment steps. The Pine Street Stormwater Treatment project was envisioned and designed to consist of the construction of a new stormwater conveyance system, improving the capability of the system to handle peak flows and physical treatment of the initial flush of stormwater through the use of a hydrodynamic separator and underground stormwater detention facility. The system would effectively manage stormwater from Fifth Street and Pine Street Park to improve stormwater quality and dampen peak flows prior to ultimately discharging to Mill Creek. The system also represents a good use of property within the central business district and employs facilities and technologies that allow for the continued use of the property as a Town amenity.

The new stormwater system was installed during construction of Pine Street Park located in downtown Highlands. The system was designed to accommodate a 25-year storm event by collecting stormwater runoff in areas where higher volumes of water were anticipated to accumulate. The collection system included a box culvert under Fifth Street which conveys flows from the unnamed tributary to a junction box. This junction box was designed with a weir wall and both a 12-inch and 36-inch (equivalent) outflow pipes; normal flows from the unnamed tributary remain below the weir wall and flow out the 12-inch discharge pipe to the downstream natural drainage channel that flows by several area businesses. This important component of the project allows base flow to stay within a natural channel, but diverts high energy flow with runoff pollutants to the treatment system and new stormwater conveyance system. This configuration not only reduces flooding and removes pollutants from the stormwater but also

protects the natural channel section from the effects of storm events. During periods of increased flows, water tops the junction box weir wall and flows through the 36-inch pipe section to a second junction box fitted with a weir wall; flows less than the 25-year design storm are routed to the hydrodynamic separator and excess flows are routed over the weir wall and bypass the treatment system via new stormwater piping. All treated stormwater is conveyed into a closed (underground) system to the hydrodynamic separator where it is screened and filtered to improve stormwater quality before entering the underground detention/attenuation system. The underground detention system is used to dampen stormwater runoff peaks and reduce runoff velocities when the system experiences high velocity flows. Upon exit from the underground detention system, the stormwater is routed to the downstream channel and discharges to Mill Creek. Figures 4 and 5 below illustrate the collection and treatment system schematic flow diagram and plan layout.

Figure 4: Pine Street Stormwater Treatment System Schematic Flow Diagram

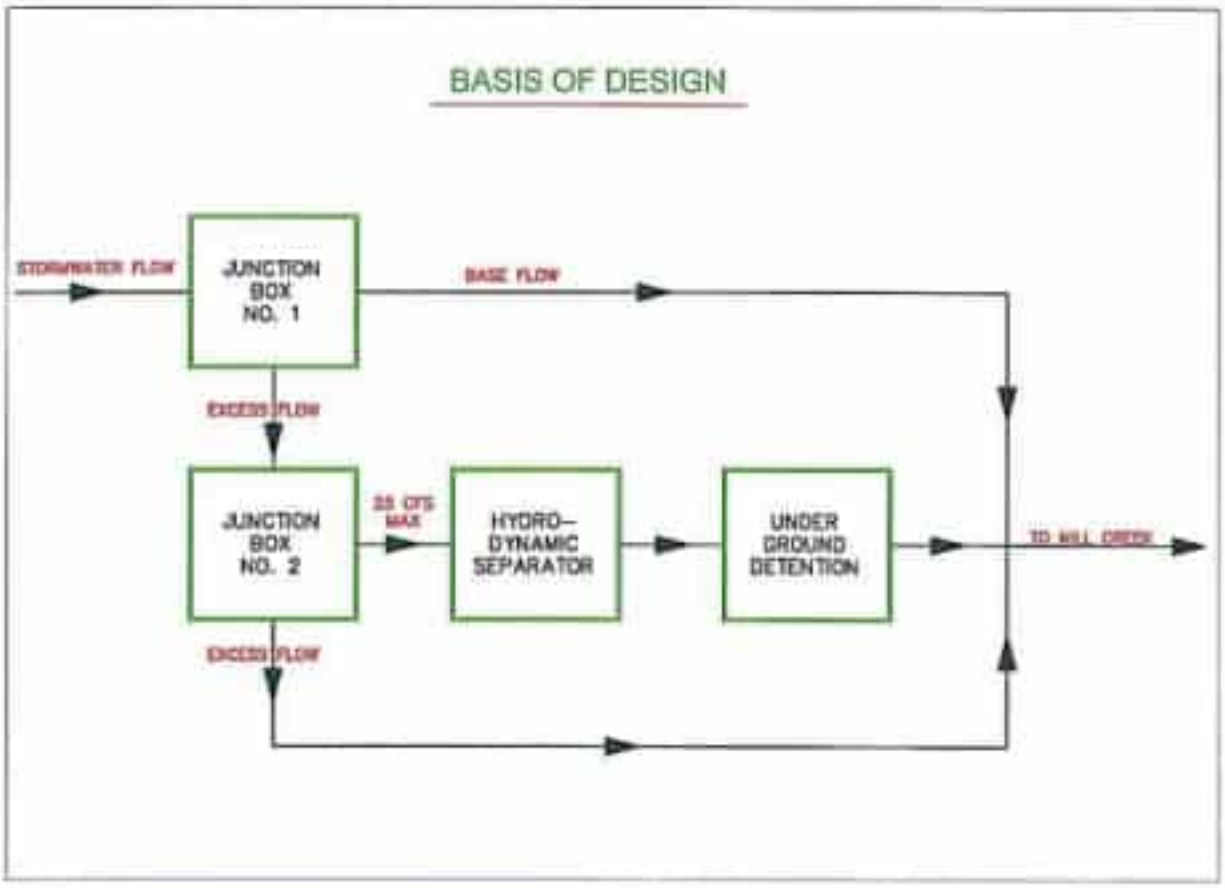
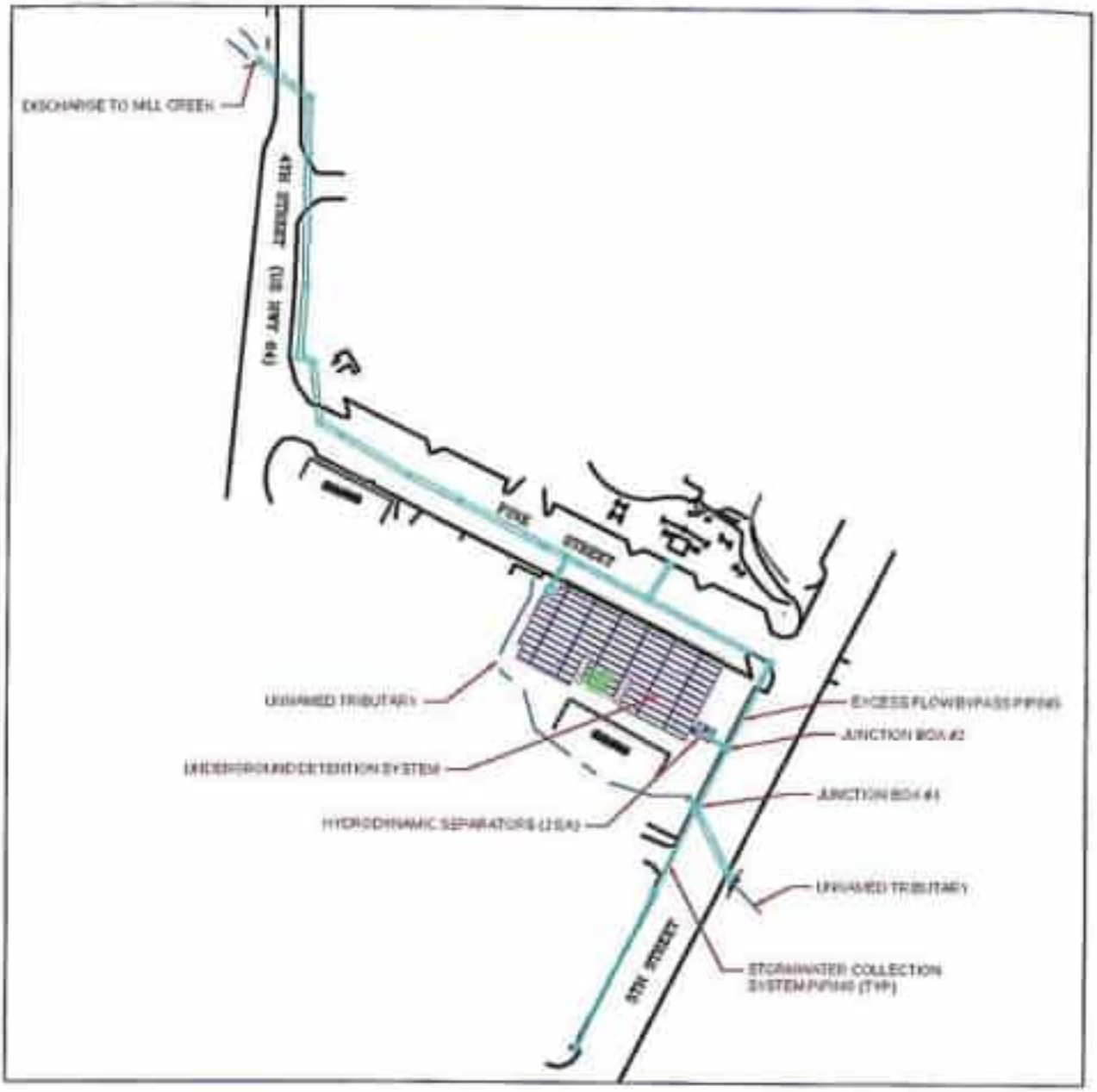


Figure 5: Pine Street Stormwater Treatment System Layout



2.2 Hydrodynamic Separator

The stormwater hydrodynamic separator installed as part of this project collects stormwater runoff and passes it through a series of chambers that removes pollutants before the runoff is released. This treatment is conducted in an area much smaller than a typical detention pond footprint, is underground, and is ideal for an urban setting where aesthetics and limited land area must be considered. The hydrodynamic separator proved to be an ideal stormwater treatment solution for the Town of Highlands since adequate square footage was not available for a water quality detention pond, but still allows for significant improvement of stormwater quality. This technology allowed the Town to accomplish the project's dual purpose; to both improve the water quality of Mill Creek and better manage stormwater flow volume from the watershed.

The hydrodynamic separator boxes were selected for installation to address the primary issue of TSS and sediment in stormwater flows and to prevent those pollutants from ending up in Mill Creek. The hydrodynamic separator collects and traps TSS and other pollutants to prevent these materials from entering into surface waters. The hydrodynamic separator boxes also facilitate the collection of surface debris that typically pollutes waterways in the form of grass clippings, leaves and trash. The hydrodynamic separators also have the potential to address removal of other stormwater runoff pollutants such as nitrogen, phosphorus and heavy metals.

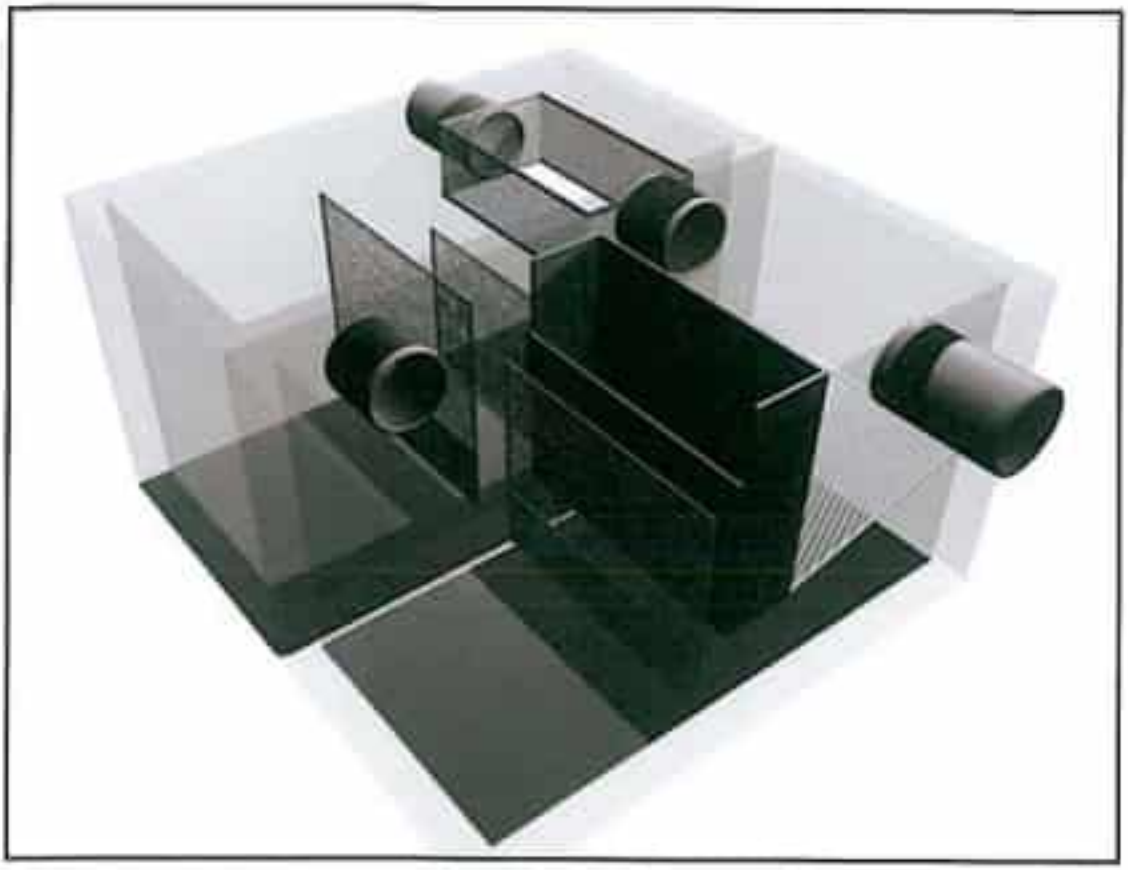
Figure 6 below illustrates the CrystalStream Technologies hydrodynamic separator boxes that were installed as part of the project. Influent stormwater is conveyed to Unit #1 and passes through a coarse screen basket where larger solids and debris are retained. The stormwater flows through the screen and passes through two (2) perforated weir plates which slow the water velocity to improve particle settling. The coarse screen and perforated weir plates are designed to unseat (move out of the way) during high flow events to allow flow to pass through the system and to keep the stormwater flowing through the system. Stormwater is then conveyed to Unit #2 where it passes through an additional perforated weir plate and an oil/water separator baffle wall; the oil/water separator collects all floatables while allowing the stormwater to pass underneath. Stormwater then flows upward through a ¾-inch coconut fiber filter in the rear chamber of the device prior to discharging out of Unit #2 and into the underground detention system. This

fabric filters almost all of the water that comes through the device, but can tilt up out of the way during high flow events, keeping the flow moving through the system.

The hydrodynamic separator was specified to meet the following design criteria:

Hydraulic Capacity	25 cfs
TSS Removal	85%
Phosphorous Removal	35%

Figure 6: CrystalStream Technologies Hydrodynamic Separator



Note: Unit #1 located on upper left side; Unit #2 located on lower right side

2.3 Underground Detention System

In addition to the hydrodynamic separator which addresses water quality, an underground detention system was installed immediately downstream of the hydrodynamic separator to address water quantity by retaining high volume flows and reducing velocities during storm events. The 32,150 ft^3 capacity underground detention system utilized RainTank® subsurface water storage structures which provide 95% void area for storage volume. This system maximizes the available area for underground detention due to its modular construction, cube geometry, and low clearance. Pictures 1 and 2 below depict a typical RainTank® unit and assembly installation. A perforated weir plate was installed in the outlet junction box to slow flow though the detention system and dampen peak flow discharges.

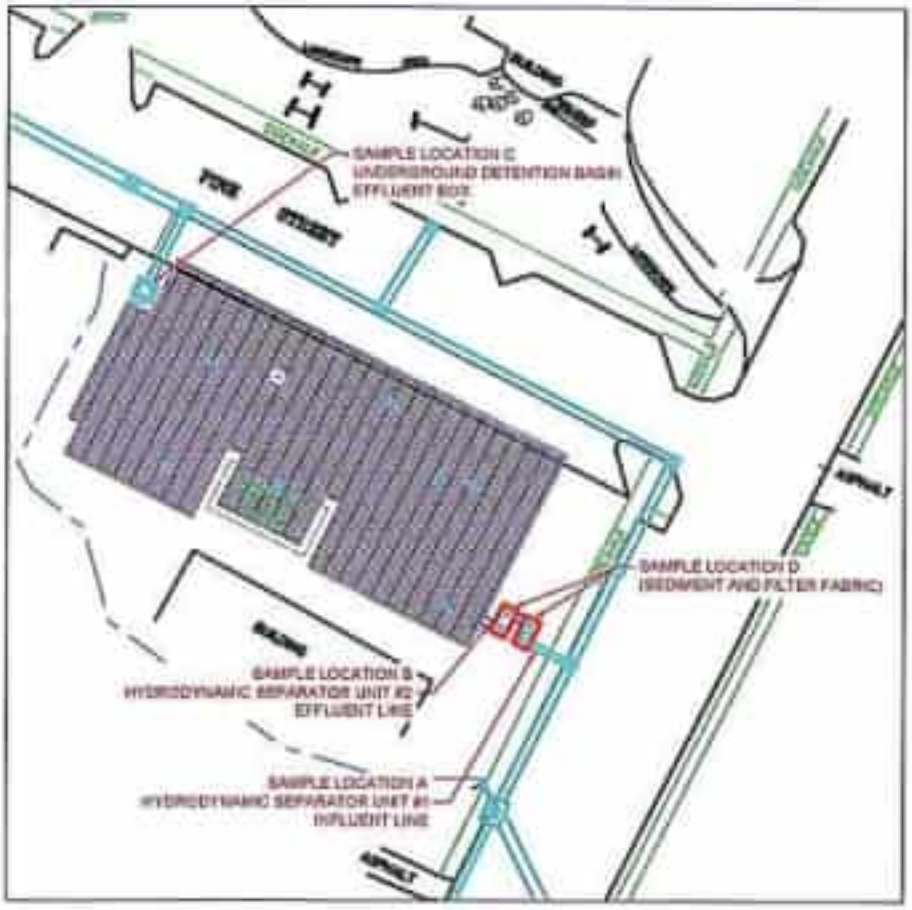
Picture 1: RainTank® Unit

Picture 2: RainTank® Assembly Installation

3.1 Data Collection Strategy

The goal of the sampling and testing plan for this evaluation was aimed at measuring incoming and outgoing solids and other pollutants to the hydrodynamic separator and underground detention system to determine their overall effectiveness. Data collected during the October 18, 2010 – July 31, 2011 study period included precipitation, water samples, sediment samples, sediment mass measurement, and filter fabric samples. A detailed sampling and testing protocol was developed to ensure consistent and systematic data collection. A copy of the sampling and testing protocol can be found in Appendix A of this report. Water samples were taken from three points within the system during or after storm events; sediment and filter fabric samples were taken during scheduled quarterly cleaning maintenance of the hydrodynamic separator. Figure 7 below illustrates the sampling point locations.

Figure 7: Sampling Point Locations



3.2 Precipitation Measurement

A combination rain collector and data logger was installed at the Highlands Town Hall, located approximately 500 feet from the hydrodynamic separator, to record precipitation during the study period. The tipping bucket gauge system is calibrated to 0.01-inch and logs total precipitation volume at a continuous one minute resolution to measure both rainfall rate as well as overall rainfall. The gauge system was fitted with a data link so that real time data can be observed and recorded remotely. Instead of having only daily precipitation data for select storm events, this gauging system provides data for every rainfall event, and information on the rate of rainfall can then be used to more accurately determine the flow rate associated with the storm. This is vitally important, as most historical rainfall data only notes the 24 hour rainfall for an event. A storm may span two days and be artificially "separated" into two events. This continuous rainfall data alone provides valuable insights into the hydraulic conditions in the stream and in stormwater conveyances during storm events. The rainfall rate is integral in estimating runoff volume and corresponding flow velocity in all areas of the drainage system to include the proposed hydrodynamic separator, which as noted is designed to treat a specific stormwater flow rate.

3.3 Water Quality Sampling

During the testing period, grab samples were taken both upstream and downstream of the hydrodynamic separator as well as downstream of the underground detention system during selected storm events. The storm event criteria to trigger water sampling consisted of a minimum 0.5-inch storm event that was preceded by three consecutive days of less than 0.2-inch, to ideally average three samples per month. A total of 20 sampling events occurred over the study period, most of which met the precipitation criteria restraints. The time of sample collection was recorded for each storm event. Measurement of temperature, dissolved oxygen, pH, TSS, and specific conductance was taken for each sample. Target nutrients were measured for eight sampling events and target metals were measured for three sampling events. Funding constraints and the necessity of "on demand" sampling in response to rainfall required that the project depend on personnel on site to collect the rainfall/runoff samples as close to the event and resulting flow increase as possible. Town personnel were critical to this step and their efforts resulted in good sample coverage.

3.4 Sediment Sampling

A total of three composite sediment samples were taken from the from the hydrodynamic separator floor and analyzed to determine particle size distribution. Distribution analysis separated the sediment sample into the following sizes: > 2mm, 1-2 mm, 0.5-1 mm, 0.25-0.50 mm, 0.10-0.25 mm, and 0.05-0.10 mm. In addition to weighing these fractions, the fines that pass through to the pan were also weighed as a group. This data is needed to document the size of particles coming off of the drainage and to determine how the hydrodynamic separator performed following the set of storm events prior to sampling. Two sets of the composite sediment samples were tested to determine concentration of target nutrients. Additionally, one composite sediment sample was tested to determine concentration of target metals.

3.4.1 Mass Measurement of Materials

The hydrodynamic separator was inspected and cleaned on a quarterly basis. Prior to cleaning, each hydrodynamic separator unit was opened and the total depth of sediment and organic debris was measured for each compartment within the two units. Measurements were made for materials retained on the floor of each compartment as well as on the influent coarse screen and oil/water separator basket. The weight of the trash, debris, and organic material from the trash basket and the filter was then summed up and reported separate from the weight of the sediments. Because of the nature of stormwater and the materials involved, trash and organic materials were present in the sediments and sediment was present in organic materials. To the maximum extent practical under field conditions, these were separated for measurement and sampling.

3.5 Filter Fabric Sampling

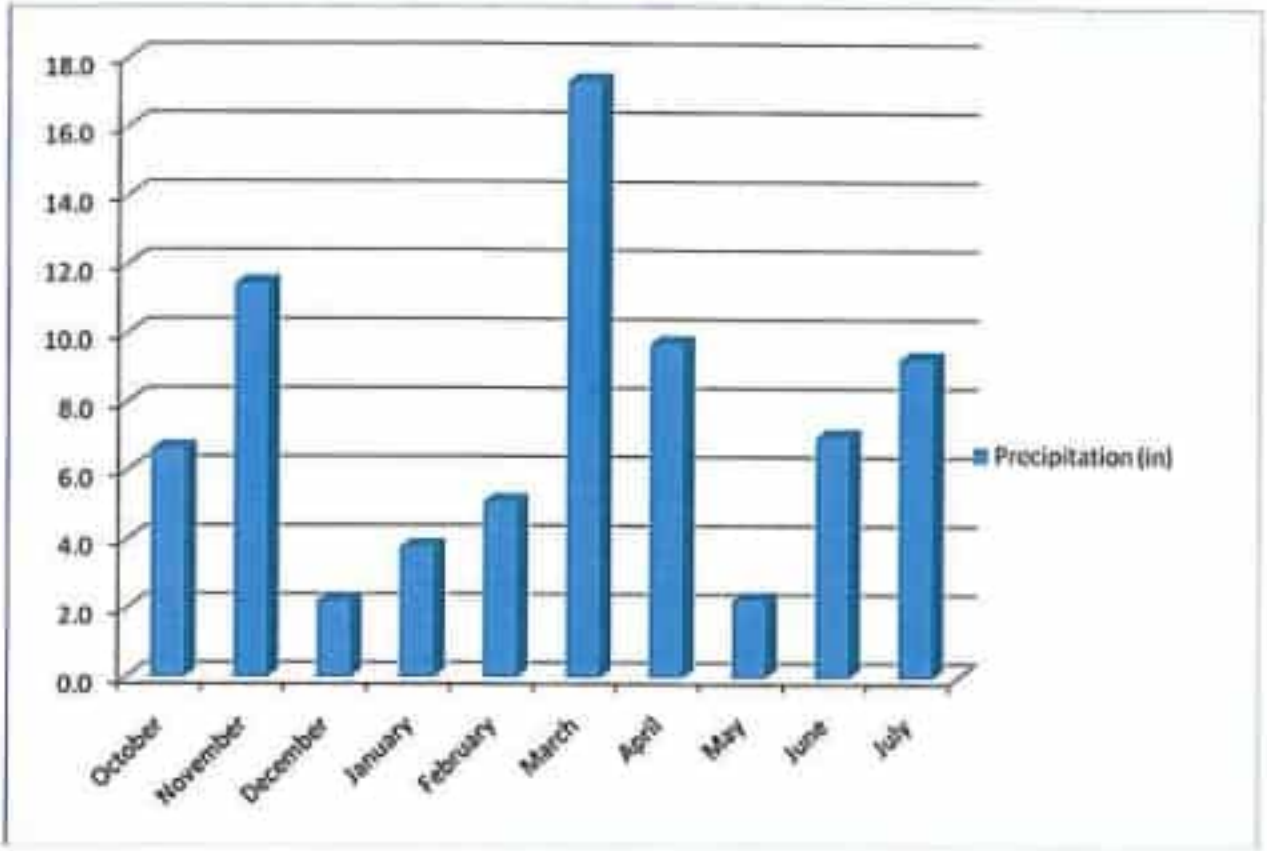
The final chamber of the hydrodynamic separator features a ¾-inch coconut fiber filter. This material filters, under most flow conditions, all of the water that comes through the device but is designed to tilt up out of the way during high flow events. Most of the material caught on this filter consists of fine sediments and organics. A total of three 12-inch by 12-inch samples of the used filter were taken in conjunction with the scheduled quarterly inspection and cleaning of the hydrodynamic separator. The used filter samples were used to measure retainage of target

nutrients and metals. Additionally, two samples of the clean filter were taken to establish a baseline for the target nutrients and metals. The representative clean filter sample was weighed wet and dry, and then the representative used filter sample was weighed when upon removal to get an approximate weight of the material contained in and on the filter.

4.1 Precipitation

The rain data was uploaded at regular intervals during the study period to monitor storm event occurrences and associated hydrodynamic separator performance. A total of 74.7 inches of precipitation were recorded over the study period. Figure 8 below illustrates the total precipitation recorded for each month of the study period.

Figure 8: Study Period Precipitation



A total of 20 storm events occurred over the study period which triggered water quality sampling actions. A portion of the storm events did not meet the protocol criteria for total precipitation. The actual storm patterns experienced over the study period necessitated sampling during smaller storm events. Table 1 below presents the storm events in which samples were taken.

Table 1: Study Period Sampling Storm Events

Event Date	Total Rain (in)	Duration (hrs)	*Storm Event
October 25, 2010	1.10	6.00	-
November 4, 2010	0.35	13.00	-
November 16, 2010	0.28	9.00	-
November 30, 2010	4.59	21.00	1-Year
December 21, 2010	0.08	2.50	-
January 18, 2011	0.07	6.75	-
January 26, 2011	0.51	9.50	-
February 1, 2011	0.14	4.25	-
February 28, 2011	0.98	2.25	-
March 9, 2011	1.65	9.00	-
March 26, 2011	0.73	4.00	-
April 12, 2011	0.26	3.75	-
April 21, 2011	0.16	1.50	-
April 26, 2011	0.16	6.75	-
May 4, 2011	0.81	8.75	-
May 27, 2011	1.12	12.00	-
June 16, 2011	1.76	5.50	1-Year
June 23, 2011	0.75	5.25	-
July 21, 2011	0.30	1.00	-
July 26, 2011	0.90	3.00	-

**Note: Storm Event reflects greatest precipitation intensity and not Total Rain/Total Duration*

The rain data was uploaded for each rain event and entered into XP-SWMM hydraulic modeling software program based on the project area watershed. Flow was estimated by this approach for the storm event and projected through the stormwater system. The modeling program simulated the storm event hydrology and system hydraulics to estimate flow rates and total liquid volume conveyed to the hydrodynamic separator. The estimated flow rates where then used to produce hydrographs for each storm event in relation to the storm event. The hydrodynamic separator hydrographs may be found in Appendix F of this report.

4.2 Water Quality Evaluation

The water quality data was collected both during and after a variety of storm event durations and intensities. A summary of the water quality data along with the collected data may be found in Appendix F of this report. Table 2 below presents the overall system performance for the entire study period in regard to target pollutant and water parameters. Care should be taken in looking at the overall system performance data since this includes the detention/attenuation system. Because of storage capability and the fact that sampling occurred during or just following an event, it is likely that the effluent values from the entire system reflects the pollutant levels of water in the system discharged well before the water entering (influent) the hydrodynamic separator actually exited the storage system. This means the overall performance is only a general indication of pollutant removal. Due to detention and the characteristics of the detention/attenuation area, biological, chemical and physical changes in the water quality characteristics of the water in the storage system will cause results to vary depending on when sampling is done and how long the water in the system was there before it was discharged. Therefore, over time sampling results from the entire system may not be reflective of the actual treatment performance. The data from the hydrodynamic separator, however, is a much better predictor of the performance of that component of the system.

Table 2: Overall System Performance

		Hydrodynamic Separator Influent (A)	Underground Detention Effluent (C)	
Parameter	**Units**	**Average**	**Average**	**Removal % [Increase %]**
Temperature	Celsius	11.7	12.3	
Dissolved Oxygen	mg/L	6.4	4.4	
pH		6.2	6.1	
Total Suspended Solids	mg/L	283.8	5.5	98%
BOD, 5 day	mg/L	7.1	5.2	27%
Fecal Coli form	CFU/100mL	1443.3	1281.7	11%
Specific Conductance	µmhos	98.1	117.3	[20%]
Ammonia, Nitrogen	mg/L	0.2	0.1	50%
Total Nitrogen	mg/L	1.66	0.71	57%
Total Kjeldahl Nitrogen	mg/L	1.36	0.46	66%
Nitrogen, NO2 plus NO3	mg/L	0.29	0.55	[90%]
Total Phosphorous	mg/L	0.19	0.07	63%
Orthophosphate as P	mg/L	Non-Detectable Level (23/24)		-
Arsenic	mg/L	< 0.005	< 0.005	-
Barium	ug/L	9.5	11.3	[19%]
Cadmium	mg/L	< 0.010	< 0.010	-
Chromium	mg/L	< 0.05	< 0.05	-
Lead	mg/L	< 0.003	< 0.003	-
Mercury	ug/L	0.1	0.1	-
Selenium	ug/L	5	5	-
Silver	mg/L	< 0.05	< 0.05	-
Copper	mg/L	< 0.05	< 0.05	-
Zinc	mg/L	0.093	0.121	[30%]

**Note: Non-Detect sampling results calculated at one-half of the Report Limit*

Table 3 below presents the overall hydrodynamic separator performance during sampled storm events throughout the study period. It can be seen that the hydrodynamic separator performance exceeded the design removal specifications for TSS and Total Phosphorous. The hydrodynamic separator also removed significant concentrations of nitrogen and ammonia. Because of the relatively short detention time of the hydrodynamic separator, these performance data are a very good indication of how this component of the system worked during the test period.

Table 3: Hydrodynamic Separator Performance

		Hydrodynamic Separator Influent (A)	**Hydrodynamic Separator Effluent (B)**	
Parameter	**Units**	**Average**	**Average**	**Removal % [Increase %]**
Total Suspended Solids	mg/L	283.8	11.9	96%
BOD, 5 day	mg/L	7.1	7.9	[11%]
Fecal Coli form	CFU/100mL	1443.3	1127.0	22%
Specific Conductance	µmhos	98.1	122.0	[24%]
Ammonia, Nitrogen	mg/L	0.2	0.1	50%
Total Nitrogen	mg/L	1.66	0.43	74%
Total Kjeldahl Nitrogen	mg/L	1.36	0.34	75%
Nitrogen, NO2 plus NO3	mg/L	0.29	0.27	7%
Total Phosphorous	mg/L	0.19	0.05	74%
Orthophosphate as P	mg/L	Non-Detectable Level		-

Table 4 below presents the overall underground detention system separator performance during sampled storm events throughout the study period. It can be seen that the underground detention system did retain TSS. A general increase in nutrient concentrations occurred through the underground detention system; it is suspected that these increases may be due to biological activity within the attenuation system which likely included biological material attached to the RainTank® structure itself. Chemical and physical changes are also expected to be factors in the variation in data from this component of the system.

Table 4: Underground Detention Performance

		Hydrodynamic Separator Effluent (B)	Underground Detention Effluent (C)	
Parameter	**Units**	**Average**	**Average**	**Removal % [Increase %]**
Total Suspended Solids	mg/L	11.9	5.5	54%
BOD, 5 day	mg/L	7.9	5.2	34%
Fecal Coli form	CFU/100mL	1127.0	1281.7	[14%]
Specific Conductance	µmhos	122.0	117.3	4%
Ammonia, Nitrogen	mg/L	0.1	0.1	-
Total Nitrogen	mg/L	0.43	0.71	[65%]
Total Kjeldahl Nitrogen	mg/L	0.34	0.46	[35%]
Nitrogen, NO2 plus NO3	mg/L	0.27	0.55	[104%]
Total Phosphorous	mg/L	0.05	0.07	[40%]
Orthophosphate as P	mg/L	Non-Detectable Level		-

4.3 Sediment Evaluation

Composite sediment samples were taken from the floors of the hydrodynamic separator units # 1 & #2. The analysis found that the sediment retained was generally comprised of the following: 57% sand, 35.5% silt and 7.5% clay. Table 5 below presents the average particle size distribution based on the sieve analysis of the composite sediment samples. The particle size distribution shows that the majority of particles retained were less than 0.25-millimeters in size. This is consistent with expectations given that flows to the hydrodynamic separator must first flow over a weir wall, which should typically exclude larger size particles from the separator.

Table 5: Average Sieve Analysis Results

Coarse Fragments (Gravel > 2mm) %	Very Coarse Particle (1-2 mm) %	Coarse Sand (0.5-1 mm) %	Medium Particle (0.25-0.5 mm) %	Fine Particle (0.1-0.25 mm) %	Very Fine Particle (0.05-0.10 mm) %
3.12	2.19	5.29	8.35	31.23	22.82

**Note: Remaining percentage is finer than 0.05 mm*

During quarterly hydrodynamic separator inspection and cleaning, measurements were taken at several points within each compartment of the hydrodynamic separator units and averaged to determine the volume of sediment and organic debris in the device. That volume was then converted to a dry weight based on a formula that has been derived over time for the average weight of wet sediments. The potential weight of a cubic foot of sand is about 165 pounds (at a relative density of 2.65). The actual average weight of sediment samples dried and measured has been found to be approximately 105 pounds per cubic foot which is a relative density of about 1.70. The actual average dry weight of organic debris was estimated to be 15 pounds per cubic foot. Using average density data, the total weight of the sediment and debris was calculated and is presented in Table 6 below. It can be seen from the Table 6 below that the hydrodynamic separator retained significant quantities of sediment and debris that would have otherwise polluted downstream waters.

Table 6: Sediment and Debris Retained by Hydrodynamic Separator

Cleaning Date	Volume of Sediment (cf)	Volume of Debris (cf)	Weight of Sediment (lb)	Weight of Debris (lb)
December 8, 2010	28.2	46.8	2,962.4	701.6
March 8, 2011	18.6	7.4	1,951.2	110.9
June 8, 2011	19.7	6.3	2,066.8	94.0
August 11, 2011	31.6	11.0	3,312.2	165.7
Total =	**98.0**	**71.5**	**10,292.6**	**1,072.2**

The composite sediment samples were also tested for the presence of target pollutants. The average pollutant concentrations for the composite samples are shown in Table 7 below. The total estimated quantity of target pollutants removed, based on the total estimated sediment retained in the hydrodynamic separators, is also presented in Table 7. It can be seen that a significant amount of various target pollutants was captured by the hydrodynamic separator.

Table 7: Sediment Pollutants Retained by Hydrodynamic Separator

Parameter	Units	Sediment Result	Total Quantity Removed (lb)
Mercury	mg/kg	0.081	0.0008
Arsenic	mg/kg	4.1	0.04
Barium	mg/kg	170.0	1.7
Cadmium	mg/kg	1.10	0.01
Chromium	mg/kg	30.00	0.31
Copper	mg/kg	170.0	1.7
Lead	mg/kg	35.00	0.36
Selenium	mg/kg	3.8	0.04
Silver	mg/kg	1.10	0.01
Zinc	mg/kg	400.0	4.1
Total Kjeldahl Nitrogen	mg/kg	2,650	27
Nitrate + Nitrite	mg/kg	24	0.2
Total Nitrogen	mg/kg	2,650	27
Total Phosphorus	mg/kg	935	10

4.4 Filter Fabric Evaluation

Representative samples of clean and used filter fabric material were collected in conjunction with scheduled quarterly hydrodynamic separator inspection and maintenance. The representative filter fabric samples were tested for the presence of target pollutants. The average pollutant concentrations for the representative samples are shown in Table 8 below. The total estimated quantity of target pollutants removed, based on the total estimated mass of used filter fabric, is also presented in Table 8. It can be seen that a significant amount of various target pollutants were captured by the filter fabric each quarter.

Table 8: Filter Fabric Performance

Parameter	Units	Clean Fabric Filter Test Result	Used Fabric Filter Test Result	Total Quantity Retained (mg)
Mercury	mg/kg	0.023	0.058	0.324
Arsenic	mg/kg	0.6	1.4	7.4
Barium	mg/kg	5.2	78.0	673.9
Cadmium	mg/kg	0.28	0.66	3.47
Chromium	mg/kg	0.36	13.50	121.59
Copper	mg/kg	3.8	191.0	1,731.6
Lead	mg/kg	0.38	18.00	162.99
Selenium	mg/kg	0.6	2.3	15.4
Silver	mg/kg	0.28	0.66	3.47
Zinc	mg/kg	8.3	660.0	6,029
Total Kjeldahl Nitrogen	mg/kg	155	1767	14,908
Nitrate + Nitrite	mg/kg	8	13	40
Total Nitrogen	mg/kg	160	1767	14,862
Total Phosphorus	mg/kg	77	447	3,419

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5.0 SYSTEM MAINTENANCE

The hydrodynamic separators were inspected and cleaned on a quarterly basis. Based on these results and recommendations from the manufacturer, the separator units should be cleaned and serviced on a minimum semi-annual basis; however, based on the sediment and debris observed at these units, it is recommended that the units be inspected at regular intervals and cleaned after periods of heavy rain or leaf fall. During periodic inspection, the screens should be checked for debris accumulation and their position adjusted as necessary to prevent short circuiting. All screens and effluent piping should be checked for blinding (materials filling and blocking openings in the screens and filters), to ensure that the system operates as designed and that system surcharging does not occur.

The units were cleaned by personnel from Storm System Services. The required equipment included vacuum truck, portable electrical generator, sump pump, ladder, confined space equipment, and replacement filter fabric. The hydrodynamic unit #1 was first dewatered, removing the clear water above the sediment deposited in the tank and discharged to the bypass storm system piping. After dewatering unit #1, all materials on the screens and floors were vacuumed out. The typically clearer decant water from unit #2 was then pumped into unit #1 to clean the walls and screens. Unit #2 was then dewatered, vacuumed, and washed down. All remaining water was pumped out of the units. The filter fabric device was then removed and replaced with new filter fabric. The process typically took a two person crew approximately three hours to complete. Pictures 3 through 20 below illustrate the hydrodynamic separator maintenance.

Picture No. 3: Unit #1 Influent Screen Sedimentation after flushing event storm (front screen removed)

Picture No. 4: Unit #1 Influent Pipe Sedimentation

Picture No. 5: Unit #1 Influent Screen typical debris and sediment (front screen shown down)

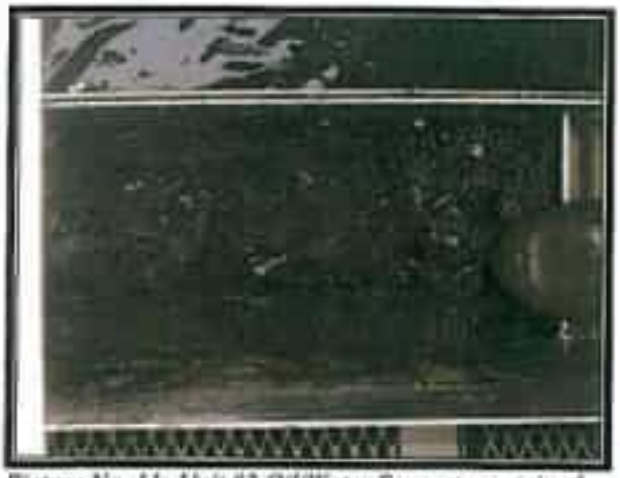
Picture No. 6: Unit #1 Influent Screen heavy leaf litter

Picture No. 7: Unit #1 Weir Screen retaining floatables

Picture No. 8: Unit #1 Weir Screen top blinded

Picture No. 9: Unit #2 Influent Compartment, Weir Screen and Oil/Water Separator

Picture No. 10: Unit #2 Oil/Water Separator



Picture No. 11: Unit #2 Oil/Water Separator retained Floatables after dewatering

Picture No. 12: Unit #2 Filter Fabric Screen caked with typical sludge

Picture No. 13: Underground Detention System Effluent Box Perforated Weir Plate

Picture No. 14: Underground Detention System Effluent Box with typical 1/8" deposition of fines. The water over these fines was very clear and free of discoloration.

Picture No. 15: Unit #1 Vacuum Cleaning

Picture No. 16: Unit #1 Influent Screen Cleaning

Picture No. 17: Unit #2 Vacuum Cleaning

Picture No. 18: Unit #2 Filter Fabric Replacement

Picture No. 19: Unit #1 Post Cleaning

Picture No. 20: Unit #1 Post Cleaning

6.0 CONCLUSIONS

The study's goal of determining typical stormwater runoff pollutant loadings in the target mountain community and evaluating the effectiveness of hydrodynamic separators in removing these pollutant loadings has been achieved. Typical stormwater runoff pollutant loadings have been documented for various storm event intensities and durations that occurred throughout the October 18, 2010 – July 31, 2011 study period. Although some of the water quality samples were taken after peak stormwater runoff flows subsided, a sufficient number of samples were collected during various stages of individual storm events such that when compiled in conjunction with results from other similar projects in mountain communities, a fairly accurate representative stormwater runoff pollutant loading baseline for western North Carolina could be established.

The evaluation collected rainfall data over the entire study period and looked at twenty (20) specific storm events. Flow modeling was performed for each noted storm event and hydrograph and discharge routing information was developed for each storm monitored. Of the events monitored, one (1) included the full range of data collection (basic water quality data, nutrient data and metals analyses), twenty (20) of the events included basic water quality data, seven (7) included nutrient data, and two (2) included metals analyses. For four of the five cleaning events, sediment capture volume and weight was determined, particle distribution samples were collected and analyzed, coconut fiber pollutant removal performance was determined and general characteristics of the debris and trash removed noted. Detailed information on these efforts, observations about the sampling procedures used, and analytical results are outlined in this report and included in the appendices. Overall, more than 24 water quality parameter results were generated from this effort.

Based on the collection and evaluation of samples and data obtained throughout the study period, the following major conclusions can be made:

- The use of hydrodynamic separators similar in design and construction to those employed in the Pine Street system can remove significant amounts of sediment, nutrients and certain types of metals.

- Removal rates for total suspended solids (TSS) are impressive and well beyond North Carolina's performance criteria for post-construction stormwater treatment.

- Average TSS removal ranged from 90-99% for all storm events with influent TSS concentrations greater than 40 mg/L.

- Nutrient data indicate significant removal, with an average of 74% removal of total phosphorus (TP) over the study period and positive removal event rates ranging from 30-95%; total nitrogen (TN) also saw an average of 74% removal over the study period with individual event rates ranging from 35-89%;

- The separators were effective in removing all particles ranging in size from greater than 2 millimeters to less than 0.05 millimeters.

- The fixed coconut fiber filters demonstrated the ability to capture fine particles along with the pollutants associated with the solids. While the ability of the filters to perform is clearly limited due to the fact that once they become saturated, the storm discharge essentially "flows around" the filter, the data shows that pollutants are captured. It is essential that these filters be removed and replaced along with each tank cleaning event to help assure the benefits of this component of the design.

- Critical to the ongoing effectiveness of hydrodynamic separators in removal of pollutants from the affected surface water system and the environment is the regular cleaning and maintenance of the structures and the proper disposal of the material removed.

- Extremely heavy storm events can cause (as in all stormwater systems) the release of huge amounts of debris, bed load and sediment from a watershed that can physically impair the ability of a storm drainage or stormwater treatment system. This means that inspection following such events is critical to the ongoing effectiveness of this BMP.

- Overall system performance data, which includes the effect of the post-separator stormwater underground volume, shows variable effect on outflow quality. This is due to several factors, including sample collection timing, possible biological, chemical and

physical changes in the stormwater as it is retained for some time in the storage area, and the variable time between storm events.

- Post-separator volume helps to "dampen" the peaking of storm events, but is insufficient in size to provide significant storm storage volume.

Based on data collected throughout the study period, the hydrodynamic separator was successful in removing TSS and target nutrients. The hydrodynamic separator performed especially well in removing TSS with an overall estimated removal rate of 96%. This removal rate is even more significant when site conditions are taken into account; the project site features fairly steep slopes and climate patterns prone to intense storm events which result in higher concentrated TSS in storm event runoff flows. It should be noted that the subject stormwater collection system utilized an external bypass system (overflow weir) to divert flows greater than that of the hydrodynamic separator design flow around the separator system. The external bypass system improved overall system performance by protecting the hydrodynamic separator from excessive flows while preventing most solids from bypassing the treatment system. This overflow weir allowed the hydrodynamic separator to normally operate under intermediate flow events which typically produced re-suspension velocities to somewhat flush the collection system and allow the hydrodynamic separator to operate as designed.

Overall, the hydrodynamic separator proved to be particularly effective in removing TSS as evidenced by the water quality sample TSS removal rates, quarterly mass removal estimates and general lack of sediment deposition observed downstream of the unit during quarterly inspections of the system. The hydrodynamic separator also proved effective in removing target nutrients. Although significant nutrient removal is expected due to the high solids removal rate, the hydrodynamic separator's coconut fabric filter proved to be a valuable treatment feature to further capture nutrients and metals. While this particular filter fabric performed well, a myriad of alternate filter fabrics exist on the market today which could easily be used to potentially achieve even better removal results for target nutrient and metal pollutants as required by project goal parameters for other specific mountain communities.

In areas of established or historic urbanization, the use of the BMPs assessed here have significant applicability where there is flexibility to retrofit these sub-drainage areas. The availability of city park areas or "open space" owned by the municipality or by home owner associations willing to work with the city provides an excellent opportunity to have a measurable effect on the ongoing pollutants contained in this type stormwater. In areas of new development where traditional stormwater structures may be difficult to install or where the consequences in terms of public safety and acceptability make their use problematic, these separator type systems offer the capability to allow for the areas of installation to continue to have public or community use and value while still making a significant contribution to water quality improvement. Based on the performance measured in Highlands the reviewed installation has excellent applicability to other similar sites in western North Carolina. Where surface waters fall under a regulatory mandates to improve water quality under the Clean Water Act, this technology has potential as retro-fit installations for existing development.

The use of hydrodynamic separators as an effective stormwater management tool must, in comparison to other options, consider the ongoing maintenance cost of cleaning the structures and removal and replacement of any filters included in the design. However, more traditional stormwater treatment systems must also include an operation and maintenance component as well. In many such systems this cost is not properly considered because the timeframe between construction and maintenance activities can be long (example: wet detention point requirement cleaning relatively far into the future). Hydrodynamic separators have to be cleaned normally several times during the year, but maintenance costs are easy to project and plan. These relatively small structures also have the benefit of easily accessible observation ports that can be checked as often as necessary to establish maintenance schedules and to trigger a special cleaning if runoff conditions between the last cleaning dictate such action.

It is typically recommended that hydrodynamic separator units be inspected and cleaned a minimum of twice per year. Hydrodynamic separators which are not equipped with bypass systems typically utilize a much larger footprint sized larger in which case the twice-yearly maintenance schedule would be adequate. However, the hydrodynamic separator utilized for this project employed a bypass system which minimized the required footprint of the treatment system but necessitated more frequent maintenance. The subject hydrodynamic separator was

maintained on a quarterly basis to facilitate data collection. The frequent cleanings allowed for the positive correlation between quantity of material retained and factors such as stormwater flow rates and material constituents such as leaf litter and floatable organics. Therefore, it is recommended that hydrodynamic separator units be inspected a minimum of once per month or after significant storm events. Although this may lead to an irregular cleaning schedule, it will undoubtedly ensure optimum unit performance and watershed protection.

The Pine Street stormwater management system provides a reasonable example of the use of a hydrodynamic separator followed by underground storage volume aimed at improving stream quality in a watershed already developed. This or a similarly designed system should be considered for similar watersheds to meet stormwater management objectives.

APPENDIX A

Sampling and Testing Protocol

TOWN OF HIGHLANDS
STORMWATER TREATMENT SAMPLING/MONITORING PROTOCOL
October 2010
Revised January 2011

Sampling Parameter	Oct #1	Oct #2	Oct #3	Nov #1	Nov #2	Nov #3	Dec #1	Dec #2	Dec #3	Jan #1	Jan #2	Jan #3	Feb #1	Feb #2	Feb #3	Mar #1	Mar #2	Mar #3	Apr #1	Apr #2	Apr #3
TSS	A,B,C	A,B,C	A,B,C	A,B,C	A,B,C	A,B,C	A,B,C	A,B,C	A,B,C	A,B,C	A,B,C	A,B,C	A,B,C	A,B,C	A,B,C	A,B,C	A,B,C	A,B,C	A,B,C	A,B,C	A,B,C
BOD & Fecal	A,B,C	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Specific Conductance	-	-	-	A,B,C	A,B,C	A,B,C	A,B,C	A,B,C	A,B,C	A,B,C	A,B,C	A,B,C	A,B,C	A,B,C	A,B,C	A,B,C	A,B,C	A,B,C	A,B,C	A,B,C	A,B,C
Temp., D.O. pH	A,C	A,C	A,C	A,C	A,C	A,C	A,C	A,C	A,C	A,C	A,C	A,C	A,C	A,C	A,C	A,C	A,C	A,C	A,C	A,C	A,C
*Nutrients	A,B,C	-	-	A,B,C	-	-	A,B,C	-	-	A,B,C	-	-	A,B,C	-	-	A,B,C, D	-	-	A,B,C	-	-
**Metals	A,C	-	-	-	-	-	-	-	-	-	-	-	-	-	-	A,C, D	-	-	-	-	-
% Solids	-	-	-	-	-	-	D	-	-	-	-	-	-	-	-	D	-	-	-	-	-
Grain Size Distrib. (w/cleaning)	-	-	-	-	-	-	D	-	-	-	-	-	-	-	-	D	-	-	-	-	-

Sampling Parameter	May #1	May #2	May #3	June #1	June #2	June #3	July #1	July #2	July #3	Aug #1	Aug #2	Aug #3
TSS	A,B,C	A,B,C	A,B,C	A,B,C	A,B,C	A,B,C	A,B,C	A,B,C	A,B,C	A,B,C	A,B,C	A,B,C
BOD & Fecal	A,B,C	-	-	-	-	-	-	-	-	A,B,C	-	-
Specific Conductance	A,B,C	A,B,C	A,B,C	A,B,C	A,B,C	A,B,C	A,B,C	A,B,C	A,B,C	A,B,C	A,B,C	A,B,C
Temp., D.O., pH	A,C	A,C	A,C	A,C	A,C	A,C	A,C	A,C	A,C	A,C	A,C	A,C
*Nutrients	A,B,C	-	-	A,B,C	-	-	A,B,C	-	-	A,B,C	-	-
**Metals	-	-	-	-	-	-	A,C	-	-	-	-	-
% Solids	-	-	-	D	-	-	-	-	-	D	-	-
Grain Size Distr. (w/cleaning)	-	-	-	D	-	-	-	-	-	D	-	-

NOTES:

1. **Sample after each 0.5" to 1" rain (or greater) that is preceded by at least 3 days of dry weather (less than 0.2" of rain), to average 3 per month.**
2. **Take samples during storm when approximately 0.5" has rained, or immediately following storm.**
3. **4 sample locations:**

A – Upstream of Crystal Stream treatment units
B – Between second Crystal Stream unit and Underground Detention
C – Downstream of Underground Detention
D – Sediment captured by Crystal Stream units & Filter Fabric Testing (in conjunction with quarterly unit cleaning).

***Nutrients to be sampled:**

Water Sampling: Total Nitrogen, Total Kjeldahl Nitrogen, Nitrogen (Nitrate + Nitrite), Total Phosphorous, Ortho Phosphate as P, Ammonia
Sediment Sampling: Total Nitrogen, Total Phosphorous
Fabric Filter: Total Nitrogen, Total Kjeldahl Nitrogen, Nitrogen (Nitrate + Nitrite), Total Phosphorous

**** Metals Series to be sampled: Arsenic, Barium, Cadmium, Chromium, Lead, Mercury, Selenium, Silver, Copper and Zinc**

APPENDIX B

Water Sampling Results Summary

&

Water Quality Sampling Data

Town of Highlands
Innovative Stormwater Project Implementation
Project No. 10.00336

Water Sample Analysis

					Sample Location:	Site A	Site B	Site C	Site A	Site B	Site C	Site A	Site B	Site C
					Sample Collection Date:	25-Oct-10	25-Oct-10	25-Oct-10	4-Nov-10	4-Nov-10	4-Nov-10	16-Nov-10	16-Nov-10	16-Nov-10
					Sample Collection Time:	11:30 AM	11:40 AM	11:50 AM	10:30 AM		10:40 AM	9:00 AM		9:10 AM
Parameter	Method	Units	RL	MDL		Result	Result		Result	Result	Result			Result
Temperature	Highlands Staff	Celcius				13.0	13.0	14.1	11.7		13.0	9.7		10.0
Dissolved Oxygen	Highlands Staff	mg/L				6.6	6.6	7.7	5.5		7.0	8.4		4.1
pH	Highlands Staff					5.9	5.9	5.8	6.3		6.2	6.2		5.9
Total Suspended Solids	SM 2540D	mg/L		2.0		364.0	< 20.0	< 20.0	< 4.0	<4.0	< 4.0	20.0	27.3	< 2.0
BOD, 5 day	SM 5210	mg/L		2.0		8.0	< 8.0	< 4.0	< 8.0	< 8.0	< 8.0			
Fecal Coliform	SM 9222D	CFU/100mL		4.0		> 1600	820.0	580.0						
Specific Conductance	SM 2510B	umhos		1.0					59.7	122.0		12.1		30.5
Ammonia, Nitrogen	SM 4500NH3-F	mg/L		0.1		0.9	0.2	< 0.1	< 0.1	< 0.1	< 0.1			
Total Nitrogen	40CFR Part 503	mg/L	0.60						0.97	1.00	2.40			
Total Kjeldahl Nitrogen	EPA 351.2	mg/L	0.10						0.81	0.94	1.90			
Nitrogen, NO2 plus NO3	EPA 353.2	mg/L	0.10						0.16	ND	0.49			
Total Phosphorous	EPA 365.1	mg/L	0.10						ND	ND	ND			
Orthophosphate as P	EPA 365.1	mg/L	0.050						ND	ND	ND			
Arsenic	SM 3113B	mg/L		0.005								< 0.005		< 0.005
Barium	EPA 200.7	ug/L	5.0									18.8		6.6
Cadmium	SM 3111B	mg/L		0.010								< 0.010		< 0.010
Chromium	SM 3111B	mg/L		0.05								< 0.05		< 0.05
Lead	SM 3113B	mg/L		0.003								< 0.003		< 0.003
Mercury	EPA 245.1	ug/L	0.20									ND		ND
Selenium	EPA 200.7	ug/L	10.0									ND		ND
Silver	SM 3111B	mg/L		0.05								< 0.05		< 0.05
Copper	SM 3111B	mg/L										< 0.05		< 0.05
Zinc	SM 3111B	mg/L										0.053		0.125
Precipitation Duration	Rain Gauge	hours					6.00			13.00			9.00	
Precipitation	Rain Gauge	inches					1.10			0.35			0.28	

RL = Reporting Limit. Values are reported down to the Reporting Limit only.

Sample Site Locations:
A = Upstream of Crystal Stream treatment units
B = Between second Crystal Stream unit and Underground Detention
C = Downstream of Underground Detention

Precipitation:
Precipitation measured from beginning of rain event to time of last sample collection

Town of Highlands
Innovative Stormwater Project Implementation
Project No. 10.00336

Water Sample Analysis

			Sample Location:		Site A	Site B	Site C	Site A	Site B	Site C	Site A	Site B	Site C
			Sample Collection Date:		30-Nov-10	30-Nov-10	30-Nov-10	21-Dec-10	21-Dec-10	21-Dec-10	18-Jan-11	18-Jan-11	18-Jan-11
			Sample Collection Time:		9:05 AM		9:10 AM	12:05 PM		12:15 PM	9:30 AM		9:40 AM
Parameter	Method	Units	RL	MDL	Result	Result	Result	Result	Result	Result	Result	Result	Result
Temperature	Highlands Staff	Celcius			8.3		10.7	8.0		7.0	6.9		7.1
Dissolved Oxygen	Highlands Staff	mg/L			9.6		7.6	6.1		3.6	6.7		4.6
pH	Highlands Staff				6.2		6.7	6.2		6.2	6.8		6.7
Total Suspended Solids	SM 2540D	mg/L		2.0	10.6	6.9	2.0	40.7	< 2.0	< 2.0	19.8	9.3	< 2.0
BOD, 5 day	SM 5210	mg/L		2.0									
Fecal Coliform	SM 9222D	CFU/100mL		4.0									
Specific Conductance	SM 2510B	umhos		1.0	38.5		18.1	132		245	466		307
Ammia, Nitrogen	SM 4500NH3-F	mg/L		0.1				< 0.1	0.1	< 0.1	0.2	< 0.1	< 0.1
Total Nitrogen	40CFR Part 503	mg/L	0.60					0.74	ND	ND	2.36	ND	0.93
Total Kjeldahl Nitrogen	EPA 351.2	mg/L	0.50					ND	ND	ND	2.10	ND	ND
Nitrogen, NO2 plus NO3	EPA 353.2	mg/L	0.10					0.29	0.29	0.58	0.27	0.30	0.80
Total Phosphorous	EPA 365.1	mg/L	0.10					0.44	ND	ND	0.16	ND	ND
Orthophosphate as P	EPA 365.1	mg/L	0.050					ND	ND	ND	ND	ND	ND
Arsenic	SM 3113B	mg/L		0.005									
Barium	EPA 200.7	ug/L	3.0										
Cadmium	SM 3111B	mg/L		0.010									
Chromium	SM 3111B	mg/L		0.07									
Lead	SM 3113B	mg/L		0.003									
Mercury	EPA 245.1	ug/L	0.20										
Selenium	EPA 200.7	ug/L	10.0										
Silver	SM 3111B	mg/L		0.01									
Copper	SM 3111B	mg/L											
Zinc	SM 3111B	mg/L											
Precipitation Duration	Rain Gauge	hours				21.00						6.75	
Precipitation	Rain Gauge	inches				4.59		0.00*	0.00	0.00		0.07	

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C = Downstream of Underground Detention

Precipitation:
Precipitation measured from beginning of rain event to time of last sample collection

Town of Highlands
Innovative Stormwater Project Implementation
Project No. 10.00336

Water Sample Analysis

					Sample Location:	Site A	Site B	Site C	Site A	Site B	Site C	Site A	Site B	Site C
					Sample Collection Date:	26-Jan-11	26-Jan-11	26-Jan-11	1-Feb-11	1-Feb-11	1-Feb-11	28-Feb-11	28-Feb-11	28-Feb-11
					Sample Collection Time:	9:20 AM		9:40 AM	11:35 AM		11:45 AM	5:30 PM		5:37 PM
Parameter	Method	Units	RL	MDL		Result	Result	Result	Result	Result	Result	Result	Result	Result
Temperature	Highlands Staff	Celcius				3.4		5.1	6.7		6.9	9.0		10.0
Dissolved Oxygen	Highlands Staff	mg/L				4.1		4.9	4.1		4.7	6.3		4.4
pH	Highlands Staff					6.5		6.5	5.8		5.8	6.1		6.0
Total Suspended Solids	SM 2540D	mg/L		3.0		42.0	27.2	10.0	77.3	25.0	3.4	2150.0	4.7	5.5
BOD, 5 day	SM 5210	mg/L		3.0										
Fecal Coliform	SM 9222D	CFU/100ml		4.0										
Specific Conductance	SM 2510B	µmhos		1.0		99.3		383	119.0		149	101.0		66.8
Ammia, Nitrogen	SM 4500NH3-F	mg/L		0.1					< 0.1	< 0.1	< 0.1			
Total Nitrogen	40CFR Part 503	mg/L	0.60						6.10	ND	ND			
Total Kjeldahl Nitrogen	EPA 351.2	mg/L	0.50						5.70	ND	ND			
Nitrogen, NO2 plus NO3	EPA 353.2	mg/L	0.10						0.37	0.30	0.50			
Total Phosphorous	EPA 365.1	mg/L	0.10						6.13	ND	0.20			
Orthophosphate as P	EPA 365.1	mg/L	0.050						ND	ND	ND			
Arsenic	SM 3113B	mg/L		0.001										
Barium	EPA 200.7	ug/L	5.0											
Cadmium	SM 3111B	mg/L		0.010										
Chromium	SM 3111B	mg/L		0.05										
Lead	SM 3113B	mg/L		0.003										
Mercury	EPA 245.1	ug/L	0.20											
Selenium	EPA 200.7	ug/L	10.0											
Silver	SM 3111B	mg/L		0.05										
Copper	SM 3111B	mg/L												
Zinc	SM 3111B	mg/L												
Precipitation Duration	Rain Gauge	hours					9.50			4.33			2.25	
Precipitation	Rain Gauge	inches					0.31			0.14			0.98	

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Precipitation:
Precipitation measured from beginning of rain event to time of last sample collection

Town of Highlands
Innovative Stormwater Project Implementation
Project No. 10.00336

Water Sample Analysis

					Sample Location:	Site A	Site B	Site C	Site A	Site B	Site C	Site A	Site B	Site C
					Sample Collection Date:	9-Mar-11	9-Mar-11	9-Mar-11	26-Mar-11	26-Mar-11	26-Mar-11	12-Apr-11	12-Apr-11	12-Apr-11
					Sample Collection Time:	9:05 AM		9:10 AM	9:15 AM		9:20 AM	9:30 AM		9:38 AM
Parameter	Method	Units	RL	MDL		Result	Result	Result	Result	Result	Result	Result	Result	Result
Temperature	Highlands Staff	Celcius				9.0		7.9	9.0		10.4	12.6		11.7
Dissolved Oxygen	Highlands Staff	mg/L				8.5		7.7	7.7		4.6	2.7		2.6
pH	Highlands Staff					6.2		6	6.4		6.1	6.3		6.1
Total Suspended Solids	SM 2540D	mg/L		2.0		18.7	16.7	< 2.0	24.4	29.3	< 2.0	1010.0	< 3.3	< 2.0
BOD, 5 day	SM 5210	mg/L		2.0										
Fecal Coliform	SM 9222D	CFU/100mL		4.0										
Specific Conductance	SM 2510B	µmhos		1.0		14.4		83.8	14.6		108.0	107.0		118.0
Ammia, Nitrogen	SM 4500NH3-F	mg/L		0.1		0.2	0.1	< 0.005				0.1	< 0.1	< 0.1
Total Nitrogen	40CFR Part 503	mg/L	0.60			ND	ND	ND				ND	ND	0.81
Total Kjeldahl Nitrogen	EPA 351.2	mg/L	0.50			ND	ND	ND				ND	ND	ND
Nitrogen, NO2 plus NO3	EPA 353.2	mg/L	0.10			ND	ND	0.39				0.39	0.30	0.81
Total Phosphorous	EPA 365.1	mg/L	0.10			ND	ND	ND				ND	ND	ND
Orthophosphate as P	EPA 365.1	mg/L	0.050			ND	ND	0.055				ND	ND	ND
Arsenic	SM 3113B	mg/L		0.001		< 0.005		< 0.005						
Barium	EPA 200.7	ug/L	5.0			8.9		16.0						
Cadmium	SM 3111B	mg/L		0.010		< 0.010		< 0.010						
Chromium	SM 3111B	mg/L		0.05		< 0.05		< 0.05						
Lead	SM 3113B	mg/L		0.003		< 0.003		< 0.003						
Mercury	EPA 245.1	ug/L	0.20			ND		ND						
Selenium	EPA 200.7	ug/L	10.0			ND		ND						
Silver	SM 3111B	mg/L		0.05		< 0.05		< 0.05						
Copper	SM 3111B	mg/L				< 0.05		< 0.05						
Zinc	SM 3111B	mg/L				0.051		0.141						
Precipitation Duration	Rain Gauge	hours					9.00			4.00			3.75	
Precipitation	Rain Gauge	inches					1.65			0.73			0.26	

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Precipitation:
Precipitation measured from beginning of rain event to time of last sample collection

Town of Highlands
Innovative Stormwater Project Implementation
Project No. 10.00336

Water Sample Analysis

			Sample Location:	Site A	Site B	Site C	Site A	Site B	Site C	Site A	Site B	Site C
			Sample Collection Date:	21-Apr-11	21-Apr-11	21-Apr-11	26-Apr-11	28-Apr-11	26-Apr-11	4-May-11	4-May-11	4-May-11
			Sample Collection Time:	10:15 AM		10:21 AM	9:10 AM		9:15 AM	11:40 AM		11:49 AM
Parameter	Method	Units	RL	MDL	Result	Result	Result	Result	Result	Result	Result	Result	Result
Temperature	Highlands Staff	Celcius			14.4		13.1	14.9		13.6	11.6		13.8
Dissolved Oxygen	Highlands Staff	mg/L			4.8		7.0	5.1		8.2	8.0		6.8
pH	Highlands Staff				6.3		6.1	6.2		6.0	6.2		5.9
Total Suspended Solids	SM 2540D	mg/L		2.0	265.0	4.7	4.8	237.0	7.0	4.5	104.0	7.7	7.3
BOD, 5 day	SM 5210	mg/L		2.0							< 8.0	< 5.0	4.6
Fecal Coliform	SM 9222D	CFU/100mL		4.0							80.0	80.0	304.8
Specific Conductance	SM 2510B	µmhos		1.0	78.7		91.3	79.4		90.8	112.0		65.3
Ammia, Nitrogen	SM 4500NH3-F	mg/L		0.1							0.1	0.3	0.2
Total Nitrogen	40CFR Part 503	mg/L	0.60								1.60	ND	ND
Total Kjeldahl Nitrogen	EPA 351.2	mg/L	0.50								1.30	ND	ND
Nitrogen, NO2 plus NO3	EPA 353.2	mg/L	0.10								0.30	0.26	0.34
Total Phosphorous	EPA 365.1	mg/L	0.10								0.55	ND	ND
Orthophosphate as P	EPA 365.1	mg/L	0.050								ND	ND	ND
Arsenic	SM 3113B	mg/L		0.005									
Barium	EPA 200.7	mg/L	5.0										
Cadmium	SM 3111B	mg/L		0.010									
Chromium	SM 3111B	mg/L		0.05									
Lead	SM 3113B	mg/L		0.003									
Mercury	EPA 245.1	ug/L	0.29										
Selenium	EPA 200.7	ug/L	10.0										
Silver	SM 3111B	mg/L		0.05									
Copper	SM 3111B	mg/L											
Zinc	SM 3111B	mg/L											
Precipitation Duration	Rain Gauge	hours				1.50			6.75			6.75	
Precipitation	Rain Gauge	inches				0.18			0.16			0.01	

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Precipitation measured from beginning of rain event to time of last sample collection

Town of Highlands
Innovative Stormwater Project Implementation
Project No. 10.00336

Water Sample Analysis

			Sample Location:	Site A	Site B	Site C	Site A	Site B	Site C	Site A	Site B	Site C
			Sample Collection Date:	27-May-11	27-May-11	27-May-11	16-Jun-11	16-Jun-11	16-Jun-11	23-Jun-11	23-Jun-11	23-Jun-11
			Sample Collection Time:	9:05 AM		9:10 AM	7:30 AM		7:40 AM	9:20 AM		9:25 AM
Parameter	Method	Units	RL	MDL	Result	Result	Result	Result	Result	Result	Result	Result	Result
Temperature	Highlands Staff	Celcius			15.8		15.8	15.8		15.9	18.6		18.5
Dissolved Oxygen	Highlands Staff	mg/L			5.6		2.5	5.7		6.1	6.6		5.8
pH	Highlands Staff				6.3		6.0	6.3		6.2	6.3		6.1
Total Suspended Solids	SM 2540D	mg/L		2.0	112.0	11.0	16.7	116.0	5.5	5.6	13.7	<6.7	<6.7
BOD, 5 day	SM 5210	mg/L		2.0									
Fecal Coliform	SM 9222D	CFU/100mL		4.0									
Specific Conductance	SM 2510B	µmhos		1.0	78.2		60.7	130.0		44.9	24.5		87.8
Ammonia, Nitrogen	SM 4500NH3-F	mg/L		0.1				0.4	< 0.1	< .1			
Total Nitrogen	40CFR Part 503	mg/L	0.60					0.96	0.67	ND			
Total Kjeldahl Nitrogen	EPA 351.2	mg/L	0.55					ND	ND	ND			
Nitrogen, NO2 plus NO3	EPA 353.2	mg/L	0.10					0.52	0.68	0.36			
Total Phosphorous	EPA 365.1	mg/L	0.10					0.077	ND	ND			
Orthophosphate as P	EPA 365.1	mg/L	0.050					ND	ND	ND			
Arsenic	SM 3113B	mg/L		0.003									
Barium	EPA 200.7	ug/L	5.0										
Cadmium	SM 3113B	mg/L		0.010									
Chromium	SM 3113B	mg/L		0.05									
Lead	SM 3113B	mg/L		0.003									
Mercury	EPA 245.1	ug/L	0.20										
Selenium	EPA 200.7	ug/L	10.0										
Silver	SM 3113B	mg/L		0.05									
Copper	SM 3113B	mg/L											
Zinc	SM 3113B	mg/L											
Precipitation Duration	Rain Gauge	hours				12.00			5.50			6.25	
Precipitation	Rain Gauge	inches				1.12			1.76			0.75	

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Precipitation:
Precipitation measured from beginning of rain event to time of last sample collection

Town of Highlands
Innovative Stormwater Project Implementation
Project No. 10.00336

Water Sample Analysis

					Sample Location:	Site A	Site B	Site C	Site A	Site B	Site C
					Sample Collection Date:	21-Jul-11	21-Jul-11	21-Jul-11	26-Jul-11	26-Jul-11	26-Jul-11
					Sample Collection Time:	8:05 AM		8:15 AM	10:30 AM		10:40 AM
Parameter	**Method**	**Units**	**RL**	**MDL**		**Result**	**Result**	**Result**	**Result**	**Result**	**Result**
Temperature	Highlands Staff	Celcius				17.7		18.7	19.6		20.5
Dissolved Oxygen	Highlands Staff	mg/L				8.4		7.2	6.3		3.8
pH	Highlands Staff					6.2		6.1	6.2		6.1
Total Suspended Solids	SM 2540D	mg/L		2.0		565.0	< 2.3	< 2.3	123.0	9.2	<2.3
BOD, 5-day	SM 5210	mg/L		2.0					5.4	<4.0	<4.0
Fecal Coliform	SM 9222D	CFU/100mL		4.0					>2420	>2480	>2900
Specific Conductance	SM 2510B	µmhos		1.0		98.3		<87.4	105.0		64.1
Ammonia, Nitrogen	SM 4500NH3-F	mg/L		0.1		0.4	0.1	< 0.1			
Total Nitrogen	40CFR Part 503	mg/L	0.60			ND	ND	0.84			
Total Kjeldahl Nitrogen	EPA 351.2	mg/L	0.50			ND	ND	ND			
Nitrogen, NO2 plus NO3	EPA 353.2	mg/L	0.10			0.34	0.31	0.84			
Total Phosphorous	EPA 360.1	mg/L	0.10			0.090	0.057	ND			
Orthophosphate as P	EPA 365.1	mg/L	0.050			0.058	ND	ND			
Arsenic	SM 3113B	mg/L		0.005		< 0.005		< 0.005			
Barium	EPA 200.7	ug/L	5.0			33.2		24.60			
Cadmium	SM 3111D	mg/L		0.010		< 0.010		< 0.010			
Chromium	SM 3111B	mg/L		0.05		< 0.05		< 0.05			
Lead	SM 3113B	mg/L		0.003		< 0.003		< 0.003			
Mercury	EPA 245.1	ug/L	0.20			0.79		0.34			
Selenium	EPA 200.7	ug/L	10.0			ND		ND			
Silver	SM 3111B	mg/L		0.05		< 0.05		< 0.05			
Copper	SM 3111B	mg/L				< 0.05		< 0.05			
Zinc	SM 3111B	mg/L				0.176		0.098			
Precipitation Duration	Rain Gauge	hours					1.00			3.00	
Precipitation	Rain Gauge	inches					0.30			0.98	

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C = Downstream of Underground Detention

Precipitation:
Precipitation measured from beginning of rain event to time of last sample collection

ENVIRONMENTAL Inc.

P.O. Box 954 (5690 Old Cullowhee Road)
Cullowhee, North Carolina 28723
Phone (828) 293-9396 (800) 213-4035
FAX (828) 293-1206
E-mail environmentalinc@aol.com

Certificate of Analysis

Client Name: McGill Associates
Address: 55 Broad Street
Asheville, NC 28801

Collection Date: 10/25/2010
Date Received: 10/25/2010

RESULTS

Sample Identification: Storm water site A (grab)

Parameters	Result	MDL	Units	Date Analyzed	Method	Foot-notes
BOD, 5 day	8.0	2.0	mg/L	10/27/2010	SM 5210	
Ammonia, Nitrogen	0.3	0.1	mg/L	11/4/2010	SM 4500NH3-F	
Solids, Total Suspended	364	2.0	mg/L	10/29/2010	SM 2540D	
Fecal Coliform	>1600	4	CFU/100mL	10/25/2010	SM 9222D	1

Sample Identification: Storm water site B (grab)

Parameters	Result	MDL	Units	Date Analyzed	Method	Foot-notes
BOD, 5 day	<8.0	2.0	mg/L	10/27/2010	SM 5210	
Ammonia, Nitrogen	0.2	0.1	mg/L	11/4/2010	SM 4500NH3-F	
Solids, Total Suspended	<20.0	2.0	mg/L	10/29/2010	SM 2540D	
Fecal Coliform	820	4	CFU/100mL	10/25/2010	SM 9222D	

Anthony Tirona, Laboratory Supervisor

1/12/11
Date

Report prepared: 1/12/2011 3:23 PM

Sample Identification: Storm water site C (grab)

Parameters	Result	MDL	Units	Date Analyzed	Method	Foot-notes
BOD, 5 day	<4.0	2.0	mg/L	10/27/2010	SM 5210	
Ammonia, Nitrogen	<0.1	0.1	mg/L	11/4/2010	SM 4500NH3-F	
Solids, Total Suspended	<20.0	2.0	mg/L	10/29/2010	SM 2540D	
Fecal Coliform	580	4	CFU/100mL	10/25/2010	SM 9222D	

1. Fecal count based on non-ideal count.

ENVIRONMENTAL Inc.

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Cullowhee, North Carolina 28723
Phone (828) 293-9396 (800) 213-4035
FAX (828) 293-1206
E-mail environmentalinc@aol.com

Certificate of Analysis

Client Name: McGill Associates
Address: 55 Broad Street
Asheville, NC 28801

Collection Date: 11/4/2010
Date Received: 11/4/2010

RESULTS

Sample Identification: Storm water site A (grab)

Parameters	Result	MDL	Units	Date Analyzed	Method	Foot-notes
BOD, 5 day	<8.0	2.0	mg/L	11/5/2010	SM 5210	
Ammonia, Nitrogen	<0.1	0.1	mg/L	11/15/2010	SM 4500NH3-F	
Solids, Total Suspended	<4.0	2.0	mg/L	11/5/2010	SM 2540D	
Specific Conductance	59.7	1.0	µmhos	11/15/2010	SM 2510B	

Sample Identification: Storm water site B (grab)

Parameters	Result	MDL	Units	Date Analyzed	Method	Foot-notes
BOD, 5 day	<8.0	2.0	mg/L	11/5/2010	SM 5210	
Ammonia, Nitrogen	<0.1	0.1	mg/L	11/15/2010	SM 4500NH3-F	
Solids, Total Suspended	<4.0	2.0	mg/L	11/5/2010	SM 2540D	
Specific Conductance	122	1.0	µmhos	11/15/2010	SM 2510B	

Anthony Tirona, Laboratory Supervisor

1/12/11
Date

Report prepared: 1/12/2011 3:42 PM

Sample Identification: Storm water site C (grab)

Parameters	Result	MDL	Units	Date Analyzed	Method	Foot-notes
BOD, 5 day	<8.0	2.0	mg/L	11/5/2010	SM 5210	
Ammonia, Nitrogen	<0.1	0.1	mg/L	11/15/2010	SM 4500NH3-F	
Solids, Total Suspended	<4.0	2.0	mg/L	11/5/2010	SM 2540D	

Pace Analytical Services, Inc.
2225 Riverside Dr.
Asheville, NC 28804
(828)284-7176

Pace Analytical Services, Inc.
9800 Kincey Ave. Suite 100
Huntersville, NC 28078
(704)875-9092

ANALYTICAL RESULTS

Project: Highlands SW PINE STREET 11/08
Pace Project No.: 9281512

Sample: HIGHLANDS STORMWATER A Lab ID: 9281512001 Collected: 11/04/10 10:31 Received: 11/05/10 09:37 Matrix: Water

Parameters	Results	Units	Report Limit	DF	Prepared	Analyzed	CAS No.	Qual
Total Nitrogen Calculation	Analytical Method: 40CFR PART 503							
Nitrogen	**0.97**	mg/L	0.60	1		11/09/10 08:51	7727-37-9	
351.2 Total Kjeldahl Nitrogen	Analytical Method: EPA 351.2							
Nitrogen, Kjeldahl, Total	**0.81**	mg/L	0.50	1		11/19/10 10:05	7727-37-9	
353.2 Nitrogen, NO2/NO3 pres.	Analytical Method: EPA 353.2							
Nitrogen, NO2 plus NO3	**0.16**	mg/L	0.10	1		11/12/10 16:18		
365.1 Phosphorus, Total	Analytical Method: EPA 365.1							
Phosphorus	ND	mg/L	0.10	1		11/19/10 08:18	7723-14-0	M1
365.1 Orthophosphate as P	Analytical Method: EPA 365.1							
Orthophosphate as P	ND	mg/L	0.050	1		11/05/10 19:49		M1

Sample: HIGHLANDS STORMWATER B Lab ID: 9281512002 Collected: 11/04/10 10:35 Received: 11/05/10 09:37 Matrix: Water

Parameters	Results	Units	Report Limit	DF	Prepared	Analyzed	CAS No.	Qual
Total Nitrogen Calculation	Analytical Method: 40CFR PART 503							
Nitrogen	**1.0**	mg/L	0.60	1		11/09/10 08:51	7727-37-9	
351.2 Total Kjeldahl Nitrogen	Analytical Method: EPA 351.2							
Nitrogen, Kjeldahl, Total	**0.94**	mg/L	0.50	1		11/19/10 10:07	7727-37-9	
353.2 Nitrogen, NO2/NO3 pres.	Analytical Method: EPA 353.2							
Nitrogen, NO2 plus NO3	ND	mg/L	0.10	1		11/12/10 14:35		
365.1 Phosphorus, Total	Analytical Method: EPA 365.1							
Phosphorus	ND	mg/L	0.10	1		11/19/10 08:21	7723-14-0	
365.1 Orthophosphate as P	Analytical Method: EPA 365.1							
Orthophosphate as P	ND	mg/L	0.050	1		11/05/10 19:49		

Sample: HIGHLANDS STORMWATER C Lab ID: 9281512003 Collected: 11/04/10 10:41 Received: 11/05/10 09:37 Matrix: Water

Parameters	Results	Units	Report Limit	DF	Prepared	Analyzed	CAS No.	Qual
Total Nitrogen Calculation	Analytical Method: 40CFR PART 503							
Nitrogen	**2.4**	mg/L	0.60	1		11/19/10 08:21	7727-37-9	

REPORT OF LABORATORY ANALYSIS

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(704)875-9092

ANALYTICAL RESULTS

Project: Highlands SW PINE STREET 11/05
Pace Project No.: 9281512

Sample: HIGHLANDS STORMWATER C | Lab ID: 9281512003 | Collected: 11/04/10 10:41 | Received: 11/05/10 09:37 | Matrix: Water

Parameters	Results	Units	Report Limit	DF	Prepared	Analyzed	CAS No.	Qual
351.2 Total Kjeldahl Nitrogen	Analytical Method: EPA 351.2							
Nitrogen, Kjeldahl, Total	**1.8**	mg/L	0.50	1		11/19/10 10:09	7727-37-9	
353.2 Nitrogen, NO2/NO3 pres.	Analytical Method: EPA 353.2							
Nitrogen, NO2 plus NO3	**0.49**	mg/L	0.10	1		11/12/10 14:38		
365.1 Phosphorus, Total	Analytical Method: EPA 365.1							
Phosphorus	ND	mg/L	0.10	1		11/19/10 08:21	7723-14-0	
365.1 Orthophosphate as P	Analytical Method: EPA 365.1							
Orthophosphate as P	ND	mg/L	0.050	1		11/05/10 19:49		

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E-mail environmentalinc@aol.com

Certificate of Analysis

Client Name: McGill Associates
Address: 55 Broad Street
Asheville, NC 28801

Collection Date: 11/16/2010
Date Received: 11/16/2010

RESULTS

Sample Identification: Storm water site A (grab)

Parameters	Result	MDL	Units	Date Analyzed	Method	Foot-notes
Temperature	9.7	---	°C	11/16/2010	SM 2550 B	
Oxygen, Dissolved	8.4	1.0	mg/L	11/16/2010	SM 4500-O G	
pH	6.2	-----	Std Units	11/16/2010	SM 4500 HB	
Solids, Total Suspended	20.8	2.0	mg/L	11/22/2010	SM 2540D	
Specific Conductance	12.1	1.0	µmhos	12/10/2010	SM 2510B	
Arsenic	<0.005	0.005	mg/L	1/27/2011	SM 3113 B	
Lead	<0.003	0.003	mg/L	1/14/2011	SM 3113 B	
Cadmium	<0.010	0.010	mg/L	1/28/2011	SM 3111B	
Chromium	<0.05	0.05	mg/L	1/28/2011	SM 3111 B	
Silver	<0.05	0.05	mg/L	1/28/2011	SM 3111 B	
Copper	<0.05	0.05	mg/L	2/2/2011	SM 3111 B	*
Zinc	0.053	0.010	mg/L	2/2/2011	SM 3111 B	*

Sample Identification: Storm water site B (grab)

Parameters	Result	MDL	Units	Date Analyzed	Method	Foot-notes
Solids, Total Suspended	27.3	2.0	mg/L	11/22/2010	SM 2540D	

Anthony Tirona, Laboratory Supervisor

2/2/11
Date

Report prepared: 2/2/2011 3:13 PM

Sample Identification: Storm water site C (grab)

Parameters	Result	MDL	Units	Date Analyzed	Method	Foot-notes
Temperature	10.8	---	°C	11/16/2010	SM 2550 B	
Oxygen, Dissolved	4.1	1.0	mg/L	11/16/2010	SM 4500-O G	
pH	5.9	-----	Std Units	11/16/2010	SM 4500 HB	
Solids, Total Suspended	<2.0	2.0	mg/L	11/22/2010	SM 2540D	
Specific Conductance	50.5	1.0	µmhos	12/10/2010	SM 2510B	
Arsenic	<0.005	0.005	mg/L	1/27/2011	SM 3113 B	
Lead	<0.003	0.003	mg/L	1/14/2011	SM 3113 B	
Cadmium	<0.010	0.010	mg/L	1/28/2011	SM 3111B	
Chromium	<0.05	0.05	mg/L	1/28/2011	SM 3111 B	
Silver	<0.05	0.05	mg/L	1/28/2011	SM 3111 B	
Copper	<0.05	0.05	mg/L	2/2/2011	SM 3111 B	*
Zinc	0.125	0.010	mg/L	2/2/2011	SM 3111 B	*

* This report amends the report prepared on 1/28/11. This report includes results for copper and zinc for water site A and water site C.

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(704)875-9092

ANALYTICAL RESULTS

Project: Highlands - SW Site A
Pace Project No.: 9282089

Sample: Highlands - SW - Site A Lab ID: **9282089001** Collected: 11/16/10 09:01 Received: 11/23/10 10:05 Matrix: Water

Parameters	Results	Units	Report Limit	DF	Prepared	Analyzed	CAS No.	Qual
200.7 MET ICP	Analytical Method: EPA 200.7 Preparation Method: EPA 200.7							
Barium	**10.0**	ug/L	5.0	1	11/30/10 09:20	12/02/10 03:18	7440-39-3	
Selenium	ND	ug/L	10.0	1	11/30/10 09:20	12/02/10 03:18	7782-49-2	
245.1 Mercury	Analytical Method: EPA 245.1 Preparation Method: EPA 245.1							
Mercury	ND	ug/L	0.20	1	12/03/10 16:15	12/06/10 11:38	7439-97-6	

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ANALYTICAL RESULTS

Project: Highlands Stormwater
Pace Project No.: 9282688

Sample: Highlands SW - Site C Lab ID: 9282688001 Collected: 11/19/10 09:09 Received: 11/23/10 10:05 Matrix: Water

Parameters	Results	Units	Report Limit	DF	Prepared	Analyzed	CAS No.	Qual
200.7 MET ICP	Analytical Method: EPA 200.7 Preparation Method: EPA 200.7							
Barium	**8.8**	ug/L	5.0	1	11/30/10 09:20	12/02/10 03:02	7440-39-3	
Selenium	ND	ug/L	10.0	1	11/30/10 09:20	12/02/10 03:02	7782-49-2	
245.1 Mercury	Analytical Method: EPA 245.1 Preparation Method: EPA 245.1							
Mercury	ND	ug/L	0.20	1	12/03/10 16:15	12/06/10 11:36	7439-97-6	

REPORT OF LABORATORY ANALYSIS

ENVIRONMENTAL Inc.

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Certificate of Analysis

Client Name: McGill Associates
Address: 55 Broad Street
Asheville, NC 28801

Collection Date: 11/30/2010
Date Received: 11/30/2010

RESULTS

Sample Identification: Storm water site A (grab)

Parameters	Result	MDL	Units	Date Analyzed	Method	Foot-notes
Solids, Total Suspended	10.6	2.0	mg/L	12/7/2010	SM 2540D	
Specific Conductance	28.5	1.0	µmhos	12/10/2010	SM 2510B	

Sample Identification: Storm water site B (grab)

Parameters	Result	MDL	Units	Date Analyzed	Method	Foot-notes
Solids, Total Suspended	6.9	2.0	mg/L	12/7/2010	SM 2540D	

Sample Identification: Storm water site C (grab)

Parameters	Result	MDL	Units	Date Analyzed	Method	Foot-notes
Solids, Total Suspended	2.0	2.0	mg/L	12/7/2010	SM 2540D	
Specific Conductance	18.1	1.0	µmhos	12/10/2010	SM 2510B	

Anthony Tirona, Laboratory Supervisor

1/12/11
Date

Report prepared: 1/12/2011 3:59 PM

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Certificate of Analysis

Client Name: McGill Associates
Address: 55 Broad Street
Asheville, NC 28801

Collection Date: 12/21/2010
Date Received: 12/21/2010

RESULTS

Sample Identification: Storm water site A (grab)

Parameters	Result	MDL	Units	Date Analyzed	Method	Foot-notes
Ammonia, Nitrogen	<0.1	0.1	mg/L	1/4/2011	SM 4500NH3-F	
Solids, Total Suspended	40.7	2.0	mg/L	12/28/2010	SM 2540D	
Specific Conductance	132	1.0	µmhos	1/4/2011	SM 2510B	

Sample Identification: Storm water site B (grab)

Parameters	Result	MDL	Units	Date Analyzed	Method	Foot-notes
Ammonia, Nitrogen	0.1	0.1	mg/L	1/4/2011	SM 4500NH3-F	
Solids, Total Suspended	<2.0	2.0	mg/L	12/28/2010	SM 2540D	

Anthony Trona, Laboratory Supervisor

1/18/11
Date

Report prepared: 1/18/2011 4:04 PM

Sample Identification: Storm water site C (grab)

Parameters	Result	MDL	Units	Date Analyzed	Method	Foot-notes
Ammonia, Nitrogen	<0.1	0.1	mg/L	1/4/2011	SM 4500NH3-F	
Solids, Total Suspended	<2.0	2.0	mg/L	12/28/2010	SM 2540D	
Specific Conductance	245	1.0	µmhos	1/4/2011	SM 2510B	

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ANALYTICAL RESULTS

Project: STORMWATER A 12/23
Pace Project No.: 9284685

Sample: HIGHLANDS STORMWATER A Lab ID: 9284685001 Collected: 12/21/10 12:06 Received: 12/23/10 09:58 Matrix: Water

Parameters	Results	Units	Report Limit	DF	Prepared	Analyzed	CAS No.	Qual
Total Nitrogen Calculation	Analytical Method: 40CFR PART 503							
Nitrogen	**0.74**	mg/L	0.50	1		12/28/10 08:16	7727-37-9	
351.2 Total Kjeldahl Nitrogen	Analytical Method: EPA 351.2							
Nitrogen, Kjeldahl, Total	ND	mg/L	0.50	1		01/04/11 11:58	7727-37-9	
353.2 Nitrogen, NO2/NO3 pres.	Analytical Method: EPA 353.2							
Nitrogen, NO2 plus NO3	**0.29**	mg/L	0.10	1		12/29/10 12:32		
365.1 Phosphorus, Total	Analytical Method: EPA 365.1							
Phosphorus	**0.44**	mg/L	0.10	1		01/01/11 15:27	7723-14-0	

Sample: HIGHLANDS STORMWATER A Lab ID: 9284685002 Collected: 12/21/10 12:07 Received: 12/23/10 09:58 Matrix: Water

Parameters	Results	Units	Report Limit	DF	Prepared	Analyzed	CAS No.	Qual
365.1 Orthophosphate as P	Analytical Method: EPA 365.1							
Orthophosphate as P	ND	mg/L	0.050	1		12/23/10 11:37		N2

REPORT OF LABORATORY ANALYSIS

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ANALYTICAL RESULTS

Project: STORMWATER 9 12/23
Pace Project No.: 9264686

Sample: HIGHLANDS STORMWATER B Lab ID: 9264686001 Collected: 12/21/10 12:10 Received: 12/23/10 09:58 Matrix: Water

Parameters	Results	Units	Report Limit	DF	Prepared	Analyzed	CAS No.	Qual
Total Nitrogen Calculation	Analytical Method: 40CFR PART 503							
Nitrogen	ND	mg/L	0.60	1		12/28/10 09:16	7727-37-9	
351.2 Total Kjeldahl Nitrogen	Analytical Method: EPA 351.2							
Nitrogen, Kjeldahl, Total	ND	mg/L	0.50	1		01/04/11 11:59	7727-37-9	
353.2 Nitrogen, NO2/NO3 pres.	Analytical Method: EPA 353.2							
Nitrogen, NO2 plus NO3	8.29	mg/L	0.10	1		12/29/10 12:33		
365.1 Phosphorus, Total	Analytical Method: EPA 365.1							
Phosphorus	ND	mg/L	0.10	1		01/01/11 15:28	7723-14-0	

Sample: HIGHLANDS STORMWATER B Lab ID: 9264686002 Collected: 12/21/10 12:11 Received: 12/23/10 09:58 Matrix: Water

Parameters	Results	Units	Report Limit	DF	Prepared	Analyzed	CAS No.	Qual
365.1 Orthophosphate as P	Analytical Method: EPA 365.1							
Orthophosphate as P	ND	mg/L	0.050	1		12/23/10 11:37		N2

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ANALYTICAL RESULTS

Project: STORMWATER C 12/23
Pace Project No.: 9284687

Sample: HIGHLANDS STORMWATER C Lab ID: 9284687001 Collected: 12/21/10 12:16 Received: 12/23/10 09:58 Matrix: Water

Parameters	Results	Units	Report Limit	DF	Prepared	Analyzed	CAS No.	Qual
Total Nitrogen Calculation	Analytical Method: 40CFR PART 503							
Nitrogen	ND	mg/L	0.60	1		12/28/10 09:16	7727-37-9	
351.2 Total Kjeldahl Nitrogen	Analytical Method: EPA 351.2							
Nitrogen, Kjeldahl, Total	ND	mg/L	0.50	1		01/04/11 11:59	7727-37-9	
353.2 Nitrogen, NO2/NO3 pres.	Analytical Method: EPA 353.2							
Nitrogen, NO2 plus NO3	0.68	mg/L	0.10	1		12/29/10 12:35		
365.1 Phosphorus, Total	Analytical Method: EPA 365.1							
Phosphorus	ND	mg/L	0.10	1		01/01/11 15:30	7723-14-0	

Sample: HIGHLANDS STORMWATER C Lab ID: 9284687002 Collected: 12/21/10 12:16 Received: 12/23/10 09:58 Matrix: Water

Parameters	Results	Units	Report Limit	DF	Prepared	Analyzed	CAS No.	Qual
365.1 Orthophosphate as P	Analytical Method: EPA 365.1							
Orthophosphate as P	ND	mg/L	0.050	1		12/23/10 11:37		N2

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E-mail environmentalinc@aol.com

Certificate of Analysis

Client Name: McGill Associates
Address: 55 Broad Street
Asheville, NC 28801

Collection Date: 1/18/2011
Date Received: 1/18/2011

RESULTS

Sample Identification: Storm water site A (grab)

Parameters	Result	MDL	Units	Date Analyzed	Method	Foot-notes
Ammonia, Nitrogen	0.2	0.1	mg/L	1/26/2011	SM 4500NH3-F	
Solids, Total Suspended	18.8	2.0	mg/L	1/25/2011	SM 2540D	
Specific Conductance	466	1.0	µmhos	1/20/2011	SM 2510B	

Sample Identification: Storm water site B (grab)

Parameters	Result	MDL	Units	Date Analyzed	Method	Foot-notes
Ammonia, Nitrogen	<0.1	0.1	mg/L	1/26/2011	SM 4500NH3-F	
Solids, Total Suspended	9.2	2.0	mg/L	1/25/2011	SM 2540D	

Anthony Tirona, Laboratory Supervisor

2/8/11
Date

Report prepared: 2/8/2011 12:05 PM

Sample Identification: Storm water site C (grab)

Parameters	Result	MDL	Units	Date Analyzed	Method	Foot-notes
Ammonia, Nitrogen	<0.1	0.1	mg/L	1/26/2011	SM 4500NH3-F	
Solids, Total Suspended	<2.0	2.0	mg/L	1/25/2011	SM 2540D	
Specific Conductance	307	1.0	µmhos	1/20/2011	SM 2510B	

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9800 Kincey Ave. Suite 100
Huntersville, NC 28078
(704)875-9092

ANALYTICAL RESULTS

Project: Highlands SW
Pace Project No.: 9289954

Parameters	Results	Units	Report Limit	DF	Prepared	Analyzed	CAS No.	Qual
Sample: Highlands SW A	**Lab ID: 9289954001**	**Collected: 01/18/11 09:32**	**Received: 01/19/11 10:15**	**Matrix: Water**				
Total Nitrogen Calculation	Analytical Method: 40CFR PART 503							
Nitrogen	2.3 mg/L		0.60	1		02/01/11 08:18	7727-37-9	
351.2 Total Kjeldahl Nitrogen	Analytical Method: EPA 351.2							
Nitrogen, Kjeldahl, Total	2.1 mg/L		0.50	1		01/25/11 10:56	7727-37-9	
353.2 Nitrogen, NO2/NO3 pres.	Analytical Method: EPA 353.2							
Nitrogen, NO2 plus NO3	0.27 mg/L		0.10	1		01/20/11 17:43		
365.1 Phosphorus, Total	Analytical Method: EPA 365.1							
Phosphorus	0.16 mg/L		0.10	1		01/31/11 10:05	7723-14-0	
365.1 Orthophosphate as P	Analytical Method: EPA 365.1							
Orthophosphate as P	ND mg/L		0.050	1		01/19/11 11:47		N2
Sample: Highlands SW B	**Lab ID: 9289954002**	**Collected: 01/18/11 09:39**	**Received: 01/19/11 10:15**	**Matrix: Water**				
Total Nitrogen Calculation	Analytical Method: 40CFR PART 503							
Nitrogen	ND mg/L		0.60	1		02/01/11 08:18	7727-37-9	
351.2 Total Kjeldahl Nitrogen	Analytical Method: EPA 351.2							
Nitrogen, Kjeldahl, Total	ND mg/L		0.50	1		01/25/11 10:58	7727-37-9	
353.2 Nitrogen, NO2/NO3 pres.	Analytical Method: EPA 353.2							
Nitrogen, NO2 plus NO3	0.30 mg/L		0.10	1		01/20/11 17:44		
365.1 Phosphorus, Total	Analytical Method: EPA 365.1							
Phosphorus	ND mg/L		0.10	1		01/31/11 10:06	7723-14-0	
365.1 Orthophosphate as P	Analytical Method: EPA 365.1							
Orthophosphate as P	ND mg/L		0.050	1		01/19/11 11:47		N2
Sample: Highlands SW C	**Lab ID: 9289954003**	**Collected: 01/18/11 09:41**	**Received: 01/19/11 10:15**	**Matrix: Water**				
Total Nitrogen Calculation	Analytical Method: 40CFR PART 503							
Nitrogen	0.60 mg/L		0.60	1		02/01/11 08:18	7727-37-9	
351.2 Total Kjeldahl Nitrogen	Analytical Method: EPA 351.2							
Nitrogen, Kjeldahl, Total	ND mg/L		0.50	1		01/25/11 10:57	7727-37-9	

REPORT OF LABORATORY ANALYSIS

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9800 Kincey Ave. Suite 100
Huntersville, NC 28078
(704)875-9092

ANALYTICAL RESULTS

Project: Highlands SW
Pace Project No.: 8265084

Sample: Highlands SW 0 Lab ID: 8265084003 Collected: 01/18/11 09:41 Received: 01/19/11 10:10 Matrix: Water

Parameters	Results	Units	Report Limit	DF	Prepared	Analyzed	CAS No.	Qual
353.2 Nitrogen, NO2&NO3 prep.	Analytical Method: EPA 353.2							
Nitrogen, NO2 plus NO3	0.66 mg/L		0.10	1		01/26/11 17:43		
365.1 Phosphorus, Total	Analytical Method: EPA 365.1							
Phosphorus	ND mg/L		0.10	1		01/31/11 15:56	7723-14-0	
365.1 Orthophosphate as P	Analytical Method: EPA 365.1							
Orthophosphate as P	ND mg/L		0.050	1		01/19/11 11:47		M2

REPORT OF LABORATORY ANALYSIS

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Certificate of Analysis

Client Name: McGill Associates
Address: 55 Broad Street
Asheville, NC 28801

Collection Date: 1/26/2011
Date Received: 1/26/2011

RESULTS

Sample Identification: Storm water site A (grab)

Parameters	Result	MDL	Units	Date Analyzed	Method	Foot-notes
Solids, Total Suspended	42.0	2.0	mg/L	1/31/2011	SM 2540D	
Specific Conductance	99.3	1.0	µmhos	2/4/2011	SM 2510B	

Sample Identification: Storm water site B (grab)

Parameters	Result	MDL	Units	Date Analyzed	Method	Foot-notes
Solids, Total Suspended	27.2	2.0	mg/L	1/31/2011	SM 2540D	

Sample Identification: Storm water site C (grab)

Parameters	Result	MDL	Units	Date Analyzed	Method	Foot-notes
Solids, Total Suspended	10.8	2.0	mg/L	1/31/2011	SM 2540D	
Specific Conductance	353	1.0	µmhos	2/4/2011	SM 2510B	

Anthony Tirona, Laboratory Supervisor

2/8/11
Date

Report prepared: 2/8/2011 12:06 PM

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Certificate of Analysis

Client Name: McGill Associates
Address: 55 Broad Street
Asheville, NC 28801

Collection Date: 2/1/2011
Date Received: 2/1/2011

RESULTS

Sample Identification: Storm water site A (grab)

Parameters	Result	MDL	Units	Date Analyzed	Method	Foot-notes
Ammonia, Nitrogen	<0.1	0.1	mg/L	2/8/2011	SM 4500NH3-F	
Solids, Total Suspended	77.3	2.0	mg/L	2/7/2011	SM 2540D	
Specific Conductance	119	1.0	µmhos	2/4/2011	SM 2510B	

Sample Identification: Storm water site B (grab)

Parameters	Result	MDL	Units	Date Analyzed	Method	Foot-notes
Ammonia, Nitrogen	<0.1	0.1	mg/L	2/8/2011	SM 4500NH3-F	
Solids, Total Suspended	25.0	2.0	mg/L	2/7/2011	SM 2540D	

Anthony Tirona
(Anthony Tirona, Laboratory Supervisor

2/17/11
Date

Report prepared: 2/17/2011 2:50 PM

Sample Identification: Storm water site C (grab)

Parameters	Result	MDL	Units	Date Analyzed	Method	Foot-notes
Ammonia, Nitrogen	<0.1	0.1	mg/L	2/8/2011	SM 4500NH3-F	
Solids, Total Suspended	3.4	2.0	mg/L	2/7/2011	SM 2540D	
Specific Conductance	149	1.0	µmhos	2/4/2011	SM 2510B	

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ANALYTICAL RESULTS

Project: HIGHLANDS STORMWATER 62/09
Pace Project No.: 6255960

Sample: HIGHLANDS STORMWATER A Lab ID: 6256960001 Collected: 02/01/11 11:30 Received: 02/02/11 10:02 Matrix: Water

Parameters	Results	Units	Report Limit	DF	Prepared	Analyzed	CAS No.	Qual
Total Nitrogen Calculation	Analytical Method: 40CFR PART 503							
Nitrogen	5.1 mg/L		0.60	1		02/14/11 14:23	7727-37-9	
351.2 Total Kjeldahl Nitrogen	Analytical Method: EPA 351.2							
Nitrogen, Kjeldahl, Total	5.7 mg/L		0.50	1		02/12/11 14:33	7727-37-9	
353.2 Nitrogen, NO2/NO3 pres.	Analytical Method: EPA 353.2							
Nitrogen, NO2 plus NO3	0.37 mg/L		0.10	1		02/03/11 21:20		
365.1 Phosphorus, Total	Analytical Method: EPA 365.1							
Phosphorus	0.13 mg/L		0.10	1		02/09/11 14:32	7723-14-0	
365.1 Orthophosphate as P	Analytical Method: EPA 365.1							
Orthophosphate as P	ND mg/L		0.050	1		02/03/11 11:03		N2

Sample: HIGHLANDS STORMWATER B Lab ID: 6256960002 Collected: 02/01/11 11:39 Received: 02/02/11 10:02 Matrix: Water

Parameters	Results	Units	Report Limit	DF	Prepared	Analyzed	CAS No.	Qual
Total Nitrogen Calculation	Analytical Method: 40CFR PART 503							
Nitrogen	ND mg/L		0.60	1		02/14/11 14:23	7727-37-9	
351.2 Total Kjeldahl Nitrogen	Analytical Method: EPA 351.2							
Nitrogen, Kjeldahl, Total	ND mg/L		0.50	1		02/12/11 14:34	7727-37-9	
353.2 Nitrogen, NO2/NO3 pres.	Analytical Method: EPA 353.2							
Nitrogen, NO2 plus NO3	0.39 mg/L		0.10	1		02/03/11 21:22		
365.1 Phosphorus, Total	Analytical Method: EPA 365.1							
Phosphorus	ND mg/L		0.10	1		02/09/11 14:33	7723-14-0	
365.1 Orthophosphate as P	Analytical Method: EPA 365.1							
Orthophosphate as P	ND mg/L		0.050	1		02/03/11 11:03		N2

Sample: HIGHLANDS STORMWATER C Lab ID: 6256960003 Collected: 02/01/11 11:45 Received: 02/02/11 10:02 Matrix: Water

Parameters	Results	Units	Report Limit	DF	Prepared	Analyzed	CAS No.	Qual
Total Nitrogen Calculation	Analytical Method: 40CFR PART 503							
Nitrogen	ND mg/L		0.60	1		02/14/11 14:23	7727-37-9	

REPORT OF LABORATORY ANALYSIS

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ANALYTICAL RESULTS

Project: HIGHLANDS STORMWATER 02/02
Pace Project No.: 9280990

Sample: HIGHLANDS STORMWATER G | Lab ID: 92809909005 | Collected: 02/01/11 11:45 | Received: 02/02/11 16:02 | Matrix: Water

Parameters	Results	Units	Report Limit	DF	Prepared	Analyzed	CAS No.	Qual
351.2 Total Kjeldahl Nitrogen	Analytical Method: EPA 351.2							
Nitrogen, Kjeldahl, Total	ND	mg/L	0.50	1		02/12/11 14:34	7727-37-9	
353.2 Nitrogen, NO2/NO3 pres.	Analytical Method: EPA 353.2							
Nitrogen, NO2 plus NO3	0.88	mg/L	0.10	1		02/03/11 21:23		
365.1 Phosphorus, Total	Analytical Method: EPA 365.1							
Phosphorus	0.20	mg/L	0.10	1		02/09/11 14:34	7723-14-0	
365.1 Orthophosphate as P	Analytical Method: EPA 365.1							
Orthophosphate as P	ND	mg/L	0.050	1		02/03/11 11:03		R2

REPORT OF LABORATORY ANALYSIS

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Certificate of Analysis

Client Name: McGill Associates
Address: 55 Broad Street
Asheville, NC 28801

Collection Date: 2/28/2011
Date Received: 2/28/2011

RESULTS

Sample Identification: Storm water site A (grab)

Parameters	Result	MDL	Units	Date Analyzed	Method	Foot-notes
Solids, Total Suspended	2150	2.0	mg/L	3/7/2011	SM 2540D	
Specific Conductance	105	1.0	µmhos	3/18/2011	SM 2510B	

Sample Identification: Storm water site B (grab)

Parameters	Result	MDL	Units	Date Analyzed	Method	Foot-notes
Solids, Total Suspended	4.7	2.0	mg/L	3/7/2011	SM 2540D	

Sample Identification: Storm water site C (grab)

Parameters	Result	MDL	Units	Date Analyzed	Method	Foot-notes
Solids, Total Suspended	5.5	2.0	mg/L	3/7/2011	SM 2540D	
Specific Conductance	86.8	1.0	µmhos	3/18/2011	SM 2510B	

Anthony Tirona, Laboratory Supervisor

3/22/11
Date

Report prepared: 3/22/2011 3:33 PM

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Certificate of Analysis

Client Name: McGill Associates
Address: 55 Broad Street
Asheville, NC 28801

Collection Date: 3/9/2011
Date Received: 3/9/2011

RESULTS

Sample Identification: Storm water site A (grab)

Parameters	Result	MDL	Units	Date Analyzed	Method	Foot-notes
Ammonia, Nitrogen	0.2	0.1	mg/L	3/22/2011	SM 4500NH3-F	
Solids, Total Suspended	18.7	2.0	mg/L	3/14/2011	SM 2540D	
Specific Conductance	14.4	1.0	µmhos	3/18/2011	SM 2510B	
Arsenic	<0.005	0.005	mg/L	4/13/2011	SM 3113 B	
Lead	<0.003	0.003	mg/L	4/12/2011	SM 3113 B	
Cadmium	<0.010	0.010	mg/L	4/6/2011	SM 3111B	
Chromium	<0.05	0.05	mg/L	4/8/2011	SM 3111 B	
Silver	<0.05	0.05	mg/L	4/5/2011	SM 3111 B	
Copper	<0.05	0.05	mg/L	3/28/2011	SM 3111 B	
Zinc	0.051	0.010	mg/L	4/8/2011	SM 3111 B	

Sample Identification: Storm water site B (grab)

Parameters	Result	MDL	Units	Date Analyzed	Method	Foot-notes
Ammonia, Nitrogen	0.1	0.1	mg/L	3/22/2011	SM 4500NH3-F	
Solids, Total Suspended	16.7	2.0	mg/L	3/14/2011	SM 2540D	

Anthony Tirona, Laboratory Supervisor — 4/13/11 Date

Report prepared: 4/13/2011 5:28 PM

Sample Identification: Storm water site C (grab)

Parameters	Result	MDL	Units	Date Analyzed	Method	Foot-notes
Ammonia, Nitrogen	0.1	0.1	mg/L	3/22/2011	SM 4500NH3-F	
Solids, Total Suspended	<2.0	2.0	mg/L	3/14/2011	SM 2540D	
Specific Conductance	83.8	1.0	µmhos	3/18/2011	SM 2510B	
Arsenic	<0.005	0.005	mg/L	4/13/2011	SM 3113 B	
Lead	<0.003	0.003	mg/L	4/12/2011	SM 3113 B	
Cadmium	<0.010	0.010	mg/L	4/6/2011	SM 3111B	
Chromium	<0.05	0.05	mg/L	4/8/2011	SM 3111 B	
Silver	<0.05	0.05	mg/L	4/5/2011	SM 3111 B	
Copper	<0.05	0.05	mg/L	3/28/2011	SM 3111 B	
Zinc	0.141	0.010	mg/L	4/8/2011	SM 3111 B	

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ANALYTICAL RESULTS

Project: STORMWATER 03/09
Pace Project No.: 9289551

Sample: HIGHLANDS STORMWATER - A | Lab ID: 9289551001 | Collected: 03/09/11 09:05 | Received: 03/10/11 09:53 | Matrix: Water

Parameters	Results	Units	Report Limit	DF	Prepared	Analyzed	CAS No.	Qual
200.7 MET ICP	Analytical Method: EPA 200.7 Preparation Method: EPA 200.7							
Barium	8.3 ug/L		5.0	1	03/16/11 15:05	03/18/11 03:23	7440-39-3	
Selenium	ND ug/L		10.0	1	03/16/11 15:05	03/18/11 03:25	7782-49-2	
245.1 Mercury	Analytical Method: EPA 245.1 Preparation Method: EPA 245.1							
Mercury	ND ug/L		0.20	1	03/22/11 11:00	03/22/11 16:30	7439-97-6	
Total Nitrogen Calculation	Analytical Method: 40CFR PART 503							
Nitrogen	ND mg/L		0.00	1		03/18/11 13:43	7727-37-9	
351.2 Total Kjeldahl Nitrogen	Analytical Method: EPA 351.2							
Nitrogen, Kjeldahl, Total	ND mg/L		0.50	1		03/22/11 12:03	7727-37-9	
353.2 Nitrogen, NO2/NO3 pres.	Analytical Method: EPA 353.2							
Nitrogen, NO2 plus NO3	ND mg/L		0.10	1		03/11/11 21:05		
365.1 Phosphorus, Total	Analytical Method: EPA 365.1							
Phosphorus	ND mg/L		0.10	1		03/22/11 18:45	7723-14-0	
365.1 Orthophosphate as P	Analytical Method: EPA 365.1							
Orthophosphate as P	ND mg/L		0.050	1		03/16/11 14:09		N2

Sample: HIGHLANDS STORMWATER - B | Lab ID: 9289551002 | Collected: 03/09/11 09:07 | Received: 03/10/11 09:53 | Matrix: Water

Parameters	Results	Units	Report Limit	DF	Prepared	Analyzed	CAS No.	Qual
Total Nitrogen Calculation	Analytical Method: 40CFR PART 503							
Nitrogen	ND mg/L		0.00	1		03/18/11 13:43	7727-37-9	
351.2 Total Kjeldahl Nitrogen	Analytical Method: EPA 351.2							
Nitrogen, Kjeldahl, Total	ND mg/L		0.50	1		03/23/11 13:04	7727-37-9	
353.2 Nitrogen, NO2/NO3 pres.	Analytical Method: EPA 353.2							
Nitrogen, NO2 plus NO3	ND mg/L		0.10	1		03/11/11 21:05		
365.1 Phosphorus, Total	Analytical Method: EPA 365.1							
Phosphorus	ND mg/L		0.10	1		03/22/11 18:48	7723-14-0	
365.1 Orthophosphate as P	Analytical Method: EPA 365.1							
Orthophosphate as P	ND mg/L		0.050	1		03/16/11 14:09		N2

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ANALYTICAL RESULTS

Project: STORMWATER 03/9
Pace Project No.: 9265551

Sample: HIGHLANDS STORMWATER - C Lab ID: 9265551003 Collected: 03/09/11 09:10 Received: 03/10/11 09:03 Matrix: Water

Parameters	Results	Units	Report Limit	DF	Prepared	Analyzed	CAS No.	Qual
200.7 MET ICP	Analytical Method: EPA 200.7 Preparation Method: EPA 200.7							
Barium	16.8	ug/L	5.0	1	03/18/11 16:00	03/19/11 03:28	7440-39-3	
Selenium	ND	ug/L	10.0	1	03/18/11 16:00	03/19/11 03:28	7782-49-2	
245.1 Mercury	Analytical Method: EPA 245.1 Preparation Method: EPA 245.1							
Mercury	ND	ug/L	0.20	1	03/22/11 11:00	03/23/11 10:46	7439-97-6	
Total Nitrogen Calculation	Analytical Method: 40CFR PART 503							
Nitrogen	ND	mg/L	0.60	1		03/10/11 13:43	7727-37-9	
351.2 Total Kjeldahl Nitrogen	Analytical Method: EPA 351.2							
Nitrogen, Kjeldahl, Total	ND	mg/L	0.50	1		03/23/11 12:05	7727-37-9	
353.2 Nitrogen, NO2/NO3 prep.	Analytical Method: EPA 353.2							
Nitrogen, NO2 plus NO3	0.39	mg/L	0.10	1		03/17/11 21:08		
365.1 Phosphorus, Total	Analytical Method: EPA 365.1							
Phosphorus	ND	mg/L	0.10	1		03/22/11 15:46	7723-14-0	
365.1 Orthophosphate as P	Analytical Method: EPA 365.1							
Orthophosphate as P	0.669	mg/L	0.050	1		03/10/11 14:08		M2

REPORT OF LABORATORY ANALYSIS

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Certificate of Analysis

Client Name: McGill Associates
Address: 55 Broad Street
Asheville, NC 28801

Collection Date: 3/26/2011
Date Received: 3/26/2011

RESULTS

Sample Identification: Storm water site A (grab)

Parameters	Result	MDL	Units	Date Analyzed	Method	Foot-notes
Solids, Total Suspended	24.4	2.0	mg/L	4/5/2011	SM 2540D	
Specific Conductance	14.6	1.0	µmhos	3/30/2011	SM 2510B	

Sample Identification: Storm water site B (grab)

Parameters	Result	MDL	Units	Date Analyzed	Method	Foot-notes
Solids, Total Suspended	29.3	2.0	mg/L	4/5/2011	SM 2540D	

Sample Identification: Storm water site C (grab)

Parameters	Result	MDL	Units	Date Analyzed	Method	Foot-notes
Solids, Total Suspended	<2.0	2.0	mg/L	4/5/2011	SM 2540D	
Specific Conductance	108	1.0	µmhos	3/30/2011	SM 2510B	

Anthony Tirona, Laboratory Supervisor

4/20/11
Date

Report prepared: 4/20/2011 5:32 PM

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Certificate of Analysis

Client Name: McGill Associates
Address: 55 Broad Street
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Collection Date: 4/12/2011
Date Received: 4/12/2011

RESULTS

Sample Identification: Storm water site A (grab)

Parameters	Result	MDL	Units	Date Analyzed	Method	Foot-notes
Ammonia, Nitrogen	0.1	0.1	mg/L	4/26/2011	SM 4500NH3-F	
Solids, Total Suspended	1010	2.0	mg/L	4/18/2011	SM 2540D	
Specific Conductance	107	1.0	µmhos	4/18/2011	SM 2510B	

Sample Identification: Storm water site B (grab)

Parameters	Result	MDL	Units	Date Analyzed	Method	Foot-notes
Ammonia, Nitrogen	<0.1	0.1	mg/L	4/26/2011	SM 4500NH3-F	
Solids, Total Suspended	<3.3	2.0	mg/L	4/18/2011	SM 2540D	

Anthony Tirona, Laboratory Supervisor

4/27/11
Date

Report prepared: 4/27/2011 1:54 PM

Sample Identification: Storm water site C (grab)

Parameters	Result	MDL	Units	Date Analyzed	Method	Foot-notes
Ammonia, Nitrogen	0.1	0.1	mg/L	4/26/2011	SM 4500NH3-F	
Solids, Total Suspended	<2.0	2.0	mg/L	4/18/2011	SM 2540D	
Specific Conductance	118	1.0	µmhos	4/18/2011	SM 2510B	

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ANALYTICAL RESULTS

Project: HIGHLANDS STORMWATER 04/12
Pace Project No.: 9291824

Sample: SITE A — Lab ID: 9291824001 — Collected: 04/12/11 09:30 — Received: 04/12/11 15:04 — Matrix: Water

Parameters	Results	Units	Report Limit	DF	Prepared	Analyzed	CAS No.	Qual
365.1 Orthophosphate as P	Analytical Method: EPA 365.1							
Orthophosphate as P	ND	mg/L	0.050	1		04/13/11 13:00		M2

Sample: SITE B — Lab ID: 9291824002 — Collected: 04/12/11 09:33 — Received: 04/12/11 15:04 — Matrix: Water

Parameters	Results	Units	Report Limit	DF	Prepared	Analyzed	CAS No.	Qual
365.1 Orthophosphate as P	Analytical Method: EPA 365.1							
Orthophosphate as P	ND	mg/L	0.050	1		04/13/11 13:00		M2

Sample: SITE C — Lab ID: 9291824003 — Collected: 04/12/11 09:33 — Received: 04/12/11 15:04 — Matrix: Water

Parameters	Results	Units	Report Limit	DF	Prepared	Analyzed	CAS No.	Qual
365.1 Orthophosphate as P	Analytical Method: EPA 365.1							
Orthophosphate as P	ND	mg/L	0.050	1		04/13/11 13:00		M2

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Certificate of Analysis

Client Name: McGill Associates
Address: 55 Broad Street
Asheville, NC 28801

Collection Date: 4/21/2011
Date Received: 4/26/2011

RESULTS

Sample Identification: Storm water site A (grab)

Parameters	Result	MDL	Units	Date Analyzed	Method	Foot-notes
Solids, Total Suspended	265	2.0	mg/L	4/28/2011	SM 2540D	
Specific Conductance	78.7	1.0	µmhos	4/28/2011	SM 2510B	

Sample Identification: Storm water site B (grab)

Parameters	Result	MDL	Units	Date Analyzed	Method	Foot-notes
Solids, Total Suspended	4.7	2.0	mg/L	4/28/2011	SM 2540D	

Sample Identification: Storm water site C (grab)

Parameters	Result	MDL	Units	Date Analyzed	Method	Foot-notes
Solids, Total Suspended	4.8	2.0	mg/L	4/28/2011	SM 2540D	
Specific Conductance	91.3	1.0	µmhos	4/28/2011	SM 2510B	

Anthony Tirona, Laboratory Supervisor

5/25/11
Date

Report prepared: 5/25/2011 1:43 PM

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Certificate of Analysis

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Address: 55 Broad Street
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Collection Date: 4/26/2011
Date Received: 4/26/2011

RESULTS

Sample Identification: Storm water site A (grab)

Parameters	Result	MDL	Units	Date Analyzed	Method	Foot-notes
Solids, Total Suspended	537	2.0	mg/L	4/28/2011	SM 2540D	
Specific Conductance	79.4	1.0	µmhos	4/28/2011	SM 2510B	

Sample Identification: Storm water site B (grab)

Parameters	Result	MDL	Units	Date Analyzed	Method	Foot-notes
Solids, Total Suspended	7.0	2.0	mg/L	4/28/2011	SM 2540D	

Sample Identification: Storm water site C (grab)

Parameters	Result	MDL	Units	Date Analyzed	Method	Foot-notes
Solids, Total Suspended	4.5	2.0	mg/L	4/28/2011	SM 2540D	
Specific Conductance	90.8	1.0	µmhos	4/28/2011	SM 2510B	

Anthony Tirona, Laboratory Supervisor

5/25/11
Date

Report prepared: 5/25/2011 1:44 PM

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Certificate of Analysis

Client Name: McGill Associates
Address: 55 Broad Street
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Collection Date: 5/4/2011
Date Received: 5/4/2011

RESULTS

Sample Identification: Storm water site A (grab)

Parameters	Result	MDL	Units	Date Analyzed	Method	Foot-notes
BOD, 5 day	<8.0	2.0	mg/L	5/5/2011	SM 5210	
Ammonia, Nitrogen	0.1	0.1	mg/L	5/17/2011	SM 4500NH3-F	
Solids, Total Suspended	164	2.0	mg/L	5/10/2011	SM 2540D	
Specific Conductance	112	1.0	µmhos	5/20/2011	SM 2510B	
Fecal Coliform	88	4	CFU/100mL	5/4/2011	SM 9222D	

Sample Identification: Storm water site B (grab)

Parameters	Result	MDL	Units	Date Analyzed	Method	Foot-notes
BOD, 5 day	<2.0	2.0	mg/L	5/5/2011	SM 5210	
Ammonia, Nitrogen	0.3	0.1	mg/L	5/17/2011	SM 4500NH3-F	
Solids, Total Suspended	7.7	2.0	mg/L	5/10/2011	SM 2540D	
Fecal Coliform	80	4	CFU/100mL	5/4/2011	SM 9222D	

Anthony Tirona, Laboratory Supervisor

5/25/11
Date

Report prepared: 5/25/2011 1:52 PM

Sample Identification: Storm water site C (grab)

Parameters	Result	MDL	Units	Date Analyzed	Method	Foot-notes
BOD, 5 day	4.9	2.0	mg/L	5/5/2011	SM 5210	
Ammonia, Nitrogen	0.2	0.1	mg/L	5/17/2011	SM 4500NH3-F	
Solids, Total Suspended	7.3	2.0	mg/L	5/10/2011	SM 2540D	
Specific Conductance	65.3	1.0	µmhos	5/20/2011	SM 2510B	
Fecal Coliform	304	4	CFU/100mL	5/4/2011	SM 9222D	

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ANALYTICAL RESULTS

Project: Highlands SW 5/4/11
Pace Project No.: 9293568

Sample: Highlands SW A	Lab ID: 9293568001	Collected: 05/04/11 11:40	Received: 05/05/11 13:45	Matrix: Water			
Parameters	Results	Units	Report Limit	DF	Prepared	Analyzed	CAS No.	Qual
365.1 Orthophosphate as P	Analytical Method: EPA 365.1							
Orthophosphate as P	ND	mg/L	0.050	1		05/06/11 09:44		M2

Sample: Highlands SW B	Lab ID: 9293568002	Collected: 05/04/11 11:44	Received: 05/05/11 13:45	Matrix: Water			
Parameters	Results	Units	Report Limit	DF	Prepared	Analyzed	CAS No.	Qual
365.1 Orthophosphate as P	Analytical Method: EPA 365.1							
Orthophosphate as P	ND	mg/L	0.050	1		05/06/11 09:44		M2

Sample: Highlands SW C	Lab ID: 9293568003	Collected: 05/04/11 11:53	Received: 05/05/11 13:45	Matrix: Water			
Parameters	Results	Units	Report Limit	DF	Prepared	Analyzed	CAS No.	Qual
365.1 Orthophosphate as P	Analytical Method: EPA 365.1							
Orthophosphate as P	ND	mg/L	0.050	1		05/06/11 09:44		M2

Sample: Highlands SW A	Lab ID: 9293568004	Collected: 05/04/11 11:40	Received: 05/05/11 13:45	Matrix: Water			
Parameters	Results	Units	Report Limit	DF	Prepared	Analyzed	CAS No.	Qual
Total Nitrogen Calculation	Analytical Method: 40CFR PART 503							
Nitrogen	1.5	mg/L	0.50	1		05/12/11 16:21	7727-37-9	
351.2 Total Kjeldahl Nitrogen	Analytical Method: EPA 351.2							
Nitrogen, Kjeldahl, Total	1.5	mg/L	0.50	1		05/17/11 14:31	7727-37-9	
353.2 Nitrogen, NO2/NO3 pres.	Analytical Method: EPA 353.2							
Nitrogen, NO2 plus NO3	0.30	mg/L	0.10	1		05/14/11 01:39		
365.1 Phosphorus, Total	Analytical Method: EPA 365.1							
Phosphorus	0.58	mg/L	0.050	1		05/19/11 18:11	7723-14-0	

Sample: Highlands SW B	Lab ID: 9293568005	Collected: 05/04/11 11:44	Received: 05/05/11 13:45	Matrix: Water			
Parameters	Results	Units	Report Limit	DF	Prepared	Analyzed	CAS No.	Qual
Total Nitrogen Calculation	Analytical Method: 40CFR PART 503							
Nitrogen	ND	mg/L	0.50	1		05/12/11 16:21	7727-37-9	
351.2 Total Kjeldahl Nitrogen	Analytical Method: EPA 351.2							
Nitrogen, Kjeldahl, Total	ND	mg/L	0.50	1		05/17/11 14:34	7727-37-9	

REPORT OF LABORATORY ANALYSIS

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ANALYTICAL RESULTS

Project: Highlands SW 5/4/11
Pace Project No.: 9293088

Sample: Highlands SW B	Lab ID: 92930880006		Collected: 05/04/11 11:44		Received: 05/05/11 13:45	Matrix: Water	
Parameters	Results	Units	Report Limit	DF	Prepared	Analyzed	CAS No.	Qual
353.2 Nitrogen, NO2/NO3 pres,	Analytical Method: EPA 353.2							
Nitrogen, NO2 plus NO3	0.26	mg/L	0.10	1		05/14/11 01:39		
365.1 Phosphorus, Total	Analytical Method: EPA 365.1							
Phosphorus	ND	mg/L	0.050	1		05/10/11 15:13	7723-14-0	

Sample: Highlands SW C	Lab ID: 92930880005		Collected: 05/04/11 11:50		Received: 05/05/11 13:45	Matrix: Water	
Parameters	Results	Units	Report Limit	DF	Prepared	Analyzed	CAS No.	Qual
Total Nitrogen Calculation	Analytical Method: 40CFR PART 503							
Nitrogen	ND	mg/L	0.60	1		05/13/11 16:21	7727-37-9	
351.2 Total Kjeldahl Nitrogen	Analytical Method: EPA 351.2							
Nitrogen, Kjeldahl, Total	ND	mg/L	0.50	1		05/17/11 14:34	7727-37-9	
353.2 Nitrogen, NO2/NO3 pres.	Analytical Method: EPA 353.2							
Nitrogen, NO2 plus NO3	0.34	mg/L	0.10	1		05/14/11 01:41		
365.1 Phosphorus, Total	Analytical Method: EPA 365.1							
Phosphorus	ND	mg/L	0.050	1		05/10/11 15:14	7723-14-0	

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Cullowhee, North Carolina 28723
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E-mail environmentalinc@aol.com

Certificate of Analysis

Client Name: McGill Associates
Address: 55 Broad Street
Asheville, NC 28801

Collection Date: 5/27/2011
Date Received: 5/31/2011

RESULTS

Sample Identification: Storm water site A (grab)

Parameters	Result	MDL	Units	Date Analyzed	Method	Foot-notes
Solids, Total Suspended	112	2.0	mg/L	6/3/2011	SM 2540D	
Specific Conductance	78.2	1.0	µmhos	6/10/2011	SM 2510B	

Sample Identification: Storm water site B (grab)

Parameters	Result	MDL	Units	Date Analyzed	Method	Foot-notes
Solids, Total Suspended	11.0	2.0	mg/L	6/3/2011	SM 2540D	

Sample Identification: Storm water site C (grab)

Parameters	Result	MDL	Units	Date Analyzed	Method	Foot-notes
Solids, Total Suspended	16.7	2.0	mg/L	6/3/2011	SM 2540D	
Specific Conductance	60.7	1.0	µmhos	6/10/2011	SM 2510B	

Anthony Tirona, Laboratory Supervisor

6/22/11
Date

Report prepared: 6/22/2011 1:04 PM

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Certificate of Analysis

Client Name: McGill Associates
Address: 55 Broad Street
Asheville, NC 28801

Collection Date: 6/16/2011
Date Received: 6/16/2011

RESULTS

Sample Identification: Storm water site A (grab)

Parameters	Result	MDL	Units	Date Analyzed	Method	Foot-notes
Ammonia, Nitrogen	0.4	0.1	mg/L	6/20/2011	SM 4500NH3-F	
Solids, Total Suspended	116	2.0	mg/L	6/20/2011	SM 2540D	
Specific Conductance	130	1.0	µmhos	7/8/2011	SM 2510B	

Sample Identification: Storm water site B (grab)

Parameters	Result	MDL	Units	Date Analyzed	Method	Foot-notes
Ammonia, Nitrogen	<0.1	0.1	mg/L	6/20/2011	SM 4500NH3-F	
Solids, Total Suspended	5.6	2.0	mg/L	6/20/2011	SM 2540D	

Anthony Tirona, Laboratory Supervisor

7/13/11
Date

Report prepared: 7/13/2011 11:12 AM

Sample Identification: Storm water site C (grab)

Parameters	Result	MDL	Units	Date Analyzed	Method	Foot-notes
Ammonia, Nitrogen	<0.1	0.1	mg/L	6/20/2011	SM 4500NH3-F	
Solids, Total Suspended	5.6	2.0	mg/L	6/20/2011	SM 2540D	
Specific Conductance	44.9	1.0	µmhos	7/8/2011	SM 2510B	

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ANALYTICAL RESULTS

Project: HIGHLANDS STORMWATER 05/17
Pace Project No.: 6255510

Sample: HIGHLANDS STORMWATER A | Lab ID: 6255510001 | Collected: 05/16/11 07:33 | Received: 05/17/11 09:57 | Matrix: Water

Parameters	Results	Units	Report Limit	DF	Prepared	Analyzed	CAS No.	Qual
Total Nitrogen Calculation	Analytical Method: 40CFR PART 503							
Nitrogen	0.56	mg/L	0.50	1		05/26/11 12:08	7727-37-9	
351.2 Total Kjeldahl Nitrogen	Analytical Method: EPA 351.2							
Nitrogen, Kjeldahl, Total	ND	mg/L	0.50	1		05/27/11 10:10	7727-37-9	
353.2 Nitrogen, NO2/NO3 prep.	Analytical Method: EPA 353.2							
Nitrogen, NO2 plus NO3	0.32	mg/L	0.10	1		05/26/11 18:43		
365.1 Phosphorus, Total	Analytical Method: EPA 365.1							
Phosphorus	0.077	mg/L	0.050	1		05/26/11 10:13	7723-14-0	
365.1 Orthophosphate as P	Analytical Method: EPA 365.1							
Orthophosphate as P	ND	mg/L	0.050	1		05/17/11 15:54		N2

Sample: HIGHLANDS STORMWATER B | Lab ID: 6255510002 | Collected: 05/16/11 07:33 | Received: 05/17/11 09:57 | Matrix: Water

Parameters	Results	Units	Report Limit	DF	Prepared	Analyzed	CAS No.	Qual
Total Nitrogen Calculation	Analytical Method: 40CFR PART 503							
Nitrogen	0.57	mg/L	0.50	1		05/26/11 12:08	7727-37-9	
351.2 Total Kjeldahl Nitrogen	Analytical Method: EPA 351.2							
Nitrogen, Kjeldahl, Total	ND	mg/L	0.50	1		05/27/11 10:10	7727-37-9	
353.2 Nitrogen, NO2/NO3 prep.	Analytical Method: EPA 353.2							
Nitrogen, NO2 plus NO3	0.53	mg/L	0.10	1		05/26/11 18:44		
365.1 Phosphorus, Total	Analytical Method: EPA 365.1							
Phosphorus	ND	mg/L	0.050	1		05/26/11 10:14	7723-14-0	
365.1 Orthophosphate as P	Analytical Method: EPA 365.1							
Orthophosphate as P	ND	mg/L	0.050	1		05/17/11 15:54		N2

Sample: HIGHLANDS STORMWATER C | Lab ID: 6255510003 | Collected: 05/16/11 07:40 | Received: 05/17/11 09:57 | Matrix: Water

Parameters	Results	Units	Report Limit	DF	Prepared	Analyzed	CAS No.	Qual
Total Nitrogen Calculation	Analytical Method: 40CFR PART 503							
Nitrogen	ND	mg/L	0.50	1		05/26/11 12:08	7727-37-9	

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ANALYTICAL RESULTS

Project: HIGHLANDS STORMWATER 05/17
Pace Project No.: 9268519

Sample: HIGHLANDS STORMWATER C Lab ID: 92685193003 Collected: 05/16/11 07:43 Received: 05/17/11 09:57 Matrix: Water

Parameters	Results	Units	Report Limit	DF	Prepared	Analyzed	CAS No.	Qual
351.2 Total Kjeldahl Nitrogen	Analytical Method: EPA 351.2							
Nitrogen, Kjeldahl, Total	ND mg/L		0.60	1		05/27/11 10:18	7727-37-9	
353.2 Nitrogen, NO2/NO3 prec.	Analytical Method: EPA 353.2							
Nitrogen, NO2 plus NO3	0.36 mg/L		0.20	1		05/20/11 19:54		M1
365.1 Phosphorus, Total	Analytical Method: EPA 365.1							
Phosphorus	ND mg/L		0.050	1		05/26/11 10:14	7723-14-0	
365.1 Orthophosphate as P	Analytical Method: EPA 365.1							
Orthophosphate as P	ND mg/L		0.050	1		05/17/11 18:54		M2

REPORT OF LABORATORY ANALYSIS

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Certificate of Analysis

Client Name: McGill Associates
Address: 55 Broad Street
Asheville, NC 28801

Collection Date: 6/23/2011
Date Received: 6/23/2011

RESULTS

Sample Identification: Storm water site A (grab)

Parameters	Result	MDL	Units	Date Analyzed	Method	Foot-notes
Solids, Total Suspended	13.7	2.0	mg/L	6/28/2011	SM 2540D	
Specific Conductance	24.5	1.0	µmhos	7/8/2011	SM 2510B	

Sample Identification: Storm water site B (grab)

Parameters	Result	MDL	Units	Date Analyzed	Method	Foot-notes
Solids, Total Suspended	<6.7	2.0	mg/L	6/28/2011	SM 2540D	

Sample Identification: Storm water site C (grab)

Parameters	Result	MDL	Units	Date Analyzed	Method	Foot-notes
Solids, Total Suspended	<6.7	2.0	mg/L	6/28/2011	SM 2540D	
Specific Conductance	87.8	1.0	µmhos	7/8/2011	SM 2510B	

Anthony Tirona, Laboratory Supervisor

7/13/11
Date

Report prepared: 7/12/2011 11:30 AM

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Certificate of Analysis

Client Name: McGill Associates
Address: 55 Broad Street
Asheville, NC 28801

Collection Date: 7/21/2011
Date Received: 7/21/2011

RESULTS

Sample Identification: Storm water site A (grab)

Parameters	Result	MDL	Units	Date Analyzed	Method	Foot-notes
Ammonia, Nitrogen	0.4	0.1	mg/L	8/9/2011	SM 4500NH3-F	
Solids, Total Suspended	565	2.0	mg/L	7/25/2011	SM 2540D	
Specific Conductance	98.3	1.0	µmhos	7/27/2011	SM 2510B	
Arsenic	<0.005	0.005	mg/L	8/11/2011	SM 3113 B	
Lead	<0.003	0.003	mg/L	8/11/2011	SM 3113 B	
Cadmium	<0.010	0.010	mg/L	8/8/2011	SM 3111B	
Chromium	<0.05	0.05	mg/L	8/12/2011	SM 3111 B	
Silver	<0.05	0.05	mg/L	8/3/2011	SM 3111 B	
Copper	<0.05	0.05	mg/L	8/5/2011	SM 3111 B	
Zinc	0.176	0.010	mg/L	8/12/2011	SM 3111 B	

Sample Identification: Storm water site B (grab)

Parameters	Result	MDL	Units	Date Analyzed	Method	Foot-notes
Ammonia, Nitrogen	0.1	0.1	mg/L	8/9/2011	SM 4500NH3-F	
Solids, Total Suspended	<3.3	2.0	mg/L	7/25/2011	SM 2540D	

Anthony Tirona, Laboratory Supervisor

8/12/11
Date

Report prepared: 8/12/2011 4:52 PM

Sample Identification: Storm water site C (grab)

Parameters	Result	MDL	Units	Date Analyzed	Method	Foot-notes
Ammonia, Nitrogen	<0.1	0.1	mg/L	8/9/2011	SM 4500NH3-F	
Solids, Total Suspended	<3.3	2.0	mg/L	7/25/2011	SM 2540D	
Specific Conductance	87.4	1.0	µmhos	7/27/2011	SM 2510B	
Arsenic	<0.005	0.005	mg/L	8/11/2011	SM 3113 B	
Lead	<0.003	0.003	mg/L	8/11/2011	SM 3113 B	
Cadmium	<0.010	0.010	mg/L	8/8/2011	SM 3111B	
Chromium	<0.05	0.05	mg/L	8/12/2011	SM 3111 B	
Silver	<0.05	0.05	mg/L	8/3/2011	SM 3111 B	
Copper	<0.05	0.05	mg/L	8/5/2011	SM 3111 B	
Zinc	0.098	0.010	mg/L	8/12/2011	SM 3111 B	

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ANALYTICAL RESULTS

Project: HIGHLANDS STORMWATE 07/21
Pace Project No.: 9299912

Sample: HIGHLANDS STORMWATER A Lab ID: 9299912001 Collected: 07/21/11 08:36 Received: 07/25/11 09:57 Matrix: Water

Parameters	Results	Units	Report Limit	DF	Prepared	Analyzed	CAS No.	Qual
200.7 MET ICP	Analytical Method: EPA 200.7 Preparation Method: EPA 200.7							
Barium	**35.2**	ug/L	5.0	1	08/02/11 11:30	08/03/11 14:30	7440-39-3	
Selenium	ND	ug/L	10.0	1	08/02/11 11:30	08/03/11 14:30	7782-49-2	
245.1 Mercury	Analytical Method: EPA 245.1 Preparation Method: EPA 245.1							
Mercury	**0.79**	ug/L	0.20	1	08/01/11 11:30	08/02/11 11:22	7439-97-6	
Total Nitrogen Calculation	Analytical Method: 40CFR PART 503							
Nitrogen	ND	mg/L	0.60	1		07/27/11 10:30	7727-37-9	
351.2 Total Kjeldahl Nitrogen	Analytical Method: EPA 351.2							
Nitrogen, Kjeldahl, Total	ND	mg/L	0.50	1		08/05/11 10:28	7727-37-9	
353.2 Nitrogen, NO2/NO3 pres.	Analytical Method: EPA 353.2							
Nitrogen, NO2 plus NO3	**0.34**	mg/L	0.20	1		08/02/11 16:37		
365.1 Phosphorus, Total	Analytical Method: EPA 365.1							
Phosphorus	**0.090**	mg/L	0.050	1		07/31/11 10:15	7723-14-0	
365.1 Orthophosphate as P	Analytical Method: EPA 365.1							
Orthophosphate as P	**0.058**	mg/L	0.050	1		07/25/11 14:45		H1,N2

Sample: HIGHLANDS STORMWATER B Lab ID: 9299912002 Collected: 07/21/11 08:09 Received: 07/25/11 09:57 Matrix: Water

Parameters	Results	Units	Report Limit	DF	Prepared	Analyzed	CAS No.	Qual
Total Nitrogen Calculation	Analytical Method: 40CFR PART 503							
Nitrogen	ND	mg/L	0.60	1		07/27/11 10:30	7727-37-9	
351.2 Total Kjeldahl Nitrogen	Analytical Method: EPA 351.2							
Nitrogen, Kjeldahl, Total	ND	mg/L	0.50	1		08/05/11 10:31	7727-37-9	
353.2 Nitrogen, NO2/NO3 pres.	Analytical Method: EPA 353.2							
Nitrogen, NO2 plus NO3	**0.31**	mg/L	0.20	1		08/02/11 16:38		
365.1 Phosphorus, Total	Analytical Method: EPA 365.1							
Phosphorus	**0.057**	mg/L	0.050	1		07/31/11 10:17	7723-14-0	
365.1 Orthophosphate as P	Analytical Method: EPA 365.1							
Orthophosphate as P	ND	mg/L	0.050	1		07/25/11 14:45		H1,N2

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ANALYTICAL RESULTS

Project: HIGHLANDS STORMWATE 07/21
Pace Project No.: 9298912

Sample: HIGHLANDS STORMWATER C Lab ID: 9298912003 Collected: 07/21/11 08:15 Received: 07/25/11 09:57 Matrix: Water

Parameters	Results	Units	Report Limit	DF	Prepared	Analyzed	CAS No.	Qual
200.7 MET ICP	Analytical Method: EPA 200.7 Preparation Method: EPA 200.7							
Barium	24.6	ug/L	5.0	1	08/02/11 11:30	08/03/11 14:33	7440-39-3	
Selenium	ND	ug/L	10.0	1	08/02/11 11:30	08/03/11 14:33	7782-49-2	
245.1 Mercury	Analytical Method: EPA 245.1 Preparation Method: EPA 245.1							
Mercury	0.34	ug/L	0.20	1	08/01/11 11:30	08/02/11 11:25	7439-97-6	
Total Nitrogen Calculation	Analytical Method: 40CFR PART 503							
Nitrogen	0.88	mg/L	0.60	1		07/27/11 10:30	7727-37-9	
351.2 Total Kjeldahl Nitrogen	Analytical Method: EPA 351.2							
Nitrogen, Kjeldahl, Total	ND	mg/L	0.50	1		08/05/11 10:32	7727-37-9	
353.2 Nitrogen, NO2/NO3 pres.	Analytical Method: EPA 353.2							
Nitrogen, NO2 plus NO3	0.84	mg/L	0.20	1		08/03/11 10:39		
365.1 Phosphorous, Total	Analytical Method: EPA 365.1							
Phosphorus	ND	mg/L	0.050	1		07/31/11 10:18	7723-14-0	
365.1 Orthophosphate as P	Analytical Method: EPA 365.1							
Orthophosphate as P	ND	mg/L	0.050	1		07/25/11 15:07		H1,N2

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Certificate of Analysis

Client Name: McGill Associates
Address: 55 Broad Street
Asheville, NC 28801

Collection Date: 7/26/2011
Date Received: 7/26/2011

RESULTS

Sample Identification: Storm water site A (grab)

Parameters	Result	MDL	Units	Date Analyzed	Method	Foot-notes
BOD, 5 day	5.4	2.0	mg/L	7/27/2011	SM 5210	
Solids, Total Suspended	123	2.0	mg/L	8/1/2011	SM 2540D	
Specific Conductance	105	1.0	µmhos	7/27/2011	SM 2510B	
Fecal Coliform	>2640	4	CFU/100mL	7/26/2011	SM 9222D	1

Sample Identification: Storm water site B (grab)

Parameters	Result	MDL	Units	Date Analyzed	Method	Foot-notes
BOD, 5 day	<4.0	2.0	mg/L	7/27/2011	SM 5210	
Solids, Total Suspended	9.2	2.0	mg/L	8/1/2011	SM 2540D	
Fecal Coliform	>2480	4	CFU/100mL	7/26/2011	SM 9222D	1

1. Fecal count based on non-ideal count.

Anthony Tirona, Laboratory Supervisor

8/16/11
Date

Report prepared: 8/16/2011 12:17 PM

Sample Identification: Storm water site C (grab)

Parameters	Result	MDL	Units	Date Analyzed	Method	Foot-notes
BOD, 5 day	<4.0	2.0	mg/L	7/27/2011	SM 5210	
Solids, Total Suspended	<3.3	2.0	mg/L	8/1/2011	SM 2540D	
Specific Conductance	64.1	1.0	µmhos	7/27/2011	SM 2510B	
Fecal Coliform	>2960	4	CFU/100mL	7/26/2011	SM 9222D	1

0°

TOWN OF HIGHLANDS

P.O. BOX 440
HIGHLANDS, NC 28741
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FAX (828) 526-2595

FACSIMILE TRANSMITTAL SHEET

TO: JC Williams	FROM: Alec Templeton
COMPANY:	DATE: 1/27/11
FAX NUMBER 828 252 2518	TOTAL NO. OF PAGES INCLUDING COVER: 3

	TEMP °C	DO	pH
10/25/2010 1.0"			
1130am A	13.0	6.6	5.9
1140am B	13.0	5.6	5.9
1150am C	14.1	1.7	5.8
11/4/2010 .4"			
1030am A	11.7	5.5	6.3
1040am C	13.8	2.8	6.2
11/16/2010			
900am A	9.7	8.4	6.2
910am C	10.8	4.1	5.9
11/30/2010			
905am A	8.3	9.6	6.2
910am C	10.7	7.6	6.7

		TEMP°C	DO	pH
12/21/2010				
~~1205~~ 1205p-	A	8.0	6.1	6.2
1205p- ~~1205~~	C	7.0	3.6	6.2
1/18/2011				
930a	A	6.9	6.7	6.8
940a	C	7.1	4.6	6.7
1/26/2011				
930a	A	3.4	4.1	6.5
942a	C	5.1	4.0	6.5

TOWN OF HIGHLANDS

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FACSIMILE TRANSMITTAL SHEET

TO: JC Williams	FROM: Alex Templeton
COMPANY:	DATE: 3/31/11
FAX NUMBER 828 252 2518	TOTAL NO. OF PAGES INCLUDING COVER: 2

Storm water results

2/1/11	TEMP °C	DO	pH
A	6.7	6.1	5.8
11:35			
C	6.9	4.7	5.8
11:45			

2/28/11			
A	9.0	6.3	6.1
1730			
C	10.0	4.4	6.0
1737			

3/9/11			
A	5.9	8.5	6.2
905			
C	7.9	7.7	6.0
910			

3/26/11			
A	9.0	7.7	6.4
915			
C	10.4	4.6	6.1
920			

TOWN OF HIGHLANDS

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FACSIMILE TRANSMITTAL SHEET

TO: JC WILLIAMS
FROM: Ale Templeton
COMPANY:
DATE: 6/2/11
FAX NUMBER
TOTAL NO. OF PAGES INCLUDING COVER: 2

Storm Water results

Please let me know

if any thing else

			TEMP °C	DO	pH
4/12/11	930	A	12.6	2.7	6.3
	938	C	11.7	2.6	6.1
4/21/11	1015	A	14.4	4.8	6.3
	1021	C	13.1	3.0	6.1
4/26/11	910	A	14.9	5.1	6.2
	915	C	13.6	3.2	6.0
5/4/11	1140	A	11.6	8.0	6.2
	1149	C	13.8	6.8	5.9
5/27/11	905	A	15.8	5.6	6.3
	910	C	15.8	2.5	6.0

TOWN OF HIGHLANDS

P.O. BOX 460
HIGHLANDS, NC 28741
PHONE (828) 526-2118
FAX (828) 526-2595

FACSIMILE TRANSMITTAL SHEET

TO: J C Williams
FROM: Alec Templeton
COMPANY:
DATE: 7/27/11
FAX NUMBER 252 2518
TOTAL NO. OF PAGES INCLUDING COVER: 2

Storm water results

	Time	Location	Temp °C	DO	pH
6/16/11	730	A	15.8	5.7	6.3
	740	C	15.8	6.1	6.2
6/23/11	920	A	18.6	6.6	6.3
	925	C	18.5	3.8	6.1
7/21/11	805	A	17.7	8.4	6.2
	815	C	18.7	7.2	6.1
7/26/11	1030	A	18.6	6.3	6.2
	1040	C	20.5	3.8	6.1

APPENDIX C

Sediment Sampling Results Summary

&

Sediment Sampling Data

Town of Highlands
Innovative Stormwater Project Implementation
Project No. 10.00336

Crystal Stream Water Quality Units #1 & #2 Combined Grain Size Distribution Analysis

Sample Date	Sample Description	Relative Density (Assumed)	Maximum Particle Size (mm)	Gravel (%)	Coarse Sand (%)	Medium Sand (%)	Fine Sand (%)	Silt (%)	Clay (%)
December 8, 2010	Gray Black Well Graded Sand w/ Sil	2.650	9.8	13.7	14.4	40.9	21.6	7.3	2.0

New Testing Firm

Sample Date	Sample Description	Coarse Fragments (Gravel > 2mm) %	Very Coarse Particle (1-2 mm) %	Coarse Sand (0.5 mm) %	Medium Particle (0.25-0.5 mm) %	Fine Particle (0.1-0.25 mm) %	Very Fine Particle (0.05-0.10 mm) %	Sand (%)	Silt (%)	Clay (%)
March 8, 2011	Sandy Loam	3.69	2.78	4.84	6.75	33.65	24.23	53.70	39.20	7.00
June 8, 2011	Sandy Loam	2.55	1.59	5.74	9.94	28.80	21.41	60.30	31.70	7.90

New Testing Firm Summary

Coarse Fragments (Gravel > 2mm) %	Very Coarse Particle (1-2 mm) %	Coarse Sand (0.5 mm) %	Medium Particle (0.25-0.5 mm) %	Fine Particle (0.1-0.25 mm) %	Very Fine Particle (0.05-0.10 mm) %
3.12	2.19	5.29	8.35	31.23	22.82

Sand (%)	Silt (%)	Clay (%)
57.00	35.45	7.45

Town of Highlands
Innovative Stormwater Project Implementation
Project No. 10.00336

Crystal Stream Water Quality Units #1 & #2 Combined Sediment Analysis

				Sediment	Sediment
			Sample Type:	Sediment	Sediment
			Sample Collection Date:	8-Mar-11	8-Jun-11
Parameter	**Method**	**Units**	**RL**	**Result**	**Result**
Ammonia Nitrogen	SM 4500 NH3 D	mg/L	4.0		
% Solids (ETS Test)	SM 2540 G	%		22.70	35.00
Mercury	7471 B	mg/kg	0.057	0.08	
Arsenic	6010 C	mg/kg	1.4	4.10	
Barium	6010 C	mg/kg	1.4	170.00	
Cadmium	6010 C	mg/kg	0.69	1.10	
Chromium	6010 C	mg/kg	0.69	30.00	
Copper	6010 C	mg/kg	1.4	170.00	
Lead	6010 C	mg/kg	0.69	35.00	
Selenium	6010 C	mg/kg	1.4	3.80	
Silver	6010 C	mg/kg	0.69	1.10	
Zinc	6010 C	mg/kg	6.9	400.00	
% Solids (Prism Lab Test)	SM 2540 G	mg/kg	0.100		
Total Kjeldahl Nitrogen	351.2	mg/kg	680	2000.00	3300.00
Nitrate + Nitrite	SM 4500-NO3 F	mg/kg	14	22.00	25.00
Total Nitrogen	Calculation	mg/kg	690	2000.00	3300.00
Total Phosphorus	SM 4500-P F	mg/kg	130	910.00	960.00
Ortho - Phosphate	SM 4500 P E	mg/kg	1.0		

RL = Reporting Limit. Values are reported down to the Reporting Limit only.

Form No. TR-D422-S
Revision No. 0
Revision Date: 02/20/08

Particle Size Analysis of Soils

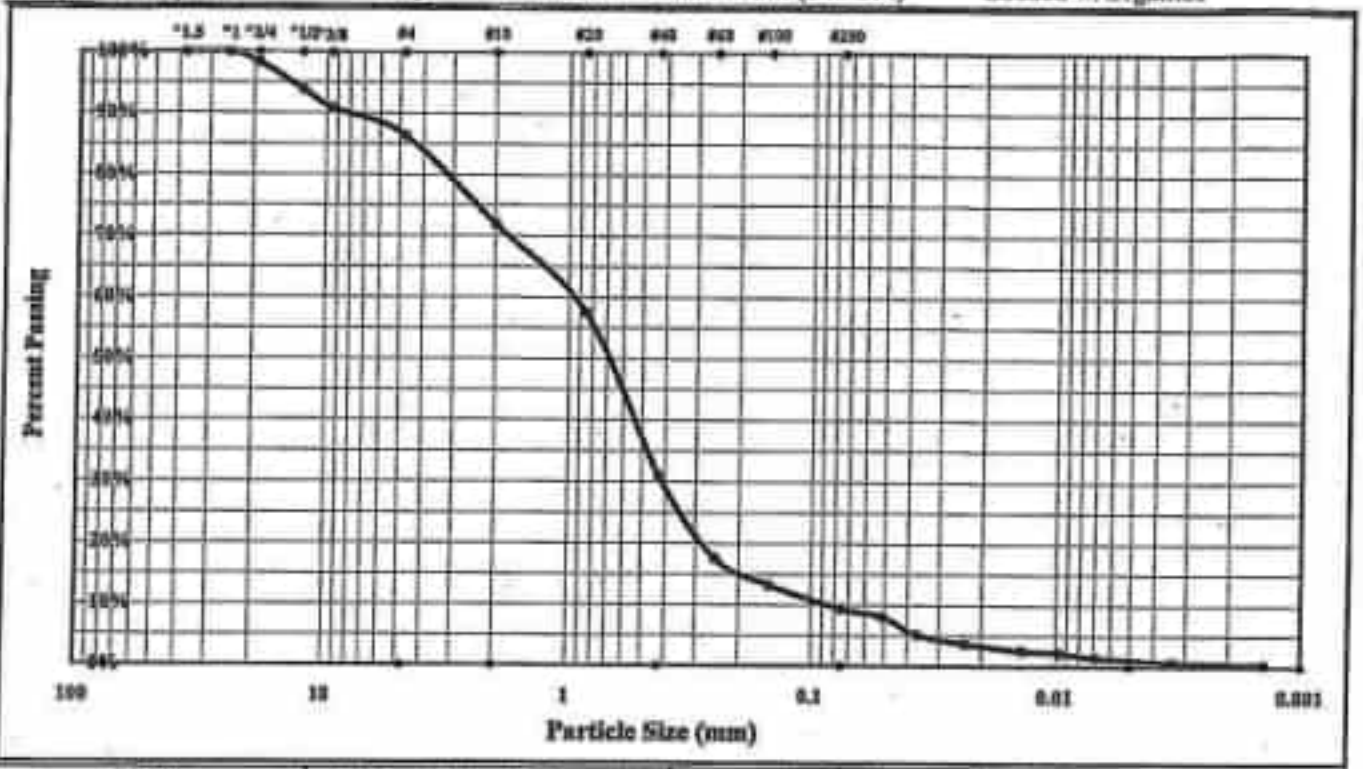
ASTM D422

S&ME

Quality Assurance

S&ME, Inc. – 9751 Southern Pine Boulevard – Charlotte, NC 28273

S&ME Project #:	1353-10-125	Report Date:	1/12/11
Project Name:	ETS Lab Testing	Test Date(s):	12/14/10-1/12/11
Client Name:	Environmental Testing Solutions		
Address:			
Boring #:	Sample #: 1	Sample Date:	12/10/10
Location:	Asheville, NC Offset:	Elevation:	Bulk
Sample Description:	Gray Black Well Graded Sand w/Silt (SW-SM)	Loaded w/Organics	



Cobbles	< 300 mm (12") and > 75 mm (3")	Fine Sand	< 0.425 mm and > 0.075 mm (#200)
Gravel	< 75 mm and > 4.75 mm (#4)	Silt	< 0.075 and > 0.005 mm
Coarse Sand	< 4.75 mm and > 2.00 mm (#10)	Clay	< 0.005 mm
Medium Sand	< 2.00 mm and > 0.425 mm (#40)	Colloids	< 0.001 mm

Maximum Particle Size:	3/4"	Gravel:	13.7%	Silt	7.3%
Silt & Clay (% Passing #200):	9.3%	Total Sand:	77.0%	Clay	2.0%
rent Relative Density(Assumed)	2.650	Moisture Content		Colloids	0.5%
Liquid Limit		Plastic Limit		Plastic Index	
Coarse Sand:	14.4%	Medium Sand:	40.9%	Fine Sand:	21.6%

Description of Sand and Gravel: Rounded ☐ Angular ☐ Hard & Durable ☐ Soft ☐ Weathered & Friable ☐

Apparatus B: Air Jet Dispersion — Dispersion Period: 1 min. — Dispersing Agent: Sodium Hexametaphosphate: 40 g / Liter

References / Comments / Deviations: ASTM D 4318, D 854, D 2487

Ron Harris
Technical Responsibility

Signature

Staff Professional
Position

1/12/2011
Date

Environmental Testing Solutions, Inc.
Fax: (828) 350-9368
Asheville, NC 28802
Phone: (828) 350-9364
Fax: (828) 350-9368

Certificate of Analysis

Project name: **McGill Associates** Project number: **110308.529**

Collection date: **8-Mar-11**
Date received: **8-Mar-11**

Sample identification: **Stormwater Sediment - Grab** Sample number: **80793**

Parameter	Method	Result	RL	Units	Date Analyzed	Analyst	Footnotes
Grain Size	ASTM D422	**See Attached Results**			18-Mar-11	A&L	2
Mercury	7471 B	**<0.081**	0.0098	mg/kg	15-Mar-11	DJS	1
Arsenic	6010 C	**4.1**	2.2	mg/kg	17-Mar-11	DWR	1
Barium	6010 C	**170**	2.2	mg/kg	17-Mar-11	DWR	1
Cadmium	6010 C	**<1.1**	1.1	mg/kg	17-Mar-11	DWR	1
Chromium	6010 C	**30**	1.1	mg/kg	17-Mar-11	DWR	1
Copper	6010 C	**170**	2.2	mg/kg	17-Mar-11	DWR	1
Lead	6010 C	**35**	1.1	mg/kg	17-Mar-11	DWR	1
Selenium	6010 C	**3.8**	2.2	mg/kg	17-Mar-11	DWR	1
Silver	6010 C	**<1.1**	1.1	mg/kg	17-Mar-11	DWR	1
Zinc	6010 C	**400**	11	mg/kg	17-Mar-11	DWR	1
% Solids	SM 2540 G	**22.7**	0.100	mg/kg	14-Mar-11	JAB	1
Total Kjeldahl Nitrogen	351.2	**2000**	1100	mg/kg	21-Mar-11	CDE	1
Nitrate + Nitrite	SM 4500-NO3 F	**<22**	22	mg/kg	15-Mar-11	RSL	1
Total Nitrogen	Calculation	**2000**	1100	mg/kg	21-Mar-11	CDE	1
Total Phosphorus	SM 4500-P F	**910**	22	mg/kg	18-Mar-11	RSL	1

PRISM | Full-Service Analytical & Environmental Solutions

Laboratory Report

03/22/2011

Environmental Testing Solutions
Attn: Kelley Keenan
PO Box 7565
Asheville, NC 28802

Project: McGill Associates

Sample Matrix: Solid

Client Sample ID: Stormwater Sediment 001
Prism Sample ID: 1030309-01
Prism Work Order: 1030309
Time Collected: 03/08/11 11:00
Time Submitted: 03/11/11 13:15

Parameter	Result	Units	Report Limit	MDL	Dilution Factor	Method	Analysis Date/Time	Analyst	Batch ID
General Chemistry Parameters									
Total Nitrogen	2000	mg/kg dry	1100	91	10	*Total Nitrogen	3/21/11 14:00	CDE	[CALC]
% Solids	22.7	% by Weight	0.100	0.100	1	*SM2540 G	3/14/11 10:45	JAB	P1C0294
Nitrate/Nitrite as N	BRL	mg/kg dry	22	2.4	1	*SM4500-NO3 F	3/15/11 8:29	RSL	P1C0298
Phosphorus-Total	910	mg/kg dry	22	3.1	2	*SM4500-P F	3/18/11 8:15	RSL	P1C0382
Total Kjeldahl Nitrogen	2000	mg/kg dry	1100	89	10	*351.2	3/21/11 14:59	CDE	P1C0415
Total Metals									
Mercury	BRL	mg/kg dry	0.081	0.0056	1	*7471B	3/15/11 16:25	DJS	P1C0313
Arsenic	4.1	mg/kg dry	2.2	0.26	1	*6010C	3/17/11 13:58	DWR	P1C0314
Barium	170	mg/kg dry	2.2	0.32	1	*6010C	3/17/11 13:58	DWR	P1C0314
Cadmium	BRL	mg/kg dry	1.1	0.12	1	*6010C	3/17/11 13:58	DWR	P1C0314
Chromium	30	mg/kg dry	1.1	0.16	1	*6010C	3/17/11 13:58	DWR	P1C0314
Copper	170	mg/kg dry	2.2	0.94	1	*6010C	3/17/11 13:58	DWR	P1C0314
Lead	35	mg/kg dry	1.1	0.27	1	*6010C	3/17/11 13:58	DWR	P1C0314
Selenium	3.8	mg/kg dry	2.2	0.44	1	*6010C	3/17/11 13:58	DWR	P1C0314
Silver	BRL	mg/kg dry	1.1	0.11	1	*6010C	3/17/11 13:58	DWR	P1C0314
Zinc	480	mg/kg dry	11	1.1	1	*6010C	3/17/11 13:58	DWR	P1C0314

A&L Eastern Laboratories, Inc.

7621 Whitepine Road Richmond, Virginia 23237 (804) 743-9401 Fax (804) 271-6449

www.aleastern.com

TEXTURE ANALYSIS

Client : ENVIRONMENTAL TESTING SOLUTIONS INC POB 7555 ASHEVILLE , NC 28802	Grower : MCGILL ASSOCIATES HIGHLANDS STORMWATER 002 SEDIMENT Farm:	Report No : 11-074-0815 Cust No : 46933 Date Printed : 03/18/2011 Page : 1 of 1 Date Received : 03/15/2011

Lab No	Field ID	Sample Identification	Percent Sand	Percent Silt	Percent Clay	Textural Classification
13746		2 SEDIMENT	53.7	39.2	7.0	Sandy Loam

Analysis prepared by: A&L Eastern Laboratories, Inc.

Report Number: 11-074-0615
Account Number: 46933

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A&L Eastern Laboratories, Inc.

7621 Whitepine Road Richmond, Virginia 23237 (804) 743-9401 Fax (804) 271-6468

Send To: ENVIRONMENTAL TESTING SOLUTIONS INC
POB 7565
ASHEVILLE NC 28802

Grower:
MCGILL ASSOCIATES
HIGHLANDS STORMWATER
002 SEDIMENT

Farm ID:

SOIL ANALYSIS REPORT

Analytical Method(s):

Date Received: 03/15/2011 **Date Of Analysis:** 03/16/2011 **Date Of Report:** 03/18/2011

Sample ID / Field ID	Lab Number	Organic Matter %	Organic Matter Rate	Organic Matter ENR lbs/A	Phosphorus Available ppm	Phosphorus Available Rate	Phosphorus Reserve ppm	Phosphorus Reserve Rate	Potassium K ppm	Potassium K Rate	Magnesium Mg ppm	Magnesium Mg Rate	Calcium Ca ppm	Calcium Ca Rate	Sodium Na ppm	Sodium Na Rate	pH Soil pH	pH Buffer Index	Acidity H meq/100g	CEC meq/100g
2 SEDIMENT	13746																			

Sample ID / Field ID	Percent Base Saturation K %	Mg %	Ca %	Na %	H %	Nitrate NO_3-N ppm	Nitrate Rate	Sulfur S ppm	Sulfur Rate	Zinc Zn ppm	Zinc Rate	Manganese Mn ppm	Manganese Rate	Iron Fe ppm	Iron Rate	Copper Cu ppm	Copper Rate	Boron B ppm	Boron Rate	Soluble Salts SS mmhos/cm	Soluble Salts Rate	Chloride Cl ppm	Chloride Rate	Aluminum Al ppm
2 SEDIMENT																								

Values on this report represent the plant available nutrients in the soil. Rating after each value: VL (Very Low), L (Low), M (Medium), H (High), VH (Very High). ENR - Estimated Nitrogen Release. C.E.C. - Cation Exchange Capacity.

Explanation of symbols: % (percent), ppm (parts per million), lbs/A (pounds per acre), mmhos (milli-mhos per centimeter), meq/100g (milli-equivalent per 100 grams). Conversions: ppm x 2 = lbs/A, Soluble Salts mmhos x 640 = ppm.

This report applies to sample(s) tested. Samples are retained a maximum of thirty days after testing.

Analysis prepared by: A&L Eastern Laboratories, Inc.

by: Paula McGroary

Paula McGroary

Report Number
11-074-0615 **Page:** 1 of 2

Account Number
46933

A&L Eastern Laboratories, Inc.
7621 Whitepine Road Richmond, Virginia 23237 (804) 743-9401 Fax (804) 271-6448
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Send To : ENVIRONMENTAL TESTING
SOLUTIONS INC
POB 7565
ASHEVILLE , NC 28802

Purchase Order :
Report Date: 3/18/2011
Date Received : 3/15/2011

Client : HIGHLANDS STORMWATER'002 SEDIMENT
MCGILL ASSOCIATES

REPORT OF ANALYSIS

Laboratory Number:	**13746**
Sample Date And Time:	
Sample Identification:	2 SEDIMENT
Analysis:	
Coarse Fragments (Gravel >2mm) ,% U.S. SIEVE	3.69
Coarse Sand (.5-1 mm) ,% U.S. SIEVE	4.84
Fine Particle (0.10-0.25 mm) ,% U.S. SIEVE	33.65
Medium Particle (0.25-0.5 mm ,% U.S. SIEVE	6.75
Very Coarse Particle (1-2 mm) ,% U.S. SIEVE	2.78
Very Fine Particle (0.05-0.10 mm) ,% U.S. SIEVE	24.23

Pauric McGroary

Pauric McGroary

Sample results are reported 'as received' and are not moisture corrected unless noted

Report Number
11-074-0615 **Page:** 2 of 2

Account Number
46933

A&L Eastern Laboratories, Inc.
7621 Whitepine Road Richmond, Virginia 23237 (804) 743-9401 Fax (804) 271-4448
www.aleastern.com

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SOLUTIONS INC
POB 7565
ASHEVILLE , NC 28802

Purchase Order :
Report Date: 3/18/2011
Date Received : 3/15/2011

Client : HIGHLANDS STORMWATER'002 SEDIMENT
MCGILL ASSOCIATES

REPORT OF ANALYSIS

Method Reference:
Methods of Soil Analysis, Part 1 - Physical and Mineralogical Methods, 2nd Ed. Rev. Soil Science Society of America, Black, C.A et al. 1982, page 404-408.
U.S. Standard Sieve Sizes

Pauric McGreary

Pauric McGreary

Sample results are reported 'as received' and are not moisture corrected unless noted

PRISM | Full-Service Analytical & Environmental Solutions

Laboratory Report

06/17/2011

Environmental Testing Solutions
Attn: Kelley Keenan
PO Box 7565
Asheville, NC 28802

Project: McGill Associates

Sample Matrix: Solid

Client Sample ID: 001-Sediment #1
Prism Sample ID: 1060217-01
Prism Work Order: 1060217
Time Collected: 06/08/11 11:30
Time Submitted: 06/10/11 11:10

Parameter	Result	Units	Report Limit	MDL	Dilution Factor	Method	Analysis Date/Time	Analyst	Batch ID
General Chemistry Parameters									
Total Nitrogen	3300	mg/kg dry	1400	120	20	Total Nitrogen	6/15/11 8:25	RSL	[CALC]
% Solids	35.0	% by Weight	0.100	0.100	1	*SM2540 G	6/13/11 10:00	JAB	P1F0248
Nitrate/Nitrite as N	BRL	mg/kg dry	14	1.6	1	*SM4500-NO3 F	6/14/11 13:12	RSL	P1F0259
Phosphorus-Total	660	mg/kg dry	140	23	20	*SM4500-P F	6/14/11 8:58	RSL	P1F0248
Total Kjeldahl Nitrogen	3300	mg/kg dry	1400	120	20	*351.2	6/15/11 8:25	RSL	P1F0253

449 Springbrook Road - P.O. Box 240543 - Charlotte, NC 28224-0543
Phone: 704/329-0384 - Toll Free Number: 1-800/529-0384 - Fax: 704/329-0409

Environmental Testing Solutions, Inc.

Fax: (828) 350-9368
Asheville, NC 28802
Phone: (828) 350-9364
Fax: (828) 350-9368

Certificate of Analysis

Project name: **McGill Associates** Project number: **118608.504**

Collection date: **8-Jun-11**
Date received: **8-Jun-11**

Sample identification: **001- Sediment - Grab** Sample number: **83202**

Parameter	Method	Result	RL	Units	Date Analyzed	Analyst	Footnotes
Grain Size	ASTM D422	**See Attached Results**			18-Mar-11	A&L	2
% Solids	SM 2540 G	**35.0**	0.100	mg/kg	13-Jun-11	JAB	1
Total Kjeldahl Nitrogen	351.2	**3300**	1400	mg/kg	15-Jun-11	RSL	1
Nitrate + Nitrite	SM 4500-NO3 F	**<14**	14	mg/kg	14-Jun-11	RSL	1
Total Nitrogen	Calculation	**3300**	1400	mg/kg	15-Jun-11	RSL	1
Total Phosphorus	SM 4500-P F	**960**	1400	mg/kg	15-Jun-11	RSL	1

Sample identification: **002 & 003 Used Filter - Grab** Sample number: **83203**

Parameter	Method	Result	RL	Units	Date Analyzed	Analyst	Footnotes
% Solids	SM 2540 G	**40.0**	0.100	mg/kg	13-Jun-11	JAB	1
Total Kjeldahl Nitrogen	351.2	**1400**	620	mg/kg	15-Jun-11	RSL	1
Nitrate + Nitrite	SM 4500-NO3 F	**<12**	12	mg/kg	14-Jun-11	RSL	1
Total Nitrogen	Calculation	**1400**	640	mg/kg	15-Jun-11	CDE	1

Footnotes:

RL = Reporting Limit. Values are reported down to the Reporting Limit only.

1. Analyzed by Prism Laboratories, Inc.
2. Analyzed by A&L Eastern Laboratories, Inc.

Date reviewed: 06-17-11
Data reviewed by: **Kelley E. Keenan**
Signature:

NC Certification Number: 600
SC Certification Number: 99053
NC Drinking Water Certification Number: 37786

Report Number
11-164-0612 **Page:** 2 of 2

Account Number
46933

A&L Eastern Laboratories, Inc.
7621 Whitepine Road Richmond, Virginia 23237 (804) 743-9401 Fax (804) 271-6449
www.aleastern.com

Send To : ENVIRONMENTAL TESTING
SOLUTIONS INC
POB 7565
ASHEVILLE , NC 28802

Client : MCGILL ASSOCIATES

Purchase Order :
Report Date: 6/15/2011
Date Received : 6/13/2011

REPORT OF ANALYSIS

Method Reference:
Methods of Soil Analysis, Part 1 - Physical and Mineralogical Methods, 2nd Ed. Rev. Soil Science Society of America, Black, C.A et al. 1982, page 404-408.
U.S. Standard Sieve Sizes

Pauric McGroary

Pauric McGroary

Sample results are reported 'as received' and are not moisture corrected unless noted

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A&L Eastern Laboratories, Inc.

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TEXTURE ANALYSIS

Client:
ENVIRONMENTAL TESTING SOLUTIONS INC
POB 7565
ASHEVILLE, NC 28802

Grower:
MCGILL ASSOCIATES

Farm:

Report No: 11-164-0612
Cust No: 46933
Date Printed: 08/15/2011
Page: 1 of 1

Date Received: 08/13/2011

Lab No	Field ID	Sample Identification	Percent Sand	Percent Silt	Percent Clay	Textural Classification
20180		001-SEDIMENT	60.3	31.7	7.9	Sandy Loam

Analysis prepared by: A&L Eastern Laboratories, Inc.

Report Number: 11-164-0512
Account Number: 46933

A&L Eastern Laboratories, Inc.

7831 Whitepine Road, Richmond, Virginia 23237 (804) 743-9431 Fax (804) 274-9468

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Send To: ENVIRONMENTAL TESTING SOLUTIONS INC
POB 7565
ASHEVILLE NC 28802

Grower: MCGILL ASSOCIATES

Farm ID:

SOIL ANALYSIS REPORT

Analytical Method(s):

Date Received: 06/13/2011 **Date Of Analysis:** 06/14/2011 **Date Of Report:** 06/15/2011

Sample ID / Field ID	Lab Number	Organic Matter %	Organic Matter Rate	ENR lbs/A	Phosphorus Available ppm	Phosphorus Available Rate	Phosphorus Reserve ppm	Phosphorus Reserve Rate	Potassium K ppm	Potassium K Rate	Magnesium Mg ppm	Magnesium Mg Rate	Calcium Ca ppm	Calcium Ca Rate	Sodium Na ppm	Sodium Na Rate	pH Soil pH	pH Buffer Index	Acidity H meq/100g	C.E.C meq/100g
001-SEDIMENT	20180																			

Sample ID / Field ID	Percent Base Saturation K %	Mg %	Ca %	Na %	H %	Nitrate NO_3-N ppm	Nitrate Rate	Sulfur S ppm	Sulfur Rate	Zinc Zn ppm	Zinc Rate	Manganese Mn ppm	Manganese Rate	Iron Fe ppm	Iron Rate	Copper Cu ppm	Copper Rate	Boron B ppm	Boron Rate	Soluble Salts SS ms/cm	Soluble Salts Rate	Chloride Cl ppm	Chloride Rate	Aluminum Al ppm
001-SEDIMENT																								

Values on this report represent the plant available nutrients in the soil. Rating after each value: VL (Very Low), L (Low), M (Medium), H (High), VH (Very High). ENR - Estimated Nitrogen Release. C.E.C. - Cation Exchange Capacity.

Explanation of symbols: % (percent), ppm (parts per million), lbs/A (pounds per acre), mmhos (milli-mhos per centimeter), meq/100g (milli-equivalent per 100 grams). Conversions: ppm x 2 = lbs/A, Soluble Salts mmhos x 640 = ppm.

This report applies to sample(s) tested. Samples are retained a maximum of thirty days after testing.

Analysis prepared by: A&L Eastern Laboratories, Inc.

by: Pauric McGroary

Pauric McGroary

Report Number
11-164-0012 Page: 1 of 2

Account Number
46933

A&L Eastern Laboratories, Inc.
7621 Whitepine Road Richmond, Virginia 23237 (804) 743-9401 Fax (804) 271-6449
www.aleastern.com

Send To : ENVIRONMENTAL TESTING
SOLUTIONS INC
POB 7555
ASHEVILLE , NC 28802

Client : MCGILL ASSOCIATES

Purchase Order :
Report Date: 6/15/2011
Date Received : 6/13/2011

REPORT OF ANALYSIS

Laboratory Number:	29180
Sample Date And Time:	
Sample Identification:	001-SEDIMENT
Analysis:	
Coarse Fragments (Gravel >2mm) ,% U.S. SIEVE	2.55
Coarse Sand (.5-1 mm) ,% U.S. SIEVE	5.74
Fine Particle (0.10-0.25 mm) ,% U.S. SIEVE	28.80
Medium Particle (0.25-0.5 mm ,% U.S. SIEVE	9.94
Very Coarse Particle (1-2 mm) ,% U.S. SIEVE	1.59
Very Fine Particle (0.05-0.10 mm) ,% U.S. SIEVE	21.41

Pauric McGroary

Sample results are reported 'as received' and are not moisture corrected unless noted

APPENDIX D

Filter Fabric Sampling Results Summary

&

Fabric Filter Sampling Data

Town of Highlands
Innovative Stormwater Project Implementation
Project No. 10.00336

Crystal Stream Water Quality Units #1 & #2 Combined Filter Fabric Analysis

				Sample Type:	Clean Filter	Used Filter	Clean Filter	Used Filter	Used Filter
				Sample Collection Date:	8-Dec-10	8-Dec-10	8-Mar-11	8-Mar-11	8-Jun-11
Parameter	**Method**	**Units**	**RL**		**Result**	**Result**	**Result**	**Result**	**Result**
Ammonia Nitrogen	SM 4500 NH3 D	mg/L	4.0		32.00	4.00			
% Solids (ETS Test)	SM 2540 G	%			93.00	25.00	90.00	40.00	40.00
Mercury	7471 B	mg/kg	0.057		0.02	0.07	0.02	0.05	
Arsenic	6010 C	mg/kg	1.4		0.56	1.50	0.55	1.20	
Barium	6010 C	mg/kg	1.4		4.90	120.00	5.40	36.00	
Cadmium	6010 C	mg/kg	0.69		0.28	0.69	0.28	0.62	
Chromium	6010 C	mg/kg	0.69		0.34	20.00	0.37	7.00	
Copper	6010 C	mg/kg	1.4		4.40	330.00	3.20	52.00	
Lead	6010 C	mg/kg	0.69		0.48	27.00	0.28	9.00	
Selenium	6010 C	mg/kg	1.4		0.67	3.40	0.60	1.20	
Silver	6010 C	mg/kg	0.69		0.28	0.69	0.28	0.62	
Zinc	6010 C	mg/kg	6.9		10.00	1200.00	6.50	120.00	
% Solids (Prism Lab Test)	SM 2540 G	mg/kg	0.100		89.90	36.70			
Total Kjeldahl Nitrogen	351.2	mg/kg	680		100.00	2600.00	210.00	1300.00	1400.00
Nitrate + Nitrite	SM 4500-NO3 F	mg/kg	14		11.00	14.00	5.60	12.00	12.00
Total Nitrogen	Calculation	mg/kg	690		110.00	2600.00	210.00	1300.00	1400.00
Total Phosphorus	SM 4500-P F	mg/kg	130		59.00	630.00	95.00	430.00	280.00
Ortho - Phosphate	SM 4500 P E	mg/kg	1.0		11.00	24.00			

RL = Reporting Limit. Values are reported down to the Reporting Limit only.

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Certificate of Analysis

Project name: **McGill Associates** Project number: **101208.502**

Collection date: **8-Dec-10**
Date received: **8-Dec-10**

Sample identification: **001- Clean Filter - Grab** Sample number: **78786**

Parameter	Method	Result	RL	Units	Date Analyzed	Analyst	Footnotes
Ammonia Nitrogen	SM 4500 NH3 D	32	2.2	mg/kg	10-Dec-10	KEK	
% Solids	SM 2540 G	93	0.10	%	8-Dec-10	KEK	
Mercury	7471 B	<0.023	0.022	mg/kg	23-Dec-10	LTB	1
Arsenic	6010 C	<0.56	0.56	mg/kg	17-Dec-10	DWR	1
Barium	6010 C	4.9	0.56	mg/kg	17-Dec-10	DWR	1
Cadmium	6010 C	<0.28	0.28	mg/kg	17-Dec-10	DWR	1
Chromium	6010 C	0.34	0.28	mg/kg	17-Dec-10	DWR	1
Copper	6010 C	4.4	0.56	mg/kg	17-Dec-10	DWR	1
Lead	6010 C	0.48	0.28	mg/kg	17-Dec-10	DWR	1
Selenium	6010 C	0.67	0.28	mg/kg	17-Dec-10	DWR	1
Silver	6010 C	<0.28	0.28	mg/kg	17-Dec-10	DWR	1
Zinc	6010 C	10	2.8	mg/kg	17-Dec-10	DWR	1
% Solids	SM 2540 G	89.9	0.100	mg/kg	13-Dec-10	JAB	1
Total Kjeldahl Nitrogen	351.2	100	28	mg/kg	20-Dec-10	CDE	1
Nitrate + Nitrite	SM 4500-NO3 F	11	5.6	mg/kg	16-Dec-10	RSL	1
Total Nitrogen	Calculation	110	33	mg/kg	20-Dec-10	CDE	1
Total Phosphorus	SM 4500-P F	59	2.8	mg/kg	21-Dec-10	RSL	1
Ortho - Phosphate	SM 4500 P E	11	1.0	mg/kg	13-Dec-10	CDE	1

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Certificate of Analysis

Project name: McGill Associates

Project number: 101208.502

Collection date: 8-Dec-10
Date received: 8-Dec-10

Sample identification: 002 - Used Filter - Grab

Sample number: 78787

Parameter	Method	Result	RL	Units	Date Analyzed	Analyst	Footnotes
Ammonia Nitrogen	SM 4500 NH3 D	<4.0	4.0	mg/kg	10-Dec-10	KEK	
% Solids	SM 2540 G	25		%	8-Dec-10	KEK	
Mercury	7471 B	0.070	0.057	mg/kg	27-Dec-10	LTB	1
Arsenic	6010 C	1.5	1.4	mg/kg	17-Dec-10	DWR	1
Barium	6010 C	120	1.4	mg/kg	17-Dec-10	DWR	1
Cadmium	6010 C	<0.69	0.69	mg/kg	17-Dec-10	DWR	1
Chromium	6010 C	20	0.69	mg/kg	17-Dec-10	DWR	1
Copper	6010 C	330	1.4	mg/kg	17-Dec-10	DWR	1
Lead	6010 C	27	0.69	mg/kg	17-Dec-10	DWR	1
Selenium	6010 C	3.4	1.4	mg/kg	17-Dec-10	DWR	1
Silver	6010 C	<0.69	0.69	mg/kg	17-Dec-10	DWR	1
Zinc	6010 C	1200	6.9	mg/kg	17-Dec-10	DWR	1
% Solids	SM 2540 G	36.7	0.100	mg/kg	13-Dec-10	JAB	1
Total Kjeldahl Nitrogen	351.2	2600	680	mg/kg	20-Dec-10	CDE	1
Nitrate + Nitrite	SM 4500-NO3 F	<14	14	mg/kg	16-Dec-10	RSL	1
Total Nitrogen	Calculation	2600	690	mg/kg	20-Dec-10	CDE	1
Total Phosphorus	SM 4500-P F	630	130	mg/kg	15-Dec-10	RSL	1
Ortho - Phosphate	SM 4500 P E	24	1.0	mg/kg	15-Dec-10	CDE	1

Sample identification: 003 - Sediment - Grab

Sample number: 78788

Parameter	Method	Result	RL	Units	Date Analyzed	Analyst	Footnotes
Grain Size	ASTM D422	See Attached Results				S&ME	2

Footnotes:

RL = Reporting Limit. Values are reported down to the Reporting Limit only.

1. Analyzed by Prism Laboratories, Inc.
2. Analyzed by S&ME, Inc.

Date reviewed: 01-12-11
Data reviewed by: Kelley E. Keenan
Signature: JK

NC Certification Number: 600
SC Certification Number: 99053
NC Drinking Water Certification Number: 37786

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NC Certification No. 402
SC Certification No. 99012
NC Drinking Water Cert No. 37738

Case Narrative

01/05/2011

Environmental Testing Solutions
Kelley Keenan
PO Box 7565
Asheville, NC 28802

Project: McGill Associates

Lab Submittal Date: 12/10/2010
Prism Work Order: 0120359

This data package contains the analytical results for the project identified above and includes a Case Narrative, Sample Results and Chain of Custody. Unless otherwise noted, all samples were received in acceptable condition and processed according to the referenced methods.

Data qualifiers are flagged individually on each sample. A key reference for the data qualifiers appears at the end of this case narrative.

Narrative Notes:

This is a Revised Report and supercedes the original laboratory report dated 01/03/11.% solids reported incorrectly.

Please call if you have any questions relating to this analytical report.

Respectfully,

PRISM LABORATORIES, INC.

Peggy J Kendall

Project Manager

Peggy J Kendall

Reviewed By

Data Qualifiers Key Reference:

B	Analyte is found in the associated blank as well as in the sample (CLP B-flag).
BH	MB greater than one half of the RL, but the sample concentrations are greater than 10x the MB.
HT	Sample received and analyzed outside of the hold time.
BRL	Below Reporting Limit
MDL	Method Detection Limit
RPD	Relative Percent Difference
*	Results reported to the reporting limit. All other results are reported to the MDL with values between MDL and reporting limit indicated with a J.

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Sample Receipt Summary

01/06/2011

Prism Work Order: 0120359

Client Sample ID	Lab Sample ID	Matrix	Date Sampled	Date Received
001-Clean Filter	0120359-01	Solid	12/08/10	12/10/10
002-Used Filter	0120359-02	Solid	12/08/10	12/10/10

Samples received in good condition at 5.3 degrees C unless otherwise noted.

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Laboratory Report

01/06/2011

Environmental Testing Solutions
Attn: Kelley Keenan
PO Box 7565
Asheville, NC 28802

Project: McGill Associates

Sample Matrix: Solid

Client Sample ID: 001-Clean Filter
Prism Sample ID: 0120359-01
Prism Work Order: 0120359
Time Collected: 12/08/10 12:15
Time Submitted: 12/10/10 13:00

Parameter	Result	Units	Report Limit	MDL	Dilution Factor	Method	Analysis Date/Time	Analyst	Batch ID
General Chemistry Parameters									
Total Nitrogen	110	mg/kg dry	33	2.9	1	*Total Nitrogen	12/28/10 16:27	CDE	[CALC]
% Solids	88.3	% by Weight	0.100	0.100	1	*SM2540 G	12/15/10 16:19	JAB	P0L0336
Nitrate/Nitrite as N	11	mg/kg dry	5.6	0.61	1	*SM4500-NO3 F	12/16/10 11:43	RSL	P0L0337
Orthophosphate as P	11 HT	mg/kg dry	1.0	0.034	2	*SM4500-P E	12/16/10 16:00	CDE	P0L0693
Phosphorus-Total	59	mg/kg dry	2.8	0.38	1	*SM4500-P F	12/21/10 8:36	RSL	P0L0318
Total Kjeldahl Nitrogen	100	mg/kg dry	28	2.2	1	*351.2	12/28/10 16:27	CDE	P0L0389
Total Metals									
Mercury	BRL	mg/kg dry	0.022	0.0033	1	*7471B	12/27/10 14:28	LTB	P0L0480
Arsenic	BRL	mg/kg dry	0.56	0.084	1	*6010C	12/17/10 8:27	DWR	P0L0329
Barium	4.9	mg/kg dry	0.56	0.084	1	*6010C	12/17/10 8:27	DWR	P0L0329
Cadmium	BRL	mg/kg dry	0.28	0.030	1	*6010C	12/17/10 8:27	DWR	P0L0329
Chromium	0.34	mg/kg dry	0.28	0.039	1	*6010C	12/17/10 8:27	DWR	P0L0329
Copper	4.4	mg/kg dry	0.56	0.24	1	*6010C	12/17/10 8:27	DWR	P0L0329
Lead	0.48 B	mg/kg dry	0.28	0.070	1	*6010C	12/17/10 8:27	DWR	P0L0329
Selenium	0.67	mg/kg dry	0.56	0.11	1	*6010C	12/17/10 8:27	DWR	P0L0329
Silver	BRL	mg/kg dry	0.28	0.029	1	*6010C	12/17/10 8:27	DWR	P0L0329
Zinc	10	mg/kg dry	2.8	0.28	1	*6010C	12/17/10 8:27	DWR	P0L0329

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Laboratory Report

01/06/2011

Environmental Testing Solutions
Attn: Kelley Keenan
PO Box 7565
Asheville, NC 28802

Project: McGill Associates

Sample Matrix: Solid

Client Sample ID: 002-Used Filter
Prism Sample ID: 0120359-02
Prism Work Order: 0120359
Time Collected: 12/06/10 12:15
Time Submitted: 12/10/10 13:00

Parameter	Result	Units	Report Limit	MDL	Dilution Factor	Method	Analysis Date/Time	Analyst	Batch ID
General Chemistry Parameters									
Total Nitrogen	3500	mg/kg dry	630	67	10	*Total Nitrogen	12/20/10 16:27	CDE	[CALC]
% Solids	36.7	% by Weight	0.100	0.100	1	*SM2540 G	12/15/10 16:15	JAS	P0L0336
Nitrate/Nitrite as N	BRL	mg/kg dry	14	1.5	1	*SM4500-NO3 F	12/16/10 11:42	RSL	P0L0337
Orthophosphate as P	24 HT	mg/kg dry	1.0	0.024	2	*SM4500-P E	12/15/10 16:08	CDE	P0L0893
Phosphorus-Total	630	mg/kg dry	130	18	20	*SM4500-P F	12/15/10 16:05	RSL	P0L0318
Total Kjeldahl Nitrogen	3500	mg/kg dry	680	65	10	*351.2	12/20/10 16:27	CDE	P0L0336
Total Metals									
Mercury	0.070	mg/kg dry	0.057	0.0065	1	*7471B	12/27/10 14:33	LTB	P0L0400
Arsenic	1.5	mg/kg dry	1.4	0.16	1	*6010C	12/17/10 8:35	DWR	P0L0329
Barium	120	mg/kg dry	1.4	0.21	1	*6010C	12/17/10 8:35	DWR	P0L0329
Cadmium	BRL	mg/kg dry	0.69	0.073	1	*6010C	12/17/10 8:35	DWR	P0L0329
Chromium	20	mg/kg dry	0.69	0.096	1	*6010C	12/17/10 8:35	DWR	P0L0329
Copper	330	mg/kg dry	1.4	0.69	1	*6010C	12/17/10 8:35	DWR	P0L0329
Lead	27 SH	mg/kg dry	0.69	0.17	1	*6010C	12/17/10 8:35	DWR	P0L0329
Selenium	3.4	mg/kg dry	1.4	0.28	1	*6010C	12/17/10 8:35	DWR	P0L0329
Silver	BRL	mg/kg dry	0.69	0.071	1	*6010C	12/17/10 8:35	DWR	P0L0329
Zinc	1200	mg/kg dry	6.9	0.71	1	*6010C	12/17/10 8:35	DWR	P0L0329

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Environmental Testing Solutions
Attn: Kelley Keenan
PO Box 7565
Asheville, NC 28802

Project: McGill Associates

Prism Work Order: 0120359
Time Submitted: 12/10/2010 1:00:00PM

Total Metals - Quality Control

Analyte	Result	Reporting Limit	Units	Spike Level	Source Result	%REC	%REC Limits	RPD	RPD Limit	Notes
Batch P0L0329 - 3050B										
Blank (P0L0329-BLK1)				Prepared: 12/16/10 Analyzed: 12/17/10						
Arsenic	BRL	0.49	mg/kg wet							
Barium	BRL	0.49	mg/kg wet							
Cadmium	BRL	0.25	mg/kg wet							
Chromium	BRL	0.25	mg/kg wet							
Copper	BRL	0.49	mg/kg wet							
Lead	BRL	0.25	mg/kg wet							BH
Selenium	BRL	0.49	mg/kg wet							
Silver	BRL	0.25	mg/kg wet							
Zinc	BRL	2.5	mg/kg wet							
LCS (P0L0329-BS1)				Prepared: 12/16/10 Analyzed: 12/17/10						
Arsenic	24.2	0.51	mg/kg wet	25.4		95	80-120			
Barium	24.9	0.51	mg/kg wet	25.4		98	80-120			
Cadmium	24.4	0.25	mg/kg wet	25.4		96	80-120			
Chromium	25.0	0.25	mg/kg wet	25.4		98	80-120			
Copper	26.1	0.51	mg/kg wet	25.4		103	80-120			
Lead	24.4	0.25	mg/kg wet	25.4		96	80-120			
Selenium	23.8	0.51	mg/kg wet	25.4		94	80-120			
Silver	24.7	0.25	mg/kg wet	25.4		97	80-120			
Zinc	24.3	2.5	mg/kg wet	25.4		96	80-120			
Batch P0L0490 - 7471B										
Blank (P0L0490-BLK1)				Prepared & Analyzed: 12/27/10						
Mercury	BRL	0.020	mg/kg wet							
LCS (P0L0490-BS1)				Prepared & Analyzed: 12/27/10						
Mercury	0.446	0.020	mg/kg wet	0.417		107	80-120			

Environmental Testing Solutions
Attn: Kelley Keenan
PO Box 7565
Asheville, NC 28802

Project: McGill Associates

Prism Work Order: 0120359
Time Submitted: 12/10/2010 1:00:00PM

General Chemistry Parameters - Quality Control

Analyte	Result	Reporting Limit	Units	Spike Level	Source Result	%REC	%REC Limits	RPD	RPD Limit	Notes
Batch P0L0318 - SM4500-PB5										
Blank (P0L0318-BLK1)				Prepared & Analyzed: 12/15/10						
Phosphorus-Total	BRL	2.5	mg/kg wet							
LCS (P0L0318-BS1)				Prepared & Analyzed: 12/15/10						
Phosphorus-Total	95.2	2.5	mg/kg wet	100		95	80-110			
Matrix Spike (P0L0318-MS1)	Source: 0120359-02			Prepared & Analyzed: 12/15/10						
Phosphorus-Total	880	140	mg/kg dry	284	628	84	80-120			
Matrix Spike Dup (P0L0318-MSD1)	Source: 0120359-02			Prepared & Analyzed: 12/15/10						
Phosphorus-Total	863	140	mg/kg dry	284	628	83	80-120	0.3	20	
Batch P0L0336 - NO PREP										
Blank (P0L0336-BLK1)				Prepared & Analyzed: 12/15/10						
% Solids	100	0.100	% by Weight							
Batch P0L0337 - NO PREP										
Blank (P0L0337-BLK1)				Prepared & Analyzed: 12/16/10						
Nitrate/Nitrite as N	BRL	5.0	mg/kg wet							
LCS (P0L0337-BS1)				Prepared & Analyzed: 12/16/10						
Nitrate/Nitrite as N	50.3	5.0	mg/kg wet	50.0		101	80-120			
Matrix Spike (P0L0337-MS1)	Source: 0120359-01			Prepared & Analyzed: 12/16/10						
Nitrate/Nitrite as N	60.8	5.8	mg/kg dry	55.6	11.5	89	80-120			

Environmental Testing Solutions
Attn: Kelley Keenan
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Asheville, NC 28802

Project: McGill Associates

Prism Work Order: 0120359
Time Submitted: 12/10/2010 1:00:00PM

General Chemistry Parameters - Quality Control

Analyte	Result	Reporting Limit	Units	Spike Level	Source Result	%REC	%REC Limits	RPD	RPD Limit	Notes
Batch P0L0337 - NO PREP										
Matrix Spike Dup (P0L0337-MSD1)	Source: 0120359-01			Prepared & Analyzed: 12/10/10						
Nitrate/Nitrite as N	60.8	5.6	mg/kg dry	55.8	11.5	88	80-120	0.4	20	
Batch P0L0399 - 351.2										
Blank (P0L0399-BLK1)				Prepared: 12/17/10 Analyzed: 12/20/10						
Total Kjeldahl Nitrogen	BRL	25	mg/kg wet							
LCS (P0L0399-BS1)				Prepared: 12/17/10 Analyzed: 12/20/10						
Total Kjeldahl Nitrogen	139	25	mg/kg wet	125		102	90-110			
Batch P0L0593 - Default Prep GenChem										
Blank (P0L0593-BLK1)				Prepared & Analyzed: 12/15/10						
Orthophosphate as P	BRL	0.50	mg/kg wet							
LCS (P0L0593-BS1)				Prepared & Analyzed: 12/15/10						
Orthophosphate as P	28.7	0.50	mg/kg wet	30.0		96	80-120			

Sample Extraction Data

Prep Method: 351.2

Lab Number	Batch	Initial	Final	Date
0120359-01	P0L0309	0.5 g	25 mL	12/17/10
0120359-02	P0L0309	0.5 g	25 mL	12/17/10

Prep Method: Default Prep GenChem

Lab Number	Batch	Initial	Final	Date
0120359-01	P0L0593	5 g	50 mL	12/15/10
0120359-02	P0L0593	5 g	50 mL	12/15/10

NO PREP

Lab Number	Batch	Initial	Final	Date
0120359-01	P0L0337	1 g	50 mL	12/16/10
0120359-01	P0L0336	30 g	30 mL	12/15/10
0120359-02	P0L0337	1 g	50 mL	12/16/10
0120359-02	P0L0336	30 g	30 mL	12/15/10

Prep Method: SM4500-P B5

Lab Number	Batch	Initial	Final	Date
0120359-01	P0L0318	1 g	50 mL	12/15/10
0120359-02	P0L0318	1.05 g	50 mL	12/15/10

Prep Method: 3050B

Lab Number	Batch	Initial	Final	Date
0120359-01	P0L0329	1.57 g	50 mL	12/16/10
0120359-02	P0L0329	1.57 g	50 mL	12/16/10

Prep Method: 7471B

Lab Number	Batch	Initial	Final	Date
0120359-01	P0L0490	0.6 g	50 mL	12/27/10
0120359-02	P0L0490	0.67 g	50 mL	12/27/10

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Phone: (828) 350-9364
Fax: (828) 350-9368

Certificate of Analysis

Project name: **McGill Associates** Project number: **110308.529**

Collection date: **8-Mar-11**
Date received: **8-Mar-11**

Sample identification: **Used Filter - Grab** Sample number: **80794**

Parameter	Method	Result	RL	Units	Date Analyzed	Analyst	Footnotes
Mercury	7471 B	**<0.046**	0.046	mg/kg	15-Mar-11	DJS	1
Arsenic	6010 C	**1.2**	1.2	mg/kg	17-Mar-11	DWR	1
Barium	6010 C	**36**	1.2	mg/kg	17-Mar-11	DWR	1
Cadmium	6010 C	**<0.62**	0.62	mg/kg	17-Mar-11	DWR	1
Chromium	6010 C	**7**	0.62	mg/kg	17-Mar-11	DWR	1
Copper	6010 C	**52**	1.2	mg/kg	17-Mar-11	DWR	1
Lead	6010 C	**9**	0.62	mg/kg	17-Mar-11	DWR	1
Selenium	6010 C	**1.2**	1.2	mg/kg	17-Mar-11	DWR	1
Silver	6010 C	**<0.62**	0.62	mg/kg	17-Mar-11	DWR	1
Zinc	6010 C	**120**	6.2	mg/kg	17-Mar-11	DWR	1
% Solids	SM 2540 G	**40.0**	0.100	mg/kg	14-Mar-11	JAB	1
Total Kjeldahl Nitrogen	351.2	**1300**	620	mg/kg	21-Mar-11	CDE	1
Nitrate + Nitrite	SM 4500-NO3 F	**<12**	12	mg/kg	18-Mar-11	RSL	1
Total Nitrogen	Calculation	**1300**	640	mg/kg	21-Mar-11	CDE	1
Total Phosphorus	SM 4500-P F	**430**	13	mg/kg	18-Mar-11	RSL	1

Environmental Testing Solutions, Inc.

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Certificate of Analysis

Project name: **McGill Associates** Project number: **110308.529**

Collection date: **8-Mar-11**
Date received: **8-Mar-11**

Sample identification: **Clean Filter - Grab** Sample number: **80795**

Parameter	Method	Result	RL	Units	Date Analyzed	Analyst	Footnotes
Mercury	7471 B	**<0.024**	0.024	mg/kg	15-Mar-11	DJS	1
Arsenic	6010 C	**<0.55**	0.55	mg/kg	17-Mar-11	DWR	1
Barium	6010 C	**5.4**	0.55	mg/kg	17-Mar-11	DWR	1
Cadmium	6010 C	**<0.28**	0.28	mg/kg	17-Mar-11	DWR	1
Chromium	6010 C	**0.37**	0.28	mg/kg	17-Mar-11	DWR	1
Copper	6010 C	**3.2**	0.55	mg/kg	17-Mar-11	DWR	1
Lead	6010 C	**<0.28**	0.28	mg/kg	17-Mar-11	DWR	1
Selenium	6010 C	**0.60**	0.55	mg/kg	17-Mar-11	DWR	1
Silver	6010 C	**<0.28**	0.28	mg/kg	17-Mar-11	DWR	1
Zinc	6010 C	**6.5**	2.8	mg/kg	17-Mar-11	DWR	1
% Solids	SM 2540 G	**90.0**	0.100	mg/kg	14-Mar-11	JAB	1
Total Kjeldahl Nitrogen	351.2	**210**	140	mg/kg	21-Mar-11	CDE	1
Nitrate + Nitrite	SM 4500-NO3 F	**<5.6**	5.6	mg/kg	15-Mar-11	RSL	1
Total Nitrogen	Calculation	**210**	140	mg/kg	21-Mar-11	CDE	1
Total Phosphorus	SM 4500-P F	**95**	5.7	mg/kg	18-Mar-11	RSL	1

Footnotes:

RL = Reporting Limit. Values are reported down to the Reporting Limit only.

1. Analyzed by Prism Laboratories, Inc.
2. Analzyed by A&L Eastern Laboratories, Inc.

Date reviewed: 03.23.11
Data reviewed by: **Kelley E. Keenan**
Signature: KK

NC Certification Number: 600
SC Certification Number: 99053
NC Drinking Water Certification Number: 37786

PRISM LABORATORIES, INC.
Full-Service Analytical & Environmental Solutions

NC Certification No. 402
SC Certification No. 99012
NC Drinking Water Cert No. 37735

Case Narrative

03/22/2011

Environmental Testing Solutions
Kelley Keenan
PO Box 7565
Asheville, NC 28802

Project: McGill Associates

Lab Submittal Date: 03/11/2011
Prism Work Order: 1030309

This data package contains the analytical results for the project identified above and includes a Case Narrative, Sample Results and Chain of Custody. Unless otherwise noted, all samples were received in acceptable condition and processed according to the referenced methods.

Data qualifiers are flagged individually on each sample. A key reference for the data qualifiers appears at the end of this case narrative.

Please call if you have any questions relating to this analytical report.

Respectfully,

PRISM LABORATORIES, INC.

Peggy J Kendall

Project Manager

Peggy J Kendall

Reviewed By

Data Qualifiers Key Reference:

MI	Matrix spike outside of the control limits. Matrix interference suspected.
BRL	Below Reporting Limit
MDL	Method Detection Limit
RPD	Relative Percent Difference
•	Results reported to the reporting limit. All other results are reported to the MDL with values between MDL and reporting limit indicated with a J.

PRISM | Full-Service Analytical & Environmental Solutions

Sample Receipt Summary

03/22/2011

Prism Work Order: 1030309

Client Sample ID	Lab Sample ID	Matrix	Date Sampled	Date Received
Stormwater Sediment 001	1030309-01	Solid	03/08/11	03/11/11
002-Used Filter	1030309-02	Solid	03/08/11	03/11/11
005-Clean Filter	1030309-03	Solid	03/08/11	03/11/11

Samples received in good condition at 4.6 degrees C unless otherwise noted.

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Phone: 704/529-6364 - Toll Free Number: 1-800/529-6364 - Fax: 704/525-0409

PRISM | Full-Service Analytical & Environmental Solutions

Laboratory Report

03/22/2011

Environmental Testing Solutions
Attn: Kelley Keenan
PO Box 7565
Asheville, NC 28802

Project: McGill Associates

Sample Matrix: Solid

Client Sample ID: 002-Used Filter
Prism Sample ID: 1030309-02
Prism Work Order: 1030309
Time Collected: 03/09/11 11:00
Time Submitted: 03/11/11 13:15

Parameter	Result	Units	Report Limit	MDL	Dilution Factor	Method	Analysis Date/Time	Analyst	Batch ID
General Chemistry Parameters									
Total Nitrogen	1300	mg/kg dry	640	82	10	*Total Nitrogen	3/21/11 14:00	CDE	[CALC]
% Solids	48.0	% by Weight	0.100	0.100	1	*SM2540 G	3/14/11 15:45	JAB	P1C0304
Nitrate/Nitrite as N	BRL	mg/kg dry	12	1.4	1	*SM4500-NO3 F	3/15/11 8:29	RSL	P1C0308
Phosphorus-Total	430	mg/kg dry	13	1.6	2	*SM4500-P F	3/16/11 8:10	RSL	P1C0302
Total Kjeldahl Nitrogen	1300	mg/kg dry	620	80	10	*351.2	3/21/11 14:00	CDE	P1C0419
Total Metals									
Mercury	BRL	mg/kg dry	0.048	0.0055	1	*7471B	3/15/11 17:06	DJS	P1C0318
Arsenic	1.2	mg/kg dry	1.2	0.14	1	*6010C	3/17/11 13:48	DWR	P1C0314
Barium	38	mg/kg dry	1.2	0.19	1	*6010C	3/17/11 13:48	DWR	P1C0314
Cadmium	BRL	mg/kg dry	0.62	0.080	1	*6010C	3/17/11 13:48	DWR	P1C0314
Chromium	6.7	mg/kg dry	0.62	0.096	1	*6010C	3/17/11 13:48	DWR	P1C0314
Copper	82	mg/kg dry	1.2	0.54	1	*6010C	3/17/11 13:48	DWR	P1C0314
Lead	8.1	mg/kg dry	0.62	0.18	1	*6010C	3/17/11 13:48	DWR	P1C0314
Selenium	1.2	mg/kg dry	1.2	0.25	1	*6010C	3/17/11 13:48	DWR	P1C0314
Silver	BRL	mg/kg dry	0.62	0.064	1	*6010C	3/17/11 13:48	DWR	P1C0314
Zinc	120	mg/kg dry	6.2	0.64	1	*6010C	3/17/11 13:48	DWR	P1C0314

PRISM | Full-Service Analytical & Environmental Solutions

Laboratory Report

03/22/2011

Environmental Testing Solutions
Attn: Kelley Keenan
PO Box 7565
Asheville, NC 28802

Project: McGill Associates

Sample Matrix: Solid

Client Sample ID: 005-Clean Filter
Prism Sample ID: 1030309-03
Prism Work Order: 1030309
Time Collected: 03/08/11 11:00
Time Submitted: 03/11/11 13:15

Parameter	Result	Units	Report Limit	MDL	Dilution Factor	Method	Analysis Date/Time	Analyst	Batch ID
General Chemistry Parameters									
Total Nitrogen	210	mg/kg dry	140	12	5	*Total Nitrogen	3/21/11 14:50	CDE	[CALC]
% Solids	80.0	% by Weight	0.100	0.100	1	*SM2540 G	3/14/11 15:45	JAB	P1C0294
Nitrate/Nitrite as N	BRL	mg/kg dry	0.6	0.61	1	*SM4500-NO3 F	3/15/11 8:29	BSL	P1C0298
Phosphorus-Total	55	mg/kg dry	5.7	0.79	2	*SM4500-P F	3/18/11 8:18	BSL	P1C0362
Total Kjeldahl Nitrogen	210	mg/kg dry	140	11	5	*351.2	3/21/11 14:50	CDE	P1C0418
Total Metals									
Mercury	BRL	mg/kg dry	0.024	0.0029	1	*7471B	3/16/11 17:11	DJS	P1C0318
Arsenic	BRL	mg/kg dry	0.58	0.062	1	*6010C	3/17/11 13:28	DWR	P1C0314
Barium	6.4	mg/kg dry	0.58	0.062	1	*6010C	3/17/11 13:28	DWR	P1C0314
Cadmium	BRL	mg/kg dry	0.28	0.029	1	*6010C	3/17/11 13:28	DWR	P1C0314
Chromium	0.37	mg/kg dry	0.28	0.038	1	*6010C	3/17/11 13:28	DWR	P1C0314
Copper	3.3	mg/kg dry	0.58	0.24	1	*6010C	3/17/11 13:28	DWR	P1C0314
Lead	BRL	mg/kg dry	0.28	0.008	1	*6010C	3/17/11 13:28	DWR	P1C0314
Selenium	0.53	mg/kg dry	0.58	0.11	1	*6010C	3/17/11 13:28	DWR	P1C0314
Silver	BRL	mg/kg dry	0.28	0.028	1	*6010C	3/17/11 13:28	DWR	P1C0314
Zinc	6.5	mg/kg dry	2.8	0.28	1	*6010C	3/17/11 13:28	DWR	P1C0314

Environmental Testing Solutions
Attn: Kelley Keenan
PO Box 7585
Asheville, NC 28802

Project: McGill Associates

Prism Work Order: 1030309
Time Submitted: 3/11/2011 1:15:00PM

Total Metals - Quality Control

Analyte	Result	Reporting Limit	Units	Spike Level	Source Result	%REC	%REC Limits	RPD	RPD Limit	Notes
Batch P1C0314 - 3050B										
Blank (P1C0314-BLK1)				Prepared: 03/15/11 Analyzed: 03/17/11						
Arsenic	BRL	0.50	mg/kg wet							
Barium	BRL	0.50	mg/kg wet							
Cadmium	BRL	0.25	mg/kg wet							
Chromium	BRL	0.25	mg/kg wet							
Copper	BRL	0.50	mg/kg wet							
Lead	BRL	0.25	mg/kg wet							
Selenium	BRL	0.50	mg/kg wet							
Silver	BRL	0.25	mg/kg wet							
Zinc	BRL	2.5	mg/kg wet							
LCS (P1C0314-BS1)				Prepared: 03/15/11 Analyzed: 03/17/11						
Arsenic	22.5	0.50	mg/kg wet	25.0		90	80-120			
Barium	23.2	0.50	mg/kg wet	25.0		93	80-120			
Cadmium	22.4	0.25	mg/kg wet	25.0		89	80-120			
Chromium	23.3	0.25	mg/kg wet	25.0		93	80-120			
Copper	23.7	0.50	mg/kg wet	25.0		95	80-120			
Lead	23.0	0.25	mg/kg wet	25.0		92	80-120			
Selenium	22.8	0.50	mg/kg wet	25.0		91	80-120			
Silver	22.4	0.25	mg/kg wet	25.0		90	80-120			
Zinc	22.9	2.5	mg/kg wet	25.0		92	80-120			
Matrix Spike (P1C0314-MS1)	Source: 1030309-03			Prepared: 03/15/11 Analyzed: 03/17/11						
Arsenic	27.7	0.58	mg/kg dry	27.8	BRL	100	75-125			
Barium	30.4	0.58	mg/kg dry	27.8	5.37	90	75-125			
Cadmium	25.0	0.29	mg/kg dry	27.8	BRL	93	75-125			
Chromium	26.7	0.29	mg/kg dry	27.8	0.357	95	75-125			
Copper	31.5	0.58	mg/kg dry	27.8	3.23	102	75-125			
Lead	26.0	0.29	mg/kg dry	27.8	0.0821	93	75-125			
Selenium	32.0	0.58	mg/kg dry	27.8	0.805	113	75-125			
Silver	22.9	0.29	mg/kg dry	27.8	BRL	82	75-125			
Zinc	34.8	2.9	mg/kg dry	27.8	6.46	102	75-125			

Environmental Testing Solutions
Attn: Kelley Keenan
PO Box 7565
Asheville, NC 28802

Project: McGill Associates

Prism Work Order: 1030309
Time Submitted: 3/11/2011 1:15:00PM

Total Metals - Quality Control

Analyte	Result	Reporting Limit	Units	Spike Level	Source Result	%REC	%REC Limits	RPD	RPD Limit	Notes
Batch P1C0314 - 3050B										
Matrix Spike Dup (P1C0314-MSD1)	Source: 1030309-03			Prepared: 03/15/11 Analyzed: 03/17/11						
Arsenic	26.8	0.56	mg/kg dry	27.8	BRL	97	75-125	3	20	
Barium	30.9	0.56	mg/kg dry	27.8	5.37	92	75-125	2	20	
Cadmium	25.0	0.28	mg/kg dry	27.8	BRL	90	75-125	4	20	
Chromium	25.5	0.28	mg/kg dry	27.8	0.387	91	75-125	4	20	
Copper	29.6	0.56	mg/kg dry	27.8	3.23	95	75-125	8	20	
Lead	25.1	0.28	mg/kg dry	27.8	0.0921	90	75-125	4	20	
Selenium	30.9	0.56	mg/kg dry	27.8	0.605	109	75-125	4	20	
Silver	24.6	0.28	mg/kg dry	27.8	BRL	88	75-125	7	20	
Zinc	32.1	2.8	mg/kg dry	27.8	6.48	92	75-125	8	20	
Batch P1C0318 - 7471B										
Blank (P1C0318-BLK1)				Prepared & Analyzed: 03/15/11						
Mercury	BRL	0.021	mg/kg wet							
LCS (P1C0318-BS1)				Prepared & Analyzed: 03/15/11						
Mercury	0.389	0.021	mg/kg wet	0.446		87	80-120			
Matrix Spike (P1C0318-MS1)	Source: 1030309-01			Prepared & Analyzed: 03/15/11						
Mercury	1.63	0.097	mg/kg dry	1.81	0.0612	87	80-120			
Matrix Spike Dup (P1C0318-MSD1)	Source: 1030309-01			Prepared & Analyzed: 03/15/11						
Mercury	1.48	0.091	mg/kg dry	1.69	0.0612	82	80-120	11	20	

Environmental Testing Solutions
Attn: Kelley Keenan
PO Box 7565
Asheville, NC 28802

Project: McGill Associates

Prism Work Order: 1030309
Time Submitted: 3/11/2011 1:15:00PM

General Chemistry Parameters - Quality Control

Analyte	Result	Reporting Limit	Units	Spike Level	Source Result	%REC	%REC Limits	RPD	RPD Limit	Notes
Batch P1C0294 - NO PREP										
Blank (P1C0294-BLK1)				Prepared & Analyzed: 03/14/11						
% Solids	99.9	0.100	% by Weight							
Batch P1C0298 - NO PREP										
Blank (P1C0298-BLK1)				Prepared & Analyzed: 03/15/11						
Nitrate/Nitrite as N	BRL	5.0	mg/kg wet							
LCS (P1C0298-BS1)				Prepared & Analyzed: 03/15/11						
Nitrate/Nitrite as N	50.1	5.0	mg/kg wet	50.0		100	80-120			
Batch P1C0362 - SM4500-PB5										
Blank (P1C0362-BLK1)				Prepared: 03/17/11 Analyzed: 03/18/11						
Phosphorus-Total	BRL	2.5	mg/kg wet							
LCS (P1C0362-BS1)				Prepared: 03/17/11 Analyzed: 03/18/11						
Phosphorus-Total	97.4	2.5	mg/kg wet	100		97	90-110			
Matrix Spike (P1C0362-MS1)	Source: 1030309-01			Prepared: 03/17/11 Analyzed: 03/18/11						
Phosphorus-Total	1550	23	mg/kg dry	460	808	143	80-120			MI
Matrix Spike Dup (P1C0362-MSD1)	Source: 1030309-01			Prepared: 03/17/11 Analyzed: 03/18/11						
Phosphorus-Total	1490	22	mg/kg dry	436	808	134	80-120	4	20	MI
Batch P1C0410 - 351.2										
Blank (P1C0410-BLK1)				Prepared: 03/18/11 Analyzed: 03/21/11						
Total Kjeldahl Nitrogen	BRL	25	mg/kg wet							

Environmental Testing Solutions
Attn: Kelley Keenan
PO Box 7585
Asheville, NC 28802

Project: McGill Associates

Prism Work Order: 1030309
Time Submitted: 3/11/2011 1:15:00PM

General Chemistry Parameters - Quality Control

Analyte	Result	Reporting Limit	Units	Spike Level	Source Result	%REC	%REC Limits	RPD	RPD Limit	Notes
Batch P1C0410 - 351.2										
LCS (P1C0410-BS1)				Prepared: 03/18/11 Analyzed: 03/21/11						
Total Kjeldahl Nitrogen	133	28	mg/kg wet	126		106	90-110			
Matrix Spike (P1C0410-MS1)		Source: 1030309-01		Prepared: 03/18/11 Analyzed: 03/21/11						
Total Kjeldahl Nitrogen	6300	2200	mg/kg dry	4410	1960	99	90-110			
Matrix Spike Dup (P1C0410-MSD1)		Source: 1030309-01		Prepared: 03/18/11 Analyzed: 03/21/11						
Total Kjeldahl Nitrogen	6280	2200	mg/kg dry	4410	1960	99	90-110	0.2	20	

Sample Extraction Data

Prep Method: 351.2

Lab Number	Batch	Initial	Final	Date
1030309-01	P1C0410	0.5 g	25 mL	03/18/11
1030309-02	P1C0410	0.5 g	25 mL	03/18/11
1030309-03	P1C0410	0.5 g	25 mL	03/18/11

NO PREP

Lab Number	Batch	Initial	Final	Date
1030309-01	P1C0294	30 g	30 mL	03/14/11
1030309-01	P1C0298	1 g	50 mL	03/15/11
1030309-02	P1C0294	30 g	30 mL	03/14/11
1030309-02	P1C0298	1 g	50 mL	03/15/11
1030309-03	P1C0294	30 g	30 mL	03/14/11
1030309-03	P1C0298	1 g	50 mL	03/15/11

Prep Method: SW4500-P B&E

Lab Number	Batch	Initial	Final	Date
1030309-01	P1C0362	0.99 g	50 mL	03/16/11
1030309-03	P1C0362	0.97 g	50 mL	03/16/11
1030309-03	P1C0362	0.97 g	50 mL	03/16/11

Prep Method: 3050B

Lab Number	Batch	Initial	Final	Date
1030309-01	P1C0314	2.02 g	50 mL	03/15/11
1030309-02	P1C0314	2 g	50 mL	03/15/11
1030309-03	P1C0314	2.02 g	50 mL	03/15/11

Prep Method: 7471B

Lab Number	Batch	Initial	Final	Date
1030309-01	P1C0318	0.55 g	50 mL	03/15/11
1030309-02	P1C0318	0.55 g	50 mL	03/15/11
1030309-03	P1C0318	0.55 g	50 mL	03/15/11

PRISM LABORATORIES, INC.
Full-Service Analytical & Environmental Solutions

NC Certification No. 402
SC Certification No. 99012
NC Drinking Water Cert No. 37739

Case Narrative

06/17/2011

Environmental Testing Solutions
Kelley Keenan
PO Box 7565
Asheville, NC 28802

Project: McGill Associates

Lab Submittal Date: 06/10/2011
Prism Work Order: 1050217

This data package contains the analytical results for the project identified above and includes a Case Narrative, Sample Results and Chain of Custody. Unless otherwise noted, all samples were received in acceptable condition and processed according to the referenced methods.

Data qualifiers are flagged individually on each sample. A key reference for the data qualifiers appears at the end of this case narrative.

Please call if you have any questions relating to this analytical report.

Respectfully,

PRISM LABORATORIES, INC.

Peggy J Kendall

Project Manager

Peggy J Kendall

Reviewed By

Data Qualifiers Key Reference:

D	RPD value outside of the control limits.
MC	Sample concentration too high for recovery evaluation.
MI	Matrix spike outside of the control limits. Matrix interference suspected.
BRL	Below Reporting Limit
MDL	Method Detection Limit
RPD	Relative Percent Difference
*	Results reported to the reporting limit. All other results are reported to the MDL with values between MDL and reporting limit indicated with a J.

PRISM | Full-Service Analytical & Environmental Solutions

Sample Receipt Summary

06/17/2011

Prism Work Order: 1060217

Client Sample ID	Lab Sample ID	Matrix	Date Sampled	Date Received
001-Sediment #1	1060217-01	Solid	06/08/11	06/10/11
002&003 Used Filter	1060217-02	Solid	06/08/11	06/10/11

Samples received in good condition at 1.8 degrees C unless otherwise noted.

449 Springbrook Road - P.O. Box 240543 - Charlotte, NC 28224-0543
Phone: 704/529-6364 - Toll Free Number: 1-888/529-6364 - Fax: 704/525-0409

PRISM | Full-Service Analytical & Environmental Solutions

Laboratory Report

06/17/2011

Environmental Testing Solutions
Attn: Kelley Keenan
PO Box 7565
Asheville, NC 28802

Project: McGill Associates

Sample Matrix: Solid

Client Sample ID: 002&003 Used Filter
Prism Sample ID: 1060217-02
Prism Work Order: 1060217
Time Collected: 06/06/11 12:05
Time Submitted: 06/10/11 11:10

Parameter	Result	Units	Report Limit	MDL	Dilution Factor	Method	Analysis Date/Time	Analyst	Batch ID
General Chemistry Parameters									
Total Nitrogen	1400	mg/kg dry	640	82	10	Total Nitrogen	6/13/11 9:37	RSL	[CALC]
% Solids	49.9	% by Weight	0.100	0.100	1	*SM2540 G	6/13/11 16:00	JAB	P1F0248
Nitrate/Nitrite as N	BRL	mg/kg dry	12	1.4	1	*SM4500-NO3 F	6/14/11 13:12	RSL	P1F0259
Total Kjeldahl Nitrogen	1400	mg/kg dry	620	80	10	*351.2	6/15/11 9:37	RSL	P1F0283

449 Springbrook Road - P.O. Box 240543 - Charlotte, NC 28224-0543
Phone: 704/529-6364 - Toll Free Number: 1-800/529-6364 - Fax: 704/525-0409

Environmental Testing Solutions
Attn: Kelley Keenan
PO Box 7565
Asheville, NC 28802

Project: McGill Associates

Prism Work Order: 1060217
Time Submitted: 6/10/2011 11:10:00AM

General Chemistry Parameters - Quality Control

Analyte	Result	Reporting Limit	Units	Spike Level	Source Result	%REC	%REC Limits	RPD	RPD Limit	Notes
Batch P1F0246 - SM4500-PB5										
Blank (P1F0246-BLK1)				Prepared: 06/13/11 Analyzed: 06/14/11						
Phosphorus-Total	BRL	2.5	mg/kg wet							
LCS (P1F0246-BS1)				Prepared: 06/13/11 Analyzed: 06/14/11						
Phosphorus-Total	103	2.5	mg/kg wet	100		103	90-110			
Matrix Spike (P1F0246-MS1)	Source: 1060217-01			Prepared: 06/13/11 Analyzed: 06/14/11						
Phosphorus-Total	1230	140	mg/kg dry	286	957	88	80-120			
Matrix Spike Dup (P1F0246-MSD1)	Source: 1060217-01			Prepared: 06/13/11 Analyzed: 06/14/11						
Phosphorus-Total	968	140	mg/kg dry	288	957	3	80-120	24	20	D, MI
Batch P1F0248 - NO PREP										
Blank (P1F0248-BLK1)				Prepared & Analyzed: 06/13/11						
% Solids	100	0.100	% by Weight							
Batch P1F0253 - 351.2										
Blank (P1F0253-BLK1)				Prepared: 06/14/11 Analyzed: 06/15/11						
Total Kjeldahl Nitrogen	BRL	35	mg/kg wet							
LCS (P1F0253-BS1)				Prepared: 06/14/11 Analyzed: 06/15/11						
Total Kjeldahl Nitrogen	136	28	mg/kg wet	125		109	90-110			
Matrix Spike (P1F0253-MS1)	Source: 1060217-01			Prepared: 06/14/11 Analyzed: 06/15/11						
Total Kjeldahl Nitrogen	6950	1400	mg/kg dry	357	3280	NR	90-110			MO

Environmental Testing Solutions
Attn: Kelley Keenan
PO Box 7565
Asheville, NC 28802

Project: McGill Associates

Prism Work Order: 1060217
Time Submitted: 6/10/2011 11:10:00AM

General Chemistry Parameters - Quality Control

Analyte	Result	Reporting Limit	Units	Spike Level	Source Result	%REC	%REC Limits	RPD	RPD Limit	Notes
Batch P1F0253 - 351.2										
Matrix Spike Dup (P1F0253-MSD1)	Source: 1060217-01			Prepared: 06/14/11 Analyzed: 06/15/11						
Total Kjeldahl Nitrogen	6590	1400	mg/kg dry	357	3280	NR	80-110	21	20	D, MC
Batch P1F0259 - NO PREP										
Blank (P1F0259-BLK1)				Prepared & Analyzed: 06/14/11						
Nitrate/Nitrite as N	BRL	5.0	mg/kg wet							
LCS (P1F0259-BS1)				Prepared & Analyzed: 06/14/11						
Nitrate/Nitrite as N	50.0	5.0	mg/kg wet	50.0		100	80-120			

Sample Extraction Data

Prep Method: 351.2

Lab Number	Batch	Initial	Final	Date/Time
1060217-01	P1F0253	0.5 g	25 mL	06/14/11 8:00
1060217-02	P1F0253	0.5 g	25 mL	06/14/11 8:00

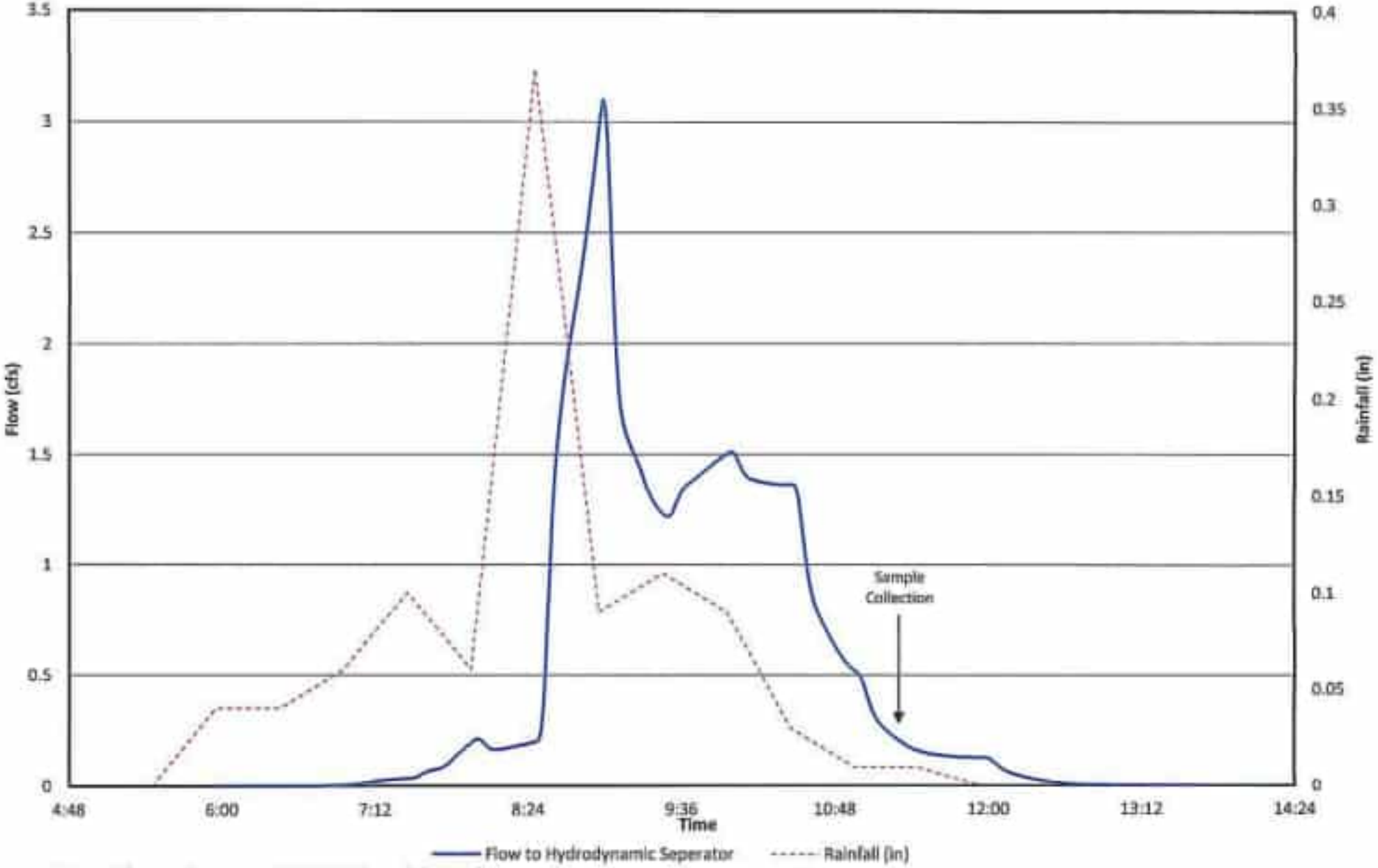
Prep Method: SM4500-P B5

Lab Number	Batch	Initial	Final	Date/Time
1060217-01	P1F0248	1 g	50 mL	06/13/11 15:20

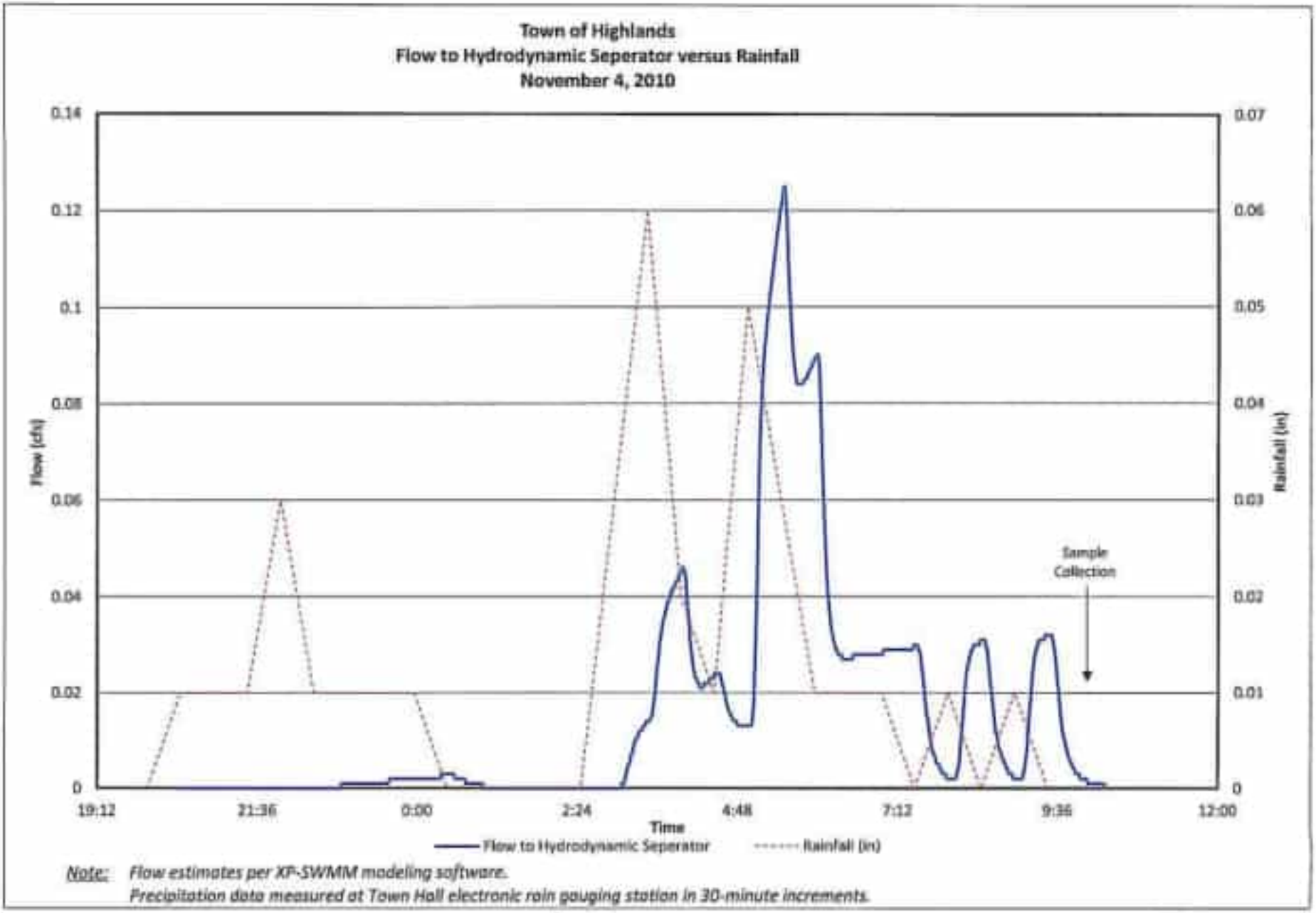
APPENDIX F

Storm Event Hydrodynamic Separator Hydrographs

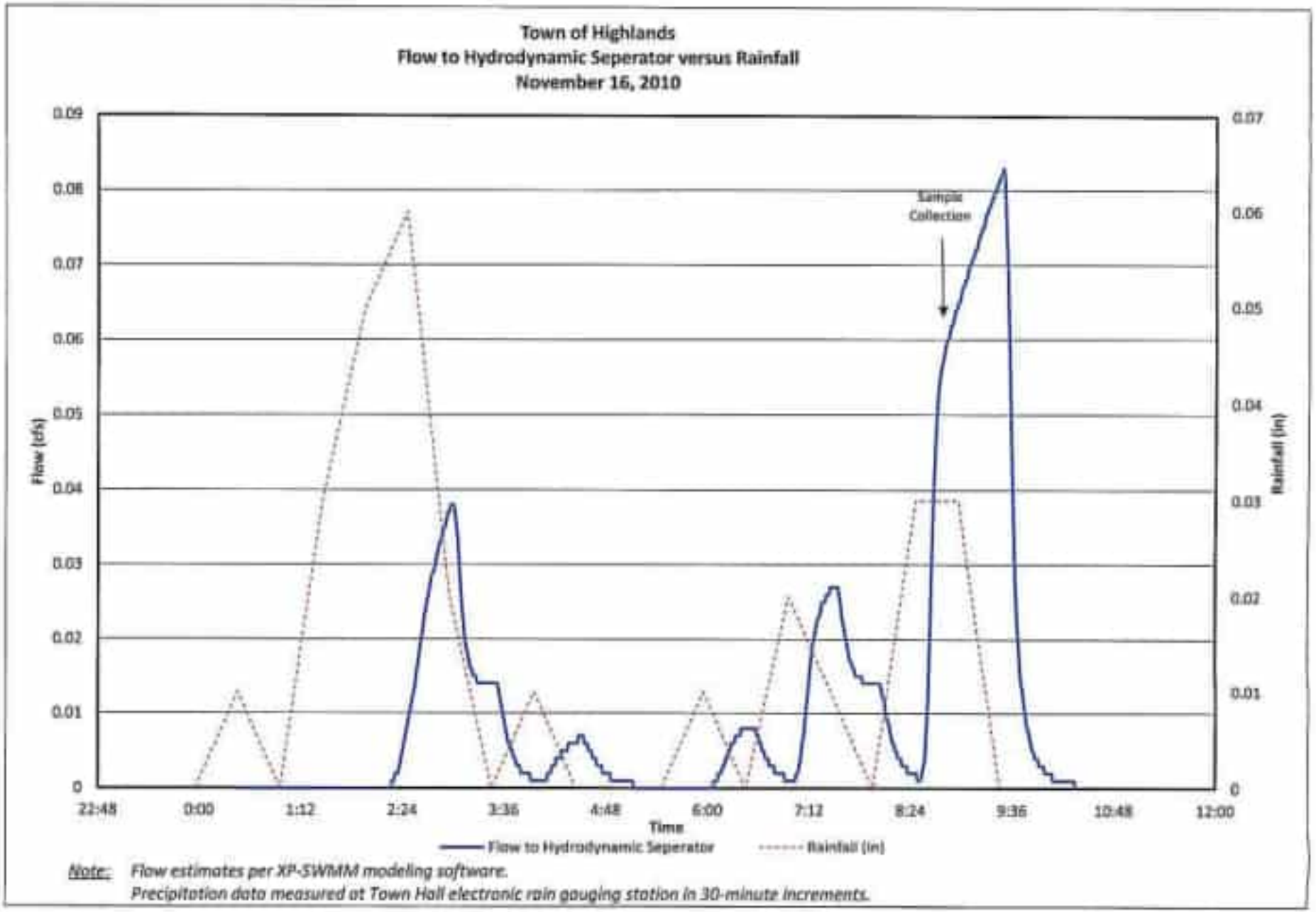
Town of Highlands
Flow to Hydrodynamic Seperator versus Rainfall
October 25, 2010



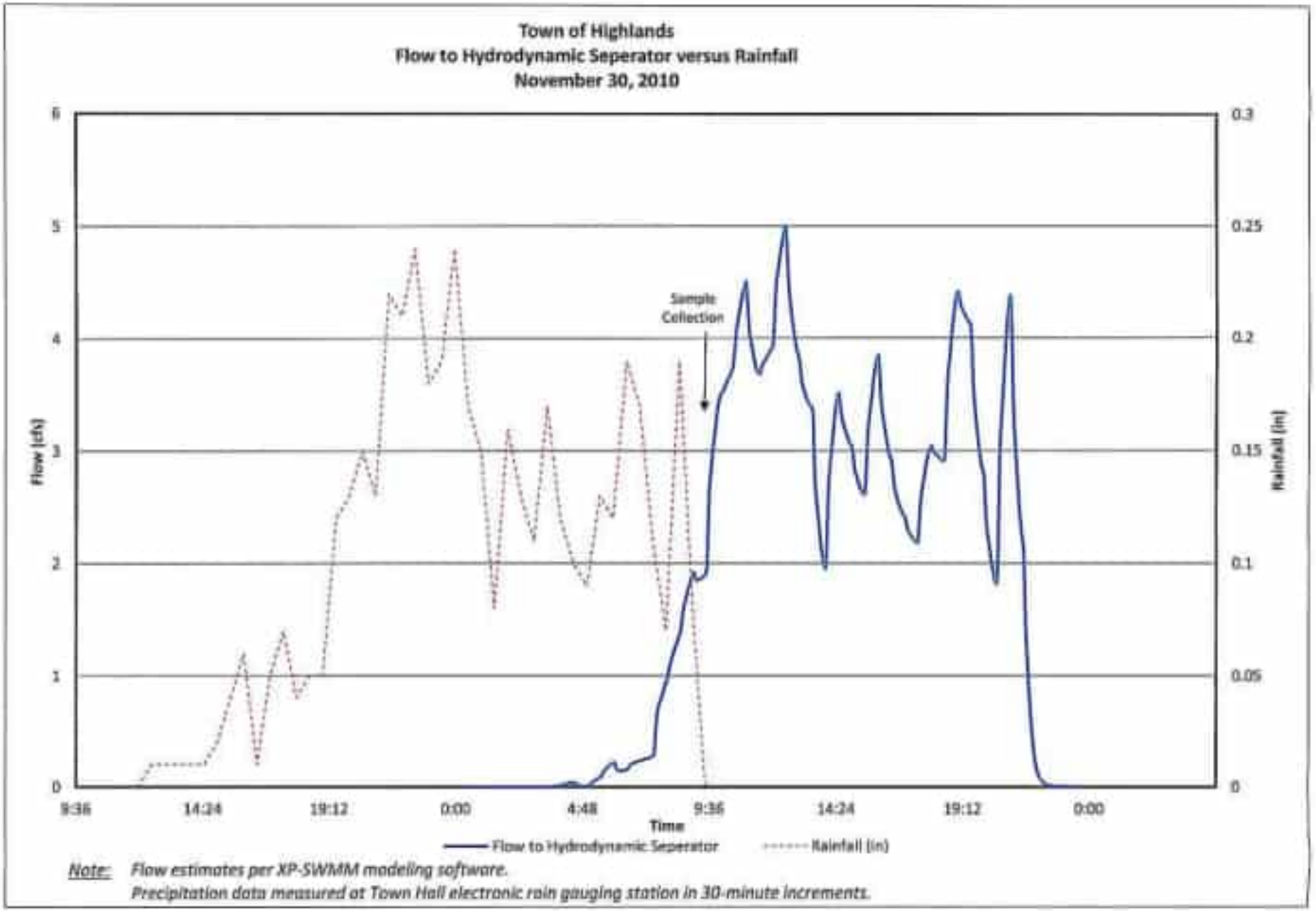
Note: *Flow estimates per XP-SWMM modeling software.*
Precipitation data measured at Town Hall electronic rain gauging station in 30-minute increments.

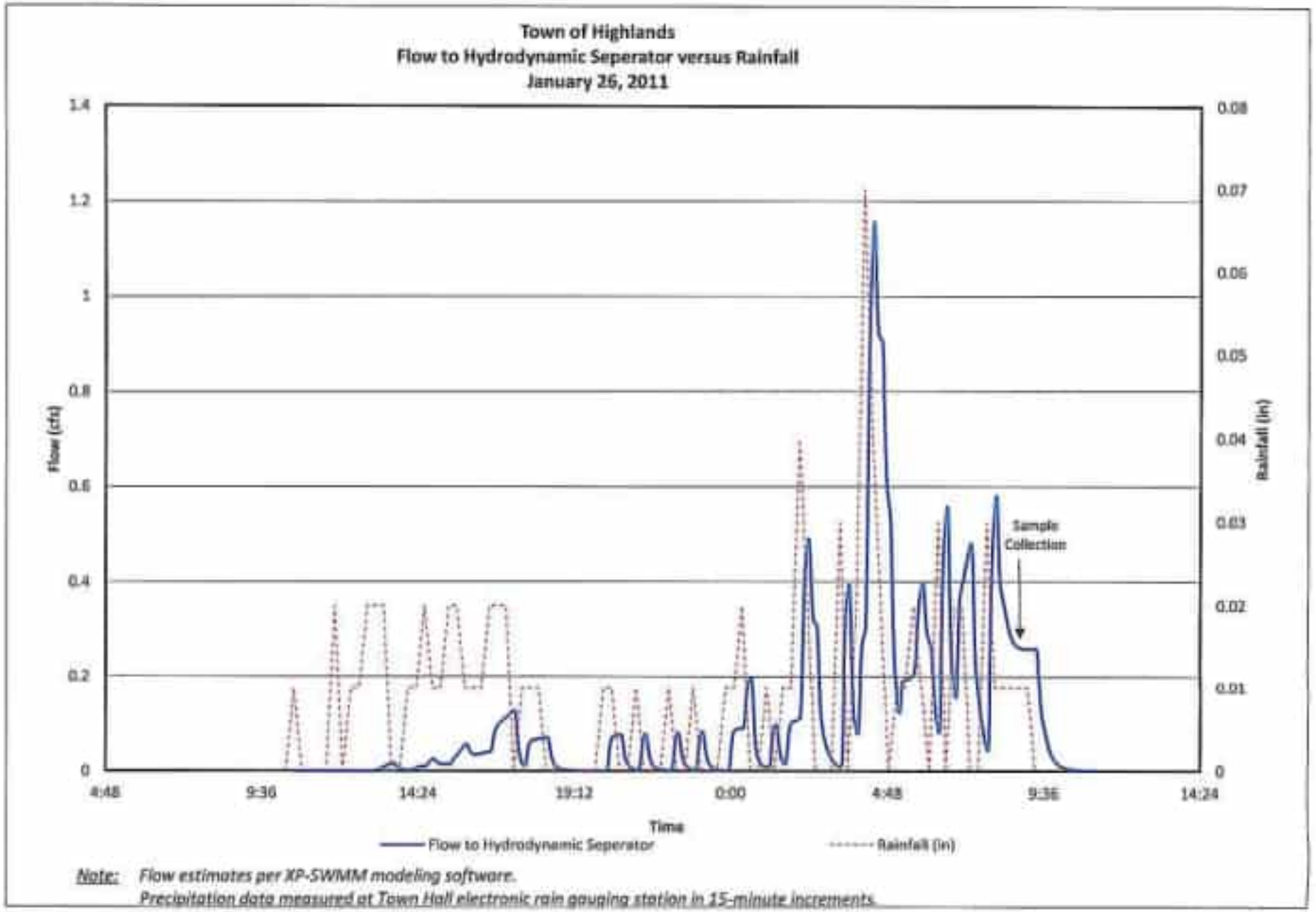


Note: *Flow estimates per XP-SWMM modeling software.*
Precipitation data measured at Town Hall electronic rain gauging station in 30-minute increments.



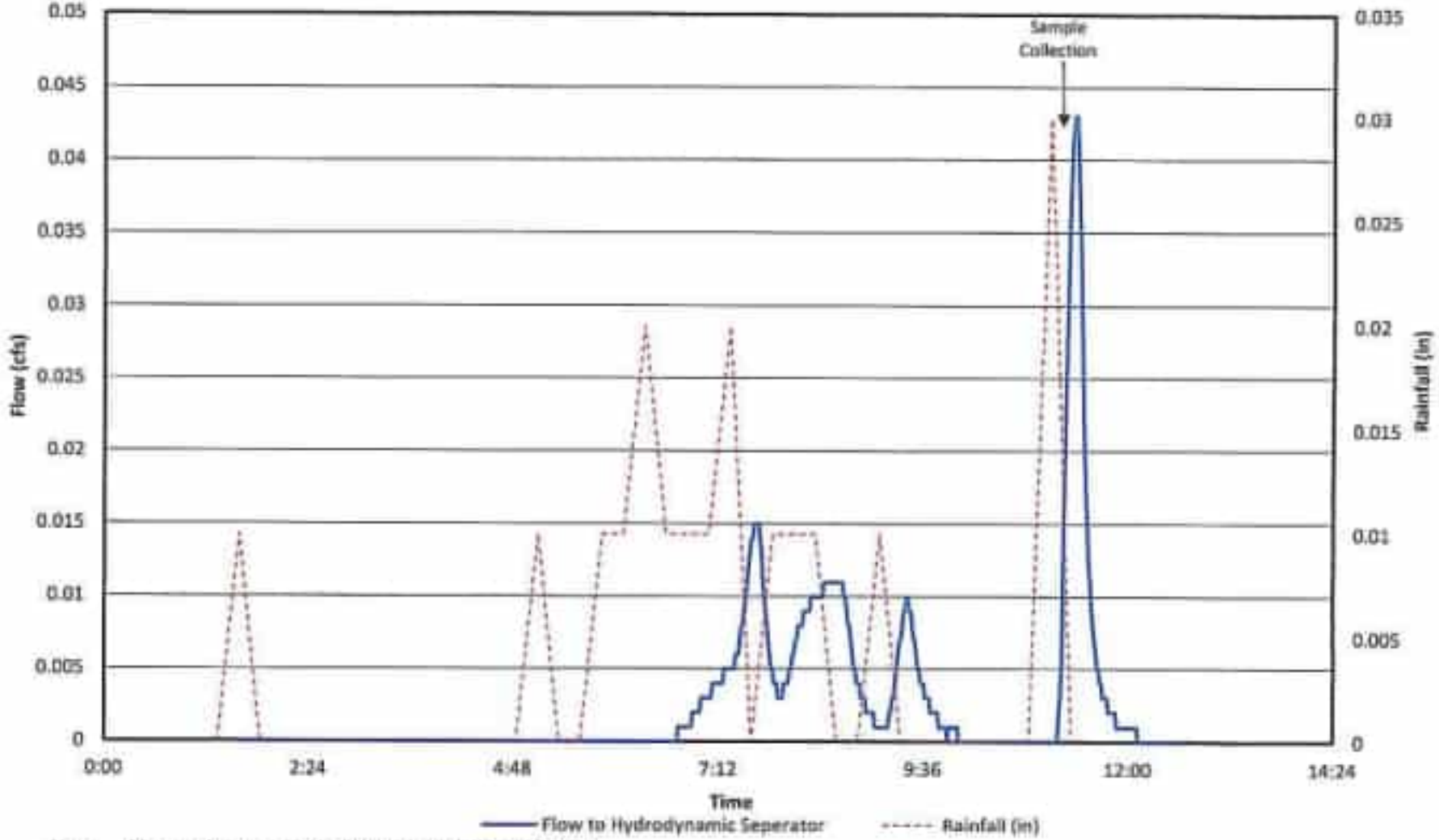
Note: *Flow estimates per XP-SWMM modeling software.*
Precipitation data measured at Town Hall electronic rain gauging station in 30-minute increments.


Town of Highlands
Flow to Hydrodynamic Seperator versus Rainfall
November 30, 2010
Flow (cfs)
Rainfall (in)
Sample Collection
Time
9:36
14:24
19:12
0:00
4:48
9:36
14:24
19:12
0:00
Flow to Hydrodynamic Seperator
Rainfall (in)
Note: Flow estimates per XP-SWMM modeling software.
Precipitation data measured at Town Hall electronic rain gauging station in 30-minute increments.

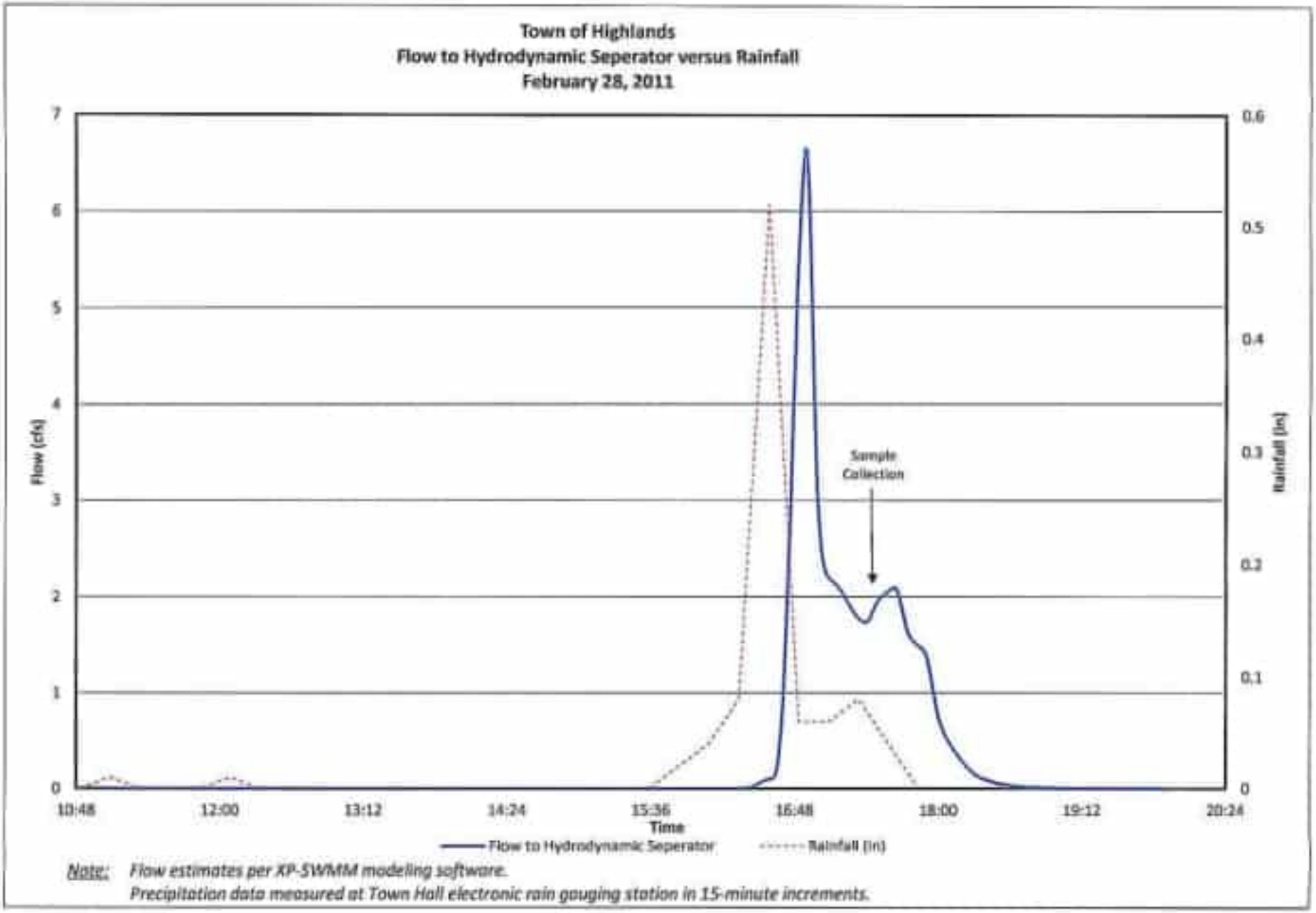


Note: *Flow estimates per XP-SWMM modeling software.*
Precipitation data measured at Town Hall electronic rain gauging station in 15-minute increments.

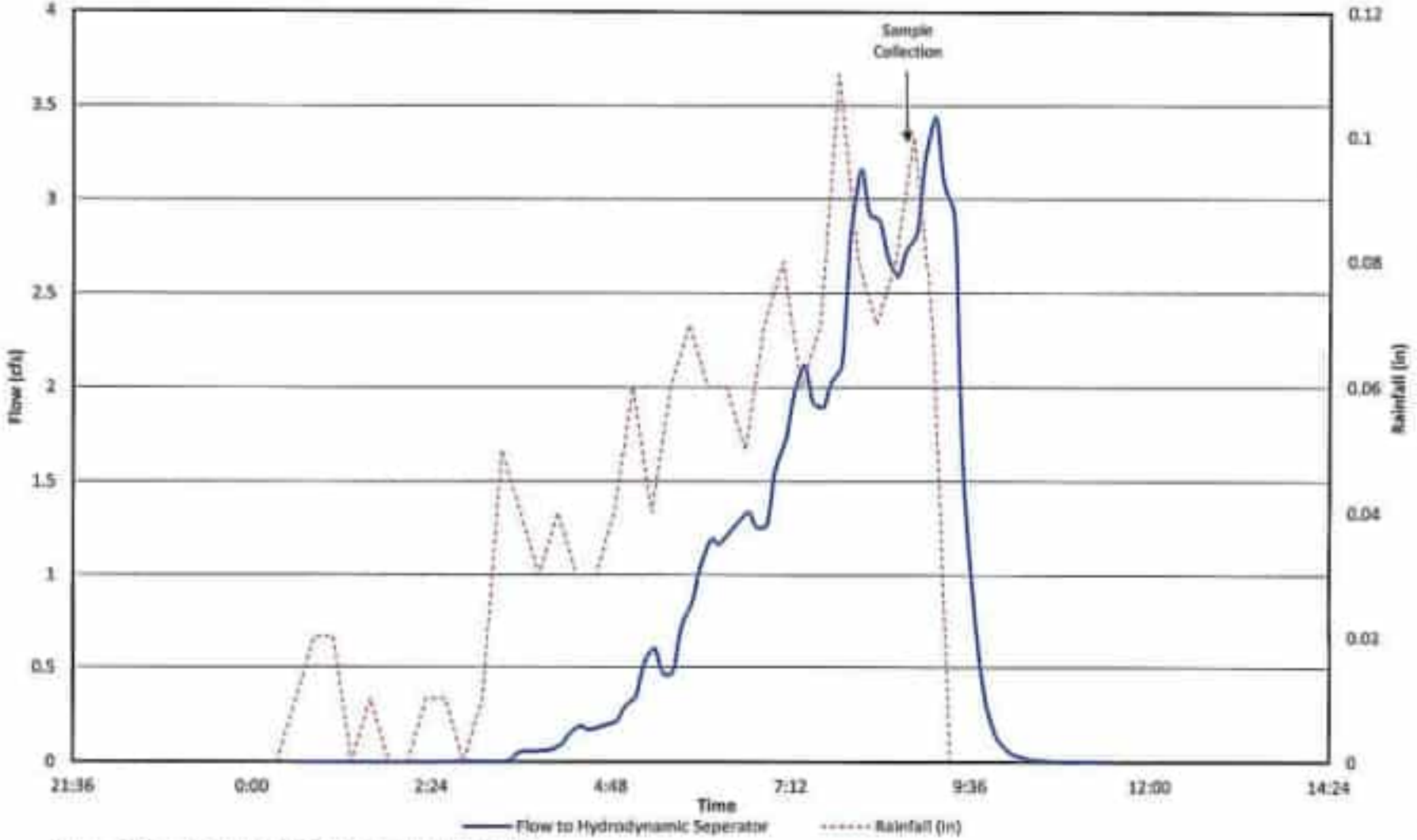
Town of Highlands
Flow to Hydrodynamic Seperator versus Rainfall
February 01, 2011



Note: *Flow estimates per XP-SWMM modeling software.*
Precipitation data measured at Town Hall electronic rain gauging station in 15-minute increments.

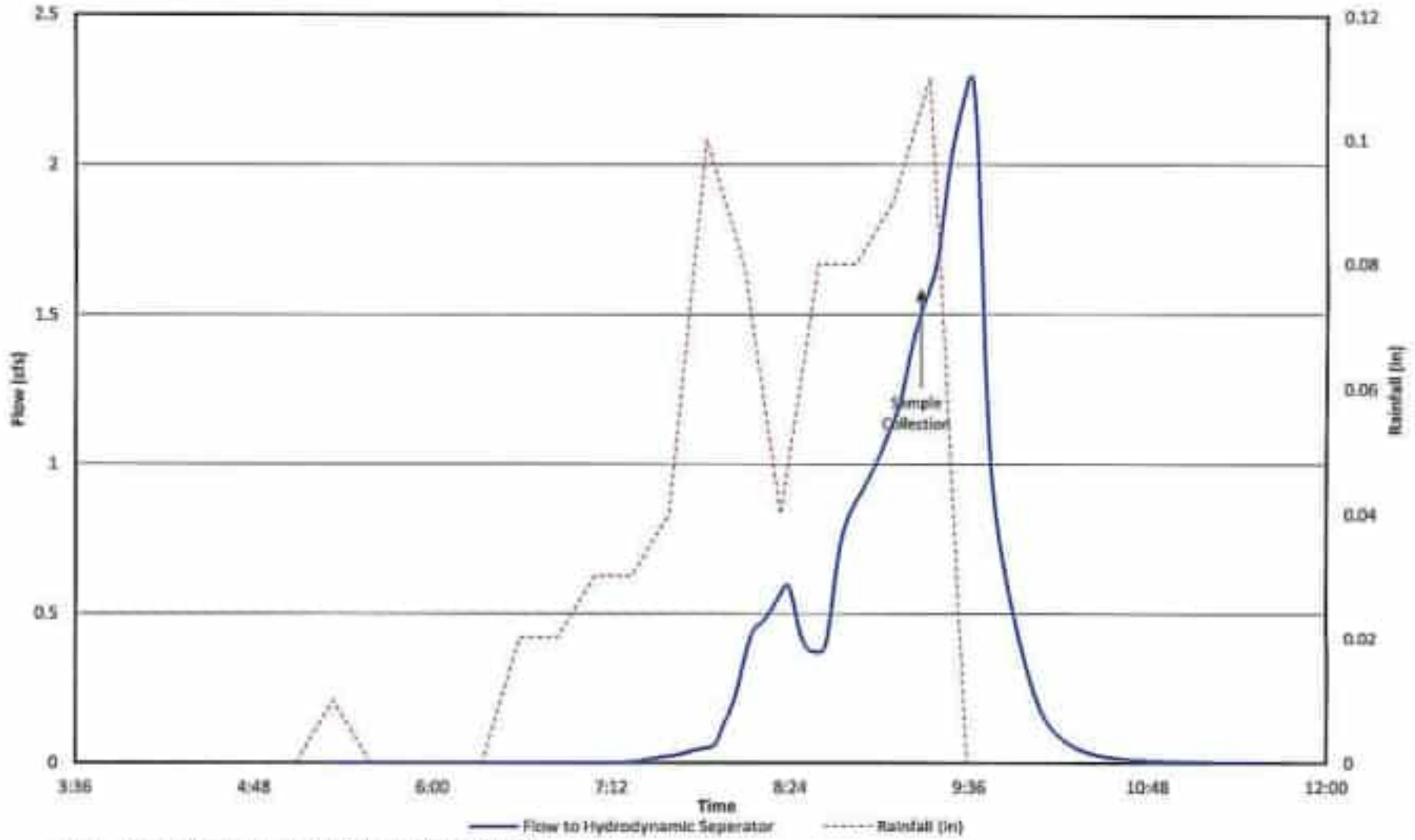

Town of Highlands
Flow to Hydrodynamic Seperator versus Rainfall
February 28, 2011
Flow (cfs)
Rainfall (in)
Sample Collection
10:48
12:00
13:12
14:24
15:36
16:48
18:00
19:12
20:24
Time
Flow to Hydrodynamic Seperator
Rainfall (in)
Note: Flow estimates per XP-SWMM modeling software.
Precipitation data measured at Town Hall electronic rain gauging station in 15-minute increments.

Town of Highlands
Flow to Hydrodynamic Seperator versus Rainfall
March 9, 2011



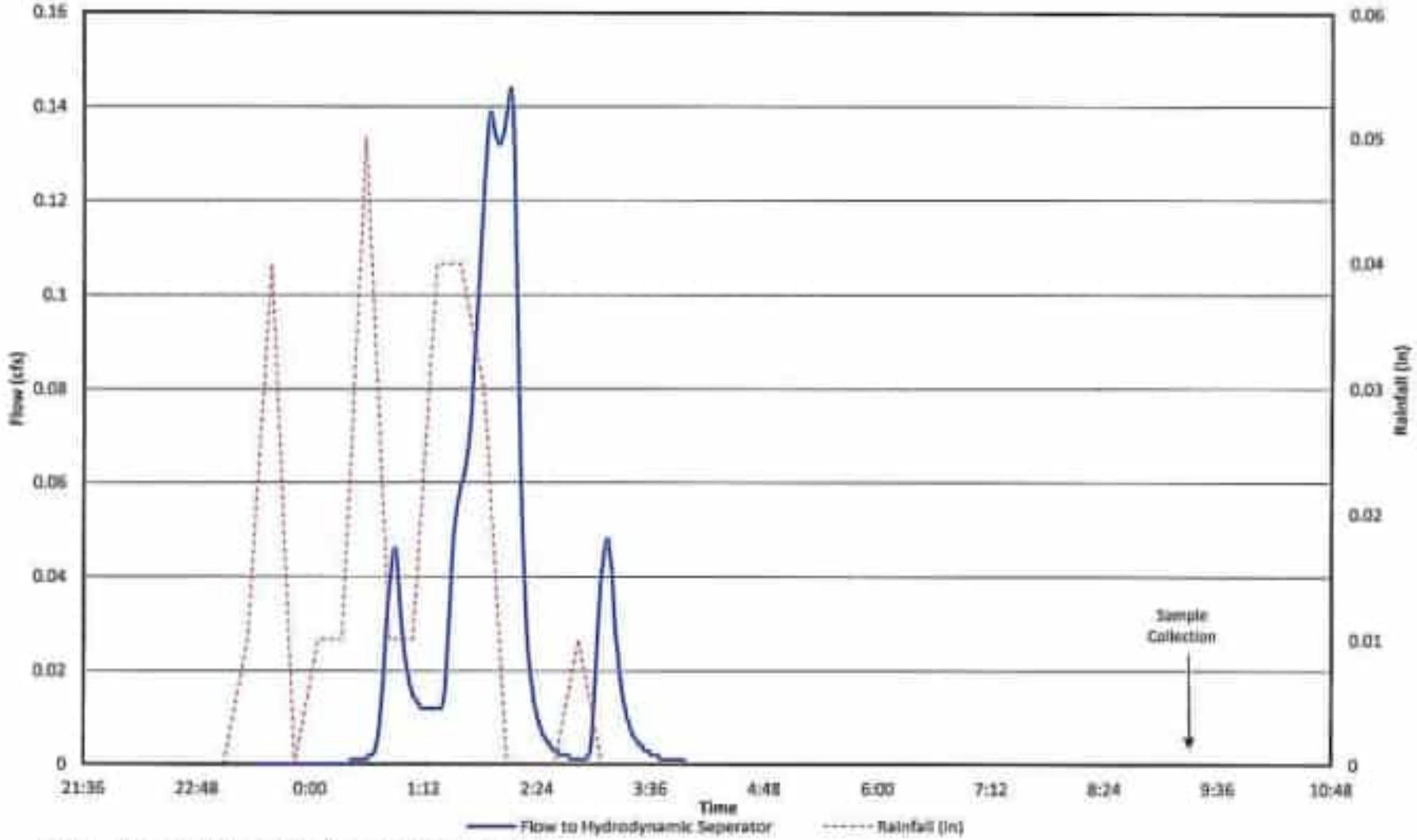
Note: *Flow estimates per XP-SWMM modeling software.*
Precipitation data measured at Town Hall electronic rain gauging station in 15-minute increments.

Town of Highlands
Flow to Hydrodynamic Seperator versus Rainfall
March 26, 2011

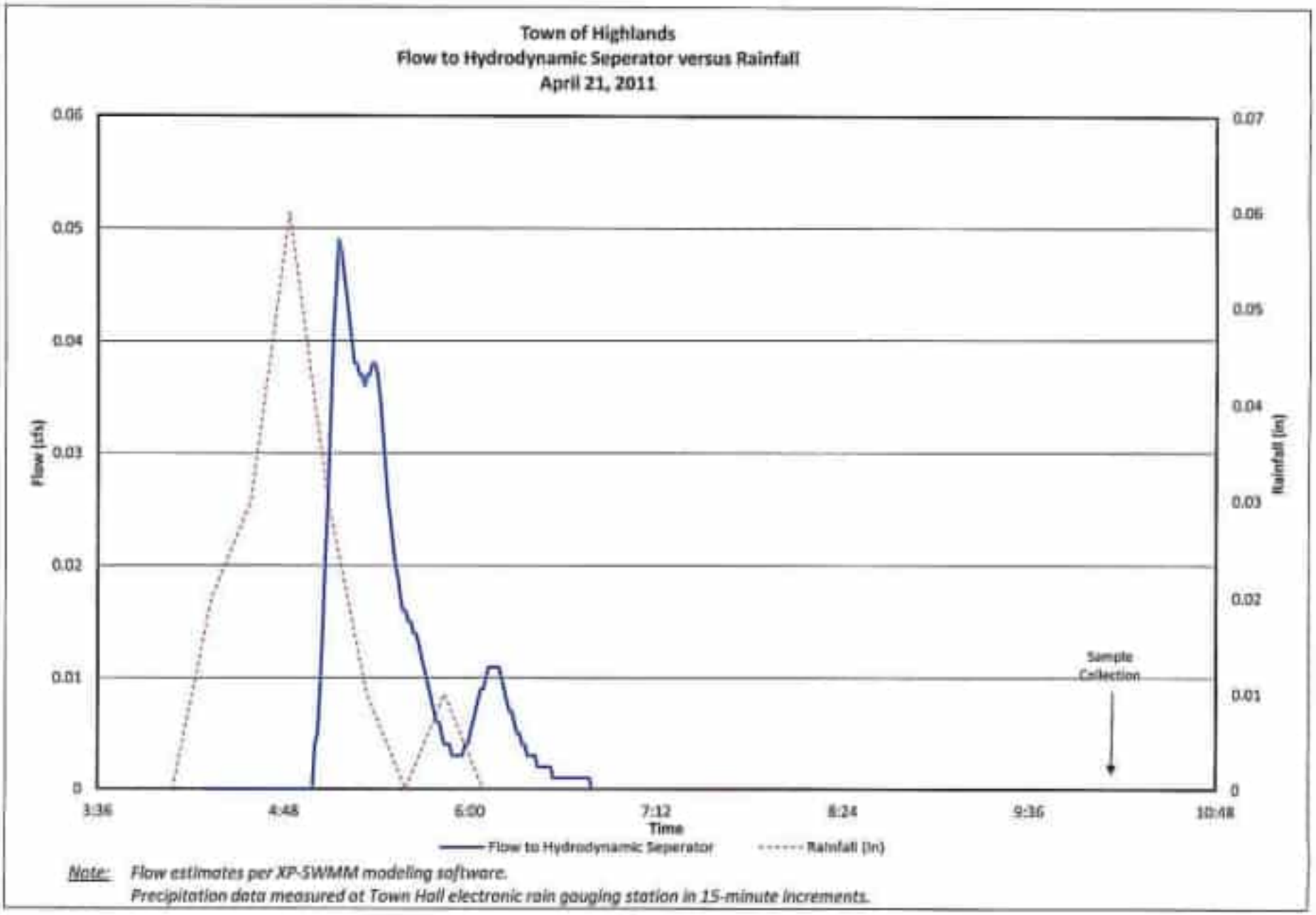


Note: Flow estimates per XP-SWMM modeling software.
Precipitation data measured at Town Hall electronic rain gauging station in 15-minute increments.

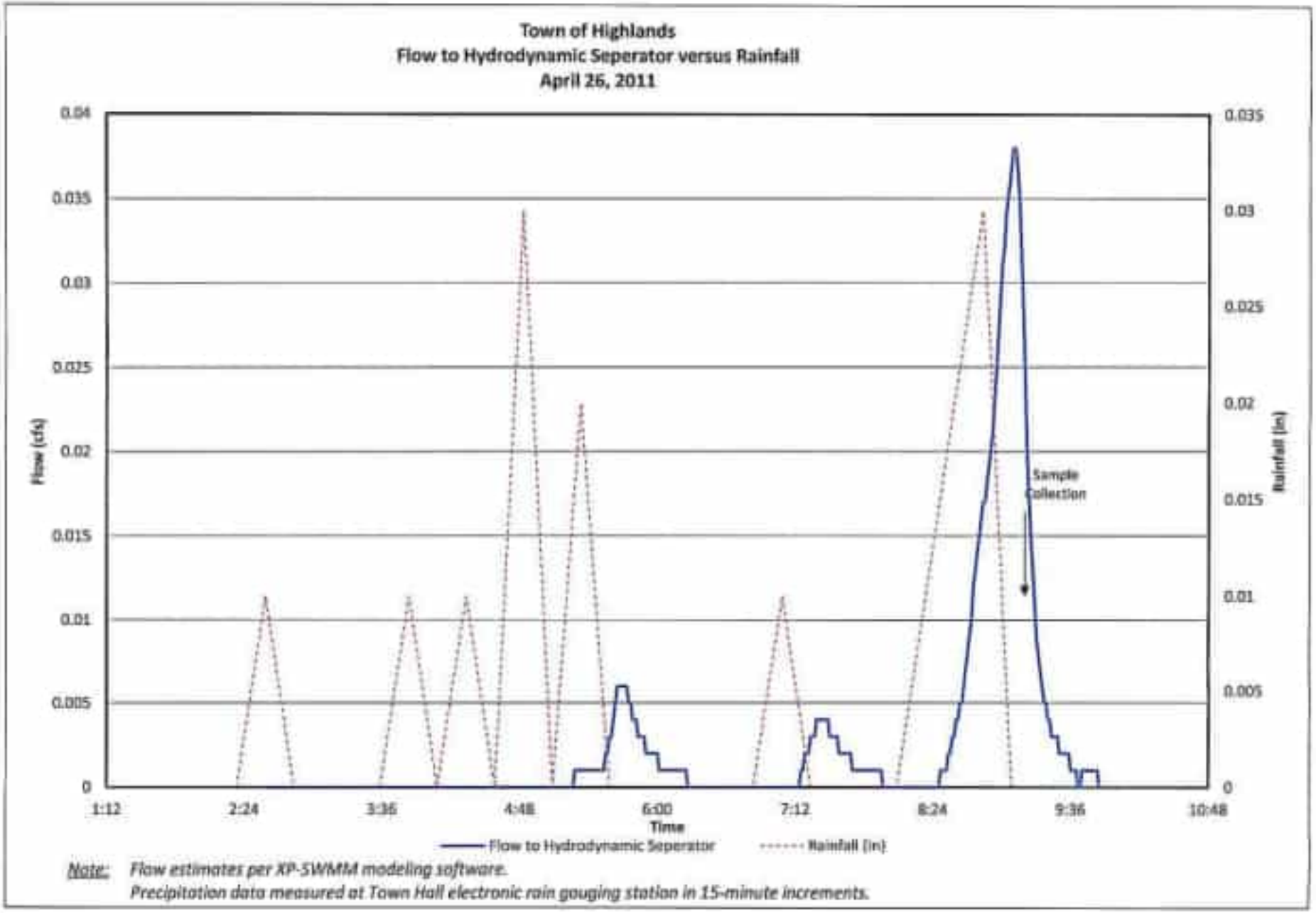
Town of Highlands
Flow to Hydrodynamic Seperator versus Rainfall
April 12, 2011



Note: Flow estimates per XP-SWMM modeling software.
Precipitation data measured at Town Hall electronic rain gauging station in 15-minute increments.

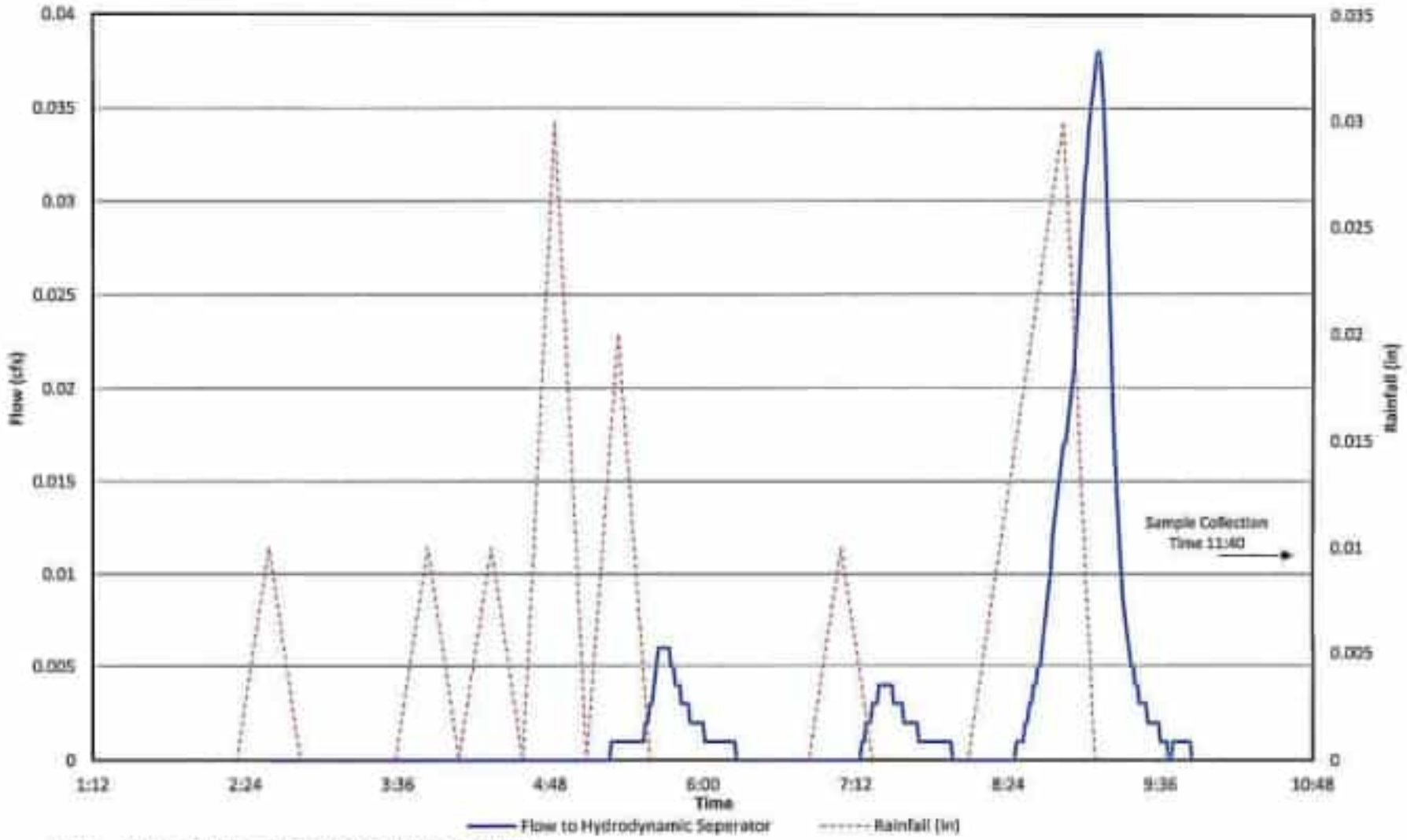


Note: *Flow estimates per XP-SWMM modeling software.*
Precipitation data measured at Town Hall electronic rain gauging station in 15-minute increments.

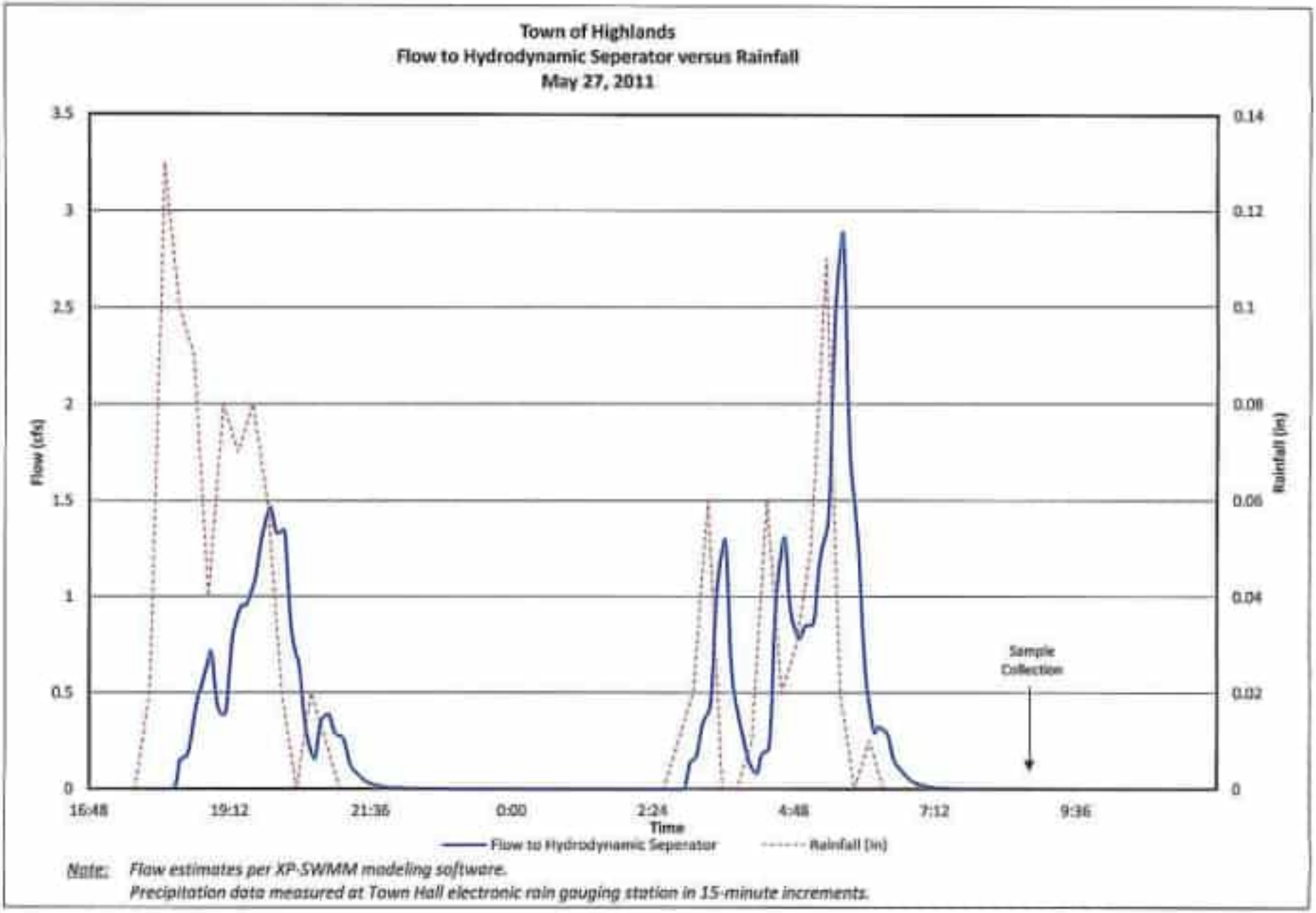


Note: *Flow estimates per XP-SWMM modeling software.*
Precipitation data measured at Town Hall electronic rain gauging station in 15-minute increments.

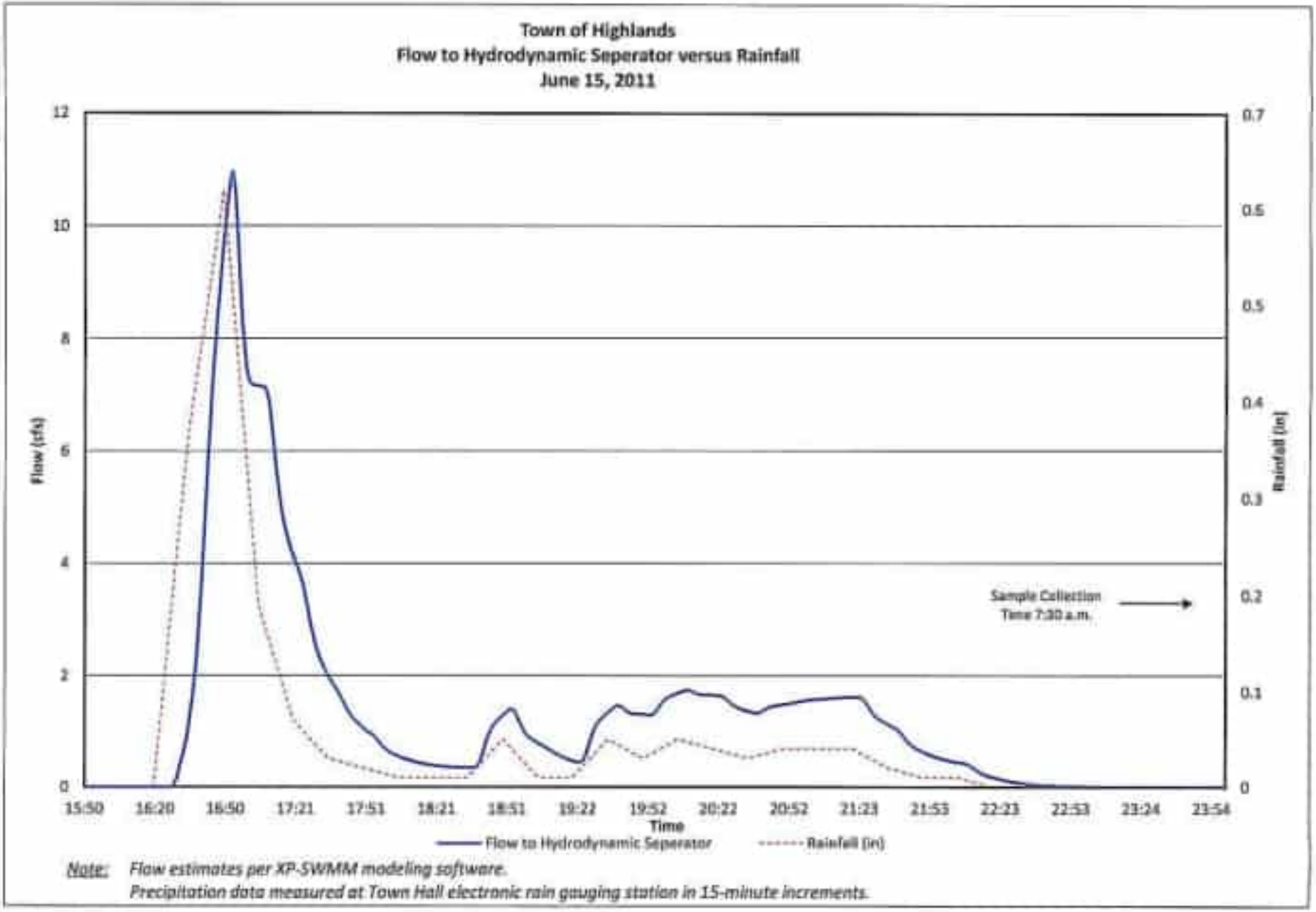
Town of Highlands
Flow to Hydrodynamic Seperator versus Rainfall
May 4, 2011



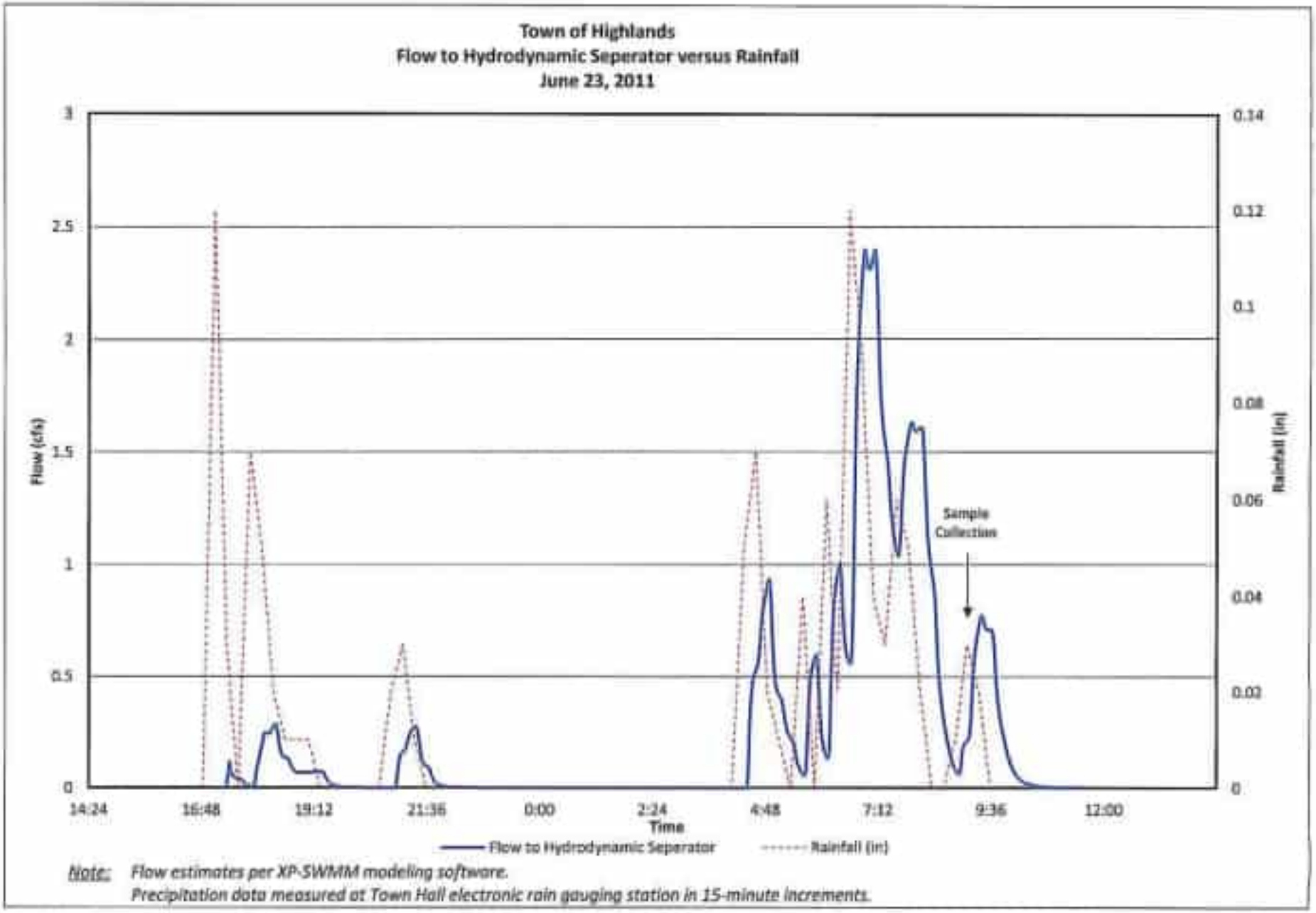
Note: *Flow estimates per XP-SWMM modeling software.*
Precipitation data measured at Town Hall electronic rain gauging station in 15-minute increments.

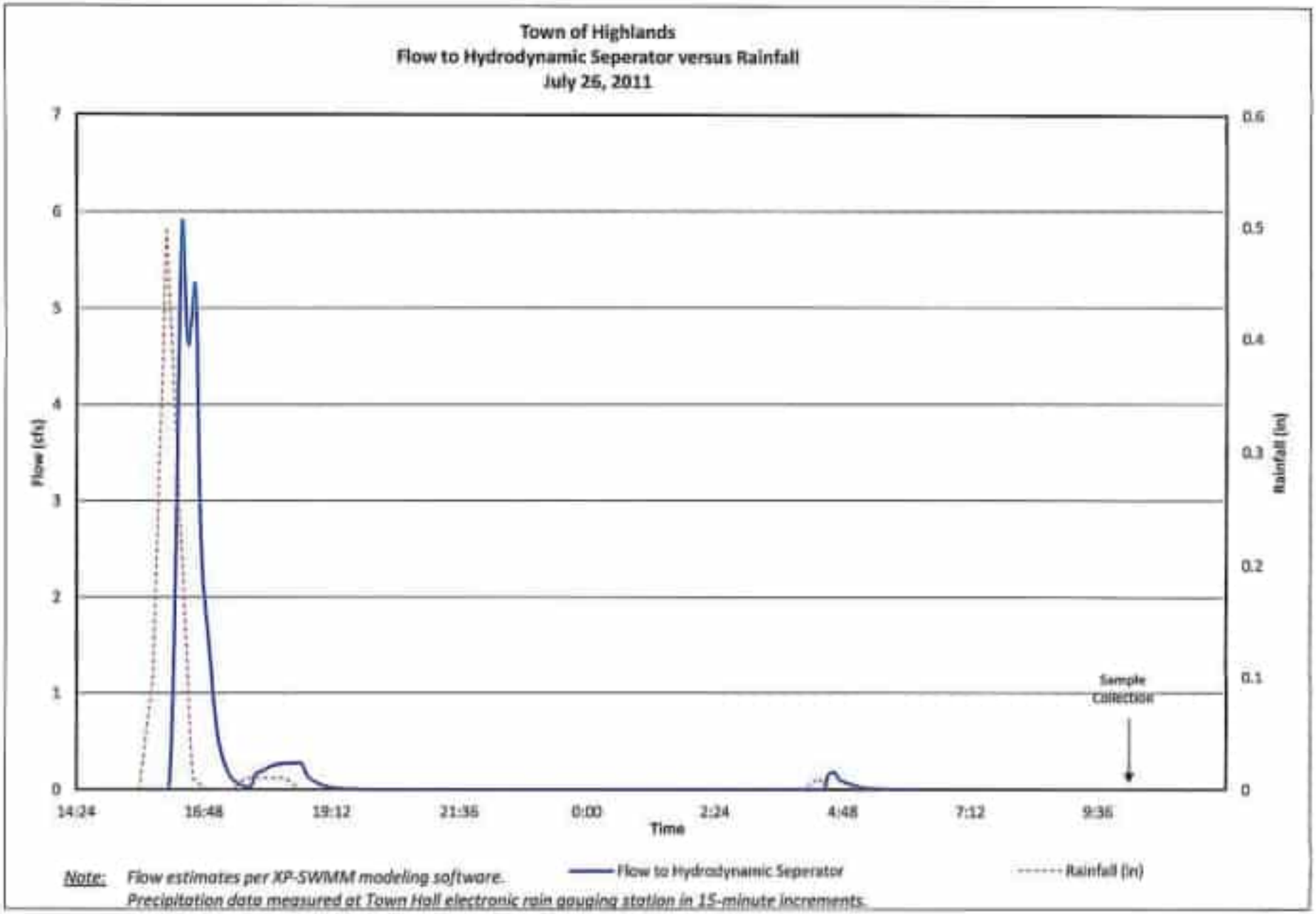


Note: *Flow estimates per XP-SWMM modeling software.*
Precipitation data measured at Town Hall electronic rain gauging station in 15-minute increments.



Note: *Flow estimates per XP-SWMM modeling software.*
Precipitation data measured at Town Hall electronic rain gauging station in 15-minute increments.


Town of Highlands
Flow to Hydrodynamic Seperator versus Rainfall
June 23, 2011
Flow (cfs)
Rainfall (in)
Sample Collection
Time
14:24
16:48
19:12
21:36
0:00
2:24
4:48
7:12
9:36
12:00
Flow to Hydrodynamic Separator
Rainfall (in)
Note: Flow estimates per XP-SWMM modeling software.
Precipitation data measured at Town Hall electronic rain gauging station in 15-minute increments.


Town of Highlands
Flow to Hydrodynamic Seperator versus Rainfall
July 26, 2011
Flow (cfs)
Rainfall (in)
Time
14:24
16:48
19:12
21:36
0:00
2:24
4:48
7:12
9:36
Sample Collection
Flow to Hydrodynamic Seperator
Rainfall (in)
Note: Flow estimates per XP-SWMM modeling software.
Precipitation data measured at Town Hall electronic rain gauging station in 15-minute increments.

APPENDIX G

Field Notes

Town of Highlands
Innovative Stormwater Project Implementation
Project No. 10.00336

Crystal Stream Unit Cleaning – Field Notes
December 8, 2010

See System Description schematic for naming conventions.

Personnel present: McGill Associates (JC Williams, Forrest Westall), Environmental Maintenance (Micky and Dale), Town of Highlands (Lamar Nix)

Splitter Box #1:
- Culvert discharging normal flow to existing creek is partially clogged

Splitter Box #2:
- Larger rocks / sediment noted upstream of overflow weir

Unit #1:
- Heavy leaf debris in Bay 1 filter basket
- Leaves and other matter blinding Bay 2 weir screen plate
- Strong sulphur/sewer odor noted upon opening
- Approximately 12-14" debris layer on basin floor (~8" leaves, 4-6" sediment)

Unit #2:
- Bay 4 weir screen plate partially blinded with leaves and matter
- Signs that flow reached ~3" below top of Bay 5 baffle/oil separator (~30" below top of concrete)
- Bay 5 baffle/oil separator partially filled with floatables and leaves (within 2" of top of lower baffle wall)
- Bay 5 baffle/oil separator contained some floatables, leaves, matter (not significant); no significant amount of oil/grease noted
- Bay 5 baffle/oil separator sediment added to sample for testing
- Approximately 8-10" debris layer on basin floor (3-4" sediment)

General Notes:
- Checked access ports; no sedimentation noted in detention system
- Leaves / sediment washed & vacuumed off coconut fiber filter prior to sampling
- Lots of sedimentation stuck to leaf litter
- Cleaners vacuum top layer of leaves/silt first
- Cleaners noted that the amount of debris in basin is more than typical for 3 months service (looks more like 6-9 months of service)

Town of Highlands
Innovative Stormwater Project Implementation
Project No. 10.00336

Crystal Stream Unit Cleaning – Field Notes
August 11, 2011

See System Description schematic for naming conventions.

Personnel present: McGill Associates (JC Williams), Environmental Maintenance (Jeff Askew)

Splitter Box #1:
- Water level topping weir
- Heavy sediment has clogged thru-flow pipe; debris within 0.75' of top of weir
- Down stream creek exhibits NO flow

Splitter Box #2:
- Coarse sediment and gravel deposit along invert of upstream pipe (4-5" deep)
- Influent pipe to Unit #1 contains small amount of sediment deposits
- No significant sediment/debris downstream of weir

Unit #1:
- Bay 1: vertical screen wall blown over
- Bay 1: 0.4' solids deposited on top of screen (85% of area);
- Bay 1: 6" sediment on bottom of basin
- Bay 2: evidence of high water 1.3' below ceiling
- Bay 2: top 16" of weir screen plate blinded with leaf litter/organics
- Bay 2: 6" sediment on bottom of basin
- Bay 3: water standing to effluent pipe invert
- Bay 3: 6" sediment on bottom of basin

Unit #2:
- Bay 4: standing water to effluent pipe invert
- Bay 4: top 16" of weir screen plate blinded with leaf litter/organics
- Bay 4: organics stuck to wall
- Bay 4: 3" sediment/muck on bottom of basin
- Bay 5: evidence of high water to within 1.3' of ceiling
- Bay 5: oil sheen, floatables, organics in baffle trap (2" total dewatered)
- Bay 6: filter fabric – appears relatively clean compared to usual caked muck
- Bay 6: < 3" solids/muck on bottom of basin

Culvert Entrance:
- Sediment to within 18" of inside top of culvert

Effluent Box:
- 1/8" fine sediment accumulated

General Notes:
- Approximately 0.9' standing water measured at detention basin access port

Town of Highlands
Innovative Stormwater Project Implementation
Project No. 10.00336

Crystal Stream Unit Cleaning – Field Notes
June 8, 2011

See System Description schematic for naming conventions.
Personnel present: McGill Associates (JC Williams), Environmental Maintenance (Micky and Assistant)

Splitter Box #1:
- Water level within ½" of top of weir; slowly moving through box
- Overflow weir appears to be free of significant sediment (10.0" from top of weir to sediment)
- Downstream creek exhibits ~2" water flow

Splitter Box #2:
- Coarse sediment and gravel (1-5") deposit along invert of upstream pipe (4" deep)
- Influent pipe to Unit #1 relatively clear; small sediment deposits
- No sediment/debris downstream of weir

Unit #1:
- Bay 1: vertical screen wall blown over to horizontal position
- Bay 1: 3" solids deposited on top of screen (75% of area); small amount of leaf litter, organics, cigarettes, trash
- Bay 1: 4" sediment on bottom of basin
- Bay 2: evidence of high water 8" above weir screen plate
- Bay 2: top 19" of weir screen plate blinded with leaf litter/organics
- Bay 2: 6" sediment on bottom of basin with mixed leaf litter
- Bay 3: water standing to effluent pipe invert
- Bay 3: 5" sediment on bottom of basin

Unit #2:
- Bay 4: standing water to effluent pipe invert
- Bay 4: top 19" of weir screen plate blinded with leaf litter/organics
- Bay 4: organics stuck to wall
- Bay 4: 1-2" sediment on bottom of basin
- Bay 5: evidence of high water to within 6" of top of baffle separator
- Bay 5: oil sheen, floatables, organics in baffle trap (2" total dewatered)
- Bay 5: 1" solids on bottom of basin
- Bay 6: filter fabric – 50% covered in sludge
- Bay 6: < 1" solids on bottom of basin

Culvert Entrance:
- Sediment to within 12" of inside top of culvert
- Sedimentation extends evenly upstream > 25'

Effluent Box:
- ~12" standing water
- High water mark = ~22"

General Notes:
- Approximately 12" standing water measured at detention basin access port

Town of Highlands
Innovative Stormwater Project Implementation
Project No. 10.00336

Crystal Stream Unit Cleaning – Field Notes
March 8, 2011

See System Description schematic for naming conventions.

Personnel present: McGill Associates (JC Williams), Environmental Maintenance (Micky and Dale), Town of Highlands (Lamar Nix, Matt Shuler)

Splitter Box #1:
- Water trickling over weir (approximately 2 gpm)
- Overflow weir appears to be free of significant sediment (10.5" from top of weir to sediment)

Splitter Box #2:
- 3" large gravel sediment noted in structure upstream of weir
- ~1.2' from top of weir to sediment

Unit #1:
- Signs of high water up to top of Bay 2 weir screen plate
- Bay 3 water clear (2" of sludge-like sediment)
- Bay 2 has ~4" solids
- Bay 1 – approximately 3" solids on filter screen; screen near blinded with organics, 6" solids on floor

Unit #2:
- Signs of high water elevation up to 7" above Bay 4 weir screen plate (5" below top of baffle/oil separator)
- Bay 4 has 1.5" solids (sludge) on basin floor
- Bay 5 has floatables in baffle/oil separator (mostly cigarettes and organics); with a slight oil sheen noted; ~1" sludge on basin floor
- Bay 6 fiber filter caked in sludge type cover

Culvert Entrance:
- Heavy sediment (see picture) in structure; approximately 12" below top of interior culvert

Effluent Box:
- ~12" standing water
- High water mark = ~18"
- Approximately ¼" fine sediment accumulated in box prior to discharge culvert

General Notes:
- Approximately 12" standing water measured at detention basin access port

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55 Broad Street, Asheville, NC 28801 828-252-0575 Fax 828-252-2518

Innovative Stormwater

PROJECT: Project Implementation

PROJECT NO.: 10.00536

DESCRIPTION: System Description

CALCULATED BY: _____ CHECKED BY: _____

DATE: _____ SHEET NO. ___ OF ___